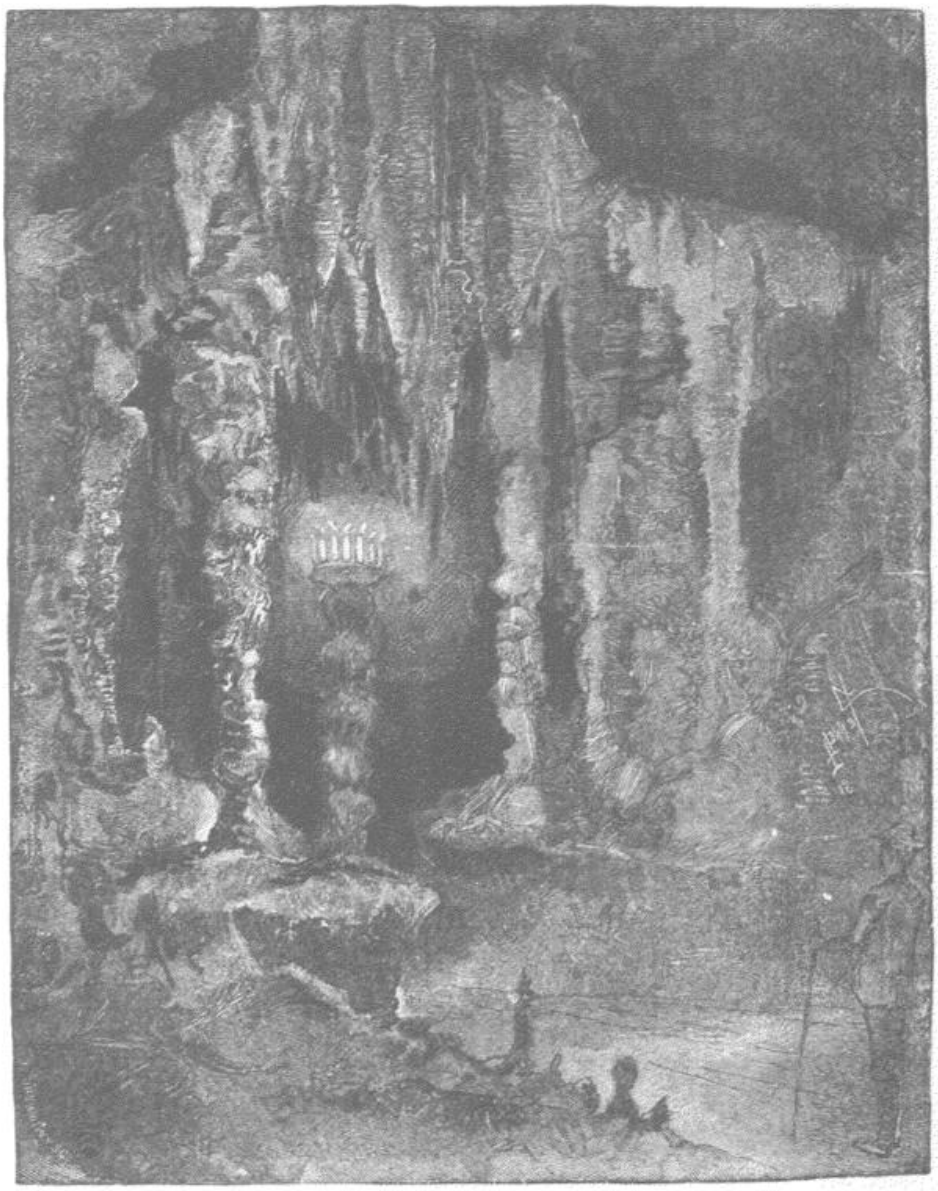

A Pavilion in Luray.

"So wondrous wild, the whole might seem
The scenery of a fairy dream."

CELEBRATED

AMERICAN CAVERNS,

ESPECIALLY

MAMMOTH, WYANDOT, AND LURAY.

TOGETHER WITH

HISTORICAL, SCIENTIFIC, AND DESCRIPTIVE NOTICES OF CAVES AND GROTTOES IN OTHER LANDS.

BY

HORACE C. HOVEY.

WITH MAPS AND ILLUSTRATIONS.

CINCINNATI:

ROBERT CLARKE & CO.

1882.

THIS VOLUME

IS INSCRIBED TO

JAMES D. DANA, LL. D.,

PROFESSOR OF GEOLOGY IN YALE COLLEGE,

WHOSE WRITINGS IN ILLUSTRATION OF SCIENCE

HAVE INSTRUCTED MANY BESIDES HIS OWN PUPILS, AND

WHOSE LOYALTY TO THE SACRED WORD HAS

STRENGTHENED THE HANDS OF

ITS MINISTERS.

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PREFACE.

My original design was to give a popular account of Mammoth, Wyandot, and Luray Caverns, without concerning myself about other portions of the subterranean world. But as the preparation for this special work advanced, materials of a more general nature were accumulated, which so deeply interested the mind of the author, that he thought they might have a degree of interest for the reader too.

I have opened the volume, therefore, with chapters on the structure, varieties, and contents of caverns, followed by a condensed account of cave dwellings, sepulchers, and temples.

Dry details and technical terms have been avoided as far as it could be done without a sacrifice of scientific exactness; and, on the other hand, the temptation has been resisted to hide facts under a profusion of adjectives. Precision of statement has been aimed at, wherever practicable; and yet the plan has not always met with favor, of reducing "cave miles" to prosaic measurement, and the most that is promised is that when the author *claims* to have taken the dimensions of a hall, dome, pit, or avenue, his statements can be depended on. Mere estimates vary amazingly, and each visitor must be left at liberty to look with his own eyes; and yet the estimates given here are frequently the result of much thought and repeated observation, and are believed to approximate accuracy. The results embodied in the

form of maps, are not to be scrutinized as would be justifiable in the case of surface surveys; for their design is not to fix the boundary lines of property, but merely to aid the imagination in following the courses pursued and the distances traversed in under-ground explorations. In the nature of the case, much obscurity must ever rest on regions shrouded in perpetual and absolute darkness, except as momentarily lighted up by artificial means; and the hope of the author is only that he may make certain points clear, and gather into one volume the winnowed results of long and varied research by others as well as himself. My collection of cave literature contains every thing of the kind that has been brought to my knowledge; including a considerable amount of material the value of which is impaired by flights of the fancy, or recklessness of exaggeration. Obligations to those whose publications have been of real service, are duly recognized in their proper place. I desire to make special acknowledgment of the personal attentions paid and the facilities for exploration furnished by the owners and managers of the principal American caverns described.

The illustrations of Mammoth, Sibert, and Wyandot caves were made under the author's direction, by Mr. J. Barton Smith, of New Haven, Conn., and were originally prepared for articles that appeared in *Scribner's Magazine* in 1880. The sketches were first done in black and white, by the light of from twenty to fifty lamps; after which the places sketched were brilliantly illuminated by magnesium, that a clearer view might be had of their outlines. The work thus begun underwent careful revision in the artist's studio, and was corrected as to minor details by comparison with photographs that had been previously taken. Several of the cuts of

Luray Cavern now appear for the first time; while others were originally made for *Harper's Weekly*, by Mr. Alexander Y. Lee, and for the *Century Magazine*, by Mr. J. Pennell.

In submitting this volume, prepared at intervals of leisure snatched from the labors of professional life, it is not without a hope that its contents, besides gratifying the reader's curiosity, may serve also to deepen his admiration of creative wisdom and skill.

New Haven, Conn., *April* 28, 1882.

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CELEBRATED AMERICAN CAVERNS.

CHAPTER I.

STRUCTURE AND VARIETIES OF CAVERNS.

Volcanic Agencies—Sunken Basins—Mephitic Gases—Grotto del Cane—Guevo Upas—Flaming Caves—Lava Caves—The Surtsheller—The Sapphire Grot—Energy of the Sea—Marine Caves—Fingal's Cave—Vertical Gulfs of Norway—Ice Fissures—Coral Caves—Limestone Caverns—Natural Bridges—Lost Rivers—Pits and Domes—Stalactites—Caves that exhale Music and Sunshine—Eldon Hole—Facts and Fancies.

THE crust of the earth is pierced by natural cavities that exist, like the hills above them, in an endless diversity of sizes, shapes and structural peculiarities. Just as there are prairies and table-lands without a semblance of a hill, so there are broad areas of non-cavernous rocks. Only a limited portion of the globe is favorable to the formation of caves, and causes are constantly at work whose effect is to close up and gradually obliterate those now existing, counter-balanced but partly by causes resulting in the excavation of new ones. The task of sifting facts from fancies is one of sufficient difficulty as matters stand; and in this attempt to lay before the public, in a single volume, the authenticated wonders of Celebrated Caverns, the writer has found them to be so numerous and marvelous, that he finds relief in the thought that there is a limit to the "world of rock-ribbed darkness," and that the earth itself is not, as was formerly taught, a hollow globe!

Among the agencies in undermining its surface, volcanic forces are conspicious. It is said that Etna has poured out, in a single eruption, 100,000,000 cubic feet of lava, and Vesuvius half as great a quantity; while Hecla has

deluged Iceland with molten rivers from 40 to 50 miles long. Such vast outbursts must leave corresponding vacancies in the interior. Sometimes the crust above these enormous cavities gives way, and forests and cities are engulfed. Lake Masaga is an instance, in Central America, whose entire basin, 10 miles in circumference, is sunk 1,000 feet below the level of the region, while its walls are wholly formed of rocks blistered and torn by the fierce heat.

The basin of the Dead Sea probably furnishes a still more remarkable caving in of the surface, owing to eruptions that once made Syria a decidedly volcanic region; relics of which exist in the adjacent streams of basaltic rock, and the bitumen floating on the saline waters that were never joined to the ocean.

The inhabitants of a mining town in Mexico were once alarmed for an entire month by subterraneous thunderings, sharp strokes alternating with long rolling peals. Humboldt ascribed this phenomenon to the rushing of steam, or gases, through hidden chambers, emptied by volcanic agency. "Thus" he says, "do chasms in the interior of the earth open and close; and the sonorous waves either reach us, or are interrupted in their progress."

In the writings of Antonio Garcias Cubas, published at Mexico in 1874, we are told of a submerged village in the district of Ixtla, where the transparency of the water permits one to see the houses, and, near the southern bank, the portico of a church, the cross on the tower rising above the surface! A like disaster, in ancient times, is said to have overtaken a town in Italy, whose ruins used to be visible at the bottom of Lake Vico, the ground on which it stood having been engulfed during a volcanic convulsion.

The Lake Agnano is also known to have been an ancient crater; and on its margin is situated the celebrated Grotto del Cane (Dog's Grotto), known from the days of Pliny. It is excavated from the tufa, and quite small, about ten feet long, four broad, and nine high, famous, not for beauty, but for its deadly exhalations of carbonic acid gas. The interior being lower than its mouth, the fatal gas exists in a stratum only two feet deep, the surplus flowing like

water over the brim. The visitor feels no discomfort, unless he should stoop toward the floor, when the momentary sensation resembles that experienced on taking a glass of soda-water in brisk effervescence. The poor dog, kept to exhibit the properties of the gas, finds it a more serious operation. The keeper drags the creature by a cord and swings him to the end of the grotto, where he lies gasping until, just before life is extinct, he is drawn out and thrown into the lake to revive in time for being half-killed again to gratify the curiosity of the next visitor. There are mephitic caverns of far grander proportions than this absurd little den that has been mentioned by every naturalist for the last eighteen hundred years.

The most extraordinary spot of the kind, though not exactly a cavern, is the famous Poison Valley of Java. This is a sunken plain, half a mile in circumference, and girt by precipitous cliffs. The floor seems to be a sieve for the ascent of noxious gases, which rise in such quantities as to be fatal to every living thing that comes within reach. The whole valley is strewn with skeletons of various animals. This place, called "Guevo Upas," gave rise to the fable of "the deadly Upas-tree," of which the senior Darwin gave an account, in his "Botanic Garden," that deceived all Europe, he himself having been imposed upon first by a Dutch surgeon at Batavia, named Foersch, who claimed to have seen the dreadful Tree. The story ran that, in the midst of the valley stood the Upas, blasting vegetation to the distance of twelve miles, and exhaling such an effluvia that no human being could exist within eighteen miles. No living animal of any kind could safely cross the plain, nor were there any fish in the waters nor birds in the air. It is now known that the Poison Valley is smaller than was represented; that its deadly exhalation is simply carbonic acid gas; and that the real Upas-tree, instead of reigning in solitary grandeur over a desert blasted by its presence, grows in luxuriant forests, and permits men and beasts to repose unharmed under its shadow, and birds to build nests in its branches—its poison lurking only in its juices.

The fatal effects of the noxious gases sometimes found in caverns gave rise, probably, to the ancient superstition concerning the Chimæra and the Basilisk; frightful monsters of the most malignant nature, whose dens were near volcanoes.

Before dismissing the subject of mephitic caves, it should be stated that, while it is prudent to look out for foul air when exploring pits and underground chambers, there is really little danger from this cause in any of the larger caverns, owing to the perfection of natural ventilation.

Flaming Caves are of course due to the fires of active volcanoes. The most striking examples are those visible in the face of a precipice in the mountains of Cumana; where two immense holes are to be seen by day-time overlooking the forest below, which at night are lighted by fires from within, and glare like the eyes of a monster, or demon, or "tiger-cat as big as a Cordillera!"

Lava Caves are sometimes of great size and fantastic beauty. They are caused by the overlapping of the fiery torrent, or more frequently by the sinking away of a portion of the fluid mass from under the cooling crust, leaving a roof of hardened basalt.

Professor Silliman mentions such a cavern near the base of Monte Rossi; said to be a mile long, but so irregular in its dimensions as to be penetrated only with difficulty and risk.

Professors Brewer and King, in clambering over the flanks of Mt. Shasta, in 1863, found perforated domes, into whose orifices you might look down 100 feet. They also explored a tubular cavern half a mile long, underlying a lava plain, whose archway is 60 feet wide and 80 high, while the roof is not more than 30 feet thick. The floor was of lava sand, strewn with rough bowlders, and in some of the larger chambers, incumbered with piles of lava-blocks. The sides were lined with blister-holes and lava-froth, looking as fresh as if the cave had been a recent creation.

Iceland, besides its ice mountains, geysers, and twenty-

five volcanoes, boasts the finest lava caves in the world. One of them is called the Singing Cave, on account of its fine echoes, and the custom that prevails of always singing a psalm in it, for the gratification of visitors. Another is known as the Sheep Pen, because used as such by the mountain shepherds; as were also, in ancient days, the "sheep-cotes" in the wilderness of Engedi; both serving to remind us of the cannibal shepherds of Sicily, whose chief had an adventure with Ulysses in a cave, as the story is told by Homer.

Mount Hecla is the best known of the Icelandic volcanoes, having had thirty eruptions during the last 1,000 years, and being at one time in a state of constant activity for six years. But the eruptions from Skaptar Jökull, in 1783, exceeded any other ever known in the modern history of the globe. Streams of boiling water deluged the plains, showers of hot ashes darkened the air, and the torrents of lava spread out over an area of 420 square miles. We are told that this eruption destroyed 9,000 persons and one-half the live stock on the island.

In the midst of the mass of solid rock remaining as the monument of this catastrophe, occurs a chasm formed by the falling in of the crust, exposing the entrance to a cavern of the greatest magnificence. It is the Surtsheller, so named for Surter, the black prince of the region of fire, who, according to the Scandinavian mythology, shall one day issue from his subterranean halls, vanquish all other gods, and wrap the universe in flames. Some of the ancient inhabitants claim to have encountered Surter; probably led to this belief by having seen a remnant of melted lava,—for it was long before so vast a mass was completely cooled. Many of the natives still refuse to enter the precincts of a spot so surrounded by superstitious dread.

Perhaps the best account extant, of the Surtsheller, is that given by Dr. Henderson, who explored it, about the year 1800, with a party of servants bearing lighted torches. According to his measurements it is forty feet high, fifty wide, and retains these dimensions for nearly 4,000 feet;

the entire length being 5,034 feet. Climbing over the banks of snow that partly filled the entrance, the explorers crossed a rugged tract of large angular blocks of lava, between which lay deep pools of stagnant water. The blackness of the walls, ornamented by vitrified stripes, the long black stalactites pendent from the spacious vault above, and other forms taken by the cooling lava, awoke the admiration of the visitors.

"The roof and sides of the cave," says Dr. Henderson, "were decorated with the most superb volcanic icicles, crystalized in every possible form, many of which rivaled in minuteness of beauty the finest zeolites; while from the floor, rose pillars of the same substance, assuming all the curious and fantastic shapes imaginable, mocking the proudest specimens of art, and counterfeiting many well-known objects of animated nature. A more brilliant scene never presented itself to the human eye, nor was it easy to divest ourselves of the idea that we actually beheld one of the fairy scenes depicted in eastern fable."

Lord Dufferin, in that charming little volume, "Letters from High Latitudes," gives a glowing description of Skaptar Jökull and its famous eruption, but says not a word of Surtsheller, or any other cave, with a single exception, to which he gives no name. It is in the vicinity of the geysers, and is so unique that the noble author went into raptures over it: "Imagine," he observes, "a large irregular opening in the surface of the soft white clay, filled to the very brim with scalding water, perfectly still, and of as bright a blue as that of the Grotto Azzuro at Capri, through whose transparent depths you can see down into the mouth of a vast subaqueous cavern, which runs, Heaven knows how far, in a horizontal direction beneath your feet. Its walls and varied cavities really looked as if they were built of the purest lapis lazuli—and so thin seemed the crust that roofed it in, we almost fancied it might break through, and tumble us all into the fearful beautiful bath!"

The Grotto Azzuro (or Blue Cave), to which Lord Dufferin refers, is not a lava cave, but is formed in the lime-

stone by the constant action of the sea. It is one of the large class of marine caverns to which we now turn our attention; peculiar, however, in its exquisite sapphire tints. The island of Capri, on which it is found, is located on the south side of the Bay of Naples. A low aperture leads directly from the water into a circular chamber. Visitors are required to lie down in the boat that conveys them under the arch, and on emerging into the grotto itself, they are amazed to find, instead of darkness, light that would be dazzling were it not blue. The water, the walls, the stalactites,—every object is tinged by the rays reflected from the brilliant skies of Greece; a fact proved by the shadow cast from the boat upward to the vault above, and by the increased luster when the entrance to the cave is closed by a curtain. It is the custom of the guide to plunge into this splendid bath, and, by agitating the waters, to increase the play of cerulean tints, varying from light to the darkest blue; his own body meanwhile seeming like an image carved from sapphire.

A broken stairway leads to a subterranean passage, now filled with debris, but supposed to have formerly communicated with one of the luxurious villas of Tiberius, for whose imperial pleasure this gigantic basin was reserved.

Another grotto has recently been discovered on the Isle of Capri, similar to the one already described, except that the prevailing tints are green, instead of blue; owing to some modification of the light as it enters from the sea.

Marine Caves constitute a class by themselves, differing materially from those that are formed by volcanic or other causes. They are found wherever the swell and lash of the billows for ages have had effect on rocks too hard to be wholly displaced by their action. The tourist, in his rambles by the sea-side, finds a charm in the rugged rocks that seem to him to have kept up, for untold centuries, a successful battle with the waves. But the fact is that the toughest granite and the hardest basalt, the firmest porphyry, and the noblest cliffs of marble, are ever losers in this eternal strife. Every shore is strewn with fragments of the barriers by which it once was girt, and,

where the coast is boldest, the broken outlines are most picturesque, and the explorer is sure to find deeper recesses, often leading to grottoes, natural tunnels, or true caverns, all carved from the compact rock by the fingers of the waves.

Mechanical forces are generally the agencies here in operation, chemical action being comparatively slight upon granites and other substances sufficiently indestructible to serve, even for a time, as a wall against the sea.

Storms, in their fury, pound these walls with liquid hammers, and hurl pebbles and even massive stones, which are sure to find some weak spot that can thus be hollowed out. Veins exist that run parallel to and across each other, and the invading foe insidiously gnaws its way along these lines, until passages called "chimneys" are made, through which, when heavy seas roll in, the water rushes furiously, ascending 50 or 100 feet into the air, like a geyser, with a loud roaring, and then retiring with a sobbing sound, as if grieved at the mischief done. The Spouting Horn of Mt. Desert is a noted instance of this. At low water, it is said, the arch can be gained by a bold adventurer. When the tide comes in, the breakers dash themselves far up the chasm. But in a storm, such is their wild fury that they spout 100 feet through the opening at the top of the cliff in a manner most terrible, and "the thunder of their angry crash against the rocks may be heard for miles." This peculiarity gives its name to Thunder Cave, a long gallery running into the Otter Cliffs on the coasts of Maine. The cavity can be entered at low tide, and the visitor sees in its recesses a number of large bowlders, which it is plain that the waves in a storm roll and toss back and forth, and grind together, with mutterings and rumblings. "The crash of the breakers against the wall is the clap of thunder; the rolling stones carry off the sound in its successive reverberations." The "Ovens" worn by the tides along Frenchman's Bay, are a pleasing contrast to the noisy caves along the sea-front. They are excavated from pink felspar, and their interior walls are painted by the sea in vivid tints; while from crevices near

the entrance the mosses and fringed gentian grow. The poet Bryant enjoyed this as one of his favorite scenes, and praised it in poetry and in prose.

One of the most remarkable groups of sea-caves is that found in the island of Sark, in the English Channel. This island is only 3 miles long, and is made up of granite cliffs 250 or 300 feet high, which are honey-combed by vaulted recesses joining each other in bold and grotesque arches, whose walls are polished by the wear of the waves. Many and singular caves are in the chalk cliffs that lie open to the roll of the North Sea. Some of them are fine "spouters."

Fingal's Cave, and others in the great Basaltic district including the island of Staffa and the Giant's Causeway, were probably due to a combination of causes, of which oceanic violence was only one. The curious Grotte des Fromages (or Cave of Cheeses), at Bertrich-Baden, is the result of atmospheric action on the basaltic columns; and the same decomposing action no doubt subjected the rocks of Staffa to its control. Yet the fact that, twice a day, year by year, and century after century, the tide invades the deepest recesses of Fingal's Cave can not be disregarded. At low tide the ends of the broken columns are stepping-stones on which a skillful climber can go to the end of the cave; but the safer way is to enter by boat.

Fingal's Cave may have been known to the ancient Britons; but its modern discoverer was Sir Joseph Banks, whose account appeared in 1772, and though many have been published since, none are more graphic and truthful than his. Banks took his measurements with care, giving 371 feet, as the extreme length from the rock without, and 250 feet as the distance from the pitch of the arch. Its breadth varies from 50 to 60 feet. The height of the arch at the mouth is 117 feet, and at the end 70 feet. The individual columns vary in height from 39 to 54 feet. The water is from 9 to 18 feet deep, according to the state of the tide.

The name of the island, Staffa, is derived from the Norwegians, who made the spot one of their piratical strong-

holds, and means an assemblage of columns. The voice of the dashing waves suggested the Gaelic name of the cave, "Llaimbinn," or the Cave of Music. The name of Fingal is a contraction of Finn Mac Coul, and figures in the poems of Ossian. Ranges of lofty columns, each about two feet in diameter, and having five or six sides, support a roof composed of sections of others that were broken off to form it. Yellow stalagmitic exudations serve to define the angles and to give an elegant variety of coloring, both to the walls and the roof, while cream-colored stalactites from above are reflected by the transparent green water below. Light from without fills the entire cave with a soft twilight, varied by the play of reflected light; while the melodious echo of the splashing surge seems in harmony with the order and symmetry of the long colonnade.

Marine caverns are seldom of any great depth. The cause that produces also tends to destroy them; and they seldom survive any great length of time after the sea has ceased its work of excavation.

"Along the whole Atlantic coast," observes Professor N. S. Shaler, "from Nova Scotia to Mexico, I do not know of a single cavern deep enough to give darkness, and above the present level of the sea. The only deep marine caves known to me are in the Magdelen Islands, but those are not above tide-level. The existence of deep caverns is a sign that the region has long been above the sea."

The vertical gulfs of Marienstadt and Frederichstahl, in Norway, are by some ascribed to ancient marine action, and if so they are an exception to the usual shallowness of such excavations. It is said that a stone thrown into one of these pits requires from a minute and a half to two minutes to give back the echo of its fall. Hence it is estimated that "They have a precipitous depth of from 39,866 feet, to 59,049,—or nearly twice the height of the loftiest summits of the Andes!" The reader must judge for himself if the sound of a falling pebble would be heard from such a prodigious depth, or whether there was not some mistake in the experiments and calculations thus

gravely recorded as matter of fact! These gulfs, however, really exist and are very remarkable. Being in granite their origin must be explained on some theory different from that on which the vast limestone caverns are accounted for; but whether the agency was igneous or aqueous is not determined.

In contrast to these frightful chasms may be mentioned the wonderfully beautiful ice caverns occasionally formed within the heart of glaciers. These are caused by the partial melting of the mass on coming in contact with the warmth of the earth beneath. The light as it is transmitted through the crystal walls of ice assumes the most brilliant colors; and the stream of cold water makes strange music as it flows away to find an unknown outlet.

The term "ice cave" is also applied to fissures in which ice is mysteriously abundant in summer and wholly absent in winter! One of the largest of these natural ice-houses is in the Carpathian mountains, near the village of Selitze, and is resorted to, in midsummer, to supply the wants of the villagers. At that season the roof is covered with immense icicles, and the drops falling on the sandy floor are instantly congealed. On the approach of winter the icy mass begins to dissolve; and, by Christmas, it is gone, leaving the cavern dry and warm till spring returns!

From a similar cave on the Peak of Teneriffe, 10,000 feet above the sea level, a great ice supply is annually obtained; which, being columnar in its structure, melts less easily than ordinary ice, and is especially suitable for use on ships.

Ice has also been known to form in deep mines; for instance, in the Imperial salt mines at Iletski, in the Ural mountains. Here there is a series of natural hollows in the gypsum, where, when the weather is hottest, the ice hangs in solid masses, that melt away amid the rigors of a Russian winter.

The most noted ice cave, in this country, is that at Decorah, in Iowa, and fully described in White's Geological Report (vol. 1, p. 80). Ice wells have also been found in

Vermont and New York, and described by Silliman and Hitchcock.

The literature of this subject, scattered through various scientific periodicals, is quite extensive. The most valuable work of the kind is that of Rev. G. F. Browne, on the "Ice Caves of France and Switzerland."

Among the conflicting theories brought to explain this class of phenomena, one is at a loss to know which should be accepted.

It has been suggested as a cause, that nitrous earth dissolved by flowing water forms a freezing mixture; that currents of air blowing through caverns produce cold by evaporation; that waves of cold set in motion in winter fail to penetrate the crust of the earth till the next summer, while warm waves are likewise retarded until the following winter; that the heavy cold air sinks into subterranean recesses, whence the lighter and warmer air of summer can not dislodge it; and, last of all, that the whole variety of phenomena observed may be accounted for by the liberation of compressed air. This curious, yet plausible, theory was suggested by the action of what is known as the Frizzel air compressor, and was defended by Prof. Lowe in a paper read before the Boston Scientific Society (1879). It is, in brief, that bubbles of air drawn into water flowing down through fissures in the rock are liable to a continually increasing pressure, compelling it to lose heat, which it immediately absorbs from the water on being liberated in the cave. This causes the freezing in summer. But, in winter, when the flow is arrested by the freezing at the surface, the cause of cold in the cave is removed.

It should be observed, however, that in most caverns of large size—such as Mammoth, Wyandot, and Luray caves—the temperature varies but little throughout the year, and corresponds with the mean temperature of the region.

Limestone Caverns form the greatest and most interesting class of all, and it is desirable that we should have a clear idea as to their structural peculiarities. Some of them, like those in granite, are sea-caves, and originate

partly in the mechanical action of the restless and resistless waves. Others, again, may be due, in a measure at least, to disturbances connected with the upheaval of the earth's crust, whereby cracks and fissures have been opened that were afterwards enlarged by different agencies.

The process, however begun, has probably been hastened by the finding of portions of the rock much softer than others, and even here and there a pocket of clay, which, on being washed out, would leave chambers connected by narrow passages through harder material.

Growing corals, amid the reefs and lagoons of the Pacific, will sometimes encircle and inclose a mass of mud, which retains its nature after the reef has emerged as dry land. There it lies, imbedded in solid strata, above which soil is formed sustaining a luxuriant vegetation. The rain-water, sinking through the loam, conveys to the underlying rocks an agent that at once attacks and dissolves particles of limestone exposed to its energy, namely carbonic acid. This chemical process is very slow, but it works perseveringly till at length the concealed mud-bed is reached. The flowing stream then acts mechanically by washing out the space previously filled with soft or loose material.

Oahu, Atiu, and other coral islands are described by Dana as containing numerous caves, some of them quite large. In one of these Rev. John Williams tells us that he wandered a mile without finding an end to its windings. "Innumerable openings," he says, "presented themselves on all sides. The roof, a stratum of coral rock 15 feet thick, was supported by massy and superb stalactitic columns, besides being richly hung with stalactites."

The Walsingham Caves, in the Bermudas, whose "sparkling roofs and pearl-blue ponds" were celebrated by Tom Moore, are also in coral-made lands.

The limestone of the Ohio Valley must have once passed through an experience analogous to that of modern coral reefs and islands. The Silurian rocks about Cincinnati abound in delicate corals, the strata being interspersed with layers of clay. Few caves exist in this formation,

because the material is not sufficiently firm to hold together after having been undermined.

At Madison, Indiana, the bluffs abruptly rise 400 feet or more, from the thin limestones I have described, to a crest of massive marble, belonging to the Upper Silurian period. Numerous cascades toss themselves over these cliffs, and striking on the softer strata below, wash out wide, shallow grottoes, that look exceedingly pretty behind their silvery veils. This process of excavation goes on until, finally, the roof falls by its own weight. Its repetition, age after age, results in a steep ravine strewn with the rocky fragments of ancient cave-roofs.

On this same theory may be explained the formation of the natural bridges found in various parts of the country. The most noted of them is in Rockbridge county, Va. As measured by Pres. Jefferson and F. W. Gilmer, who visited it in 1815, the lower face of the arch is 160 feet above the water of Cedar creek, which it spans; and the height of the upper surface is 215 feet, although incorrectly represented by other writers to be as much as 270 feet.*

"Caverns," observes Mr. Gilmer, "only require a section of their ends to be taken away to become natural bridges; and these remain only because their arches are thick enough to support the superincumbent weight."

Hitchcock explains, on the same principle, a bridge of white marble spanning Hudson's brook, in Adams, Mass. In this instance the walls of the chasm run back into a cave. In visiting caves of large extent, one is at first inclined to regard the long halls, huge rifts, deep pits and lofty domes, as evidences of great convulsions of nature, whereby the earth has been violently rent asunder. But, while mechanical forces have had their share in the work, as has been shown, the main agent in every case, has been the comparatively gentle, invisible gas known as *carbonic acid.* This is generated by the decay of animal and vege-

*For one of the best accounts of the Natural Bridge the reader is referred to Picturesque America, vol. I, pp. 82-90. They found another one in Scott county, estimated to be more than 300 feet high.

table substances, and is to a considerable degree soluble in water. Under ordinary circumstances one measure of water will absorb one measure of carbonic acid; and the eye will detect no difference in its appearance. Under pressure the power of absorption is rapidly increased, until the water thus surcharged has an acid taste, and effervesces on flowing from the earth, as in Saratoga-water.

Rain-water falling amid the leaves and grass, and sinking into the soil, absorbs large quantities of carbonic acid. On reaching the under-lying limestone, the latter is instantly attacked by the acidulated water in which it is dissolved and carried away.

A familiar example is furnished by every soda-fountain, where it will be seen that the polished marble slab, on which the fountain rests, becomes roughened and worn by use. This is due to the eating energy of the carbonic acid with which the water is charged.

The very same agent works on the marble before it is cut and polished. When examining the celebrated quarries of white marble, in Berkshire county, Mass., I inquired if there were any caves in the vicinity. Accordingly I was taken to see several little grottoes, that were as evidently eaten out by acid, as in the case of the soda-fountain referred to a moment ago.

The largest of the Berkshire caves is small compared with the famous grotto of Antiparos, one of the islands of Greece, which was also excavated from marble, and is said to be 300 feet long and 80 feet high, with a splendid array of stalactites.

It is agreed among geologists, amazing as the statement may seem, that the immense caverns of Virginia, Kentucky and Indiana, including Mammoth Cave itself (the largest of all), were eaten out of the solid mass of limestone by the slow, patient, but irresistible action of acidulated water.

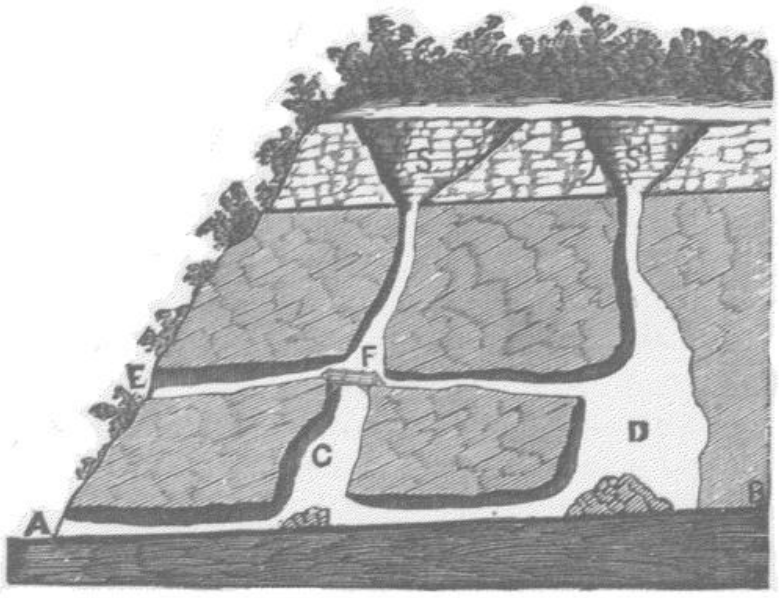
The traveler amid the regions named, sees, on the face of every rocky hill, grooves and furrows, proving that it is not alone the "continual dropping that wears away the stone," but it is the corroding power of the carbonic acid

remaining in the drops, and rills, that consumes the solid cliffs and tunnels the globe.

So extensive is this area of undermined surface, in certain regions, that one may journey on horseback all day long, even in a wet season, without crossing a single stream of any kind! All the smaller ones are swallowed by what are called "sink-holes," that is, circular depressions, sometimes expanding into valleys, but leading down to no true channel; only to a crevice or pit, connecting the sink-hole with a cavern below, in which is the real gathering bed for the accumulated waters.

Sometimes these underground streams emerge in full power, and with volume enough to run a mill or a factory. But more commonly they gush forth in large springs, at the foot of high bluffs, and feed rivers of considerable size.

The streams, flowing down through the sink-holes, carry pebbles in with them, to be used as teeth for cutting through the successive floors of the cavern, and thus enlarging its dimensions. This is generally done in longitudinal channels, resulting in long avenues, whose walls retain horizontal projections marking former levels or galleries.



VERTICAL SECTION.

A. The mouth of a cave.
B. Solid limestone.
AB. Line of drainage level.
C, D. Domes or pits.
E. Closed Entrance.
F. Bridge over a chasm.
S. S. Sink-holes.

Occasionally the whirling pebbles cut a vertical shaft completely through from the uppermost chambers down to the drainage level. Surprising effects are thus produced, in opening great pits or "domes," as they are often called.

It only remains to be said, in closing this introductory chapter concerning the structure of caverns, that by a singular law of nature, oozing water tends to fill up and obliterate the cavities excavated by running water! Not only are quantities of mud and sand swept in, but deposits of limestone are made in various forms.

Stream-swept channels do not favor the production of such deposits, for the reason that the water runs away before it can lay its burden down. But when the water drips from the roof, or trickles down the walls, freighted with bi-carbonate of lime, it leaves, on evaporation, a thin film of alabaster. A single drop will leave a ring. The next will add a second ring. Successive rings grow into a tube, somewhat like a pipe-stem. The slender tube gradually thickens to an elongated cone. Groups of pipe-stems are united into a single pendant, a section of which will show the original tubes. A number of them hanging from a seam in the roof may join to form a stony curtain with fringe and tassels. Or, if the drops trickle slowly along a sloping surface, alabaster scarfs are woven.

All these varieties of pendants are called stalactites—from a Greek word signifying to form by dropping, and often applied to icicles, which are stalactites of water, as these are of limestone.

The term stalagmites, having the same derivation, belongs to incrustations made on the floor. They grow as solid cones, flattened on top; or on an uneven floor, they spread out into shapeless masses and grotesque resemblances. When the cones meet the pendants, columns are formed. In a similar manner the curtains are transformed into walls, that separate the cave into chambers. The water collected in shallow pools, deposits, on evaporation, layers of the carbonate of lime, which, when broken, often exhibit variegated stripes, like the markings of agate.

The general term "dripstone" is now applied to any sort of formation made by dripping water, as shorter than the older terms stalactites and stalagmites, and really meaning the same thing.

Thus, as we have shown, the acidulated water first eats out the cave, and then it fills it up again with dripstone!

Among the mysteries of caverns may be mentioned the strange music breathed from their mouths under certain circumstances. Humboldt tells us of a granite cave by the Orinoco that emitted harmony at sunrise, proceeding from the passage of rarified air through fissures. The Arabs explain similar organ tones in Arabia Petræa by referring them to a convent of monks miraculously entombed, and who are chanting their matins. Travelers have described "a moaning, Æolian sound," breaking in upon the stillness of wild and lonely passes of the Pyrenees, and supposed to issue from cavities in the Maladetta mountain.

Still more wonderful than these Memnon-like sounds is what we are told of a cave in Bolivia, "that gapes on a mountain side, as black and gloomy as cave may be, until the close of day; when the shades of evening having fallen over it, and over every thing else in its neighborhood, on a sudden warm *sunshine* gushes from its jaws, lights up the objects around, smiles, trembles, fades and then expires!" No Humboldt has visited the spot; and, in absence of other explanation, it may be suggested as possible that the mountain is tunneled by the cave, so that the sun, having set behind it, shines for a brief moment through, and lights up in this marvelous manner the valley he had left in gloom.*

An example or two may serve to show how hard it is sometimes to get, from others, the exact truth concerning those subterranean regions that mankind have ever in-

* Tubular openings of this sort are found in Switzerland, Heligoland and New Zealand. The Tschlingel Peak, highest of the Dodi chain, "is so perforated that, twice in the year, in March and in September, the sun appears as if through a pipe, giving a pleasing and singular light to the valley beneath."

vested with awe, and amid whose profoundest depths they have even located the fires of Tartarus and the asphodel meadows of Elysium.

The gulfs of Norway have already been mentioned. Eldon Hole may be put in the same category. This is a famous pit in the Peak of Derbyshire, about which Hobbes wrote in Latin and Cotton in English. The latter thus testifies in verse:

> "I myself, with half the Peak surrounded,
> Eight hundred, four score and four yards have sounded;
> And though of these four score returned back wet,
> The plummet drew and found no bottom yet!"

In other words the poet's measurement found no bottom at the astounding depth of 2,652 feet! Probably Mr. Cotton let the rope coil on the bottom, mistaking the weight of it for that of the plummet—a mistake actually made by a civil engineer in Kentucky, who reported a pit to be 300 feet deep, which afterwards was proved to be but about 90 feet! Concerning the Eldon Hole, it is further stated that the Earl of Leicester hired a man to descend, who, after going down 750 feet, was drawn up a raving maniac, and died in eight days. Very likely he imitated the Knight of La Mancha, when in the Spanish cave, who ensconced himself on a convenient shelf, and let the rope dangle as far as it might below, while he dreamed the rest of the adventure. At all events when Mr. Loyd, a member of the Royal Society, took it in hand to sound the bottom of the Eldon Hole, he found it at the exact depth of 186 feet, and told the story in the Transactions of the Society. The currents of air and water flowing through its fissures probably connect with the lateral caverns for which Derbyshire is famous. The largest of these, the Peak Cavern, at Castleton, runs horizontally 2,250 feet into the mountain, and has six capacious chambers and a lake. Another goes by the name of the Speedwell Mine, because miners blasting for lead ore, accidentally opened a door into one of the finest caverns known. The visitor goes down 106 stone steps, embarks on a canal five feet wide, and pulls himself along by pegs in the wall for a

quarter of a mile to a chasm down which a cataract plunges with a deafening noise. The dome over this pit is said to be 300 feet high, and is very grand and solemn. It is estimated that 40,000 tons of material from the mine have been cast into the chasm, without seeming to make any difference in its depth.

The Adelsberg Grotto, in Carniola, Austria, is generally pronounced the largest in Europe, and the most incredible stories are told as to its magnitude; and yet a recent official survey reduced its "many miles" to exactly 10,142 feet. Its magnificent chambers with imperial names, its fine stalactites, and the mysterious river heard murmuring in its recesses, attract thousands of tourists annually. It is now known to be excelled in actual size by the Aggtelek Cave, in Hungary, which is about 20,000 feet long.

Why is it that men are always tempted to magniloquence in attempting to describe subterranean wonders? We smile at the glorious account, in the Tipperary *Free Press*, of a cave in Ireland, found in 1833, whose chambers are "wider than angels' ken," one of them being "nearly a mile in circumference, and another fully three miles around;" and we have grim satisfaction in knowing that before the relentless surveyor the one shrank to a room 90 by 150 feet, and the other to a room 100 by 250.

And yet it becomes us to indulge our humor in moderation, remembering that "cave miles" are proverbial in America, and that we, too, on this side the Atlantic have been made the occasional victims of perverted ingenuity. A writer in a popular journal, this very year, in giving the dimensions of a certain cave that is known to be less than 2,000 feet long, mentions two avenues in it one 10 and the other 13 miles in length! Among the many hoaxes perpetrated at the cost of a credulous public, the most notable are those invented about the Grand Crystal Cave, and another near Leitchfield, both in Kentucky; whose subterranean seas of breadth immense and swarming with blind fish, whose well-paved carriage-roads many miles long, were as nothing in comparison with their wonderful pyramids, Masonic altars and sculptured sarcophagi!

It seems hardly necessary to expose these amazing and amusing frauds; but the reaction from them should lead us to welcome statements from competent geologists and civil engineers, prepared to furnish exact information on matters about which the imagination is so ready to run ahead of the tape-line and level.

CHAPTER II.

CONTENTS OF CAVES—MINERAL, VEGETABLE AND ANIMAL.

Alabaster—Precious Stones—Salt Mines—Useful Ores—Flints—Silver Caves—Mushroom Farms—Cave of the Guacharo—A Fat Harvest—A Natural Aquarium—Cavern Life—Eyeless Fish—Fossil Fauna—The Bone-caves of Europe—Of Australia—Of Brazil—Of Pennsylvania—Ancient Geography—Gigantic Beasts—Man amid Monsters.

In considering the contents of caverns it is convenient to regard, first, those of a mineral description, which are many and diversified.

Dripstone, though often coarse and valueless, is sometimes exceedingly beautiful and even precious. One species, known as oriental alabaster, to distinguish it from the soft and perishable common sort which is but gypsum, is more hard and durable than most kinds of marble, and from it, in ancient times, Grecian sculptors carved some of their finest work.

The so-called "Mexican onyx" is but a fine-grained and translucent species of dripstone. Another variety is known as "Gibraltar-stone," and is greatly admired for its exquisite agate-like markings. The genuine article, of course, comes from the caves found in the Rock of Gibraltar; but equally beautiful specimens are produced by some of our American caves. The manufacture of tablets and ornaments from the more choice kinds of stalagmitic rock has been carried on to a considerable extent, and parties who own localities that amount to nothing as "show-caves," might find them valuable as quarries. It should be taken into account, however, that special machinery for cutting and polishing will have to be supplied, superior to what is ordinarily used for marble.

Cave-pearls, concretions found in shallow pools where

they have polished each other by attrition, are occasionally fit to be set as gems.

Fluor-spar, from which blue or amethystine vases are cut, is often called Derbyshire spar, because found in its perfection in the caves of that locality.

Saltpeter has been taken in great quantities from many American caverns; but the history of these works will be given in another place. The sulphates of soda and magnesia are also abundant in some of them, in a natural state.

The celebrated salt mines of Salzberg, in Austria, were originally caves, though now greatly enlarged by the mining operations that have been carried on for the last 250 years. Although for so long a period in constant use, their supply seems inexhaustible. The entrance to them is through a narrow, arched passage, 1,200 feet long, leading under the mountain. Then there is a staircase of 126 steps up to another gallery. One is next ferried over a salt lake, five feet deep and 250 feet long. The salt-chambers then are reached, whose walls glisten with myriads of crystals. Their prevailing color is a pinkish white, but occasionally an iron-gray is seen.

I hardly know whether to mention the "Grotto of Topazes;" for the romantic nature of the discovery makes one suspect that it exists only in Dreamland. It is said, however, to be in actual existence, near the Pfeiffer Glacier in Switzerland, and to have been discovered about twelve years ago. Admittance was gained only by the greatest exertions and at imminent peril. The explorers were rewarded by finding a grotto, 45 feet long, and 16 high, whose roof and sides were completely studded with blocks of topaz. Some of these they are said to have removed, across the glacier, and to have sold for a large sum of money.

This nest of topazes is hardly more wonderful than a grotto that some workmen opened in 1869, while deepening the channel of the Mississippi river near Rock Island. It was about 16 feet in depth, by 25 feet long, and completely lined with brilliant iron pyrites, sparkling in the lamp-light like yellow gold! I visited this unique grot

just after its discovery. There is also another cave, at the lower end of Rock Island, about 60 feet long, and concerning which there are several romantic legends; but which boasts no such display as that previously described.

Lead caves are found near Dubuque and elsewhere in the great lead-bearing area of the Upper Mississippi. They are usually mere "pockets" or vertical fissures filled in with galena. Fortunes have been made by working them as mines.

Ores of iron, zinc, manganese, and other useful metals are frequently found in cavities, and sometimes in paying quantities; though more often as mere stains and incrustations.

Flint nodules abound in some of the caves in Indiana and Kentucky, and vary in size from a few inches to several feet in diameter. They are gray on the exterior, but a glossy black within; the difference being due to the loss of iron by the portion exposed to the action of water. Arrow-heads, originally black, turn to a dull gray after long exposure to the weather. The same is true of nodules, or fragments of them, that have been lying on the surface, or in the beds of streams. Hence the Indian arrow-maker sought his materials in caves; or, if these were not accessible, in pits of his own digging.

The silver caves of Huallanca are worth mentioning, if for no other reason than because the precious metals are rarely found in such places, though many have patiently hunted for them. We are indebted to Mr. Sewall, an American mining engineer in Peru, for an account of his visit to them, in 1878. They are probably the highest caves in the world, being in the Andes, at an elevation of 14,700 feet above the sea, where the attenuation of the air makes labor of any sort difficult however alluring the reward.

Imagine a series of grottos, in sandstone riven by a dike of porphyry, and each about 25 or 30 feet in diameter. In some of them you may see veins and crystalline masses of native copper, and in others threads and beautiful sprays of virgin silver shooting from the walls and

within reach of the hand! The deposit, however, is usually in the form of argentiferous ores, yielding from 150 to 800 ounces of silver to the ton.

Vegetation under ground is, as a general thing, neither abundant nor varied. Yet it presents a few points of interest.

Ferns and mosses usually fringe the entrance, and tangled vines often hang over the rocks. The floors of marine caves are strewn with masses of sea-weed. Those along the coast of Wales, and also of Devon and Cornwall, abound in a fine variety of sea-fern that is said to be rare elsewhere.

Fungi thrive wherever there is decayed wood or soil suited to their growth. I found a bed of mushrooms, in 1881, growing naturally, near the river Styx in Mammoth Cave. The genus was *Agaricus*, but the species was not determined. Minute fungi were found growing on the stalactites in Luray Cave when it was first opened. On examination they proved to represent a new species, to which I gave the name of *Mucor stalactitis*.

The cultivation of mushrooms below ground is extensive in France. A cave at Montrouge has six miles' run of mushroom beds, with a daily yield of 400 pounds of marketable fungi. Another, near Frépillon sends, on favorable days, 3,000 pounds to Paris, from beds aggregating 16 miles in length. Still another, belonging to M. Renaudot, at Méry, is said to have had under cultivation, in 1869, over 21 miles at once, giving employment to a large class of laborers, who devoted themselves wholly to the business.

The cave of the Guacharo (or oil-bird), in South America, is described by Humboldt as adorned by tropical vegetation far within its recesses. From its arched entrance a river rolls forth. The dense foliage of gigantic trees, laden with vines, and the oxalis and orchids from crevices in the rocks, effectually conceal this grand abyss at the distance of 400 yards. Through a grove, bright with gorgeous blossoms, and gay with singing birds, you enter the cave, and find the grove continuing for more than

100 feet within. The opening being toward the south, and the channel straight, lights are not needed till you have advanced 1,200 feet, and the entrance is visible from a point much farther in. From a cascade, 1,450 feet under ground, the visitor looks back upon one of the most singular spectacles imaginable. Flowers grow around his feet, lifting their blanched stalks among the sparry growths of the cavern, pale and fantastic, yet beautiful. He wonders if there might not have been some truth in the grove of Aladdin, with its fruits of diamonds, emeralds, rubies, and sapphires; and whether the famous subterranean garden found by Don Quixote in Montesinos was all a dream.

Beyond these pale, phantom plants, that are regarded by the natives with great awe as belonging to departed spirits, the long vista opens, extending over grotesque objects rising from the floor and slender stalactites depending from the roof, to the mazes of subterranean vegetation near the entrance. Still beyond all this, the vivid light of noon-day illumines the rocks and plants outside, and the river sparkling amid the foliage.

The mention of the nocturnal bird, whose name is attached to this extraordinary cavern, serves to introduce our next topic, viz. the varieties of *animals found* in such recesses.

Concerning the Guacharo, it need only be further said, that its principal characteristics are those of the night swallow, and its color is brown mottled with darker shades, and sprinkled with white spots. Its cry is hoarse, and one can hardly imagine what a noise is made when thousands of them join their clamor in the darkness. They seek the outer air only on moonlight nights, or just at twilight. Their food is fruits and seeds, on which they grow to be exceedingly fat. The "fat harvest," as it is called at Caripe, near which the Guacharos abound, occurs in mid-summer. At that time the Indians build huts of palm leaves at the mouth of the caverns. Entering the latter they strike down great numbers of the birds, especially the young ones in the nests, try out their fat and preserve it in clay vessels. The Indians are deterred by

their superstitious fears from venturing far within, expressing the belief that the souls of their ancestors dwell in those mysterious abodes; and when they hear a wailing cry at night, it is a saying among them that "some one has gone to the Guacharos."

The living contents of marine caverns, subject to the ebb and flow of a strong tide, are often of extreme variety and beauty. I can never forget my impressions on visiting some of the granite grottoes along the Bay of Fundy, where the tide rises higher than in any other part of the world. At low tide, in these places, it was as if you were walking at the bottom of a deep sea, and examining the shell-fish, crustacea and annelids ordinarily to be brought to view only by dredging.

Ober describes a deep natural aquarium in the Bermudas, where immense fishes, some of them weighing as much as twenty-five pounds, were daily fed and tamed. At the call of the guide they would swim lazily up from the depth, take the morsels cast on the waters, then glide away through fantastic submarine arches, and in and out among the stalagmitic pillars.

"In such spots," observes the author of the Rambles of a Naturalist (speaking of grottoes along the coast of France), "I was able to contemplate, in its incredible variety, the domain of the lower marine animals. Here I could admire, in all their glory, the unknown wonders of the deep." Rose-colored cowries and orange-tinted sea-slugs, carmine star-fishes, and sponges of every shape and hue, are described by this writer, as found by him, under a vaulted roof clothed with bright-red Ascidians, and amid walls decked by a living tapestry.

Life in caverns remote from the sea has none of these brilliant aspects, but is usually a very sober and quiet affair. It is well known that certain animals love cool and shady spots, and such would naturally seek a retreat in dense forests, or deep ravines, or, if opportunity offered, under rocky ledges. Bats and other nocturnal creatures, rats and mice and other rodents, bears and other carnivora, are known to seek the shelter of caves,

especially during the period of hybernation. The oil-birds have already been mentioned as building their nests in the caves of Cumana. A kind of macaw does the same thing in Mexico. Halliday speaks of "countless multitudes of pigeons" that find a retreat in the murky depths of some of the Irish caverns.

Aside from these visitors, constituting an immigrant fauna, a few animals seem to be expressly created for subterranean habitations. In some instances they have congeners living outside; but in others they have such peculiarities as make it proper to classify them in groups by themselves.

The cave-mouse twirling his rotary cage in the room where I am writing these pages, looks like other mice, except that he is half white, has extremely long whiskers, eyes that stand out like great jet beads, and absurdly large ears. Plainly these peculiarities mark him as a different species from the common mouse. Such cave-rats as have come under my notice are equally unlike common rats. Flies, fleas, beetles, spiders, centipedes, pseudo-scorpions, and other minor representatives of the animal kingdom, have fallen into the clutches of the naturalist. But the ordinary visitor may rest assured that he may ramble for miles without encountering a single one of them; and, when found, they awaken interest from the fact that they are usually blind, colorless and harmless. Their antennæ hairs and limbs are extremely long, and their habits curious. Nothing is more ludicrous than the spry antics of a cave cricket, when some pursuer is bent on his capture.

The waters of limestone caverns are often inhabited by eyeless fish, and other creatures, to be more fully described in connection with Mammoth and Wyandot caves. They have not been found in any European caves, so far as I have learned; but instead of them there is a most singular vertebrate found in the caves of Carniola—the *Proteus anguinus*. "It is a foot long, of the size of a human finger, with four little legs, too imperfectly developed to be of any use as limbs. It has no fins, but two curious, coral-red crests, or naked gills, close to the fore-limbs, are com-

bined with true lungs, giving the animal a double system for the aeration of the blood. Its jaws are well furnished with teeth, and its nostrils are large; but its ears are covered by flesh and skin, and the eyes are not only small, but are also covered by skin, and are represented externally by small points."

The literature descriptive of cave-fauna is quite extensive; and the reader who desires further acquaintance with the subject is referred to the published proceedings of the various scientific bodies, and to the entomological journals. Professors Putnam, Cope, Packard and Hubbard are the principal American authorities. Among foreign ones the first place probably belongs to Prof. Schiödte, the eminent Danish zoologist, who has published an interesting account of his researches in the Transactions of the Royal Danish Society of Science (Fifth Series, Vol. II., Copenhagen; 1851).

A list of recorded subterranean fauna, as found in European caves, prepared by Prof. A. H. Halliday in 1857, includes 65 species distributed as follows: Vertebrata, 1; Insecta, 33; Arachnida, 7; Myriapoda, 1; Crustacea, 5; Annelida, 1; Mollusca, 17. This list would no doubt be greatly increased by more recent discoveries, to which, however, the writer has not access at present.

A similar list of the inhabitants of caves in Kentucky and Indiana, according to American authorities—as late as 1882—includes 46 species distributed as follows: Vertebrata, 6; Insecta, 22; Arachnida, 8; Myriapoda, 3; Crustacea, 5; Vermes, 2; to which may be added Polygastric Infusoria, 8; and Phytolitharia, 5. (See Appendix.)

We come now to speak of *fossil* forms of life. Beasts of prey have always sought places where they might quietly devour the bodies of their victims; hence they would, anciently as well as now, tenant dens. Besides being thus used as larders, caverns have always received the remains of such animals as fell into them, whether an ox, sheep or horse; or a rhinoceros, elephant or bison. Every cavern is, therefore, to some extent a bone-yard.

The first "bone-cavern" discovered, or that attracted

attention, was near Wirksworth, in the lead mine of Baules. The story is thus told by an honest miner:

"They came to an open place, as large as a church, and found a skeleton reclining against the side, so large, that his brain-pan would have held two strikes of corn, and so big that they could not get it up without breaking it. My grand-father, having a share in said mine, they sent him a tooth weighing four pounds." Such is the account given by George Mowers of the fossil elephant found in A. D. 1663.

Osseous caverns in the Hartz mountains were discovered at about the same time, and the tusks found in them went by the name of "unicorns' horns," and were popularly supposed to have high medicinal virtues.

The famous cave of Gailenreuth, in Franconia, explored by Dr. Goldfuss in 1810, contained remains that were identified by Cuvier as those of the hyena, lion, wolf, stag, bison, and bear. The bears were in the majority, however, the bones of 800 individuals having been exhumed, from this one locality—a regular Ursine cemetery!

Shortly after this discovery, Dr. Buckland explored bone caves in Yorkshire, Derbyshire, and elsewhere, and gave the results in his Reliquae Diluvianae, in 1822, a work that opened a wholly new field of scientific investigation.

The village of Kirkdale already enjoyed a measure of celebrity on account of its old Saxon church of the date of Edward the Confessor; but an opening amid the grass and rushes near its walls led some workmen down into a low-roofed vault, boasting far higher antiquity than the moss-grown church above, and destined to a far wider fame. The floor was a mud-bed, coated over with drip-stone, through which, as one of the workmen told Dr. Buckland, "the bones were sticking, like legs of pigeons through a pie-crust!" Here, according to this enthusiastic explorer, were the bones of more than a hundred hyenas, mingled with the remains of carcasses they had dragged in thither for food. Among these broken and gnawed fragments were relics of the mammoth, rhinoceros, tiger and bison, all of which must once have lived in York-

shire, as they could not have floated from tropical regions to the spot where they lay.

Fossil bones of the same description were found in Kent's Hole, near Torquay, by Rev. J. MacEnery, whose explorations from 1825 to 1841, brought to light the first flint implements associated with the bones of animals belonging to species now extinct. He was first led to visit the spot on account of its stalactitic formations. But, on turning over a block of dripstone, one day, he saw some bones which proved to be those of the great cave-bear. On removing more of the stalagmitic crust, he found more bones—exclusively those of gigantic bears! Making his way, next, into a group of chambers, beyond the first room, he found, under a mass of dripstone, bones packed together so thickly that, as he tells us, "no idea of their number could be given!" From this spot he collected thousands of teeth, lying amid myriads of bones. He says, "it seems as if more wild beasts had died there than would stock all the menageries on the globe!" It was in fact a common sepulcher for animals small and great, from the mouse to the elephant.

In addition to these were found abundant relics of man. The surface soil of the cavern floor yielded mediaeval pottery, implements of bronze, iron and stone. Under this came a stratum of stalagmite from one to three feet thick, below which, in red earth, among the remains of mammoths, lions and hyenas, were flint spears and arrow-heads, pins and bodkins of bone, and an engraved antler. All these had lain there, side by side, undisturbed, undecayed, for centuries untold!

MacEnery's discoveries, the reality and value of which were at first disputed, have since been verified by investigations made by a committee of the British Association, working under the direction of Mr. Pengelly. Excavations have been made with the utmost system. Each barrow-load of bones has been boxed by itself. In 1870 there were 3,948 such boxes forwarded to Prof. Boyd Dawkins for inspection. The very dust was put under the microscope, and efforts made to wrest every secret from the

bosom of the earth that had been, for so many ages, kept hermetically sealed under masses of stalagmite. In a single room 366 flint implements were found. Flints were also found in the hard breccia filling the bottom of the cave to the thickness of 12 feet; which, by the rudeness of their form, as well as by the peculiarity of their location, were proved to have vast antiquity.

The caves of Brixham, Wookey, Cresswell, and other localities, were explored by eminent British geologists, with results of the highest importance to science, and all confirmatory of what had been observed at Kirkdale and Kent.

Meanwhile explorers were busy elsewhere, and the caverns of France, Switzerland, Belgium and Germany were ransacked for bones! It is said that one set of investigations, continued during seven years, resulted in the presentation of 40,000 bones and 80,000 worked flints to the museum at Brussels! The fact was proved beyond a doubt that the ancient mammalia of the continent were identical with those formerly found on the British Islands, and that no barrier prevented their passing from the Alps to Ireland.

The caves of Gibraltar, Sicily and Malta contain the remains of African mammals, alongside of those recognized as European; showing, according to Falconer, and other authorities, that Europe and Africa were once connected by a bridge of land running south from Sicily, and that a large part of what is the Mediterranean Sea was submerged at the same time that the sea-bottom was lifted to form what is now the desert of Sahara.

While such singular lessons in zoology and geography are taught by the bone-caves of Europe, it is interesting to note the results of explorations at the antipodes.

It is well-known that the animals of Australia are, for the most part, marsupials; bringing their young into the world in an imperfect state and for a long time afterward carrying them in a natural pouch, or fold of the skin. No animal outside of Australia is thus provided, with the single exception of the American opossum. The marsupials include, besides the kangaroo, numerous varieties

of this general type; some of which are root-eaters, some grass-eaters, some insect-eaters, and others flesh-eaters. There are carnivorous marsupials in Tasmania so fierce and dangerous as to be known as "tigers" and "devil-beasts."

Now the curious fact is that fossil marsupials, three or four times as large as any now living, have been found in the caverns of South Australia and New South Wales, both of carnivorous and herbiverous species, and the accumulations of bones in these places is said to be as remarkable as those of England or Germany. The inference is that altered conditions of existence led to the simultaneous production, and subsequent extinction, of many kinds of gigantic creatures, in widely remote parts of the globe; and, also, that these changing conditions were somehow connected with changes of the sea-level affecting entire continents.

These conclusions are confirmed by geological explorations in North and South America. The bone-caves of Brazil, and other regions lying between the Andes and the Atlantic, boast of giants as remarkable as any. Sloths as large as elephants, armadillos encased in a cuirass tougher than the hide of the rhinoceros, and equaling that animal in size—these, and other unique monsters characterized the ancient fauna of Brazil, fit rivals of the huge beasts that left their bones in Kirkdale and Torquay.

The extinct animals of the United States are known to have exceeded in size and variety any found elsewhere, and our caverns are the largest in the world; but, for some hitherto unexplained cause, the big beasts did not seem to find the great caves, but chose to leave their bones in bogs, gravel-beds, and mountain parks. A few bones, however, have been exhumed from nearly every cave, in which search has been made for such remains; and some of the smallest grottoes have contained the best deposits.

Hartman's Cave, Durham Cave and caves near Carlisle, in Pennsylvania, were found to contain accumulations of bones, which were classified by Baird and Leidy, who identified nearly all as belonging to species now living on the

continent. The list is long, and includes, besides small animals, the bison, black bear, moose, elk, caribou, stag, wolf, lynx, fox etc., all of larger size than now.

A bone cave found near Port Kennedy, Penn., is described by Mr. C. M. Wheatly (Am. Jour. Sci. and Arts, April, 1871). It was cut into in a quarry. Its width varied from 10 to 30 feet, and its depth was perhaps 50 feet; and yet, in this contracted space, the bones of 27 species of vertebrates were found, besides the remains of 10 kinds of fossil insects, and as many more of plants, making 47 species in all! Some of these were great beasts, such as the mastodon, the taper, the megalonyx, the mylodon, and a gigantic bear! Probably this pit was a portion of an old cavern unroofed by time. This agrees with the opinion expressed by Shaler that, in undertaking extensive and systematic explorations in the cavernous region of the Ohio Valley, "the best chances will be found in the uppermost set of caverns, or in crevices in the summits of hills, where old caverns have lost their roofs, and only the accumulations formed in their halls remain to attest their existence."

Geologically, many of the animals whose bones are found in caves, date back to the Post-Tertiary (Pleistocene) Period, and the picture of life thus set before us is in its most gigantic forms. The British tiger then far exceeded that of Bengal now, the bear of Germany was more huge than the polar or the grizzly bear of modern times, and the lion was a monster in whose presence his cousin of Africa would quail. The king of carnivores, however, was one that fortunately has no living representative, and whose saber-like teeth eight inches long indicate his destructive ferocity. These beasts preyed upon herds of colossal oxen and elk, pursued horses and reindeer larger than those now living, and contended with huge elephants twice as bulky as those now found in Ceylon, and with varieties of the rhinoceros and hippopotamus more formidable than their congeners of Africa; while troops of hyenas fierce and great crunched the fragments left by the nobler tyrants of the forest and the jungle. Herds of mammoths roamed

from Siberia to Behring's Straits, and ponderous mastodons ranged over North America, while in South America they were rivaled by enormous sloths, ant-eaters and armadillos.

Into a world thus occupied by creatures monstrous and terrible, a being was introduced unarmed and defenseless, that had no sharp fangs nor cruel claws; that wore no cuirass like the river-horse, nor coat of mail like the glyptodon, and yet that was destined to surpass and control, to tame or exterminate every other denizen of the globe —and this wonderful being was MAN!

CHAPTER III.

CAVE DWELLINGS, SEPULCHERS AND TEMPLES.

Fossil Man's Reception—Cautious Philosophers—Prehistoric Races—Paleolithic Period—The Stalagmitic Seal—Valley of Vézère—Savants in Conference—Nobility of Primitive Man—Troglodyte Arts—Fossil Sculpture—Portrait of a Mammoth—Neolithic Period—Caves of Spain—Textile Fabrics—Cave Mummies—Burial Caves of Atruipe—Of Aleutian Islands—Old-fashioned "Seal-Skin Sack"—Canary Islands—Ages of Bronze and Iron—Historic Caves—Sepulchers of Palestine—Embalmed Patriarchs—Thomson's Cavern—Robber Caves—British Refugees—A Cave-Tragedy—Thor's Cave—Temples of Greece—Of India—Of Egypt.

FOSSIL MAN met with a cool reception! He was by no means a welcome guest in the world he had inhabited so long ago. Even the great Cuvier declined to have such a skeleton in his closet. Naturalists did well to be on their guard. Too many pretenders had been unmasked for them to let any fossil man go unchallenged. The first of the kind, exhumed in 1700 at Constadt, from amid the bones of extinct species of animals, had to wait for recognition till 1835. The human remains found in the *loess* of the Rhine, in 1823, long weighed heavily upon science. When Lund announced the Brazilian skull from Lagoa Santa as a true fossil, in 1844, men of intelligence were so incredulous that the finder denied his own discovery. An era in scientific investigation was marked when three learned Danes, a geologist, a zoologist, and an archaeologist, were officially commissioned, in 1847, to examine the contents of peat-mosses and "kitchenmiddens." The gravel-pits of Abbeville and Saint Acheul next yielded up their secrets; and when this was followed by the brilliant discoveries of MM. Lartet and Christy, in the grotto of Aurinac and the caves and rock shelters of the valley of the Vézère, longer doubt became impossible, so

far as men of science were concerned, and the fact of man's ancient association with extinct species of animals was fully established. The details of this long and bitter controversy—made so by atheism on the one hand and bigotry on the other—does not now concern us, and might be tedious to the general reader. But the important facts and conclusions reached can not fail to interest every thoughtful mind.

It is conceded, at the outset, that human relics buried in the ground, or found in caves, or even imbedded in solid stone, are not necessarily of high antiquity. The skeletons in the shell limestone of Guadaloupe, are now known to be the remains of Caribs who were slain in battle about two centuries ago. The famous skeleton of the Luray Cavern, entombed in alabaster, is not regarded as more than 500 years old. The Peoria coin, brought up from a depth of 125 feet, bore the plain date of 1572; and the coins in conglomerate, obtained at a depth of 10 feet below the river bed, at Tutbury, in England, were of the reign of Edward I. Buried cities, such as Nineveh, Troy, and Pompeii, have held for ages an abundance of human remains, works of art, engraved tablets, statues, etc., from which the archaeologist has been able to reproduce a complete picture of the daily life of the ancient inhabitants. None of these relics would be counted by Lartet and Christy as human fossils. The term has come to be applied almost exclusively to the remains of races that dwelt on the globe in prehistoric time.

Imagine a cavern that had been used as a dwelling-place from the creation of man until now; the formation of dripstone going on in the meantime, securely sealing down, under its layers, the utensils, weapons, ornaments, and occasionally the bones and skulls of each succeeding generation. Could you find such a cavern, it is clear that you would be as favorably situated for studying the manners and customs of the very earliest occupants as of the latest; all that would be needed would be due care in

removing one layer after another, and in examining what lay beneath, down to the bed-rock.

No cavern will ever be found, it may be presumed, in which the relics of all generations have been thus conveniently kept for our inspection. But the case has been more nearly realized than one might suppose who had not given the matter consideration.

Prehistoric time has been divided into four distinct epochs, to which names are given corresponding to the materials used for the manufacture of weapons and implements. The Paleolithic Period is the most ancient, including the time when man had only rough and uncouth flints for service and defense, along with awls and needles of bone. The Neolithic Period, also very remote, marked an improvement in the development of a purely stone age, the elaborate finish given to axes, arrow heads, cups and vases, polished by patient grinding, commanding admiration even now. The Bronze Period comes next, in which men had found that copper was malleable, and laying aside their flints, whether rough or polished, wrought swords, spears, shields, and ornaments of that metal and its alloys. The civilization of ancient Mexico and Peru shows what may be attained by a purely bronze age. The nobler metals have always been scarce, and therefore were laid aside, except for adornment, when the Iron Period brought in the common and useful metal that has ever since been regarded as so indispensable in the arts, both of peace and war. The later iron period, of course, brings us down to the era of authentic history. And it should be remarked that all these periods really overlap each other, the dividing lines not being sharply marked. The barbaric hosts of Darius and Xerxes made use of stone arrows, as well as of superior kinds of weapons. The same is true of savage tribes of recent times. Dr. Arthur Mitchell, in a recent visit to the Hebrides, Shetland and the Orkeneys, found people who could even read and write, and yet were using, from choice, stone implements of various sorts, and some of whom dwelt in caves.

Whatever exceptions there may be to the classification

just explained, it has found general favor among writers on archæology, and appears to be founded on characteristic distinctions. It is as though we should speak of America as a civilized nation, knowing that there are within our borders wild Indians and other human beings whose individual claims to culture would be disputed.

The point that now interests us is that under the stalagmitic flooring of caverns are found the unmistakable relics of man in all the prehistoric periods, by examining which we can learn facts about the race not to be ascertained otherwise. It is matter of regret that little has been done in this line of research in our own country. France has led the way, although some important discoveries have been made in Belgium, England and elsewhere. The valley of the Vézère, especially, has become, as one might say, almost classic ground, from the great number of eminent savants whose names have been linked with its exploration. Here, within an area less than eight miles square, are eight caves and shelters, representing the same number of human settlements known to have been contemporary with the mammoth, reindeer, cave-bear, and other animals that geologists had universally relegated to an age wholly past. This interesting valley was visited, in 1872, by the French Association for the Advancement of Science, whose members found the wonderful statements to be true concerning the osseous fragments and implements of their remotest ancestors. On the surface were collected numerous relics of the ages of bronze and of polished stone. In the cave of the Eyzies were bones, flints, and other relics of the age of the reindeer. In the shallow cave of Cromagnon were the same description of relics, and also five human skeletons—those of an old man, two young men, a woman and a child, together with amulets of shell, ivory and horn. Next the Association visited the caves of Upper and Lower Laugerie, where an avalanche of rocks had buried the homes of the troglodytes. They then descended to the very large cave in the Gorge D'Enfer, reserving to the last the cave of Moustier, the most ancient of all. The supply of relics was so

abundant that, when the savants retook the train and under full steam sped under the brows of the hills over which the ancients had chased the mammoth, the bear and the lion, their pockets were filled with specimens of the flints with which the old-time hunters had been armed. In an address delivered before this learned body, M. Paul Boca more fully detailed the results of investigation into the peculiarities of the fossil population whose cave-dwellings they had been visiting.

From the facts collected from various parts of Europe, and systematically compared by Dawkins, Quaterfages, Boca, and others, it is surprising what a vivid picture we obtain of the arts, industries, battles, feasts, life and death of people who existed so long ago that ordinary chronology can not express the date.

Waiving the question of time—which bristles with difficulties—we content ourselves with simply looking at those of our race farthest from the present age, and admiring what science discloses.

The Fossil Man was an emigrant from the warmer East. He came naked to a region of vast snow-fields and glaciers, where the most gigantic animals, such as the mammoth and rhinoceros, were clothed with fur. Those who doubt if man could have been coeval with the Age of Ice, forget that the glaciers linger amid Alpine valleys, and the wide fields of snow yet wrap northern Scandinavia and other hyperborean realms. The mountaineers of Switzerland and the people of Finmark and Greenland, still face austerities similar to those that human paleontology intimates once confronted the race. It is conceded by that noble champion of scientific orthodoxy, Dana, that "the earliest remains of man and his art occur with the bones of extinct post-tertiary animals." With the Tertiary Man, of whom some have thought they had glimpses, we have nothing to do; for if he lived as alleged, it was before the existing caverns were formed.

The cavern-record shows the primitive man to have been a brave paleolithic hunter, no taller nor stronger than men are to-day, yet pursuing monsters terrible of limb

and formidable of fang, and conquering them in the chase. The Neanderthal skull, found in 1857 in a small cave near Dusseldorf, has had the epithets "brutal" and "simian" applied to it, and as this is one of the oldest craniums exhumed, some have imagined the fossil men to have been all of that type. But, of this very skull, Darwin says it is "well developed and capacious," and Quaterfages claims for its possessor "all the moral and intellectual qualities compatible with his condition." Hence, though he may have been of a savage aspect, as befitted one set to contend with savage monsters, he was a true man. But the Neanderthal skull is only one of forty that have been found entire, besides many fragments that have been useful for comparison; and these tell us of "those craniological characters generally considered as the sign of great intellectual development." The only really brutal one seems to have been the remarkable *jaw* found in the cave of Naulette, whose great canines might properly be regarded as exceptional rather than typical.

That the primeval troglodytes were familiar with the genial warmth and useful energy of fire, appears from the ancient hearth-stones and quantities of charcoal and ashes. We do not know how they kindled their fires, nor how they cooked their food. These people lived by hunting and fishing, as is proved by their weapons and the broken and calcined bones accompanying their remains. They pursued animals of every size, great and small; but their main dependance was on the enormous herds of reindeer. They also fed upon the bison, the musk-sheep, the ibex, the ox and the horse. There is no evidence that they had any domesticated animals. They are not supposed to have learned the art of spinning, nor the potter's trade; but the numerous bone awls and needles found show that they probably clad themselves in garments of skins sewed together with sinews. Bone harpoons, like those now used by the people of Terra del Fuego, were common, and proved the owners to be fishermen; and hundreds of seashells hint plainly of occasional voyages.

The Fossil Man was an artist. He had his hours of

leisure when floods or storms shut him into his cave-dwelling, and he exercised his ingenuity in carving figures of the creatures he knew. Many specimens of his art have been found—older far than the most ancient Egyptian handiwork, and compared with which Grecian sculpture is a thing of yesterday. True, some of those prehistoric attempts at etching look very much like the pictures children draw on their slates and that need an interpreter. But others were done with a skillful hand and with sufficient clearness to enable us to form an idea of the object represented. The material used was of a durable nature, being usually tablets of horn or ivory, and more rarely a smooth stone. A pebble shows a tracing of the great cave bear; and a piece of schist, one of a reindeer fight. Cylinders, supposed to have been handles of some kind of weapon, display now the figure of an ox, and again of a reindeer, while a third shows the head of a horse or a bison. On the scapula of an ox there is a picture of a fishing scene, the creature harpooned looking "very like a whale." The man in this case is badly drawn, and, indeed, the rule seems to hold concerning all attempts by the cave artists to preserve their own features for modern inspection.

The most important, and also the best executed of all these etchings, is that representing the mammoth. It was found in 1864, in the rock hollow at La Madelaine, and correctly describes this greatest of mammals, judging from his perfectly preserved remains in the ice-fields of Siberia. How can we withhold our respect from the man who first fought the mammoth, and then had the skill to carve the figure of his foe on a tablet of ivory taken from its own tusk? What more could you ask of Nimrod himself?

While, as has been seen, the gentlemen of the French Association recognized their ancestors in those men of Vézère, others regard the latter as allied to the modern Esquimaux. The probability is that, on the invasion of Europe by the men with the polished flints, the older tribes were partly dispersed and partly absorbed, thus forming new ethnical groupings.

Neolithic caverns abound both in Europe and America.

They are distinguished from those we have been considering, by their superior flints, their pottery, their textile fabrics, and by the mingling of the bones of domestic animals with those of human beings. There seems to be a disagreement among scientific explorers as to the exact place to draw the dividing line—a matter in which Prof. Dawkins is more critical than the French savants. The latter find evidence that Paleolithic man buried his dead and had a dim belief in a future state; while their critic does not think this conclusion supported by any satisfactory proof. Be that as it may, it is certain that the Neolithic men venerated their dead. Their chambered tombs are numerous, and the interments often went on till the cave was filled from floor to roof. The cairns and mounds in Great Britain were built by them or their near descendants.

Systematic exploration of this class of caverns was not begun till the year 1869; since when the contents of many have been examined, from Ireland to the shores of the Mediterranean, with precisely similar results, showing that one population occupied that entire area. At a later day the ground was disputed with them by another race, with which they coalesced; and both are represented to-day by the Basques and several other remnants of ancient tribes.

All these seem to have been good troglodytes, except those who left in Mediterranean caves proofs of cannibalism. As special interest attaches to the researches in the caves of Genista and St. Michael's, and others, by which the promontory of Gibraltar is honeycombed, it may be said of them, that they have yielded remains referred to both periods of the Stone Age, besides a rich Quarternary fauna. St. Michael's Cave, which is much visited by tourists, has its entrance 1,100 feet above the sea, and descends rapidly 300 feet below the surface within 400 feet of traveling distance. Capt. Brome made a thorough survey of its chambers (1863-8); and the beauty of its stalactites, as well as the romance of its legends, have made it famous. Everybody has heard the fable that monkeys made their way from Africa to Europe by this tunnel under the founda-

tions of the broad Strait; and the dream of the Moors is that, at some day, a great leader shall guide them from the cave of Ampelusia, in Morocco, by this same submarine way, that they may regain their former home in Grenada. The human remains found in the caves of Gibraltar, have been described by Busk and Falconer, and are pronounced by Dawkins of precisely the same type as those found in the caves of North Wales.

The textile fabrics found in neolithic caves are of peculiar interest. In the cave of Murcielagos, in Andalusia, according to an authentic account, there were found groups of skeletons sitting in semicircles, amid polished implements of stone, along with articles made of bone and wood, and various baskets, sandals, and ornaments braided from "esparto grass." One skeleton seemed to be that of a king, as the skull was adorned with a plain coronet of gold, while the body was "clad in a tunic made of esparto grass finely plaited, so as to form a pattern like that on some of the gold ornaments in Etruscan tombs." Similar remains, it is said, have been found in the Woman's Cave, near Alhama, in Grenada.

In connection with these European discoveries it is interesting to note some of the similar American antiquities, although it may never be possible to trace the chain uniting them. The mummies, sandals, utensils, and ornaments found in the Kentucky caves, and described in another chapter, bear a general resemblance to the relics found in the Spanish ones. They also remind us of the Cave of Atruipe, in South America, where Humboldt counted 600 skeletons, each preserved in a basket woven from the petioles of the palm-tree, some of them bleached in the air and sun, others dyed red with anoto, and others still kept as mummies by being varnished with odoriferous resins, and wrapped in leaves of the heliconia. Large urns also stood near, of oval form and painted edges, with handles like serpents. The tribe that had used this sepulcher was wholly extinct, but how long it had been so was entirely matter of tradition.

An elegant monograph published by the Smithsonian

Institution in 1876, gives an illustrated description of some prehistoric remains, from the burial caves of the Aleutian Islands, explored by Mr. W. H. Dall during a four years' residence in the archipelago. These deposits vary in age, some of them not being more than 120 years old, while others are very ancient and approach the typical Esquimaux form. The readiness with which animal matter dries without decaying, in the Aleutian region, made it an easy task to lay the dead away in rock shelters. The bodies, in some instances, seem to have been entombed without much ceremony; but in others the cerements were elaborate. Each mummy was first dried in a sitting posture with the knees drawn up to the chin (precisely as in the case of the Kentucky mummies), the object probably being the utilitarian one of saving space. It was then carefully wrapped in fine grass matting ornamented with tufts of reindeer's hair and with feathers. Above this was a coarser wrapping, and the whole was put in a sack made from the skins of birds. Then came more mats, fine and coarse, until the body looked like an oblong bundle. Next it was packed firmly, with dry grass, into a case made for the purpose, and covered with fine large otter skins, of the sort used for "seal-skin sacks." And finally this unique package was secured by beautifully braided net-work of twisted sinews. The process, of course, was not the same exactly in every instance, but was varied in the details. The practice seems not to have been uncommon of drying the mummies in some natural attitude, and placing them in a cave gayly attired, as if they were pursuing their customary occupations during life. The articles found in the burial caves with the dead, were too varied for enumeration here. Among them were carved masks and effigies, the work seemingly done by stone implements; these were generally of wood, but sometimes of the ivory obtained from the teeth of the sea-lion; and there were awls and needles of the same material. One chisel-shaped stone ax, and several flint arrows showed the occupants to have belonged to some sort of stone age. Baskets of fine grass held trinkets and charms. The

most unique relic of all, perhaps, was a piece of body-armor, made of small wooden rods bound together by braided sinews, which must have been, to some degree, a defense against flint arrows, but of little avail to resist iron or lead!

We are told that when the Canary Islands were discovered it was found that the natives were in the habit of embalming their dead and depositing them in caves. "When the embalming process was complete, the body was sewn up in goat-skins and bandaged with leather. The chiefs had a sarcophagus formed of a hollow tree, but in all cases cave-burial obtained. In one spacious sepulcher in a steep cliff, in Teneriffe, upwards of a thousand mummies were found, and five or six were commonly joined together, the feet of one being sewed to the head of the next!"

Having dwelt at such length on the cave-men of the two periods of the Stone Age, we may be expected to speak of those of the Bronze and Iron Ages. But the fact is that there is little to be said. As mankind approached civilization they ceased to live under the ground, preferring to use the metallic tools in their possession for constructing houses of some kind. The grassy turf, the stately mound, or the hewn tomb also seemed a better resting-place for the dead than the natural cave. It is to be taken into consideration, too, that, except in the dryest chambers, metallic arms and tools left by cave-dwellers would be liable to corrosion. Hence the rarity of bronze and iron relics. Yet they have been found, along with ornaments of gold and silver, in the Cave of Cesareda, in Portugal; and also in several caves in Great Britain and elsewhere.

Historic caves include those linked with the known events of history, or that furnish materials for its construction. It is evident that, whenever safety or convenience might require it, the early inhabitants of any land would resort to the same kind of life that had suited the condition of their ancestors. Hence ancient history, both sacred and profane, contains many allusions to cave refu-

gees. We may never know whether the Hebrew archæologists are right who hold that Cain, the criminal fugitive, when he "builded a city," really intrenched himself in a cave, claiming that the phrase will bear that translation; but it is certain that many a man in a similar situation has done so. Job taunts his critics with their troglodyte ancestry, saying that "they were driven forth from among men, to dwell in the cliffs of the valleys, in caves of the earth, and in the rocks." He probably refers to the Horites, a name that means the cave-dwellers, a race earlier than the Canaanites, and that is mentioned by Strabo. The chalky limestones of Syria and Palestine abound in fissures and caverns, and it is doubtful if there was ever a time when they were wholly unoccupied.

Many of the caves mentioned in the Bible are positively identified, and the sites of others are approximately determined. We may not know the very "clift in the rock" where Moses lay while the glory of the Lord passed by, nor the hiding-place of Elijah from the wrath of Jezebel; but we know that old Horeb to-day is full of just such places. In like manner we know that in some one of the existing caverns near the Dead Sea, Lot found retirement after the fall of Sodom; while on the western side of the same sea are "the sheep-cotes" that still bear the name of En-Gedi, and that once sheltered fugitive David. The cave where good Obadiah concealed a hundred prophets "by fifties," was one of those large ones in the northern portion of the country. Tradition wavers in pointing out the Cave of Makkedah, in which Joshua imprisoned five kings, whom he afterwards buried there at sunset, having slain them, and walled up the entrance. In Thomson's "Land and the Book" we find extended accounts of his visits to the stronghold of Adullam and the sepulchral cave of Machpelah, both of which are clearly identified. Of the former he says: "We started for the cave, having a fearful gorge below, gigantic cliffs above, and the path winding along a shelf of the rock, narrow enough to make the nervous among us shudder. At length, from a great rock hanging on the edge of this shelf, we sprang by a

long leap into a low window which opened into the perpendicular face of the cliff. We were then within the hold of David, and, creeping half-doubled through a narrow crevice for a few rods, we stood beneath the dark vault of the first grand chamber of this mysterious and oppressive cavern. We returned to the light of day, fully convinced that, with David and his lion-hearted followers inside, all the strength of Israel under Saul could not have forced an entrance."

There is not the least doubt that the Cave of Machpelah lies intact under the mosque at Hebron. In that ancient vault, now guarded by insolent Moslems, lie the remains of Abraham and Sarah, Isaac and Rebekah, Jacob and Leah, Joseph, and it may be of others, their descendants, whose names are not recorded. Dr. Thomson was only allowed to examine the exterior of the mosque; and the statements of travelers who claim to have seen the interior will not bear very close criticism, so far as the matters that most interest us are involved. It seems, however, that the cells and sarcophagi actually exhibited to the faithful are only imitations of the real ones down in the cave, which no one is allowed, under any pretext, to enter. Could we do so, we should probably see a collection of venerable mummies like those found in the rock-tombs along the Nile. It is expressly said that Jacob and Joseph were embalmed. The sons of Heth, of whom Abraham purchased the cave for a burial-place, said to him, "Thou art a mighty prince among us; in the choice of our sepulchers bury thy dead"—a speech showing that the custom of cave burial prevailed among them, and was not a peculiarly Abrahamic idea. The usage, indeed, may be said to have been universal among the Oriental nations, and to have continued for centuries after the patriarchal times. Palestine is full of the cave-tombs of saints and heroes, and however we may question their connection with the judges, kings, prophets and apostles whose names are attached to them by tradition, it is clear that they were once sepulchral caves, often embellished by art. We read of the grave of Lazarus, that "it was a cave, and a stone lay

upon it." A stone was rolled against the door of the tomb of Joseph of Arimathea, in which was laid the body of our Lord to await its embalming. This most sacred spot on the globe was one of those garden grottoes hewn from the solid rock by the wealthy in preference to the rougher natural cavities.

Piety not only built chapels and costly churches in honor of these ancient sepulchers, but led many hermits to dwell in the more common chambers of the dead. The same taste led the Fathers to locate many important events in grottoes and caves, for which they had no authority beyond the wildest tradition.

Syrian caverns have been explored, to some extent, by the missionaries, especially those in Mt. Lebanon. Dr. Thomson called attention in 1836 to the wonderful scenery of the Dog river gorge, and to the cave whence its waters flow. During the dry season the river is fed entirely from subterranean sources, the springs issuing from the huge rocks at the base of a precipice 1,000 feet high, and only four miles from the sea, which the river reaches, circuitously, at a point six miles north of Beyrout. For want of a boat Dr. Thomson was unable to penetrate "this dark and watery labyrinth" but a little distance; and its more thorough exploration was left to a party led by W. J. Maxwell, C. E., in 1873, his companions being Pres. Bliss, of the Syrian College, and Messrs. H. G. Huxley and R. W. Brigstocke. They took with them a portable raft made of planks lashed upon inflated goat-skins; and by means of this with an occasional swim in the ice-cold water, they made their way into a cavern of more vast proportions than they had anticipated. Their preliminary trip was followed by a second, and a third, on which occasions they were more thoroughly equipped. In this manner they pursued the channel of the stream till it grew so narrow and swift that they could not stem its current. It is claimed, however, that there was no perceptible diminution of the quantity of water. The length of their subterranean voyage was a little less than one mile; but they could

see that the cavern extended far beyond. No animal remains were found; but the grandeur of the chambers and dazzling beauty of the stalactites delighted and rewarded the explorers. In honor of the veteran missionary who discovered this deep excavation from the face of old Lebanon, it was decided to call it Thomson's Cavern.

Besides the caves of the Dog river already described, may be mentioned the stalactite cave of Akoura in the upper range of Mt. Lebanon, explored for 800 feet by Rev. H. H. Jessup, D. D.; the bone breccia cavern on the Dog river Promontory 9 miles from Beyrout, discovered by Canon Tristram in 1864, and afterward developed by Dr. Jessup. The roof has disappeared and the stratum of bone breccia is about 8 feet thick, full of animal-bones, and teeth and flints. This is an important discovery taken along with the discovery of similar caves at Malta and in the Rock of Gibraltar.*

We must pass with brief mention the immense burial-places of Egypt, where countless generations were gathered in rocky receptacles, which contain the mummies of cats and crocodiles as well as of men; the myriads of tombs piercing the superb cliffs of Petræa; the remarkable sepulchral caves on which Grecian art lavished its adornment, as in the "mountain of tombs" marking the site of Telmessus; and, most wonderful perhaps of all, the Catacombs at Rome, with their miles of subterranean galleries, curious inscriptions, and touching records of faith and martyrdom. All these were artificial excavations, which do not come within the scope of a treatise intended to deal exclusively with those of a natural origin.

Robber-caves have also figured both in history and romance. David's band of malcontents gathered at Adullam were by no means the only banditti that inhabited the caves of Palestine. Josephus tells us of insurgents who fortified themselves in the caves of Arbela, near Gennesaret, and whom Herod attacked successfully by means of soldiers let down from above in iron baskets, dragging some of the inmates forth with hooks and hurling them

*The above facts were given to me personally by Dr. Jessup.

down the precipice, while others were suffocated by fires kindled at the mouth of their retreat. Strabo describes one of the caverns of Trachonitis as capable of holding 4,000 men, and held by banditti who annoyed the trade with Damascus. Josephus himself, along with other Jewish leaders in the war with the Romans, sought concealment in caverns beneath Jerusalem, where many perished from hunger and other causes.

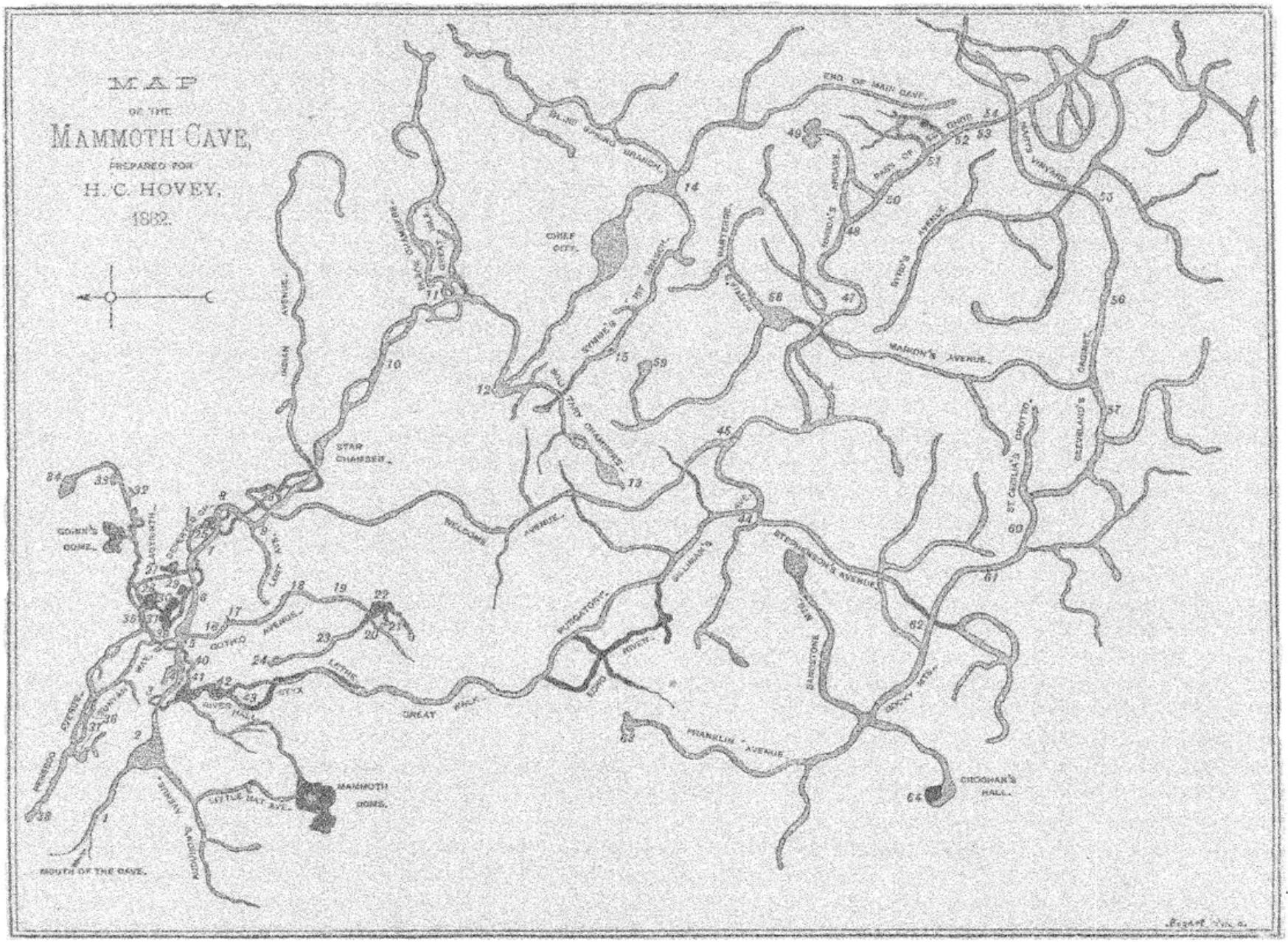
A systematic exploration of historic caves has been undertaken in England within the last twelve years. It has long been known that during old wars fugitives often resorted to subterranean retreats; and it is thought, likewise, that the haunts of smugglers and pirates might contain more valuable materials than the writers of dime-novels have wrought into shape. More than one cave-tragedy has blackened the pages of British history. One of the darkest of them has been told in verse by Sir Walter Scott, who relates how the Laird of MacLeod revenged himself on the islanders of Egg. They retreated to a cavern in a high peak that rises in the center of the island, whither the Laird tracked them through the snow. On their refusing to surrender he caused a fire to be kindled at the single entrance of it, and destroyed the refugees by suffocation. Explorers have since found the remains of more than 200 persons in its dismal chambers. But the researches of the Commission mentioned above, are intended to throw light on the period when the inhabitants of the old Britannia were driven to the wall by the invasion of Angles and Saxons, whose rude barbarism supplanted whatever culture Roman civilization had introduced. The results thus far are drawn mainly from the Victoria and Albert caverns, those of Arncliffe and Buxton, and Thor's Cave. Roman coins and jewels, articles of bronze, silver and iron, pottery of various kinds, and richly enameled ornaments, belonging to the first half of the 5th century, prove the cave-dwellers to have been persons of refinement compelled to fly from persecution.

Thor's Cave is celebrated for other reasons; for in its gloomy recesses the ancient Druids are said to have off-

ered human victims. It has a noble entrance and a spacious interior. A natural window sixty feet within lights this strange temple; while, at a point where the light begins to struggle with the gloom, a rude stone altar is observed, whereon it is alleged that bloody rites were performed in honor of the cruel Thor.

The subject of Cavern Temples is one of such importance and magnitude as to demand a volume by itself. The Corycian Cave on Mount Parnassus, sacred to Pan and the Nymphs, and so large as to have afforded, it is said, an asylum to 3,000 Greeks fleeing from the army of Xerxes; and the grotto of Apollo on Mount Hymettus, to which Plato was taken, when a boy, to present his offering; the Grotto del Sibylla, on the bank of Lake Avernus, famous for its oracular responses—these, and many others, are celebrated in ancient mythology, and have been sung by the pagan poets. Modern pilgrims, too, have their grotto-shrines; like that of "Our Lady at Lourdes," whose healing spring attracts thousands of visitors annually. And then there are the cavern-temples of India, fabulous for their gigantic dimensions and magnificent embellishment! The very names of Elephanta, Salsette, and Ellora bring before us an array of wonderful chambers guarded by colossal figures, some of them beautiful and others hideous, and invite us to wander from the path we have selected into all sorts of mythological digressions. Egypt's cavern-temples rival or excel those of India, although the approaches have, in many cases, been obstructed by wind-wafted sand. Luxor's stately colonnade, and Karnak's mighty propylon, avenues of sphynxes, avenues of enormous rams, noble obelisks, leading on to interior chambers, rich in hieroglyphic sculpture, and ornate relics of sun-worshiping kings, form an assemblage of massive ruins of such magnitude that no brief description, such as might be admissible here, could convey a just idea of their imperishable grandeur. Leaving these monuments of human industry and art, splendid and imposing in their isolation as the pyramids, let us return to our own hemisphere.

The remaining chapters are wholly devoted to the grandest examples of American Caverns.



MAIN CAVE.

1. The Iron Gate.
2. The Rotunda.
3. Kentucky Cliffs and the Corkscrew.
4. The Methodist Church.
5. Gothic Galleries.
6. Standing Rocks.
7. Grand Arch.
8. Giant's Coffin.
9. Acute Angle, and Cottages.
10. Proctor's Arcade.
11. Wright's Rotunda.
12. The Cataracts.
13. Fairy Grotto.
14. St. Catherine's City.
15. Symmes' Pit.

GOTHIC AVENUE.

16. Seat of the Mummy.
17. Register Hall.
18. Gothic Chapel.
19. The Arm Chair.
20. Lover's Leap.
21. Elbow Crevice.
22. Napoleon's Dome.
23. Lake Purity.
24. Annette's Dome.

DESERTED CHAMBERS.

25. Wooden Bowl Room.
26. Black Snake Avenue.
27. Side-Saddle Pit.
28. Bo[illegible]nless Pit.
29. Covered Pit.
30. Scylla.
31. Charybdis.

LABYRINTH.

32. Putnam's Cabinet.
33. Hovey's Cabinet.
34. Ariadne's Grotto.

PENSICO AVENUE.

35. Revelers' Hall.
36. Grand Crossing.
37. Pineapple Bush.
38. Angelica's Grotto.

ON THE LONG ROUTE.

39. Scotchman's Trap.
40. Fat Man's Misery.
41. Great Relief.
42. The Dead Sea.
43. Cascade at the Styx.
44. Cascade Hall.
45. Serpent Hall.
46. Valley-Way Side-Cut.
47. Great Western.
48. Valley of Flowers.
49. Lucy's Dome.
50. Ole Bull's Concert Hall.
51. Fly Chamber.
52. Sheep Shelter.
53. Corinna's Dome.
54. Black Hole of Calcutta.
55. Washington Hall.
56. Snow Ball Room.
57. Floral Cross and Last Rose of Summer.
58. Paradise.
59. Zoe's Grotto.
60. Flora's Garden.
61. Vale of Diamonds.
62. Charlotte's Grotto.
63. Serena's Arbor.
64. The Maelstrom.

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CHAPTER IV.

MAMMOTH CAVE.

Pioneer Patriots—Saltpeter Miners—Discovery of Mammoth Cave—War of 1812—Change of Owners—The Croghan Heirs—The Guides—Early Literature of this Cavern—Its Geological Survey—Its Fauna—Map-making under Difficulties.

THE pioneers who followed in the wake of Daniel Boone, a century ago, were thrown on their own resources in all respects. Gunpowder was one of the necessaries of life for men in daily peril from wild beasts and more savage Indians; but its importation was attended with expense and difficulty. Hence they sent out such strolling chemists as happened to be among them, to hunt for niter beds. These were found in considerable quantities under the shelter of ledges at the heads of ravines. The jutting crags reminded them of "Gothic cathedrals and the ruins of baronial castles" (as one of them expressed himself in writing to his friends), and therefore they called the smaller ones "Rock Houses," and the larger ones "Rock Castles." The soil and sand-banks, thus protected from the rains, proved to be richly impregnated with the coveted saltpeter, and solid masses were sometimes found weighing from 100 to 1,600 pounds. Usually, however, three men would not obtain more than from 50 to 100 pounds a day at the works.

The tools and methods used were of the most primitive kind, and the workmen were readily induced to forsake a niter-bed as soon as its yield grew scanty, and were continually searching for masses of pure niter, and hoping to find veins of precious ores. This led to the exploration of calcareous caverns, of which as many as twenty-eight are said to have been found in Kentucky before the year 1800. A Mr. Fowler obtained from them more than

100,000 pounds of niter, and they were so far from being exhausted that, according to the estimate of local chemists, the deposits remaining in six of them exceeded 2,000,000 pounds.

In the year 1799 a pioneer, named Baker, entered an arched opening near Crooked creek, in Madison county, about 60 miles south-east of Lexington, and proceeding a short distance under-ground, saw so many things to excite his wonder, that he returned to his cabin and took along with him his wife and three children to enjoy the further exploration. They carried with them a torch and a supply of pine splinters, but no food. Advancing about 500 yards, Mr. Baker unfortunately dropped his torch and it was extinguished. "For two days and nights this miserable family wándered in total darkness, without provision and without water, though sometimes within hearing of a cataract which they durst not approach. At length Mrs. Baker, in attempting to support herself on a rock, perceived that it was wet, and conjectured that this was caused by the mud which they had brought in on their feet. Baker immediately ascended the rock, and saw the light of day!"

This locality became known throughout the region as "the Great Cave," and was particularly described by Samuel Brown, M. D., of Lexington, in a paper read by him before the American Philosophical Society, in 1806—probably the very first of all communications of its kind in this country.

Dr. Brown describes the Great Cave as having two mouths, 646 yards apart, with a commodious passage for wagons from one to the other, the floor having the appearance of a public road that had been much frequented. The level is 80 feet above that of Crooked creek, from which its entrance is 150 yards distant. The arch varies from 10 feet to 60; and the breadth averages 40 feet, though in some parts it is 70 or 80 feet. The narrator enlarges on the scenes romantic and sublime that astonish the beholder, when the vast chambers are "sufficiently illuminated by the torches and lamps of the workmen."

The statement is made that the temperature of the cave never falls much below 52 degrees Fah., even in the coldest winter weather, and does not rise above 57 degrees at any time. To this, however, a curious exception is made, which I give in Dr. Brown's own words: "In one chamber the heat was frequently so great as to be disagreeable The room is nearly circular and about 20 feet in diameter. The air which fills the main avenue in summer and autumn is forced into this chamber, whenever the external atmospheric air becomes so much condensed by cold as to rush into the mouth of the cave; and whenever during the winter any portion of air in the main avenue is heated by fires or lamps, as this heated air can not escape by the mouth of the cave (for the arch descends toward the mouth) it ascends into this chamber and rises to the ceiling, where it must remain." He then compares this peculiar cell to the Russian vapor bath to which Count Rumford had recently called the public attention.

Workmen dug down fifteen feet into the soil on the floor of this cave, and found it still rich in niter, although no animal remains are mentioned, nor Indian relics.

The learned authority quoted next enters into the details of preparing saltpeter for the market, claiming for it superiority to that found in Spain and India, and closes his really remarkable and historic paper with an appeal to the patriotism of Americans to make themselves independent of foreign sources of supply. "A concern for the glory and defense of our country," observes Dr. Brown, "should prompt such of our chemists as have talents and leisure to investigate this interesting subject. I suspect that we have much to learn with regard to this salt, so valuable in time of peace, so indispensable in time of war."

Had Mammoth Cave, with its immense deposits of nitrous earth, been known at the time the exhaustive description from which I have made extracts was prepared (viz., in 1806), the important fact would certainly have been recorded. I am led, therefore, to set aside the statement made by Bayard Taylor and others—I know not on what authority—that this cavern was first entered in 1802,

and to accept the commonly received tradition that it was discovered by a hunter named Hutchins, in 1809, while pursuing a wounded bear. The aperture by which Hutchins entered was small at the time, and has since been considerably enlarged. It is not regarded as the original mouth, which is supposed to have been in reality the mouth of Dixon's Cave, about a quarter of a mile north of it, a chasm 50 feet wide, and once, perhaps, the outlet of a subterranean stream.

The first purchaser of what is now held as very valuable property, was "a small, dark, wiry man of great energy and industry," whose name was McLean, and who, for $40, bought the cave and 200 acres besides! He soon sold it to Mr. Gatewood, a brother-in-law of the founder of Bell's Tavern—that celebrated hostelry of by-gone days. After enlarging the works, Gatewood sold them to Messrs. Gratz, of Philadelphia, and Wilkins, of Lexington, Ky., who brought experience and capital to aid in developing the hidden resources of Mammoth Cave. Their agent, Mr. Archibald Miller, employed a large number of negro miners, who were reported as finding there a quantity of nitrous earth "sufficient to supply the whole population of the globe with saltpeter!"

During the war of 1812, our government being excluded from foreign sources of supply, had use for all that the miners were able to furnish under the circumstances. There were lofty mountains and interminable forests between them and the sea-board, but under the two-fold impetus of patriotism and high prices, Gratz and Wilkins, and others who embarked in the speculation, though with less brilliant success, transported thousands of pounds of the precious salt by ox-carts, and on pack-mules, mainly to Philadelphia. Let it be remembered by a grateful people that this Kentucky *salt* went far toward saving the nation in its hour of deadly peril!

The method of manufacture, as nearly as I have been able to ascertain it, was as follows: The nitrous earth was collected from various parts of the cave, by means of ox-carts for which roads were constructed that are in them-

selves surprising monuments of industry, and the soil thus gathered was carried to hoppers of simple construction, each having a capacity of from 50 to 100 bushels. Cold water, conveyed by wooden pipes into the cave, was poured on the charge in each hopper, and in a day or two a solution of the salts would run into the vats below, whence it was pumped into a second set of pipes, tilted so as to let the liquor flow out of the cave. After boiling a while in the open air, it was run through hoppers containing wood ashes, the result being, if skill had been used in mixing materials, a clear solution of the nitrate of potash, which, having been boiled down sufficiently, was put in troughs for cooling. In about 24 hours the crystals were taken out ready for transportation.

Ordinary "peter dirt," as the miners called it, was expected to yield from three to five pounds of the nitrate of lime to the bushel; and to make 100 pounds of saltpeter it would be necessary to use 18 bushels of oak ashes, or 10 of elm, or two of ashes made by burning the dry wood in hollow trees. It is stated that "the contract for the supply of the fixed alkali alone, for this cave, for the year 1814, was twenty thousand dollars;" from which we may infer the extent to which saltpeter was manufactured at that time.

When the war was happily ended by the treaty of Ghent, the demand for saltpeter fell off to such a degree that Messrs. Gratz and Wilkins stopped the manufacture at Mammoth Cave, and since then it has been valued mainly as a place of exhibition. The original territory of 200 acres has grown to nearly 2000 acres, a portion of which has some value for farming purposes, while other parts are covered by heavy timber. Most of it was acquired for the sake of controlling all possible entrances to the under-lying cavern.

Mr. Archibald Miller, aided by his brothers William and James, was the agent of Messrs. Gratz and Wilkins, and remained at the cave to look after their interests and to show the place to visitors. His brother-in-law, Mr. James Moore, at one time a wealthy merchant in Phila-

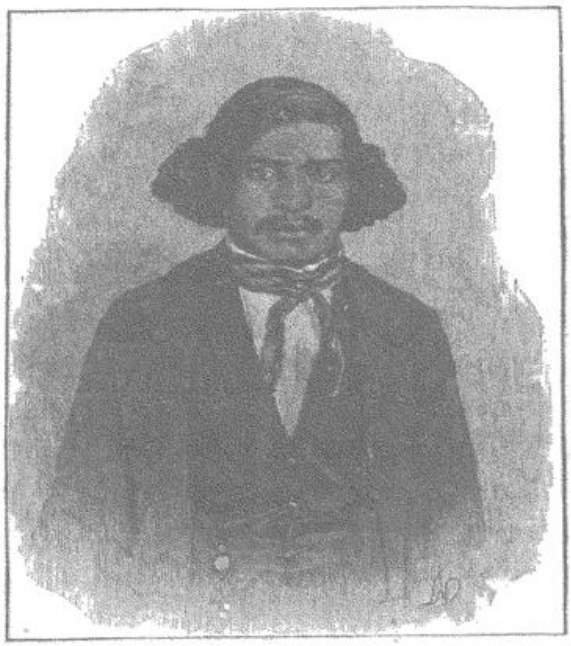
delphia, took possession of the property in 1816. He became mixed up, in some manner, with the conspiracy of Burr and Blennerhassett, and was financially ruined. Gatewood again took charge of the cave for a number of years, a period not marked by any important events, either of manufacture or discovery.

Mr. Frank Gorin bought the property in 1837, employing Messrs. Moore and Archibald Miller, Jr., as his agents. The circumstance of Mr. C. F. Harvey's being lost in the cave for 39 hours, determined the proprietor to make more thorough explorations, in the course of which he found the great chamber called, in honor of him, "Gorin's Dome." He also placed Stephen and Matt, as guides, who aided in making further discoveries; so that, within the next five years, the known regions of the cave were at least trebled.

At the close of the Revolutionary war, special land grants having been made to officers and soldiers in the vicinity of Green river, Major William Croghan, a Scotchman who had distinguished himself in the United States army, was sent to survey and distribute them. His office was located at Louisville, where he also married a sister of General G. R. Clarke. He left five sons and two daughters. John, the second son, was graduated from the University of Pennsylvania, in 1813, and studied medicine with Dr. Rush, of Philadelphia, afterward taking a supplementary course at Edinburgh. During his travels in the Old World, Dr. Croghan was repeatedly asked for particulars as to the chief curiosity of his native state, and the result of his mortification at his inability to reply was that, on returning, he visited and finally purchased the Mammoth Cave. He continued the management as he found it, but expended large sums on roads, bridges and buildings. Dr. Croghan never married; and when he died, in 1845, he left the estate to trustees, to be managed for his eleven nephews and nieces, the children of Col. George Croghan, Mr. Wm. Croghan, and Gen. Thomas S. Jessup. Seven of these now survive; of whom four reside in Washington, D. C., two in New York, and one in

San Francisco. The business at the cave has been carried on by agents, among whom may be mentioned Mr. L. R. Proctor, Captain W. S. Miller, and Mr. Francis Klett, the present manager, whose extensive improvements have made the cave more accessible, and whose urbanity and excellent regime have won many friends.

A brief description of the guides is here in place; for while others explore these subterranean realms occasionally, these men do so daily, until they become almost identified with the rocks, rivers, and crystals found there.



Stephen Bishop, the Guide—Mammoth Cave.

The original guide, whose daring exploits and striking traits made him famous, was Stephen Bishop. He was a slave, half negro and half Indian, although the latter point is in doubt. His likeness shows him to have had intelligence and wit, and the statements of his employers and visitors agree in according to him an excellent knowledge of geology and other sciences, so far as they related to caverns. He had also a smattering of Latin and Greek, and a fund of miscellaneous information. The remains of this sable son of genius now rest beneath a cedar tree in the tangled grave-yard near the garden.

Matt and Nick Bransford, formerly slaves, were for

many years associated with Stephen. Like him, they picked up ideas from tourists, and on occasion can handle scientific terms with considerable skill. These old and faithful guides, who have now been in service about 45 years, begin to think it is time for them to retire on a pension!

William Garvin, another colored man, has acted as guide for about seventeen years, and is a general favorite, both on account of his perfect familiarity with all parts of the cave, and his exhaustless *repertoire* of jokes, original and selected. William is a person of remarkable nerve and physical strength, a good singer, and an admirable ventriloquist. What more could be desired?

Mr. Samuel Meredith, a white man and a native of the county, familiar from boyhood with underground explorations, has acted as guide for many years, and is both intelligent and obliging. He excels in producing transformation scenes, as, for instance, in the Gothic Chapel and the Star Chamber.

The brothers John and Tom Lee, although but occasionally employed as guides, have made independent explorations and some remarkable discoveries. There are others, also, whose services are in requisition when the number of visitors is unusually great.

Civil and respectful as all these guides uniformly are, the tourist will do well both to heed their instructions as to the exhibition of the cave, and to recognize their authority while below.

The early literature of Mammoth Cave is scattered through many magazines and newspapers. The oldest account that has fallen under my observation is contained in a letter from Louisville, dated July 5, 1814, and published in the *Medical Repository*, vol. xvii, pp. 391–393. It is accompanied by a map and a list of localities. The name given is the "Green River, or Mammoth Cave." The letter-writer describes a mummy "supposed to have been a queen," found a quarter of a mile from the mouth of the cave, but "lately deposited there from a neighboring cave." It is curious to note the old names. Audubon

Avenue was called "The Right-hand Chamber;" the Corkscrew, "The Mountain Room;" The Gothic Gallery, the "Sand Room;" the Gothic Avenue "The Haunted Room;" and the Chief City, "The Devil's Chamber, supposed to be ten miles from the mouth!" In the *Medical Repository*, vol. xviii, is a letter from Mr. Gratz, one of the owners of the great cave, and also an engraving of the famous mummy from a drawing by Rafinesque. Mr. Wilkins, the other owner, wrote an account that is to be found in the Transactions of the American Antiquarian Society, vol. I., where are also letters by S. L. Mitchill, M.D., concerning the mummies found in Kentucky and Tennessee. The oft-quoted letter of Nahum Ward, M.D., dated Marietta, O., April 4, 1816, was first published in the *Worcester Spy*, and reprinted in the *Monthly Magazine or British Register*, July, 1816, with a map of the cave and an engraving of the mummy. The "Great Kentucky Cavern" is numbered among "The Hundred Wonders of the World," in a book with that title, by Rev. E. C. Clark, published in New Haven, Conn., 1821.

A survey of the Mammoth Cave was made, in 1834–5, by Edmund F. Lee, C.E., who devoted three months to the task, and his "Map with Notes" was published by James & Gazley, of Cincinnati, O. Next came a brilliant account, in the *American Monthly Magazine*, May and June, 1837, by Robert M. Bird, M.D. (author of "Calavar"), with an engraving, by Sartain, of the mouth surrounded by the ruins of the saltpeter works. Dr. Dekay gave the first description of the blind fish (*Amblyopsis spelæus*), in 1842, see Zoology of New York, pt. 3d, p. 187. Professors Locke, Wyman, Agassiz, Silliman, and others, have at different times written communications as to the phenomena of Mammoth Cave, that have appeared in the *American Journal of Science and Art*; and an extended description of the cave fauna, by Dr. Telkampf, appeared, in 1844, with figures, in *Müller's Archiv.*

"Rambles in the Mammoth Cave, during the year 1844, by a Visitor" (supposed to be by Alexander Bullett, Esq.), with six cuts, and a map, by Stephen, the guide, was published by Morton & Griswold, of Louisville, in 1845. Col-

lin's "History of Kentucky" (1847), contains quite a full account of this cave. "A Pictorial Guide to the Mammoth Cave," with nine cuts and eleven poems, came from the pen of Rev. Horace Martin, in 1851; and, in the same year, "An Officer of the Royal Artillery," gave a most entertaining account in *Frazer's Magazine*, republished in *Littell's Living Age*, No. 348. One still more graphic was written in 1855, by Bayard Taylor, for the *New York Tribune*, afterwards published in his "At Home and Abroad." Professor Wright's "Guide Manual" was printed in 1860, at Louisville. "The Mammoth Cave and its Denizens," by A. D. Binkerd, M.D., was published, in 1869, by Robert Clarke & Co., of Cincinnati, O. About that time Mr. Charles Waldack took a number of photographs by magnesium light, and others have since been taken by Mr. Thumm. These views are on sale at the cave hotel. Forwood's "Historical and Descriptive Narrative of the Mammoth Cave," with twelve illustrations and a map, passed through four editions between 1870 and 1875. It is from observations made in 1867, supplemented by information derived from Messrs. Proctor and Gorin, and others, and embodies the results of much investigation. The illustrated description, by A. R. Waud, in Appleton's "Picturesque America," vol. II., pp. 540–544, is very fine, artistically considered.

The State Geological Survey of Kentucky—both the former one under Prof. D. D. Owen, and that now in progress under Prof. N. S. Shaler, with an able staff of assistants—contains valuable materials as to the cavern region of the Ohio valley. Admirable monographs on cave animals have been published by Professors Putnam, Packard, Cope, S. I. Smith and H. G. Hubbard. The latter gives a table of the fauna of Mammoth Cave, including all species described down to March, 1880. Omitting scientific details, it may be stated, in a general way, that there have thus far been described, as species peculiar to this cavern: Vertebrata, 4; Insecta, 11; Arachnida, 6; Myriapoda, 2; Crustacea, 2; Vermes, 3; Polygastric Infusoria, 8; and Phytolitharia, 5. (See *Am. Entomologist*, Vol. III., Nos. 2 and 3, Feb. and March, 1880.)

To all the foregoing authorities I desire to express my obligation for facts and suggestions that have been of use in the study of the subjects treated in this volume, and in my former articles in *Scribner's Magazine* (April and Oct., 1880), and in other periodicals.

The maps made of Mammoth Cave are in themselves an interesting study. A critic would hardly recognize them as representations of the same locality. Few can appreciate the difficulties of an underground survey, amid rugged and tortuous paths, deep pits and lofty domes, all wrapped in darkness but imperfectly scattered by lamplight. Imagine a map of Pike's Peak plotted from observations taken by torchlight on a series of moonless midnights! Then, again, the singular atmospheric conditions throw doubt on the barometrical tests, though applied by men of experience. A few facts only, of this nature, seem to be agreed on, and those are mentioned in their place in another chapter. I am informed that a set of levels was run by the State Geological Survey, from Green river to Echo river, but the results, I believe, have not appeared.

It should be understood, therefore, that accuracy is not claimed for the accompanying map. The portion this side Echo river corresponds with the recent survey made by Mr. Francis Klett, conducted independently of all previous ones, and with the advantage of a long experience in the United States Geographical Survey. Yet he only claims for it an approximation to correctness, and that not in detail but in the general courses. The part beyond the rivers is modified from older surveys, with the assistance of my artist, Mr. J. Barton Smith, and may serve as an aid to the memory, if nothing more. It is not attempted to include all the 223 avenues that are said to have been explored,* and many of which are never entered by visitors.

* "The known avenues of Mammoth Cave amount to 223, and the united length of the whole equals 150 miles. The average width is 7 yards, and the height the same. About 12,000,000 cubic yards of cavernous space have here been excavated by calcareous waters and atmospheric vicissitudes." Owen's *Geological Survey of Kentucky*, Vol. I., page 81.

CHAPTER V.

MAMMOTH CAVE—*Continued.*

Location and Geological Relations—White's Cave—Salt Cave—Short and Long Caves—Proctor's Cave—Diamond Cave—Grand Crystal Cave—Mammoth Cave without a Rival—Cave City—A Stage-coach Ride—A Charming Resort—Hotel evolved from a Log Cabin—The Outfit—Necessary Regulations—Entrance to Mammoth Cave—Green River—Dixon's Cave—A Noble Vestibule—The Iron Gate—Blowing Caves—A Changeless Realm.

THE cavernous limestone of Kentucky covers an area of 8,000 square miles, and varies in thickness from 10 feet to 300 or 400, the average, perhaps, being about 175 feet. This rock shows few traces of dynamic disturbance, but has been carved by acidulated water, since the Miocene epoch, into numberless caverns.

The absence of running streams is one of the striking features of the region, explained by the fact that nearly all the rivulets have long ago eaten their way through to the drainage level, and re-appear as large springs feeding rivers of considerable size. It is said that one may, in certain directions, travel fifty miles without crossing running water. The voyager along such rivers as exist, will observe, at intervals, arches in the bluffs, whence the waters of subterranean streams emerge; and should he explore these openings, he would find them the entrances to caverns ascending by tiers toward the general surface of the country. And were he to make his way from stage to stage—a thing not often possible—he would at length come out into a valley shaped like an inverted cone, along whose sides grow bushes and trees, usually matted into a dense thicket. These valleys are called "sink-holes," and they serve to drain the surface around them. These sink-holes are said to average 100 to the square mile; and, ac-

cording to Shaler, the State Geologist, "there are at least 100,000 miles of open caverns beneath the surface of the carboniferous limestone in Kentucky."

Several small caves have gained a measure of celebrity, partly by reason of their own attractions, and partly because they supply some feature in which the great cavern is supposed to be deficient. A few of these may here be mentioned.

White's Cave, half a mile from Mammoth Cave, is remarkable for the beauty and variety of its stalactites, and should be visited by any one who can spare an hour or two for the purpose. It is really a section of Mammoth Cave, and belongs to the Croghan estate. The exact point of communication is supposed to be with the extremity of Little Bat Avenue and Mammoth Dome, though no one has yet made his way through. The entire length of this grotto is 500 yards.

Salt Cave, also near to Mammoth Cave and belonging to the same proprietors, rivals it in the magnitude of some of its avenues, but is more especially noted for the multiplicity of its relics of prehistoric occupancy. It is difficult of access, on account of the loose and jagged rocks that have fallen from the roof. Prof. Putnam explored it for a long distance, finding fire-places, piles of fagots, cast-off sandals, and other things described more fully elsewhere.

Short Cave is noted for its mummies, found by the saltpeter miners, in 1813, and transferred to Mammoth Cave. There was also the Long Cave, and both were worked for niter in former days. They are in the vicinity of Glasgow, Kentucky.

Proctor's Cave is three miles from the Mammoth Cave. It is represented as having a wonderful succession of domes, and an endless variety of stalactites, with many gypsum rosettes and other "formations." It is entered by an easy stairway, and plank walks are laid along some of the avenues. Guides and lamps are furnished, and about three miles of the cave are said to be open to the public. The principal attractions, as enumerated by Dr. Wright,

are the following: the Hercules Dome, Coral Chamber, Cactus Hall, the Corinthian Dome, the Curtain Dome, Elfin Grotto, Hall of Pyramids, Drapery Hall, and Aladdin's Palace. This is certainly a fine bill of fare, and visitors find the feast to correspond to the promises.

The Diamond Cave has also won celebrity by reason of its beautiful and elaborate formations and display of sparkling crystals. Prof. N. S. Shaler says: "Diamond Cave is the most beautiful of the hundred or more I have visited in various parts of the world."

The Grand Crystal Cave, near Glasgow Junction, belongs to Mr. Thomas Kelly, who has favored me with a written description; from which it appears that it has none of those wide and deep rivers and long paved roads, that some wag described as found in it. But it really is a fine, large cavern, some three miles long, with several large domes and a number of beautiful springs.

It is significant that the custom is to compare these small caves with Mammoth Cave; and the process is never reversed. No writer on Mammoth Cave ever took pains to say that it was a rival of any other on earth. The general feeling was well expressed by the driver of the stage-coach, who said to me, that "to go from any other cave to Mammoth Cave, was like going from a log-cabin to a palace!"

Mammoth Cave may be regarded, then, as the noblest specimen of the 500 caves found in Edmondson county, and is certainly the largest known in the world. Its exact location is 37° 14′ N. latitude, and 86° 12′ W. longitude. It is easily reached by trains on the Louisville and Nashville Railroad all of them stopping at Cave City. This cluster of houses amid the cornfields is by rail 85 miles S. S. W. of Louisville, and ten miles from the Mammoth Cave Hotel, with which it is connected by a stage-line. The road, which is good as compared with others in the region, winds among the hills, in and out among the sink-holes, with here and there a bold or picturesque bit of scenery, until it gains the high table-land extending to the bluffs of Green River, on which the hotel stands.

A bugle flourish heralds the arrival of passengers, and brings around the coach a throng of guests expecting friends, or curious to see strangers, and plenty of negro servants offering to take care of the luggage.

The hotel register shows an aggregate of from 2,000 to 3,000 visitors a year. Many of these come from the North, and a few from various parts of Europe, drawn by their curiosity to behold this far-famed locality. The majority, however, are from Louisville, Nashville, Memphis, New Orleans, and other cities of the Sunny South; and he who wishes to meet the best types of southern society, will be sure of finding them here.

The spot is a charming resort, aside from its peculiar attraction—the cave. The region around it is a hunter's paradise, in which quail and grouse abound, and not a few wild turkeys and deer. The grounds have been laid out with taste, ornamental shrubbery being interspersed among ancient oaks, over-shadowing a well-kept lawn. Extensive gardens supply the hotel with fresh vegetables of every kind, and the table is furnished amply with whatever the season and the market may afford.

The hotel itself is an architectural curiosity. The original cabin, built by the miners in 1812, still stands and is used as a wash-house. Next came a more stylish log-house with a wide hall between two large rooms. As visitors multiplied the cabins also multiplied, until they stood in a long row. These isolated structures were, at a later day, connected with each other and weather-boarded, the halls and rooms remaining unchanged. Then a spacious frame-house was erected in front, with offices, parlors, ball-room, and other appointments in modern style. Finally wide verandas were added, having about 600 feet of covered portico. The structure thus evolved from a log-cabin germ, is shaped like the letter L, and a more airy, delightful place can not be found in the State of Kentucky! Loitering amid the long colonnade, on the evening of our first arrival, we looked out between the tall white pillars, and the night-air floating through the noble grove of aged oaks and across the blue-grass lawn, seemed redolent of

romantic associations. How many thousands of tourists, savants, and lovers have here strolled in the moonlight! At 11 P. M. the band left the ball-room for the veranda, and, according to their custom, gave the signal for retiring by playing "Home, sweet home;" and the next morning, at six, the same musicians awoke us by playing "Dixie"—that tune dear to every Southern heart!

The convenience of visitors is consulted by the establishment of two principal lines of cave exploration, designated as the Long Route and the Short Route the fees for which are, respectively, three and two dollars, including the services of a competent guide, with lamps, fire-works, and luncheon-basket. Special terms are made for tourists wishing to make a leisurely exploration, and also for large parties. Facilities are likewise furnished, if desired, for visiting White's Cave, and other caves in the vicinity.

It should be added, to correct an erroneous impression, that while guarding their property rights, the management of the cave has always encouraged scientific investigation. No restraints were laid on the members of the American Association, when they visited it, at the close of the Cincinnati meeting, except those heartily approved of by themselves. And I take this opportunity of expressing my appreciation of the aid given me by the present and the former manager, and of the faithful assistance rendered by the guides in my explorations.

The regulation hours for entering the cave are 10 A. M. and 7 P. M.—a provision necessary for the welfare of the guides, and suited to the general convenience of the guests. The lamp-cabin faces the garden. There, as the hour approaches, the guides may be seen trimming their lamps, and preparing the outfit of the visitors whom they are to escort. The lamp used is a simple affair for burning lard-oil, and swings from four wires twisted into a handle, with a tin shield to protect the hand. Each visitor is expected to carry one of these lights, but it is not given to him till he enters the cave.

The guide's appearance is unique as he stands ready for duty. No uniform is worn, but each, white or black,

dresses according to his own taste. The bunch of lamps, sometimes strung on a stick if there are many of them; the flask of oil swung by the side; the oddly-shaped basket carried on the other side, containing an assortment of chemicals for illuminating the larger rooms, together with any thing else that may be needed—makes a queer *tout ensemble.*

At the ringing of a large bell the party to go in on that trip gather in the garden, clad in any dress that suits the wearer; the ladies often donning a gymnastic dress trimmed, perhaps, with spangles and tiny bells; while easy shoes, close-fitting caps, and canes are desirable for all who consult their own comfort.

Matt., the Guide—Mammoth Cave.

The entrance to Mammoth Cave is reached by a shady path down a wild ravine, and is about 300 yards from the hotel on the bluff. Another hotel stood, formerly, in front of the entrance, but it was burned about fifteen years ago, and the scorched trees carry the scars of the fire. A plat-

form has been leveled off and furnished with rustic seats, where, on the hottest days of mid-summer, one may enjoy refreshing coolness. It is 118 feet below the summit of the bluff, and 194 feet above the level of Green river, which flows along at the distance of about half a mile, and furnishes excellent boating and fishing for those who are fond of such sport. The waters of this stream are remarkable for issuing mainly from caves; for which reason they are never frozen, even in the coldest winters, and are a refuge for steamboats and other craft, when the Ohio is obstructed by ice.

The air, as well as the water, of the cave is of uniform temperature the year round. The mercury in the set of Smithsonian thermometers kept at the hotel, may have indicated 100° when you began your walk down into this shady dell, but at the cave's mouth it falls to 66° at noon, and 65° at night, with very little regard to what kind of weather the rest of the world is having. Stand on this bench of stone and lift your hand above your head, and there you will find the fervid heat again. The current of cold air may be traced for a long distance before it mingles with the mass of common atmosphere. Within the cave, as we shall have occasion to observe, the temperature is several degrees lower than at the mouth.

As I have already remarked, the ancient outlet of the subterranean region before us was through what is now known as Dixon's Cave. A small opening on our left as we stand facing the present entrance, points in the direction of Dixon's Cave, but the guides say there is no opening through, although persons in one cave can make themselves heard in the other, as was proved by the miners in 1812, whose picks could be heard as stated.

Mammoth Cave has a noble vestibule! Amid tulip trees and grape-vines, maples and butternuts, fringing ferns and green mosses, is the gate-way to this underground palace. The fingers of a rippling rill pried the rocks apart, perhaps ages ago, and when the roof fell in, this chasm that we see remained. The rill still runs, and from a frowning ledge above it leaps fifty feet to the rocks

below, where it instantly disappears as if its work were done. The arch has a span of seventy feet, and a winding flight of seventy stone steps conducts us around the lovely cascade, into a roomy ante-chamber under the massive rocks.

The prevailing coolness and uniformity of temperature led the late Dr. Croghan to excavate a deep hollow here to serve as an ice-house.

The passage-way suddenly grows very narrow, at a point about 300 feet within, and here there is an iron gate made of rude bars crossing each other. This was built by Capt. W. S. Miller, in 1874, as a safeguard against secret surveys, spoliation, and the escape of fugitives from justice. Each guide carries a key, and the gate is unlocked and locked again for every party that may enter.

The current of air that had already been quite noticeable, increases to a gale as we cross the portal, so strong indeed that our lamps are blown out. This phenomenon is due to several causes operating together. The most obvious one is the difference of temperature between the air within and that without. During most of the year in this bland climate the outside air is warmer than that of the cave, and therefore the current is outward. But when it is otherwise, the current is reversed and blows into the cave. It is not necessary to assume the existence of some lower opening as a cause for a ventilating current; yet, if there are such openings, they may help to keep the air in motion.

Prof. Silliman, who visited the cave in 1852, offered still another explanation. Regarding the mouth of the cave as the only communication between the external air and the vast labyrinth of galleries stretching away for miles in the limestone, he accounts for the purity of the air on chemical principles. Calling attention to the incredibly extensive niter beds, he says: "The nitrogen consumed in the formation of the nitrate of lime must have its proportion of free oxygen disengaged, thus enriching this subterraneous atmosphere with a larger portion of the exhilarating element." The result would be that the cave-

air, being both more pure and more dense than that outside, would expand and flow outward whenever pressure was lifted by a rise of temperature above its own, which remains constant.

The word for cave, both in Latin and Greek, signifies "a *breathing-place*," as if these places were the mighty lungs of Mother Earth, through which she inhales and exhales the vital air. The classic fable of Æolus also comes to mind, in which the god of storms is represented as confining all the winds in a vast cavern, where he has his throne.*

The current of air dies down, as we advance, and only a few yards beyond the Iron Gate we have no difficulty in relighting our lamps. Here we catch the last glimpse of daylight shining in through the entrance, and all that lies beyond us is in absolute darkness. A strange sensation is usually felt by the visitor at this point, and occasionally one is found who shrinks back from the journey he has undertaken. The story is told of a Scotchman who had come to America as a tourist, led to do so by the hope of seeing the great cave, as a special object of attraction; but, when he reached this spot, and found to his surprise that *it was dark* in the cavern, he positively refused to enter!

Most visitors, however, find a certain romantic charm on entering these regions of perpetual silence, where the pleasing alternation of day and night is unknown, as is also the change of the seasons, summer and winter being alike, and vernal and autumnal airs the same. Whatever

*There are many "blowing caverns" in existence, and in some of them the blast is marvelous and inexplicable. I find the following statement in Johnson's Physical Geography, though I do not vouch for its correctness: "From a blowing cave in the Alleghany mountains, 100 feet in diameter, the current of air is so strong as to keep the weeds prostrate to the distance of sixty feet from its mouth. But the most extraordinary example is the great cave of Ouybe, of unknown extent, in central Asia. The tempests that rush from it are sometimes so violent as to carry off every thing on the road into an adjoining lake! The wind coming from the interior of the earth is said to be warm in winter, and so dangerous that caravans often stop for a whole week till the tempests have subsided!"

tremendous energies may once have hurled the loose rocks to the floor that now lie scattered around, no convulsion has disturbed the strata for ages, and there is no safer place above ground than is here below. The loudest thunder-storm may roll across the heavens, but its din does not invade the profound quiet of these deep vaults.

CHAPTER VI.

MAMMOTH CAVE—*Continued.*

The Main Cave—The Narrows—Saltpeter Works—Rotunda—Audubon's Avenue—Bat Rooms—Skeletons—Temperature of Mammoth Cave—Kentucky Cliffs—Methodist Church—A Subterranean Sermon—Standing Rocks—Grand Arch—Water-clock—Wandering Willie's Spring—Grotesque Fancies—Giant's Coffin—Acute Angle—Rude Monuments—Stone Cottages—A Strange Sanitarium—Star Chamber—A pleasing Incident—Salts Room—Proctor's Arcade—Kinney's Arena—Wright's Rotunda—Black Chambers—Cataracts—Solitary Chambers—Fairy Grotto—Chief City—St. Catherine's City—End of Main Cave.

WHATEVER route one takes, he must traverse for a longer or shorter distance, what is fitly designated as the MAIN CAVE, because it is like a great trunk, from which the avenues seem to branch. I shall, therefore, devote this chapter to its description, together with some of the less frequented places not now included in any regular route.

For perhaps fifty yards, after leaving the Iron Gate, the way lies under a low ceiling, and is walled in by fragments of rock piled up by the miners. Beyond the Narrows, as this passage is called, and where the way grows wider, there is a well-marked cart-road, and places where the oxen were tied up to be fed, corn-cobs also lying scattered around. The carts could not have been driven in through the Narrows, but were brought in piecemeal and put together again inside. The oxen, likewise, were unyoked and led in singly. Wooden pipes are laid in the earthen floor, each being about 20 feet long and 10 inches in diameter, bored lengthwise and joined together by iron bands. Such of them as were for conveying water into the cave are decayed badly, while those used to conduct the alkali out to the boilers are in excellent preservation.

Suddenly the roof lifts above our heads, and we are in the Rotunda, located, it is said, directly under the dining-room of the hotel. On our right are three huge vats, built of oak plank, and partly full of nitrous earth. The tall frame that once held the pump is now made useful for holding any superfluous wraps we may feel like leaving—for it is not well to be too warmly clad.

The area around us, including about half an acre, is rugged with heaps of rubbish that might have been leveled long ago, had it not been for their flavor of antiquity, and the guide's satisfaction in telling visitors that "these piles of lixiviated earth are monuments of the War of 1812!"

Looking aloft, we are impressed with a sense of the magnitude of the room we have entered, but, when we come to figures we miss the accustomed objects of comparison.

"Guess how wide this chamber is!" says the guide.

One thinks it can not be less than 150 feet; another says 200 or 250; and yet another is sure it is fully 300 feet.

"Guess how high it is!"

We look up to the dim ceiling and estimates vary again. To one it seems 50; to another 80, to a third, 100 feet high.

The lack of charity shown for errors in guesswork is sometimes very amusing to one who has used the tape-line in underground surveys, and knows how easy it is to be deceived in mere estimates of distances. The atmosphere of the cave is optically pure; *i. e.* no motes nor dust floats in it, and therefore the rays of light are not distributed as in ordinary air; while at the same time, as it is also chemically pure, the lamps burn very brightly. This combination of causes leads to a confusion of ideas as to the nearness or remoteness of objects.

Apply the tape-line to those two arches that open out from the Rotunda. One is found to have a span of 46, and the other of 70 feet! Our path lies through the latter, but let us make a brief digression into the other that trends away to the right.

This is Audubon's Avenue, so named in honor of the famous naturalist. It used to be called Big Bat Room, and the branch from it, running to Crevice Pit, was called

Little Bat Room—a title that clings to it yet. Here myriads of bats take up their winter quarters, congregating for the purpose from all the region around. Deposits of bat-guano abound, and this is supposed to be connected with the quantities of nitrous earth, which is richest here. Not a stone in these two rooms but what has been upturned for "peter-dirt;" and one can not refrain from admiring the energy and diligence of those old-time miners. Audubon's Avenue, as measured by me, is three quarters of a mile long, to where it ends in a group of stalactites. It is seldom visited.

The miners are said to have exhumed two skeletons, in 1811, in the Rotunda, at the entrance to Audubon's Avenue: one, that of a child; the other of a giant seven or eight feet in height! Mr. Gorin, as quoted by Dr. Forwood, states positively, that "no mummies were ever found in Mammoth Cave; and that no bones, either human or of the lower animals, except the two skeletons already spoken of, were ever found therein."

Before proceeding further, it may be as well to speak of the temperature of Mammoth Cave. It has been roughly estimated that twelve million cubic yards of limestone have been displaced by this immense excavation; and the importance occurred to me of ascertaining *exactly* the temperature of such a body of subterraneous air. On inquiry I learned that this had never been accurately done.

Hence I made a series of observations in 1878, that satisfied me of the need of still more careful work. Accordingly, in 1881, armed with two standard thermometers, one a Casella from the Kew Observatory, England, and the other a Green from Winchester Observatory at New Haven, Conn., I took a number of observations with the utmost care. Among my conclusions were the following: That the highest degree reached at any time in any part of Mammoth Cave is 56° Fah.; and the lowest 52½° Fah.: the mean for summer being 54°, and for winter, 53°. The latter is probably the true temperature of the earth's crust in the region where this cave is located.

The above conclusions are confirmed by the readings of an ordinary thermometer placed by Mr. Klett in the Rotunda and left there till it was, so to speak, acclimated. This gentleman reports, as the result of almost daily inspection by himself or the guides, that during the period of six months, the mercury did not rise above 54° nor fall below 53° Fah., the fair inference being, that there was not, at any time, a variation of more than one degree !*

At a point some distance beyond the Rotunda, and exactly half a mile by my pedometer, from the top of the hill, the guide calls our attention to a shelf of rock on the left, and informs us that there is the entrance to "The Corkscrew." This is a short-cut by which visitors, on returning from the Long Route, save themselves a mile or two of traveling.

Advancing in the Main Cave, we pass under over-hanging ledges called the Kentucky Cliffs, and about four feet from the floor we examine a cluster of little openings, like pigeon-boxes, that show the peculiar action of the water by which they were eaten out.

We next come to the Methodist Church, about eighty feet in diameter and forty feet high, where those ancient

*As this is a matter that has been under dispute, former observations by scientific observers having agreed on 59° Fah. as the correct temperature, I give below a table of my main observations, which were most carefully made with practically perfect instruments, on the 13th, and 15th days of August, 1881:

At the hotel on the hill the mercury indicated	92	deg.	Fah.
At the mouth of the cave (at noon)	65¼	"	"
" " " (7 P. M.)	60	"	"
At the Iron Gate, 100 yards within, where the current is strongest	59½	"	"
In the Rotunda (1,000 yards within)	53	"	"
In Audubon's Avenue	54	"	"
In Little Bat Avenue	54	"	"
In the Gothic Avenue (oldest and driest portion)	56	"	"
In Richardson's Spring (in the water)	54	"	"
In the Arched Way	54½	"	"
At the Bottomless Pit (top)	54	"	"
" " (midway)	56	"	"
" " (at the bottom)	53	"	"
In the Mammoth Dome (top, 250 feet above bottom)	54	"	"
" " (midway)	53½	"	"
" " (bottom)	53	"	"
At the Echo River (in the water)	55	"	"
" " (in the air)	56	"	"
" " (where it empties in Green River)	53	"	"

miners used to hear the Gospel preached by itinerant ministers, who sought their welfare. The logs that served for benches are still in position, and many a sermon has been delivered from the rocky pulpit since the days of the pioneer worshipers. The writer can not soon forget a religious service he had the privilege of attending in this natural temple, one summer Sabbath. The band did duty as orchestra, the guests and guides were seated around the pulpit in decorous order, the servants from the hotel were a little in the back-ground, the walls were hung with a hundred lamps, and the scene itself was beautiful. Then the psalm arose, led by the instruments, and waves of harmony rolled through those rocky arches till they died away in distant corridors. The text from which the clergyman, himself a visitor, wove his discourse was peculiarly adapted to the place and the occasion: John XIV: 5, "*How can we know the way?*"

For the next 150 yards the old cart ruts run between mountainous heaps of "lixiviated earth," and the hoof-prints of the oxen remain as if they had lately drawn loads to the hoppers. Here are more ruins of niter-works, eight huge vats, lines of wooden pipes, pump-frames, and other signs of former activity. What a busy set those old fellows must have been! One can almost credit their boast that they could dig saltpeter enough from Mammoth Cave to supply the whole world.

Leaving, for the present, the Gothic Galleries, where these ruins lie, we pursue our way under the Grand Arch, about sixty feet wide and fifty high, and extending for many hundred feet. On our left are the Standing Rocks, four in number, thirty feet long, and weighing may be twenty tons apiece. What a shaking there must have been when they fell from the lofty arch above and buried themselves in this upright position in the earthen floor!

New objects of interest meet us at every step, as we advance. During a moment's pause we are startled by what seems the loud ticking of a musical time-piece. It is but the measured melody of water dripping into a basin hidden behind the rocks. It is only a small basin, and the

drops fall but a few inches, yet such are the acoustic effects of the arch that they can be heard for a long ways, as they monotonously fall, drop by drop, just as, perhaps, they have fallen for a thousand years.

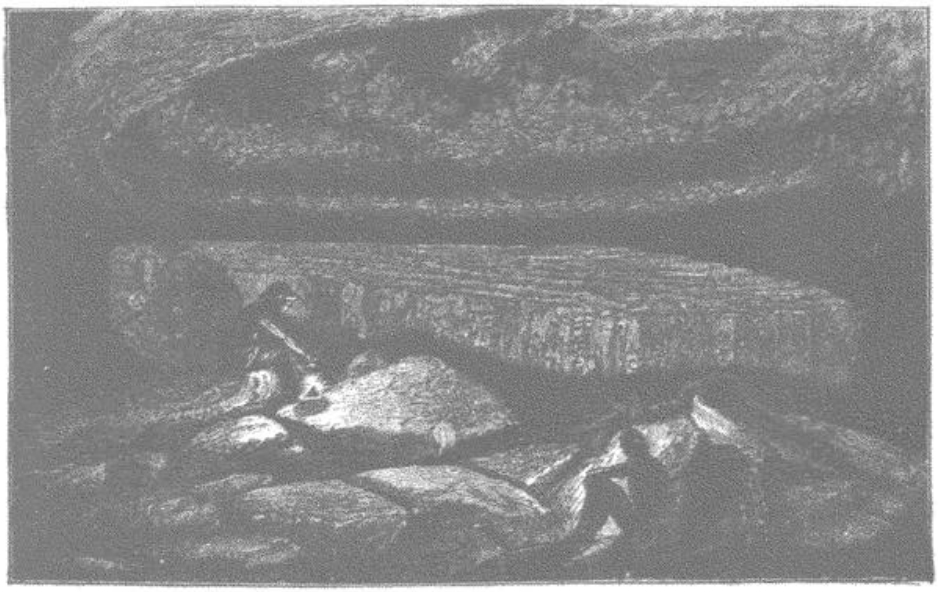
Not far from this natural water-clock, is a symmetrical recess chisled by a tiny rill, whose limpid water is collected in a pool. The story is told of a blind boy who rambled over the country, winning a precarious living by his violin, and who, as he said, was resolved *to see* the cave for himself. He lost his way, and when found by his companions, was quietly sleeping beside this basin, which ever since has been called "Wandering Willie's Spring."

Singular effects are produced by the devices of the guides. At a certain spot we are requested by William to stand still while he goes back a little ways and burns a blue light. The result is a splendid view of the Grand Arch, but the guide's pride is in a shadow profile cast by the projecting buttresses. He assures us that it is an exact likeness of George Washington, and points out the familiar features of the Father of our Country. In case Englishmen are along, William tells them that he sometimes thinks it looks more like the Duke of Wellington. He was caught one day telling a simple-hearted German that it was the profile of Bismarck.

The incrustations of gypsum stained by the black oxide of manganese, seem to cut gigantic silhouettes from the ceiling of creamy limestone. At first we ridicule these fancies, but at last they fascinate us. Wild cats, buffaloes, monkeys and ant-eaters—indeed, a whole menagerie is on exhibition, including the old mammoth himself, and Barnum's fat girl. There is an especially fine side-show of a giant and giantess playfully tossing papooses to and fro.

It is well to observe the large rock on our right very carefully, not only for the interest it excites by its singular resemblance to a mighty sarcophagus, but because the Giant's Coffin, as it is called, is one of the most important land-marks in the cave. It equals in size one of the famous blocks of Baalbek, being forty feet long, twenty wide, and eight or more deep. Often as I have passed it,

whether alone or with a hundred companions, it has ever been with a feeling as if I had intruded into some sacred mausoleum. This ponderous rock hides behind it the crevice that, until recently, was the only known way of access to the wonderful region of pits, domes and rivers, that we are to visit another day.

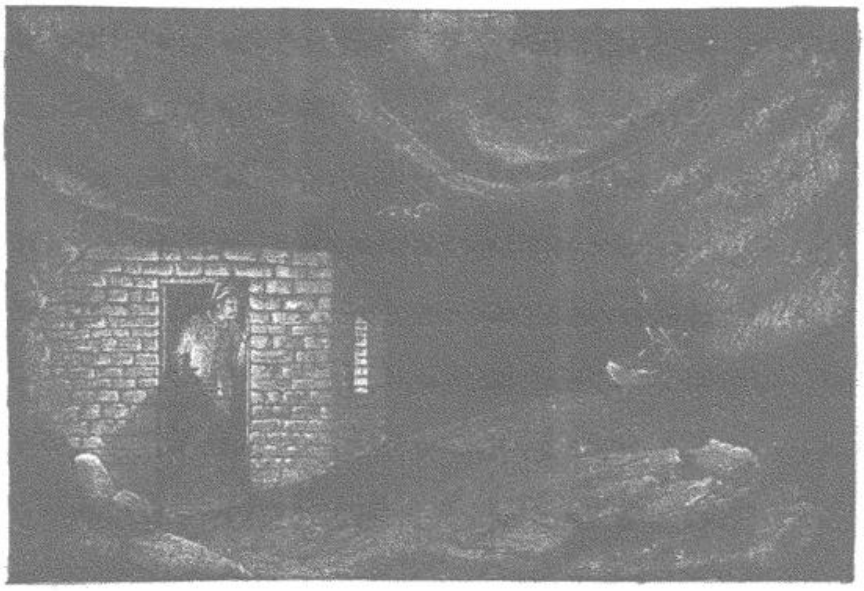


THE GIANT'S COFFIN.

At a point 100 yards beyond the Giant's Coffin, the trend of the Main Cave turns upon itself at an acute angle, on the left, and sweeps around in a magnificent amphitheater on the right. This enchanting place should not be hastily passed. The effect of fire-works here is remarkably brilliant, and the sublime scene thus illumined is one to be remembered long.

The apex of the acute angle is marked by McPherson's monument, a rude pile of stones in memory of a gallant soldier. More than 300 such monuments have been erected in different portions of the cave, in honor of various individuals, literary institutions, and the several States of the Union. Some of these pillars reach from floor to roof, each tourist who chooses to do so, adding a stone. An

incidental benefit of the custom is that it has helped to clear the paths.



A Strange Sanitarium.

The roofless remains of two stone cottages are next visited, as having a melancholy interest on account of their history. These, and ten frame ones, now torn down, were built in 1843 for the use of fifteen consumptive patients, who here took up their abode, induced to do so by the uniformity of the temperature, and the highly oxygenated air of the cave, which has the purity without the rarity of the air at high altitudes. The second stone house was a dining-room; all the rest were lodging rooms, and were well furnished. The cottages were not all at this spot. One was about 100 yards within Audubon's Avenue; in which a Mr. Mitchell, from South Carolina, lived for five months, and then died. He was buried in the little cemetery near the cave, and his body was afterward taken away. The next cottage was near Wandering Willie's Spring. Still another was erected in Pensico Avenue. All the others, nine in number, stood in a line, about 30 feet apart, extending from the acute angle onward. The

experiment was an utter failure; as was also the pitiful attempt on the part of these poor invalids to make trees and shrubbery grow around their dismal huts. The open sunshine is as essential to rosy health as it is for green leaves.

The salubrity of the cave, so far as its effects on the spirits and health of visitors are concerned, is decidedly marked. The air is slightly exhilarating, and sustains one in a ramble of five or ten hours, so that at its end he is hardly sensible of fatigue. In one of the earliest accounts of the cave, published in 1832, it is said that "the niter diggers were a famously healthy set of men;" and that, on humanitarian grounds, it was customary to employ laborers who were in feeble health, "who were soon restored to good health and strength, though kept at constant labor; and more joyous, merry fellows were never seen." It certainly is noticeable that most tourists, whether it is due to the delicious air or some other happy cause, generally mingle a jocund feeling with the awe and solemnity that one would suppose should be awakened by scenes so sublime.

A strangely beautiful transformation scene is exhibited in the Star Chamber, a hall from 200 to 500 feet long (according to the place you measure from), about 70 feet wide at the floor and narrowing to 40 at the ceiling, which is 60 feet above our heads. The light gray walls are in strong contrast to the lofty ceiling coated with black gypsum; and this, again, is studded with thousands of white spots, caused by the efflorescence of the sulphate of magnesia. The guide bids us seat ourselves on a log bench by the wall, and then collecting our lamps, vanishes behind a jutting rock; whence, by adroit manipulations, he throws shadows, flitting like clouds athwart the starry vault. The effect is extremely fine, and the illusion is complete. The ceiling seems to have been lifted to an immense distance, and one can easily persuade himself that by some magic the roof is removed, and that he looks up from a deep cañon into the real heavens.

"Good night," says the guide, "I will see you again in the morning!"

With this abrupt leave-taking he plunges into a gorge, and we are in utter darkness. Even the blackest midnight in the upper world has from some quarter a few scattered rays; but here the gloom is without a gleam. In the absolute silence that ensues one can hear his heart beat. The painful suspense is at length broken by one of those outbursts of laughter that come when least expected; and then we ask each other the meaning of this sudden desertion. But, while thus questioning each other, we see in the remote distance a faint glimmer, like the first streak of dawn. The light increases in volume till it tinges the tips of the rocks, like the tops of hills far away. The horizon is bathed in rosy hues, and we are prepared to see the sun rise, when all at once the guide appears, swinging his cluster of lamps, and asking us how we like the performance. Loudly encored, he repeats the transformations again and again,—starlight, moonlight, thunder-clouds, midnight and day-dawn, the latter heralded by cock-crowing, the barking of dogs, lowing of cattle, and various other farm-yard sounds; until, weary of an entertainment that long ago lost its novelty for him, he bids us resume our line of march.

It is doubtful if one visitor in fifty goes farther into the Main Cave than to the Star Chamber; but none fail to see this favorite hall of illusions. The path to it is dry and so well-trodden as to be quite dusty.

A pleasing incident comes to mind, showing how easily it may be reached, although a mile under ground. One evening, after tea, I had entered thus far alone, without a guide, and after studying for a while the peculiar effects of light and shade, I sat down on the log bench and put my lamps out, in order to enjoy the luxury of darkness, silence, and solitude. But ere long voices were heard, and mysterious peals of laughter. Soon the day-dawn effect was unexpectedly produced, by the approach of a party of jocund youths and maidens, with lights, who, having dressed for a hop, first paid a visit to this enchanted

ground; and, as cave dust never flies nor sticks, they did so without a speck on polished boot or trailing robe.

It may be well to say here that the remainder of the Main Cave is one of the "Special Routes," and those who wish to visit it should make their arrangements for doing so at the start.

As we pass along under a mottled ceiling that changes, from the constellation just described, to a mackerel sky with fleecy masses of floating clouds, many curious objects are pointed out to us. Here is a stout oak pole, projecting from a crevice, now inaccessible—put there when, and by whom, and for what purpose? There are snow-drifts of native Epsom salts, whitening the dusky ledges. Spaces are shown, completely covered by broad slabs, underneath which are the ashes and embers of ancient fires. Side-cuts occasionally tempt us from the beaten path, into which we return by a circuitous way. These are generally short, though some of them are several hundred yards long.

Proctor's Arcade, the next considerable enlargement beyond the Star Chamber, is said to be 100 feet in width, 45 in height, and three-quarters of a mile in length. Its proportions are very symmetrical throughout, and when illuminated by blue lights, burning at several points, deserves the encomium pronounced on it by Dr. Wright, of being "the most magnificent natural tunnel in the world."

Kinney's Arena is a hall about 100 feet in diameter, and 50 feet in height. Here another stick in the ceiling is pointed out, concerning which there has been much speculation.

After passing the S Bend, which has no special points of interest, we enter a spacious chamber, thus described by Prof. C. A. Wright, in whose honor it is named:

"Wright's Rotunda is 400 feet in its shortest diameter. The ceiling is from 10 to 45 feet in height, and is perfectly level, the apparent difference in height being produced by the irregularity of the floor. It is astonishing that the ceiling has strength to sustain itself." "When this immense area is illuminated at the two extremes, simultane-

ously, it presents a most magnificent appearance." Nicholas' Monument, named for one of the guides, stands at one end of this large hall, a column four feet in diameter and extending from the floor to the ceiling.

In this part of the cave the path, which I have said was very free from incumbrances, grows extremely rough, and the floor is but a bed of angular blocks, over which we make slow progress. We are willing to take the guide's word for it that Fox Avenue is worth exploring, and that various other spots are curious or beautiful.

We clamber over the big rocks, however, to survey a mass of ruins known by the ominous name of the Black Chambers. The walls and ceilings are here completely coated with black gypsum. We find that the funereal darkness defies magnesium, and refuses to be cheered even by red fire.

Crossing to the right hand side from these baronial ruins, we ascend through the Big Chimneys to an upper level, and, as we proceed, we hear the sound of a waterfall, which increases as we draw near, until we find ourselves at the Cataracts.

I have never happened to see this spot except in a dry season, and then, although there is quite a cascade, there is nothing to correspond with the frightful torrents that are said to pour down after heavy rains, "with a roar that resounds afar, and seems to be shaking the cave itself from its foundations." The water, be it more or less, falls from large perforations over-head, and is instantly lost to sight in a deep, funnel-shaped pit.

No creeping nor crawling has to be done in the Main Cave, the average width, throughout its entire extent being about 60 feet, and its height about 40 feet; the length is estimated at nearly four miles, of which we have, thus far, traversed less than half.

For the sake of variety, let us digress to visit the Solitary Chambers; to reach which we have to pass for perhaps 20 feet under a low arch. Pursuing our way across these lonely apartments, we finally, by dint of much crawling, arrive at the Fairy Grotto, once famous for its ten

thousand stalactites, as varied in form as the shapes visible in the kaleidoscope. Ruthless hands have marred this beautiful place, demolishing its exquisite creations, until it is difficult to realize the truth of the earlier descriptions.

Entering the Main Cave again, near the Cataracts, we continue our walk, clambering over great masses of fragments, taking care not to break our necks, until we find ourselves beyond this rocky pass, and under the stupendous vault known as the Chief City. Amid its wonders we linger long. Bayard Taylor's estimate of this colossal room shows the vigor of his imagination: "Length, 800 feet; breadth, 300 feet; heighth, 125 feet; area, between 4 and 5 acres!" Another, whose imagination was still more lively, estimates the area at 11 acres! There probably are about *two* acres; but the reader who has never explored this underground realm, will find it tax his mind to realize how large even such an area would seem, clothed with eternal night, built in by walls of massive rock, and over-arched by so vast a dome as to make us hold our breath, lest if silence were broken it would fall.

"Why does n't it fall?" I heard a timid visitor ask the guide.

"I know of no reason why it should not fall at this very moment," said he, solemnly, "and I never come underneath without some degree of fear. Yet the arch appears to be a solid, seamless block of limestone, and it may stand for a thousand years."

Immense rocks are thrown about in the wildest confusion, and it is evident that mighty forces were once here at play. But all is quiet now, and the dust of ages lies on those huge blocks. The guide picks out from interstices between the stones, half-burnt bits of cane, which he assures us the red men used to fill with bear's fat and burn, in lieu of torches, to light them in their solemn councils, or during their search for hidden treasures of flint or alabaster. The fact that no weapons have ever been found here shows that the councils held were of a peaceful nature; and the absence of human remains proves that they were not here on a funereal errand. But certain it is

that Indian chiefs saw this city centuries before we saw the light of day. It should be added, concerning the cane torches, that although now comparatively few, they were formerly so numerous as to furnish materials for hundreds of bon-fires by which the guides were accustomed to illuminate the mountain and the dome. Dr. Bird speaks (in 1837) of the supply as inexhaustible, filling the rocky crevices in "astonishing, unaccountable quantities."

The stern features of the scene are best surveyed from the summit of a rugged ascent, called quite appropriately, a mountain. Here we sit, while, again and again, the guide lights red fire and burns Roman candles, and discharges rockets that find ample room to explode before they strike the far-distant walls. The probability is that electric lamps will be placed, at an early day, in these dim regions, and then every nook and secret recess will be brought into view; but it is doubtful if the picturesque effects could be heightened beyond those now caused by the pyrotechnic glare that, as it flashes and dies away, over the long slope of irregular rocks, and athwart the gigantic vault, brings to view such glories as no torch-bearing mound-builder ever saw or dreamed of seeing.

The majestic dome appears to follow us, as we retire from it, overarching us at every step; as is the case with the sky, that bends the same canopy of blue above every meadow and valley, as the traveler moves from place to place. This phenomenon, first noticed by Mr. E. F. Lee, affords an impressive proof of its symmetrical proportions and vast dimensions.

And while the crimson light stains the arches and pinnacles, we take leave, with many a backward look, of this prehistoric council-chamber of sagamores and dusky braves.

Resolute pedestrians may cross the Chief City, and explore St. Catherine's City—which presents few novelties—and then go on under overhanging cliffs, to a place where, beneath a ceiling about fifteen feet high, the cave spreads out to a considerable width, and curious botryoidal formations grow. This branch ends in Symmes' Pit, a well

thirty feet deep. The Blue Spring Branch is a long passage, with very rough going, that leads on to a place where the rocks fill the cave from floor to roof, hopelessly obstructing further progress. And this is the end of the Main Cave.

SALTPETER VATS.

CHAPTER VII.

MAMMOTH CAVE—*Continued.*

The Short Route—Gothic Gallery—Gothic Arcade—Mummies—Ancient Relics—Short Cave—Salt Cave—Haunted Chamber—Register Hall—Gothic Chapel—Aged Pillars—Romantic Marriage—Old Arm Chair—Main Cave Again—Deserted Chambers—Wooden-Bowl Room—New Discovery—Arched Way—Pits and Domes—The Labyrinth—Side-Saddle Pit—Gorin's Dome—Putnam's Cabinet—Hovey's Cabinet—Bottomless Pit—Pensico Avenue—Scylla and Charybdis.

THE Short Route may be taken either by day or by night, as suits the convenience of the visitors; but those coming for a brief stay prefer the latter, as it leaves the entire ensuing day for the longer journey. The time required is four hours; hence those who enter at 7 P. M. may expect to come out again by 11 P. M., and with no more fatigue than will insure a sound night's rest in a hotel where a mosquito never has been seen, and where locks and bolts are only ornamental.

Passing without further mention points already described in the preceding chapter, we pause first at the Gothic Gallery. Here in the foreground are the old vats and pump-frames; and a stairway beyond them leads to the gate of a long avenue we are shortly to explore. From this ample gateway a narrow gallery, or rocky shelf, sweeps entirely across the Main Cave—really forming a bridge, whereby one might pass to the other side. Should he do so, he would find indications that this was once a continuance of the avenue, and both representing the highest level known in the cave. Taken as a whole, the amphitheater is a noble one, and you are not surprised to be informed that here Edwin Booth once rendered selections from the play of Hamlet, taking yonder rocky plat-

form on the right as his temporary stage. Fire-works are generally exhibited here, and to great advantage.

Ascending the steps we enter the Gothic Arcade, and after proceeding about forty yards, our attention is directed to a niche in the left hand wall, which we are told is the Seat of the Mummy. The legend is that here were once found the dried bodies of a woman and a child, unlike modern Indians, and probably belonging to some extinct and ancient race. Such conflicting statements have been published concerning these remains, that many have classed the "Mammoth Cave Mummy" with the numerous hoaxes with which ingenious perversity has amused itself at the expense of a credulous public. The facts are these:

In 1813 a scientific visitor, probably Mr. Merriam, of Brooklyn, N. Y., saw what he mentions as "a relic of ancient times, which requires a minute description." This description is substantially as follows: That some miners had exhumed a female body while digging saltpeter-earth in the Short Cave (not any portion of the Mammoth Cave, but a small cave in the neighborhood). The grave was covered by a flat rock, and contained the wardrobe, as well as the body of the woman. The latter was in a sitting posture, with the arms folded, and hands crossed and bound by a small cord. The inner wrapping was made of two deer-skins, closely shaved and ornamented with vines and leaves marked in white. Next came a woven sheet, in texture like fabrics made by the South Sea Islanders. The hair on the mummy's head was red and clipped within an inch of the skin. The teeth were white and perfect; the nails long; the features regular; the color dark but not black; the body free from blemish, except a wound between the ribs and an injury to one eye; the frame that of a person about 5 feet 10 inches in height; the flesh hard and dry upon the bones; and the weight, at the time of discovery, but 14 pounds, though it gained 4 pounds more by absorbing dampness. A knapsack, a reticule, and a pair of moccasins, all of woven or knit fiber, lay by the mummy's side. The articles contained in the reticule and knapsack were head-dresses of feathers; a cap of woven

bark; several hundred strings of beads tied up in bunches; a necklace of red hoofs of fawns; an eagle's claw and the jaw of a bear; folded skins of rattlesnakes; vegetable colors done up in leaves; bunches of sinews, thread, and twine; seven needles (or awls); a deer-skin hand piece, to protect the hand in sewing; and two whistles of cane, bound together by a cord. After explaining that the cause of such perfect preservation was not due to any embalming process, but merely to the antiseptic properties of the nitrous earth, combined with the extreme dryness of the cave, this writer concludes his fanciful description, by saying, "The features of this ancient member of the human family much resembled those of a tall, handsome American woman. The forehead was high, and the head well formed."

This same mummy was found by Dr. Nahum Ward, of Marietta, O., in 1815, in the Gothic Avenue (according to Mr. Proctor, a former proprietor of the hotel), and sent by him to the Antiquarian Society of Worcester, Mass., where it now is. The gentleman to whom the credit of finding is really due, was Mr. Charles Wilkins, of Lexington, Ky., one of the owners of Mammoth Cave. In a letter dated October 2, 1817, in reply to the inquiries of the secretary of the Antiquarian Society, Mr. Wilkins first describes the mummy of an infant about one year old, found in a cave about four miles from Mammoth Cave, and which, with its clothing, had been thrown into the furnace by the workmen. He regretted this so much as to offer a reward for the next that might be found. The result was the discovery, a month later, of the one that was afterwards sent to Worcester. His agent (Mr. Miller) sent for it and placed it, for safe-keeping, in the Mammoth Cave, and quite possibly he laid it in the niche of the Gothic Avenue that is now pointed out; but this is doubted by some. Wilkins, in a matter of fact style quite in contrast with the flowing sentences of Merriam, tells the same story, confirming the account of the utensils, ornaments, and articles of dress.

Samuel L. Mitchill, M. D., of New York, also wrote to

the Secretary, giving an account of other mummies from the caverns of Kentucky and Tennessee. His letter is dated, August 24, 1815, and is preserved in the published Transactions of the Antiquarian Society. He states that "In exploring a saltpeter cave near Glasgow, several human bodies were found enwrapped carefully in skins and cloths." He particularly describes one that had "a deep and extensive fracture of the skull, near the occiput, which probably killed him."

In the Medical Repository (vol. XVIII, p. 187), is published, a letter from Mr. Gratz, one of the owners, accompanying a parcel of curiosities sent to Dr. Mitchell, from which we may fairly conclude that, besides interlopers from Short Cave and elsewhere, there were genuine Mammoth Cave mummies. Mr. Gratz says:

"There will be found in this bundle two moccasons, in the same state they were when dug out of the Mammoth Cave, about 200 yards from its mouth. Upon examination, it will be perceived that they are fabricated out of different materials; one is supposed to be a species of flag, or lily which grows in the southern parts of Kentucky; the other of the bark of some tree, probably the pawpaw. There are also, in this packet, a part of what is supposed to be a kinniconeke pouch, two meshes of a fishing net, and a piece of what we suppose to be the raw material, and of which the fishing net, the pouch and one of the moccasons are made. All of which were dug out of the Mammoth Cave, nine or ten feet under the ground; that is, below the surface or floor of the Cavern." Mr. Gratz also describes "an Indian bowl, or cup containing about a pint, cut out of wood, found also in the Cave;" and adds "lately there has been dug out of it the skeleton of a human body, enveloped in a matting similar to that of the pouch."

During the progress of the recent State geological survey, Prof. F. W. Putnam, through his connection with it, was able to examine the archæology of the various rock shelters and caverns of Kentucky; and his report was published in 1875, in the Proceedings of the Boston Society of

Natural History. He collated all known facts concerning the relics here mentioned; examined the celebrated mummy in the museum at Worcester, finding ample proof of the general correctness of the earlier accounts; and also exhibited exceedingly curious fabrics from Salt Cave, a small cave near Mammoth Cave, and belonging to the same proprietors.

Indian fire-places, with ashes and embers remaining; imprints of feet shod with braided moccasons or sandles, as distinct as if made but a few days previous; numerous cast-off sandles, artistically braided from the leaves of the cat-tail flag; woven cloth, dyed with black stripes, and in one corner showing that it had been mended by darning; bunches of bark, and pieces of bark-twine and rope; fringes and tassels of fibers; wood cut by a stone ax; a few arrow-heads, and various fragments—these were among the curiosities found by Prof. Putnam in the Salt Cave. It is to be hoped that this enthusiastic lover of science may find his example of thorough research imitated by those who do not have to travel a thousand miles to do their cave hunting!

On the old maps of the cave the Gothic Avenue is put down as the Haunted Chamber, on account of an adventure that befell one of the saltpeter miners. The story runs that a raw hand disdained the guidance of an older workman, and trudged off alone to dig his lot of "peter-dirt," and was forgotten by the other miners until dinner time. Then a few negroes, half-naked, as was their custom when working, started to hunt him up. The poor fellow had filled his salt-sacks and started back, but finding the way longer than it had seemed when going in, concluded that he was lost. In his fright he became thoroughly bewildered, and, to make matters worse, fell over a stone and put his lamp out. His sins came in remembrance, and he gave himself up to alternate frenzy and prayer. "It was at this moment," says Dr. Bird, who tells the story, "that the miners in search of him made their appearance; they lighted upon his sack, lying where he had thrown it, and set up a great shout, which was the first intimation he had

of their approach. He started up, and seeing them in the distance, the half-naked negroes in advance, all swinging their torches aloft, he, not doubting they were the identical devils whose appearance he had been expecting, took to his heels, yelling lustily for mercy. Nor did he stop, notwithstanding the calls of his amazed friends, until he had fallen a second time over the rocks, where he lay on his face, roaring for pity, and only by dint of much pulling and shaking was he convinced that he was still in the world and in the Mammoth Cave!"

The Post Oak is a pillar about twelve feet high, bearing some resemblance to a trunk of a tree, and is formed by the meeting of a stalactite and stalagmite. It stands at the entrance of the Register Hall, on whose smooth ceiling hundreds of names have been inscribed in lampblack, before the rules of the cave had prohibited that cheap method of gaining immortality. As a substitute for this rocky album, convenient places are provided for visitors to leave their cards, which, in this extremely dry portion of the cave, will remain fresh and uninjured for many years. Thousands of cards, from all parts of the world have thus been left, and it affords amusement to look over them. Here are also many memorial heaps erected by admirers of celebrated persons, each pile having a sign to show in whose honor it stands, and by whom it was erected.

On reaching what are called the Pillars of Hercules, the guide collects the lamps and arranges them with fine effect among the arches of the Gothic Chapel, which he then invites us to enter. The roof of this room seems to rest on groups of stalagmitic columns, once beautiful, no doubt, but now sullied by sacrilegious smoke. I counted eight, and found fragments of thirty more of them. Their growth was slow, requiring centuries to develop their present dimensions; but I can hardly accept the conclusion of Dr. A. D. Binkerd that 940,000 years were needed for their completion. It should be remembered that the rate of increment varies with changing conditions. Some of them are still dripping slowly, while others are perfectly

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MARRIAGE SCENE IN GOTHIC CHAPEL.

dry. Hence any estimate as to their age in years is idle and fruitless. It is only certain that they are *very old.*

Three pillars are so grouped as to form two Gothic arches, and before this unique altar once stood a runaway bride who had promised an anxious mother that she would "never marry any man on the face of the earth." She kept the letter of her promise, but was married after all to the man of her choice, in this novel Gretna Green. Several romantic marriages have since been celebrated here.

This entire avenue is more than a mile long, and abounds in grotesque curiosities. The Old Arm Chair is a stalagmite resembling the object for which it is named; and one of a lively fancy might say the same of the Elephant's Head. Other objects pointed out are Vulcan's Shop, the Lover's Leap, Gatewood's Dining Table, Lake Purity, and Napoleon's Dome—grand in its symmetry and size. The avenue ends in a double dome and a small cascade.

Retracing our steps to the Main Cave, and proceeding as far as the Giant's Coffin, we leave it again, by a crevice behind that huge sarcophagus, and presently find ourselves in the Deserted Chambers, in one of which was found the wooden bowl mentioned by Mr. Gratz. The opening on the left is called Black Snake Avenue, on account of its serpentine windings—not for its reptiles! There has never been found a snake or any other hurtful creature in all this cavern. The avenue named tunnels under the Main Cave, with which it communicates near the stone cottages; thence it goes on for a long distance, and opens into the New Discovery made in September, 1879, by Messrs. J. and T. Lee, in pursuance of a suggestion made by William, the guide. It may be added that Mr. Florian Giauque, of Cincinnati, claims priority in this discovery. Welcome Avenue, as it is fitly named, comes out, finally, in Serpent Hall, beyond Echo river. It contains some interesting rooms, but its value consists in furnishing what has long been desired—a way of exit from the remoter

portions of the cave, in case of a sudden rise in the subterranean streams. It is not open to the public.

There is also another way out from the Wooden Bowl Room, by a stairway on the right, bearing the whimsical name of the Steeps of Time. Down this we go to a lower level, and proceed along the Arched Way, leading to a wonderful region of pits and domes. Early writers mention the finding of moccason tracks near a basin here called Richardson's Spring, where every body stops for a taste of the clear water flowing down from the rocks. Plodding quietly along for 150 yards, the guide suddenly cries, "Danger on the right!" Beside our path yawns a chasm called the Side-saddle Pit, from the shape of a projecting rock, on which we seat ourselves, and watch with fearful interest the rolls of oiled paper lighted by the guide and dropped into the abyss. Down they go in a fiery spiral, burning long enough to give us a view of its corrugated sides and of a mass of blackened sticks and timbers sixty-five feet below, the distance being thus measured by a line and plummet. The opening is twenty-five feet across, and above it, or nearly so, is Minerva's Dome, thirty-five feet high.

Descending a stairway, 50 yards beyond, we enter the Labyrinth,* a narrow, winding passage, barely wide enough for two persons to go abreast; and after climbing a second stairway and going down a third, and turning about till we are almost bewildered, we find ourselves peering through a window-like aperture into profound darkness. The gloom is intensified by the monotonous sound of dripping water that seems to fall from a vast height to a dis-

*The original Labyrinth was near Crocodilopolis (Arsinoe), not far from the Lake Moeris, in Egypt. Herodotus describes it as "consisting of 1,500 chambers excavated under ground, and as many above the surface, the whole inclosed by a wall." He explored a number of the mazes. No traces of it now exist. Perhaps filled up with sand. A second labyrinth was made in Tuscany, a third in Lemnos, and a fourth in Crete.

"As the Cretan labyrinth of old
With wandering ways, and many a winding fold,
Involved the weary feet without redress,
In a round error which denied recess."—(*Virgil's Æneid.*)

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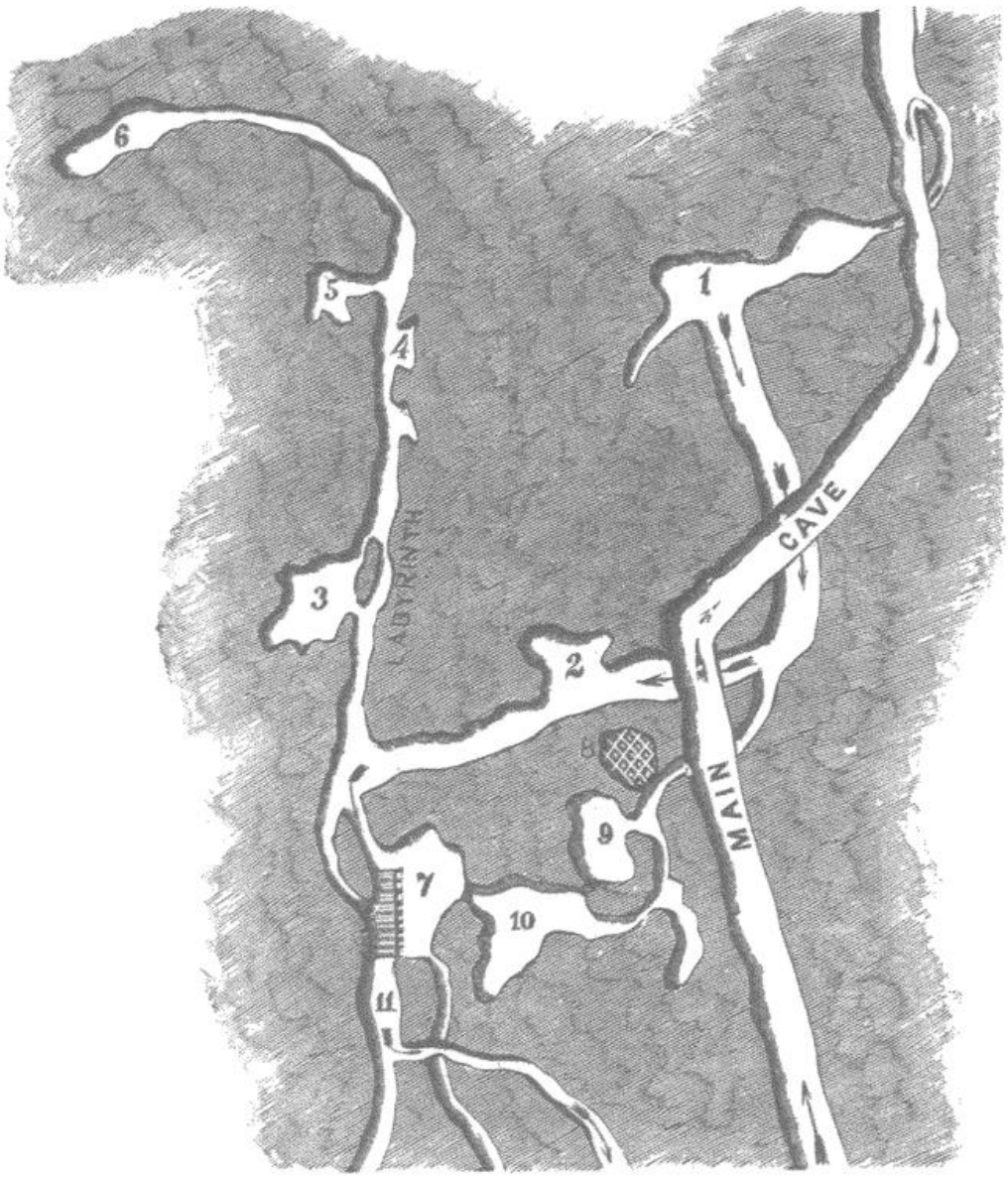


The Labyrinth in Mammoth Cave.

1. Wooden Bowl Room.
2. Side Saddle Pit.
3. Gorin's Dome.
4. Putnam's Cabinet.
5. Hovey's Cabinet.
6. Ariadne's Grotto.
7. Bottomless Pit.
8. Covered Pit.
9. Scylla.
10. Charybdis.
11. Revellers' Hall.

mal depth. The guide bids us stay where we are, while he goes to a smaller window still further on, through which he thrusts blue lights and blazing rolls, disclosing indescribable wonders to our gaze. Igniting magnesium (of which it is well to have a supply, as it is not furnished by the guides), we discern the floor far below us, about an acre in area, its general level about 90 feet lower than the window. A small pit in it leads to a body of water 12 feet deep, making the total distance to the lowest point 117 feet. The height of the vault over-head seems to be about 100 feet; which gives 217 feet as the extreme altitude of this mighty chasm known as Gorin's Dome. It used to be called 500 feet high; but as the distance from the surface to drainage level is now known to be only 328 feet, that fact effectually disposes of such exaggerated estimates. The perpendicular walls are draped with three immense stalagmitic curtains, one above another, whose folds, which seem to be loosely floating, are bordered with fringes rich and heavy. These hangings, dight with figures rare and fantastic, fit for Plutonian halls, were woven in Nature's loom by crystal threads of running water!

Putnam's Cabinet, and Hovey's Cabinet, still further on in the Labyrinth, are smaller domes, where concretions known as cave-pearls, are found, and also some of the finest alabaster in the cave. Here, too, are specimens of oölitic limestone, which under the microscope has the appearance of being made up of tiny eggs. The passage terminates in Ariadne's Grotto.

On retracing our way out of the Labyrinth, we next come to the famous abyss known as the Bottomless Pit, above which expands Shelby's Dome. This frightful pit was long regarded as constituting an impassable barrier to further progress; but its terrors have been greatly overdrawn. The author of "Warwick, or the Lost Nationalities of America," makes his hero descend *many miles* into the Bottomless Pit, by the aid of Stephen the guide! The depth of the chasm has ordinarily been given as more than 200 feet. It is really a double pit, being nearly divided by a tongue of rock that juts into it for 27 feet; from the

point of which, in 1837, Stephen threw a ladder across, and ventured into the unknown regions beyond. A substantial bridge now spans the gulf, which, for safety is renewed every four years. Leaning over the hand-rails, we safely admire the gleaming rolls as they whirl to and fro, slowly sinking till they vanish, lighting up, in their capricious progress, the wrinkles and furrows made by the torrent's flow during untold ages. Bringing the mysterious abyss to the severe test of line and plummet, we find its depth to be, on one side only 95 feet, and on the other 105 feet. Shelby's Dome overhead may be 60 feet high, and the space between 15 feet, thus making 180 feet the greatest distance from top to bottom of the entire chasm.

Reveler's Hall, the first room beyond the Bottomless Pit, is about 40 feet in diameter and 20 feet high, and was formerly a place where parties stopped to dine. The path to our left leads to the Rivers, which are reserved for another time. That on the right is Pensico Avenue, about a mile long, and containing various objects of interest. The Sea Turtle is the first of these to which our attention is called; a rock fallen from the roof and shaped like the carapace of a huge tortoise, 30 feet in diameter. Wild Hall is next entered, where the great rocks are strewn about in the most amazing disorder, under a roof of elaborate lancet arches. A low passage on the left, called Bunyan's Way, communicates with River Hall, but is seldom traversed, as visitors take the more direct path mentioned above. Proceeding still through Pensico Avenue, we admire the snowy nodules incrusting the Snowball Arch, beneath which we go on to the Grand Crossings, where four avenues meet. This place is much admired. The same is true of Mat's Arcade, 50 yards long, 30 feet wide and 60 high, where Mat himself pointed out to us the series of cavern floors that had successively given way leaving four narrow terraces along the entire length of the walls. A large white column is called, for some unknown reason, the Pine-Apple Bush. A little beyond this formation is the Hanging Grove, where the stalactites resemble

branches of coral rather than those of trees. About a hundred yards on and we arrive at Angelica's Grotto, sparkling with crystals.

This is the end of the Short Route; and here this chapter might also end, were it not that I wish to describe certain remarkable pits discovered, in February 1881, by Mr. J. T. Hill and William Garvin the guide. These are not ordinarily exhibited, on account of their dangerous surroundings; and, indeed, I was assured that I was the first visitor who had been permitted to explore the locality, though it had been seen by several persons connected with the Cave.

The approach is by a low, creeping passage, opening from the Arched Way, and leading across what has for many years been known only to be shunned—the Covered Pit. This treacherous chasm is imperfectly concealed by loose slabs of limestone, between which the black depths seem to be lying in wait for the heedless explorer. Cautiously crossing it, and crawling on our hands and knees for some distance further, we stopped, and William told me to listen to the slow dripping of a waterfall. Throwing a pebble in the direction of the sound, I could hear it bound from side to side as it descended, until, after a long interval, it fell into a body of water below. On examination we found that we lay on a rocky partition between the old Covered Pit on the right, and a new one on the left. The latter proved to be a pit within a pit, as we found on throwing lighted paper down its mouth. The upper one is about 90 feet deep, and at its bottom we could just discern the orifice of the lower one.

I was anxious to find a point from which to examine this inner pit to better advantage. Creeping back from off the partition, we made our way around a rocky pillar for perhaps 40 yards, and came upon the further edge of the pit that had excited our curiosity, and also found another horrible pit on the left, separated from the first by a ridge only six feet wide! The proximity of the two chasms suggested to Mr. Klett the names of Scylla for the

first, and Charybdis for the second; in memory of the classic line:

"*Incidis in Scyllam cupiens vitare Charybdim.*"

(You may fall into Scylla, trying to shun Charybdis.)

Willing to run some risk to accomplish my object, I clambered a short distance down into Scylla, to a ledge overhanging its very deepest portion, and cleft by a serpentine crevice about five inches wide. Dropping pebbles through this crack, we timed them as they fell unobstructed, and by repeated trials found the time taken in reaching the bottom to be exactly five seconds by the watch. This, by a well-known formula for calculating accelerated motion, would give 402 feet as the depth *in vacuo*. Making due allowance for the resistance of the atmosphere, and for the time necessary for the sound to return, the space passed was not less than 200, nor more than 250 feet. William, not satisfied with scientific guess-work, produced his ball of cord, fastened a lamp to its end, and let it down into the darkness. The glimmering light served to show the irregular walls of the abyss, as it descended, until at length it caught on a projecting rock. In his efforts to shake it loose, the cord was burned off; but the lamp remained where it had lodged, shining on as if determined to do its duty to the last! The part of the cord that was drawn up measured 135 feet, leaving us, after all, to conjecture the remaining depth. Probably the pit perforates the limestone down to the drainage level—a distance according to the barometer, of 220 feet.

Glad to forsake the thin crust on which we stood, overhanging such prodigious depths, we climbed out of the jaws of Scylla, and made experiments on Charybdis. Here, again, the pebbles were five seconds in reaching the pool below. Along the perilous rim William led the way to still another chasm, which we identified as the farther edge of the Bottomless Pit. Regaining, not without some difficulty, the bridge over it, we proceeded a short distance on the path that leads to River Hall, and then turned back, by a passage under the rocks, to an opening into the side of the Bottomless Pit, about 40 feet below the bridge.

Here we saw the famous pit in a new light, and also obtained the best view to be had of Shelby's Dome. The accompanying picture of the Bottomless Pit was taken from this point of view. While we were standing there, on the occasion referred to, I noticed a volume of smoke issuing from a window beyond us. Investigating this phenomenon, we found ourselves looking again into Charybdis, though not at its deepest part. The smoke came from the blue lights we had ignited just before leaving it.

THE BOTTOMLESS PIT.

Thus, as we have shown, there are, within an area whose diameter does not perhaps exceed 600 yards, six of the largest naturally formed pits in the known world, besides several others of smaller dimensions; and the entire group is joined together by connecting passages. An inspection of the accompanying diagram (opposite page 97) will enable the reader to get an idea of this extraordinary locality.

On inquiring of Mr. Klett if there was any sink-hole in the vicinity to correspond with this cluster of chasms,

he directed me to a piece of unbroken forest, less than half a mile from the Mammoth Cave Hotel, where all the requirements of the case seem to be met. This vast depression embraces many acres, and is so deep that, when standing on its edge, one can overlook the tops of the trees growing in the central portion. It remains to be proved by further explorations whether there are any hidden tunnels of communication between it and the remarkable group of domes and pits I have been trying to describe.

A Snow Cloud. (See page 111.)

CHAPTER VIII.

MAMMOTH CAVE—*Concluded.*

The Long Route—Main Cave once more—Beyond the Pits—Fat Man's Misery—Bacon Chamber—Spark's Avenue—Mammoth Dome—Egyptian Temple—A Lamp Lost and Found—River Hall—Dead Sea—A Jolly Crowd Crossing the Styx—Lake Lethe—Echo River—Eyeless Fish—Subterranean Music—Silliman's Avenue—El Ghor—A Purple Vintage—Dinner in the Shade—A Crystal Paradise—Cleveland's Cabinet—Cave Flowers—Rocky Mountains—Croghan's Hall—The Maelstrom—A Daring Exploit—The Corkscrew—Old Matt in Danger—Out of the Cave and under the Stars.

MAMMOTH CAVE has gained a reputation as a cave of "magnificent distances;" and many a critical visitor has set himself to correct the over-estimates of others. Yet the fact remains that the Long Route is a day's journey under ground. The signal for starting is given at 9 A. M., and the return is about 6 P. M., after nine hours of steady walking over a road, a little rough in spots, but for the most part quite smooth and easy. I was one of "a rapid transit party," one day, that tried to see how quickly the trip could be made. None but fast walkers were included, and no stops were made, except at points of special interest; and the time consumed was just seven hours. Allowing, therefore, two miles an hour as the rate of travel, it follows that the Long Route is not less than 14 miles, nor more than 18; and this estimate may as well be accepted until the distance is exactly measured. Long as the trip is few persons find it fatiguing, being sustained by the variety and novelty of the scenery, and also by the cool and pure air for which the cave is celebrated.

Down the valley again, and under the thick horizontal plates of limestone, from whose green and mossy ledge the wild pattering rill falls on the rocks below; on through the

Narrows, and the Rotunda, where perhaps a generation of dead men sleep; climbing the piles left by the niter-diggers of old, or led by the musical ringing of the guide's footsteps on the hard rocky floor; between heavy buttresses bending beneath the gray ceiling above, or walls hollowed into low-browed niches and nobler arches—thus we go through the wide and lofty Main Cave until the Giant's Coffin is reached. This rock was originally chrisened the "Steamboat," and the early accounts explained the points of resemblance, and had poetical things to say about her "reposing in her river of stone." Creeping around her bows, we next descend into those dens of darkness, the Deserted Chambers, and soon hear the faithful guide call ont "danger on the right!" Safely by the terrible pits, we pause to take breath, meanwhile blowing our lights out in order to prove by the "horror of a great darkness" what a blessed thing light is. Happy are we in the knowledge that the lamps are still near, and our pockets full of matches! A brief imprisonment in an atmosphere that seems to have been suddenly solidified to a mass of coal suffices, and we relight our lamps and march on.

"March," however, is not just the right word; for progress now is by the Valley of Humility, a low passage four feet high, conducting us into the Scotchman's Trap, where a canny Scot paused lest the broad rock, suspended by the tip, might fall and bury those venturing through the circular orifice beneath. Less timid than he, we dive down the trap-door, and presently are made acquainted with the famous and original Fat Man's Misery, of which all others are but base imitations. Some fastidious soul once tried to change this name to "the Winding Way," but the attempt was a failure. Here the path enters a serpentine channel, whose walls, 18 inches apart, change direction 8 times in 236 feet, while the average distance from the sandy floor to the ledge overhead is but 5 feet. The rocky sides are beautifully marked with waves and ripples, as if running water had been suddenly petrified. There seems to have been first a horizontal opening be-

tween two strata, by taking advantage of which this singular channel was chiseled, from whose too close embrace we gladly emerge into Great Relief, where we can straighten our spines, and enjoy once more the luxury of taking a full breath. The question is sometimes asked, "How fat a man is the fattest man that can get through the Fat Man's Misery?" Some reader may be comforted by learning that, in August, 1881, Mr. Abraham Meuks, a colored man from Lebanon, Ky., whose weight was previously 282½ pounds, succeeded in the attempt. He did without help till he came to the place where the floor comes up and the roof comes down, to bother tall men as well as fat ones, and then William, who is equal to any emergency, helped him through.

"How did you manage it?" said a listener to the story, as it was told at the hotel that evening.

"Easy enough," gravely answered the guide. "I took him through in sections." Meuks himself claimed to have lost 15 pounds in the operation, and the guides, to this day, point out places where the rocks had to bend to let this jolly fat man through!

It was formerly supposed that if this passage were blocked up, escape from the regions beyond would be impossible. But another mode of exit was discovered by William, in 1871, through the Cork-screw. This intricate web of fissures was known as long ago as 1837, but not as a passage through to River Hall. In the oldest published accounts of Mammoth Cave it is stated that "among the Kentucky Cliffs, just under the ceiling, is a gap in the wall, into which you can scramble, and make your way down a chaotic gulf, creeping like a rat under and among huge loose rocks, to a depth of 80 or 90 feet—provided you do not break your neck before you get half way." Since William made his way through, the obstructions have partly been removed, so that now, by mounting three stairways, crawling through narrow crevices, and leaping from rock to rock, one may ascend for what would perhaps be a vertical distance of 150 feet, and thus reduce the journey from Great Relief to the mouth of the cave by

nearly a mile. Visitors who come in one way, generally go out the other, and regard the last route chosen the worst, whichever it may have been.

The guide calls attention, as we now proceed, to the Odd Fellow's Links, and other concretions on the ceiling, which are caused by the wearing away of the more soluble limestone from around hard ridges of ironstone, leaving these emblems in bass-relief.

Bacon Chamber is a still more striking instance of mimickry, for the masses of rock projecting from the ceiling certainly look like the rows of hams in a packing-house, and it seems as if nature must have made this chamber when in some jocose mood.

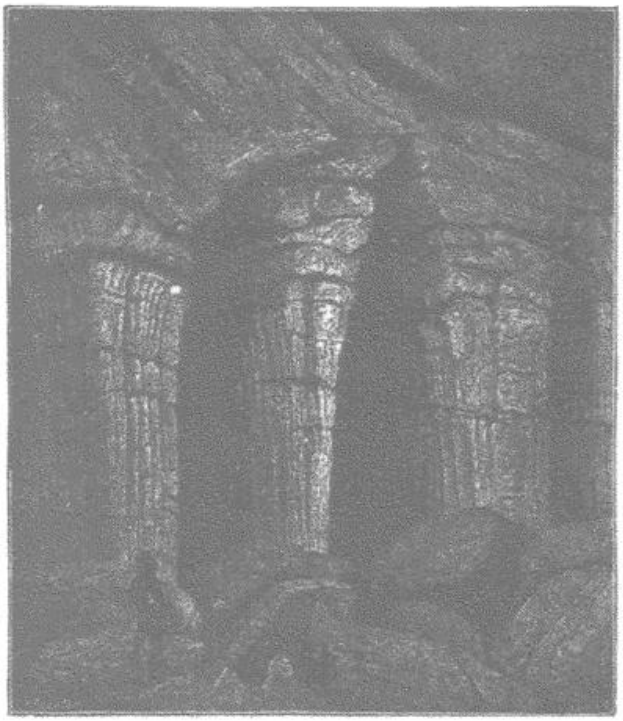
Spark's Avenue runs from the Bacon Chamber to the Mammoth Dome, the most spacious of the many domes in this cave. As this is a "special route," I took my guide early one morning, long before the regular hour for parties to enter for the Long Route, meaning to complete the trip in time to join a large company of tourists from Nashville, who were going beyond the rivers. My guide, on this occasion, was Tom Lee, and we were accompanied by Barton, the artist, whose pencil has furnished many of the cuts that embellish this volume. Leaving the latter to make a drawing of the Cork-screw, Tom and I entered Sparks' Avenue, which, as he told me, is named for Mr. C. A. Sparks, of New York. It begins well by an ample room named Bandit's Hall, where there is a wild confusion of huge rocks. Brigg's Avenue, to the right of it, we did not explore, though it is said to be of great extent. I also took for granted the "petrified saw-logs" in Clarissa's Dome, at the end of Sylvan Avenue, 100 yards on our left, after leaving Newman's Spine—a crevice where we have the privilege of straightening our own spines, after no little stooping. We finally emerged from Sparks' Avenue, and found ourselves on a terrace thirty feet long and fifteen feet wide, confronted by a realm of empty darkness. Our lamps revealed neither floor, nor roof, nor opposite wall. And this is Mammoth Dome, the grandest hall in all this domain of silence and of night. I directed Tom to

leave me here, and to return for my comrade and for fireworks.

Not until Tom's glittering light was gone, and his retreating steps had ceased to echo along the corridor, did I realize the utter loneliness that surrounded me. I sat on the edge of the terrace for a time, and amused myself by throwing lighted papers down, thus discovering that the floor was less than forty feet below me, and was accessible only by a rude ladder blackened with age. Here and there a rung was missing, and I hesitated to trust myself to such a fragile support. Retreating into the avenue, I whiled the time away by catching cave crickets, till Tom and Barton came with twenty lamps and a supply of red fire and bengolas.

Carefully descending the treacherous ladder, which has since been replaced by a substantial stairway, we lighted up the huge dome, by burning magnesium at three points at once, and estimated its dimensions to be about 400 feet in length, 150 feet in width, and varying from 80 to 250 feet in height. The floor slopes down to a pool that receives a waterfall from the summit of the dome. The walls are curtained by alabaster drapery in vertical folds, varying in size from a pipe-stem to a saw-log, and decorated by heavy fringes at intervals of about twenty feet. A huge gateway at the farther end of the hall, opens into a room so like the ruins of Luxor and Karnak, that we named it the Egyptian Temple. The floor here is paved with stalagmitic blocks, stained by red and black oxides into a kind of mosaic. Six colossal columns, 80 feet from base to capital, and 25 feet in diameter, stand in a semi-circle, flanked by pyramidal towers. The material of the shafts is gray oolite, fluted by deep furrows, with sharp ridges between; the whole column being veneered with yellow stalagmite, rich as jasper, and covered by tracery as elaborate as Chinese carving. The capitals are projecting slabs of limestone, and the bases are garnished by mushroom-shaped stalagmites. The largest of them is Caliban's Cushion. By an opening behind the third column in the row, we clambered down a steep de-

scent into gloomy catacombs beneath, which we did not fully explore for lack of time. Tom pointed out to us, on our way back to the terrace, an opening overhead, and assured us that it was identical with the Crevice Pit in the branch of Andubon's Avenue, known as the Little Bat Room.



THE EGYPTIAN TEMPLE.

In old times the miners, in searching for the best beds of saltpeter-earth, had the notion that there must be a very rich deposit in the Crevice Pit, and one of them, in examining it, dropped his lamp. He climbed down into the ugly black hole, and tried to get his lamp again by feeling around with a stick. Suddenly the stick fell rattling down an abyss. A sprightly young negro volunteered to be let down at the end of a rope, as a sort of animated plummet, to sound the depth of the pit. The story he told, on being drawn up again, was so wonderful that nobody believed him, of a spacious and splendid room, far larger than the Rotunda. When Mr. Edmund F. Lee, a civil engineer of Cincinnati, made his survey of Mammoth Cave, in 1835, he tied a stone to a string and "struck bottom at 280 feet." As the real distance is less than 100 feet, the probability is that he paid out the rope after the stone rested; or else that the stone rolled down toward the pool below, and was then drawn up and the whole length of cord taken as telling the depth.

One of the guides named John Buford, while accompa-

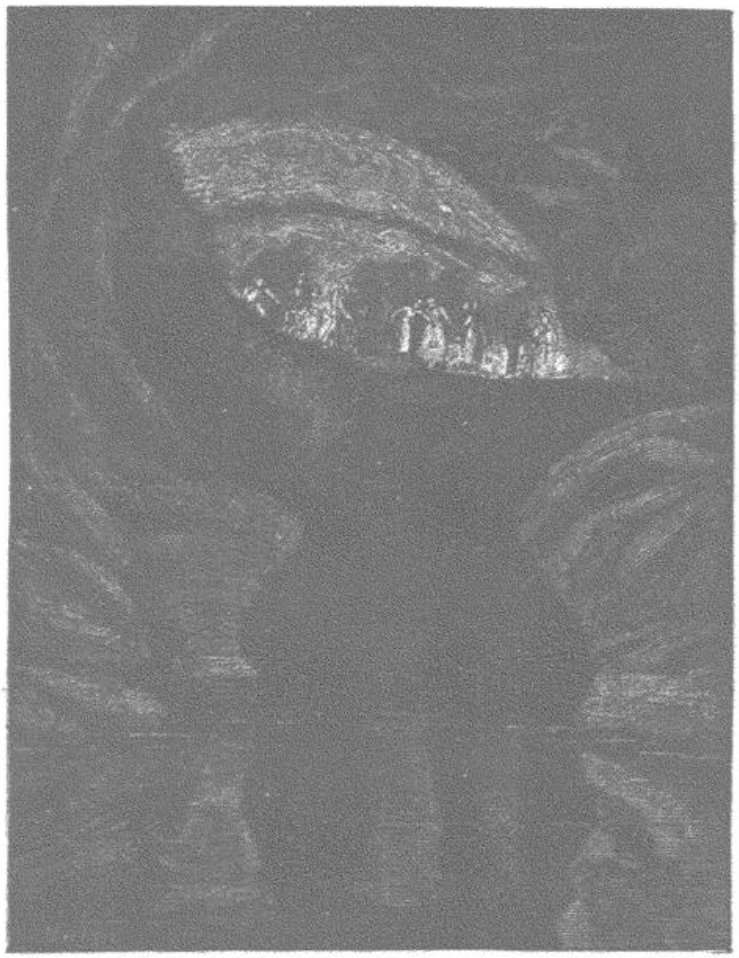
nying a certain visitor named Smith, in 1843, discovered the entrance through Sparks' Avenue, to the immense room that was named, in honor of the explorer, "Smith's Mammoth Dome." On a subsequent visit, one of the guides—I think it was old Mat—found the miner's lamp lying on the floor where it had fallen thirty years before.

It was time to return, if we were to carry out our original plan. On the way, Tom called our attention to certain signs on the walls, by means of which the guides could tell their way, if they were at any time in doubt. Each guide has his own mark, and it is said that many a time, when one of the later ones has congratulated himself on a new discovery, he has been chagrined by finding Stephen's or Mat's sign on the wall, showing a previous visit.

On entering River Hall, we followed a path skirting the edge of cliffs sixty feet high and one hundred feet long, embracing the sullen waters to which the name of Dead Sea is given. Descending a flight of steps, we came to a cascade, but a little further on, by some conjectured to be a reappearance of the waterfall at the entrance of the cave. It precipitates itself into a funnel-shaped hollow in a massive mud-bank. On another visit, in 1881, we found a natural bed of mushrooms growing here, a species of Agaricus, that has suggested the idea of a mushroom farm, similar to those at Frèpilon and Méry, in France, whence many thousands of bushels are sent to market annually.

Our various speculations were broken in upon by the hilarious sounds heralding the party under Mat's escort, long before they came in view. There never was a prettier sight than this merry company, sixty in all, as with flashing lamps and spangled costumes they skirted the somber terrace, astonishing the gnomes by "Litoria," and other jolly college songs. They wound past us, in single file, disappearing behind a wall of stone to come into view again on the natural bridge, whence they swung their lamps to catch sight of the River Stix, on whose banks we now were standing.

The estimated length of the Styx is 400 feet, and its breadth about 40 feet. It was formerly crossed by boat, before the discovery of the natural bridge, whence Mat's party are hailing us with invitations to join their number and go on.



CROSSING THE STYX.

Lake Lethe comes next—a body of water about as large as the Styx, and, like it, once crossed only by boat. It is now lower than formerly, being slowly filled with mud, and a narrow path runs along its margin, at the foot of cliffs 90 feet high, leading to a pontoon at the neck of the lake. Crossing this, we step upon a beach of the finest yellow sand. This is the Great Walk, extending to Echo river, a distance of 500 yards, under a lofty ceiling mottled

with white and black limestones, like snow-clouds drifting in a wintry sky. A rise of only five feet would completely cover this sandy walk, and this is its condition for from four to eight months in every year. The streams are usually low in summer, when there are also the most visitors—a fortunate coincidence.

The connection of the cave rivers with Green river has been demonstrated by the simple experiment of throwing chaff upon them, which comes to the surface in the upper and lower big springs; deep, bubbling pools, lying half a mile apart, under cliffs bristling with hemlock and pine. When these pools are submerged by a freshet in Green river, the streams in the cave are united into a continuous body of water. The rise is augmented by the torrents emptied down through the sink-holes, and sometimes is so great as to touch the iron railing above the Dead Sea.

The subsidence of so vast a body of water, although for some reason less rapid than of streams without, must be with powerful suction causing eddies and whirlpools. In order to save from destruction, at such times, the uncouth little fleet, built of planks and timbers, every piece of which was brought in through passes we had traversed with difficulty empty-handed, the boats are securely fastened, when not in use, by long ropes of twisted grapevines that let them swim with the flood.

The first persons that ever crossed the rivers were Stephen, the guide, with Mr. John Craig, of Philadelphia, and Mr. Brice Patton, a teacher in the Blind Asylum at Louisville. A number of blind men and women have, at different times, visited Mammoth Cave. Mat piloted four in one party in 1880. They took only the Short Route. They seemed much interested, and talked about what they had *seen*, and said that every thing was very fine!

Four boats now await us on the banks of Echo river. Each has seats on the gunwales for twenty passengers, while the guide stands in the bow and propels the primitive craft by a long paddle, or by grasping projecting rocks. There is hardly a perceptible current at any season when the stream can be crossed at all; hence the inac-

curacy of pictures that represent the river as boisterous, and frantic oarsmen striving with might and main to keep the boat from shipwreck. And as the only gale in the entire cavern is that which blows *out* of its mouth, there is equal impropriety in a striking picture I have seen of *sail*-boats on this unruffled tide!

The low arch, only three or four feet high, under which we go at embarkation, soon rises to a height varying from ten to thirty feet, while the plummet shows a still greater depth below. The surface at low water is by the barometer but 20 feet above the level of Green river; and this may, therefore be regarded as the lowest part of the cave, at least so far as it is accessible to visitors.*

The width of Echo River varies from 20 to 200 feet, and its length is said to be about three quarters of a mile. Throughout its entire extent there are only one or two points where a landing could be made, and the stream can not properly be said to have any shore. Hence the guides exercise the strictest authority, in order to guard against accidents.

Tom secures for our exclusive use a boat smaller than those into which the others crowd. He then draws from a hiding-place a hand-net, and tries to catch for us a few of the famous eyeless fish, that dart to and fro, but vanish on the least agitation of the waters. His success at this time was not very encouraging. But subsequently, on other trips, we captured numerous specimens, from two to six inches long, and usually destitute even of rudimentary organs of vision. Several, however, had protuberances or sightless eyes, and one had good eye-sight. The gradations of color are from olive-brown to pure white; while some are perfectly transparent. They have simple cartilage instead of bones, and are destitute of scales. They are known to be viviparous, the young being born in October, and without external eyes when born. There are also blind and white crawfish, that are oviparous, as is proved by a fine specimen now in my cabinet, which still

*One authority makes the river 240 feet below the mouth of the cave, by barometric measurement. Others make it but 174 feet.

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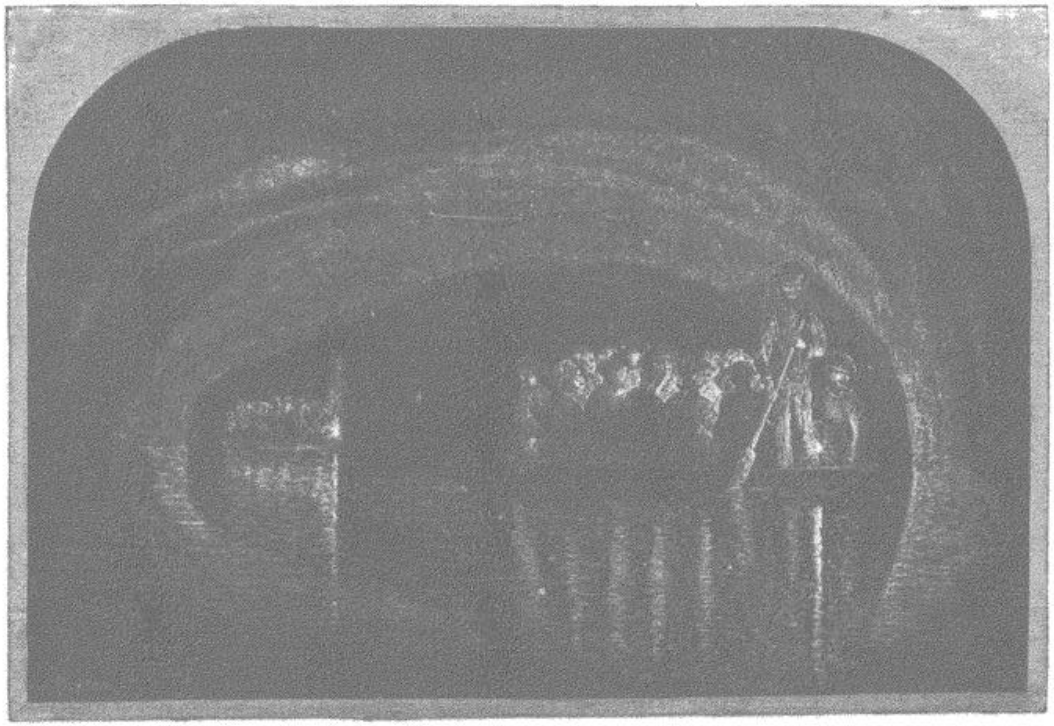

BOAT RIDE ON ECHO RIVER.

carries its cluster of salmon-colored eggs. The Cambarus and Amblyopsis have a wide distribution; being found in many other caves, and also in certain deep wells, both in Kentucky and in Indiana. These, as well as other true subterranean fauna, may be regarded as chiefly of Pleistocene origin; yet certain forms are supposed to be remnants of Tertiary, and possibly of Cretaceous life. The strongly marked divergence of cave-animals from those found outside, convinced the elder Agassiz that they were especially created for the limits within which they dwell. But it is doubtful if there is more variability than can be accounted for by their migration, many generations ago, from the outer world to a realm of absolute silence and perpetual darkness.

Along the water's edge are cavities, from a few inches to many feet in depth, washed out by the stream. These gave a wag along with the jolly Nashville party an opportunity to break the silence that had settled over the voyagers, and he shouted with absurd glee, pointing to the cavities:

"Oh, see these little bits o' caves—three for five cents!"

The solemn echoes caught his silly tones, and bore them, as if in derision, hither and thither and far away. When the peals of laughter that followed had died away, a quiet lady in black velvet led the company in sacred song. The concord of sweet sounds was surprisingly agreeable.

Allowing the Nashville party to go on without us, we remained alone on Echo river, floating over its strangely transparent water, as if gliding through the air, and trying every echo its arches were capable of producing. A single aerial vibration given with energy, as by a pistol-shot, rebounded from rock to rock. The din awakened by discordant sounds was frightful. On the other hand when the voice gave the tones of a full chord *seriatim*, they came back in a sweeping *arpeggio*. Flute-music produced charming reverberations; and the cornet still finer effects. It should be explained that this symmetrical passage-way does not give back a distinct *echo*, as the term is commonly used, but a harmonious prolongation of sound for from 10

to 30 seconds after the original impulse. The long vault has a certain key-note of its own, which, when firmly struck, excites harmonics including tones of incredible depth and sweetness, reminding me of the profound undertone one hears in the music of Niagara Falls.

An extraordinary result was obtained by the guide's agitating the water vigorously with his broad paddle, and then seating himself in silence by my side. The first sound that broke the stillness was like the tinkling of silver bells. Larger and heavier bells then seemed to take up the melody, as the waves sought out the cavities in the rock. And then it appeared as if all chimes of all cathedrals had conspired to raise a tempest of sweet sounds. They then died away to utter silence. We still sat in expectation. Lo, as if from some deep recess that had been hitherto forgotten, came a tone tender and profound; after which, like gentle memories, were re-awakened all the mellow sounds that had gone before, until River Hall rang again. Those who try their own voices are pleased to have the hollow wall give back shout and song, whimsical cry and merry peal; but the nymphs reserve their choicest harmonies for those who are willing to listen in silence to the voice of many waters.

A rocky inlet receives our craft, and as we land we are greeted by the melody of a cascade that breaks itself into pearls on the sloping ledges. An avenue extends from Cascade Hall to Roaring river—a succession of shallow ripples and deep basins, navigated by a canoe. The passage-way through which it flows has an echo of remarkable power, but hoarse rather than musical.

We overtake Mat's party in Silliman's Avenue, where the irregular floor, rugged walls finished by a well marked cornice, and sides pierced by cavities, show that we are now in a portion of recent formation as compared with the Main Cave. Among points of interest in this long avenue, may be mentioned the Dripping Spring, around which are grouped the first stalactites we have seen since entering River Hall. The scarcity of these ornaments in a cave so large as this has often excited remark. The explanation

probably is, that the massive limestone from which it is excavated is almost completely covered by a bed of sandstone, through which the water makes its way, not by percolation, but through fissures and sink-holes. Hence the present dryness of large portions of the cave, and their lack of stalactites. The Infernal Region is the odious name given to a miserably wet and disagreeable spot beyond the Spring, and it does not surprise us to have Serpent Hall come next, where the guide points out the trail of the reptile on the wall overhead. Here also is the inner terminus of the New Discovery that leads by a dry path back to the Main Cave. In a side-cut called the Valley Way, we find white masses of fibrous gypsum. Beyond the Hill of Fatigue stands the Great Western, like the stern of an immense ship, with its rudder to the starboard. We mount to a slender ledge between the Vale of Flowers and Rabbit-rock, and follow Rhoda's Arcade for 500 yards, amid rare incrustations, to twin-domes, seldom visited because so difficult of access. The one we enter is about 60 feet in diameter, and opens into the other by a gothic window 150 feet above the floor. The guide climbs up to it, and burns magnesium, while we do the same below. Thus we are enabled to survey the long stalagmitic curtains that drape the sides, aud to catch a glimpse of the oval apex, 300 feet over us. This is Lucy's Dome—the loftiest natural dome yet discovered!

Silliman's Avenue (named for Prof. Silliman, of Yale College), ends in Ole Bull's Concert Hall, where the renowned violinist once gave a musical entertainment.

Continuing our journey by a picturesque pass, known as El Ghor, we have successively brought to notice, the Fly Chamber, whose walls are singularly sprinkled with little crystals of black gypsum; Suicide Rock, so-called "because it hung itself;" Table Rock or the Sheep-shelter; the Crown, and other curiosities. Corinna's Dome, 9 feet wide and 40 high, rests directly over El Ghor; the Black Hole of Calcutta, is an ugly pit on the left of the pass; while a narrow avenue further on leads to Stella's Dome,

250 feet high, and said to be very fine, though rarely visited.

El Ghor may be followed half a mile further, and is said to communicate with Mystic River—on what authority I do not know, for none of the guides could give information concerning it. We leave the gorge at a small basin called Hebe's Spring, by climbing by a ladder up 20 feet, and going, one at a time, through a very uninviting hole in the roof; and thus we gain admittance to an upper tier of caverns. When the last man is through, Tom burns blue fire, and we are surprised to find ourselves in a vineyard—the famous Mary's (or Martha's) Vineyard! Countless nodules and globules simulate clusters on clusters of luscious grapes, burdening hundreds of boughs and gleaming with party-colored tints through the dripping dew. No covetous hand is permitted to gather this marvelous vintage. By a detour one may reach a natural chapel, named by an enraptured priest, the Holy Sepulcher; there are fine stalactites also in the vicinity.

Leaving this enchanted ground we soon enter Washington Hall, which is but a smoke-stained lunch-room, strewn with relics of hundreds of dining-parties, while along its walls are the sharp fragments of numberless bottles that have survived their usefulness. We find that servants from the hotel have anticipated our coming, and have spread for us an abundant meal. Vigorous exercise whets the appetite, and we leave but few remnants for the rats. Cans of oil are kept here, and while we dine the guides trim and fill the lamps.

The ceiling of the next room is dotted with hemispherical masses of snowy gypsum, each of which is from 2 to 10 inches in diameter, looking like snow-balls hurled against the wall and sticking there.

A charming special trip is from this point down Marion Avenue, said to be a mile and a half long. It is from 20 to 60 feet wide, has a clean, sandy floor, and a clouded ceiling. At its farther end it has two branches. That on the left leads to Zoe's Grotto. The other branch leads to

Dinner in the Shade.

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a Paradise where all the flowers are fair and crystalline, and which, in the opinion of some of the guides, is the most beautiful place in the whole cave. Portia's Parterre is of the same general description; while Digby's Dome is remarkable simply because it cuts through to the sandstone.

The regular route takes us, however, next into that treasure-house of alabaster brilliants known as Cleveland's Cabinet. What words can picture forth its beauty? Imagine symmetrical arches, of 50 feet span, where the fancy is at once enlivened and bewildered by a mimickry of every flower that grows in the garden, forest, or prairie, from the modest daisy to the flaunting helianthus.

Select, for examination, a single one of these cave flowers—the "oulopholites" of the mineralogist. Consider the charms of this queenly rose that has unfolded its petals in Mary's Bower. From a central stem gracefully curl countless crystals, fibrous and pellucid; each tiny crystal is in itself a study; each fascicle of curved prisms is wonderful; and the whole blossom is a miracle of beauty.

Now multiply this mimic flower from one to a hundred, a thousand, a myriad. Move down the dazzling vista, as if in a dream of Elysium—not for a few yards, or rods, but for one or two miles! All is virgin white, except here and there a little patch of gray limestone, or a spot bronzed by some metallic stain, or again, as we purposely vary the lovely monotony by burning colored lights. Midway is a great floral cross overhead, formed by the natural grouping of stone rosettes. Floral clusters, bouquets, wreaths, garlands, embellish nearly every foot of the ceiling and walls; and the very soil sparkles with trodden jewels. The pendulous fringes of the night-blooming cereus are rivaled by the snowy plumes that float from rifts and crevices, forever safe from the withering glare of day-light. Clumps of lilies, pale pansies, blanched tulips, drooping fuchsias, sprays of asters, spikes of tube-roses, wax-leaved magnolias,—but why exhaust the botanical catalogue? The fancy finds every gem of the green-house and parterre in this crystalline conservatory. Earlier visitors have described long sprays, like stalks of celery, run-

ning vines, and branches of a chandelier, and I had not believed them. But when I told my doubts to good old Mat, he kindly took me to a spot where they were still to be seen—in Charlotte's Grotto. It has been impossible to guard all these exquisite formations from covetous fingers, and too many have been smoked by the lamps of careless visitors. But happily the subtle forces of nature are at work to mend what man has marred, and to replace by fresh creations what has gone to the mineralogist's cabinet or the amateur's *étagère.*

Cleveland's Cabinet terminates at the base of a pile of fragments fallen from the roof, and dignified by the name of the Rocky Mountains. Its height does not exceed 100 feet, and the gorge the other side of it, the Dismal Hollow, is only about 70 feet deep.

The cave here divides into three branches. That on the right leads a long distance, and ends in Sandstone Dome, the roof of which, judging from its material, can not be far below the surface. The middle branch is named Franklin Avenue, from 30 to 60 feet wide, and about a quarter of a mile long. The path is very uneven and wild. It leads to a circular canopy 12 feet in diameter, called Serena's Arbor, thus described by a clerical writer in the New York Observer: "It is, of itself, floor, sides, roof, and ornaments, one perfect, seamless, stalactite, of a beautiful hue and exquisite workmanship. Folds or blades of stalactitic matter hang like drapery around the sides, reaching half way down to the floor; and opposite the door, a canopy of stone projects, elegantly ornamented, as if it were the resting-place of a fairy bride."

Tourists generally are content with taking the left-hand path, which leads them at once to Croghan's Hall, which is the end of the Long Route. This hall is about 60 feet in diameter, and 35 feet high, and contains the finest stalactites in the cave, many of them, however, sadly disfigured. Some of them are translucent and very hard. On the right is the Maelstrom, a pit 20 feet wide, and said to be 175 feet deep. It is due to the memory of a daring youth to tell how Mr. W. C. Prentice, son of the poet and

editor, George D. Prentice, descended this abyss in quest of adventures.

As the guides tell the story, they furnished a rope by which the young hero was lowered, amid fearful and enchanting scenes, then first lighted since creation's morning by the feeble rays of his solitary lamp. Midway he encountered a waterfall, spouting from the wall, into whose sparkling shower he unavoidably swung. Escaping all dangers, he stood at last on the solid rock below. On his way up, he swung himself into a huge niche, whence he roamed through wide and wondrous chambers till checked by rocky barriers. Then returning to the place where he had fastened his rope to a stalactite, he found it disentangled and dangling beyond his reach. Ingeniously twisting the wires of his lamp into a long hook, he caught hold again, and signaled to the guides to draw him up. It is said (believe it who may) that they did this with such zeal that the cable was fired by friction, and that one of the guides crawled out on the beam and emptied a flask of water on the burning rope! The whole story, with all its embellishments, is done into spirited verse by Rev. George Lansing Taylor. The hero himself, whose life was so miraculously spared, finally sacrificed it during the late war. Prentice has had at least one imitator, if not two, who accomplished the descent into the Maelstrom, but without his adventures.

A dog-story worth telling is connected with the last trip I made to the end of the Long Route, in 1881, as it offers some striking peculiarities. Many a dog will bravely follow his master amid tangled forests and lofty hills, that will refuse to go with him into a dark and silent cave.

Jack, the old house-dog at the hotel, is not an exception to this rule; for he has long had the habit of escorting guests as far as the Iron Gate. There he waits till all have gone in, and then trots home again, his duty done. But Jack has had a companion in his old age.

"We call him *Brigham*," explains William, "'cause he's *Young*, you know!"

From the first Brigham seemed to have no fear of dark-

ness. The two dogs would trot side by side, as far as the Iron Gate; but there they would part. Jack would return, as usual, to the hotel; while Brigham would push on into the cave. The latter grew to be a great favorite with the guides; and Manager Klett warned us not to lose him when we took him in with us.

The day that Brigham went with us on the Long Route, he grew very weary, and cared less for the lovely arches of cave flowers than for some cozy nook, where he might curl down for a nap. Soon after lunch in Washington Hall he was missing, and did not come at our repeated calls.

"Perhaps he has gone ahead to Echo river," said I, "and is waiting for us there."

"Like enough," said William, "I had n't thought of that."

But no bounding form or joyful bark welcomed our approach. The echoes answered to our calls, as if a thousand voices were crying for Brigham, as well as we; and our whistling was repeated, as if all the spirits of the cave had been let loose for an Æolian concert.

Plainly the dog was lost! William thought Brigham might track us as far as the river; but that on reaching the water he would lose the scent and not try to swim across. Lighting a freshly filled lamp, he set it on a ledge at the entrance to a passage called Purgatory, by which, with only a little swimming, the dog might make his way around the river.

Sadly we returned to the hotel, where the announcement of the loss caused a sensation. Early the next morning a party crossed Echo river, and there they were met by Brigham, who returned in the boat with them to this side. Shortly, however, he again disappeared, and was left to his fate.

Nothing was seen of him all that day. This time, of deliberate choice, he remained a second night under ground. The next morning Jack, too, was missing, and was found at the Iron Gate, exchanging experiences with Brigham, who was still behind the bars!

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THE CORKSCREW.

Our curiosity led us to examine Brigham's tracks. We found that he had followed our trail, step by step, his only guide, of course, being his sense of smell. Thus he had tracked us, over soft mud-banks and mellow nitrous earth, ridges of sand and heaps of stone, from Echo river to the Corkscrew, by many a spot where a single misstep would have sent the poor lonely creature plunging downward in darkness to inevitable death. On reaching the Corkscrew he did not seem to have hesitated an instant, but climbed up through that intricate and hazardous pass, where most men would be in confusion even with a lamp and a map of the cave. I could not learn that the dog had ever been that way before; and when he went in with us he entered by the way of the Deserted Chambers.

By contrast with this perfect and fearless operation of instinct (which Prof. Brewer cites as a case of "orientation"), the story may be told of Old Mat's escape under somewhat similar circumstances.

Once, during troublous times, Old Mat was at work near the pits when he heard some young men coming with song and with shout, as if they had been taking more wine than was for their good. The ex-slave thought that "discretion was the better part of valor," and hid in a crevice, put his lamp out, and quietly waited for the revelers to pass by. On coming forth from his hiding-place he found that he had no matches, and therefore could not re-light his lamp.

The hour was late, and he feared lest a long time might elapse before help should come; he therefore determined to make his way out in the dark. Feeling cautiously along with his staff, he went safely until it suddenly dropped into a pit of unknown depth. Brave as Mat is known to be, he fell in a swoon, and lay, no one knows how long, on the edge of the chasm. On coming to, he collected his wits as well as he could, and felt with his hands for the path. He presently found it, and proceeded on his perilous journey, making his way finally to the surface. Old Mat told me this story himself, as he and Brig-

ham and I sat on the brink of the very abyss in which he so narrowly escaped finding a tomb.

The full moon was riding in a cloudless sky, when we emerged from our last day's journey in the great cavern. We had, as usual, a practical proof of the purity of the exhilarating cave atmosphere, by its contrast with that of the outer world, which seemed heavy and suffocating. The odors of trees, grass, weeds and flowers were strangely intensified and over-powering. The result of a too sudden transition is frequently faintness and vertigo. The custom is to linger awhile on the threshold, where the outer and inner airs mingle. Resting thus, on rustic seats, near the entrance, my companions and I interchanged our views concerning this wide subterranean realm whose secrets we had been exploring. Tom said we had tramped to and fro, in and out, not less than a hundred miles; and there was none to dispute him! We had gained less definite knowledge than we had anticipated; and had a surfeit of conjectures, estimates and mysteries. We were grateful, however, for the impressions we had received, and for the memories retained of wonderful scenes and strange adventures. Feelings akin to friendship had sprung up within us for Mammoth Cave; and it was with positive regret that we finally turned away from the fern-fringed chasm lying there in the soft moonlight, where the sparkling cascade throws pearly drops from the mossy ridge, and spreads its mist like a silver veil.

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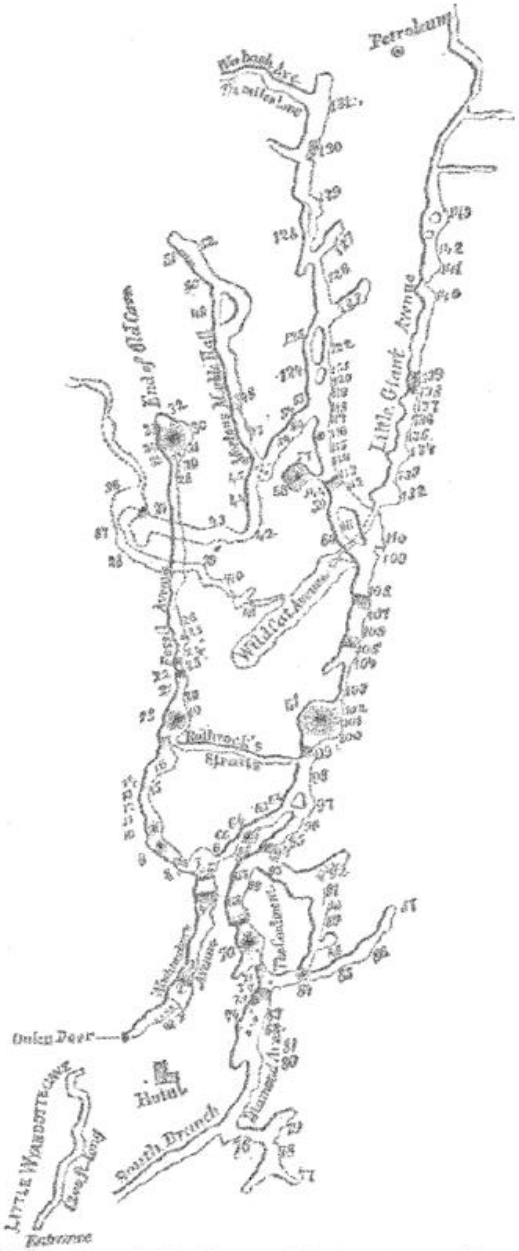


[Reduced from the Sketch prepared for the 10th Annual Report of the Geological Survey of Indiana, by Prof. JOHN COLLETT, A. M.—By permission.]

TABLE OF DISTANCES IN WYANDOT CAVE.

Measured and Estimated by WASH. ROTHROCK, a Guide of Twenty-eight Years' Experience.

	MILES.	MILES.	
Outer Door to Bandits' Hall	0.25		
Bandits' Hall to Pillar of Constitution	1.75		
		2.00	1st Route.
Outer Door to Auger Hole	1.25		
Auger Hole to Junction Room	1.25		
Junction Room to Crawfish Spring	1.00		
Crawfish Spring to end of Wabash Avenue	1.50		
		5.00	2d Route.
Junction Room to Fairy Palace		0.90	
Outer Door to Delta Island	0.50		
Delta Island to the Throne	1.00		
Throne to South Branch	1.00		
		2.50	3d Route.
Lower Division, partly explored, 10 to 7 miles		7.00	
Smaller Avenues		6.50	
Total		23.50	

REFERENCES.

0 Saltpeter Hoppers.
1 Arched Entrance.
2 Faneuil Hall
3 Columbian Arch.
4 Falling Rock.
5 Bats' Lodge.
6 Entrance to New Cave and Fat Man's Misery.
7 Bandits' Hall.
8 Jacob's Ladder.
9 Pigmy Dome.
10 Debris Dome.
11 Continued Arch.
12 The Canopy.
13 Lucifer's Gorge.
14 Natural Bridge.
15 The Stoop.
16 Temple of Honor.
17 Secret Entrance to Rothrock's Straits.
18 Odd Fellows' Hall.
19 Phantom Ship, "Millie."
20 Pharoah's Stairway.
21 Conrad's Hall.
22 The Cliffs.
23 The Pit.
24 Falls of Minnehaha.
25 Dead Fall.
26 Cyclops' Chasm.
27 Dead Sea.
28 Screw Hole.
29 Polished Bowlders—Indian.
30 Senate Chamber.
31 Chair of State.
32 Pluto Ravine.
33 Stallasso Monument.
34 Stillo Mountain.
35 Pillar of the Constitution.
36 Heman's Bower.
37 Hine Cliffs.
38 Lonigan's Pass.
39 Diamond Labyrinth.
40 Emmonecy Arcade.
41 Rode Rock No. 1.
42 Queen Mab's Retreat.
43 Snow Banks.
44 Zoe Grotto.
45 Ice House.
46 Frosted Rock.
47 Snowy Cliffs.
48 Indian Footprints.
49 Beauty's Bower.
50 Queen Mab's Marble Garden.
51 Fairy Palace.
52 Wyandotte Potatoes—Pebbles.
53 The Arm Chair.
54 Lovers' Retreat.
55 Ewing Hall.
56 Frost King's Palace.
57 Bowlder Flints.
58 Milroy Temple.
59 Penelope Grotto.
60 Ulysses' Straits.
61 Rothrock Cathedral.
62 Coons' Council Chamber.
63 The Rotunda.
64 Rugged Mountain.
65 Cut Off.
66 Counterfeiters' Trench.
67 Starry Hall.
68 Wyandotte Grand Council Chamber.
69 The Card Table.
70 Hall of Representatives.
71 Hill of Science.
72 The Alligator.
73 The Mound.
74 The Throne.
75 Gen'l Scott's Reception Room.
76 Ante Room.
77 Hovey Point.
78 The Pit and Selve.
79 The Amphitheater.
80 Rocky Hill.
81 Muddy Fork.
82 Lost Rivulet.
83 Frozen Cascades or Curtains.
84 The Hippopottamus.
85 Fairy Grotto.
86 Neptune Retreat.
87 Hermit Cell.
88 The Sepulcher.
89 Purgatory.
90 Caliope Bower.
91 Palace of the Genii.
92 Pillared Palace.
93 Creeping Avenue.
94 Junction Room.
95 Drawing Room.
96 Dining Room.
97 Delta Island.
98 Sandy Plain, 300 feet long.
99 Hill of Difficulty.
100 Monument Mountain, 135 feet high, over which is Wallace's Grand Dome, 50 feet above top of Mountain, and 185 feet above base of the hill.
101 Sulphur Spring.
102 The Auger Hole.
103 Lilliputian Hall.
104 Spade's Grotto.
105 Slippery Hill.
106 Hall of Ruins.
107 White Cloud Room.
108 Sentinel Office.
109 Bishop's Rostrum or Pulpit.
110 Journal Office.
111 Calypso's or Island No. 2.
112 Cerulean Vault.
113 Rugged Pass.
114 Chapel.
115 Vestry.
116 Josephine's Arcade.
117 The Parsonage.
118 The Junction.
119 The Lone Chamber or Ball Room.
120 Dry Branch.
121 Island of Confusion, or No. 3.
122 Grand View Island, or No. 4.
123 Sandy Branch and Air Torrent.
124 Newhall's Forum.
125 Grosvenor's Avenue.
126 Gothic Chapel.
127 The Gallery.
128 Indian Footprints.
129 The Den.
130 Ship in the Stocks.
131 Crawfish Spring.
132 Maggie's Grotto.
133 Joseph's Pit.
134 Lama's Bower.
135 Marble Rivulet.
136 Marble Hall.
137 Miller's Reach.
138 Andrew's Retreat.
139 Rode Rock No. 2.
140 The Devil's Elbow.
141 The Pit.
142 Langsdale's Basin.
143 Wash. Rothrock's Island.
144 Bourbonot.

CHAPTER XI.

CAVE REGION OF INDIANA—WYANDOT CAVE.

Rock-houses near Madison—Lost River—Hamer's Cave—Donelson's Cave—Shiloh Cave—Trumpet Cave—Blue Spring Cave—Rothrock's Purchase—Survey of Wyandot Cave—Map-making—Artist and Author—Sibert's Cave—Peri's Prison—A Perilous Pass—Geological Section—Frank and the Wolf—Cave Beasts—Outfit—Routes—Size of Wyandot Cave.

THE cave region of Indiana resembles, in general, that of Kentucky, and covers the same geological formations.

For 20 miles north of Madison, nearly every ravine has its rock-houses and water-swept chasms. Occasionally true caverns are found whose roof is the solid limestone of the Upper Silurian, while the excavation itself is in the softer rocks of the Lower. One of these is estimated to be a mile and a half long; though at a point about 1,000 yards from its entrance the roof has fallen in, and the obscure opening, by which access is gained to the ample chambers and winding passages beyond, might readily escape notice. The stream flowing out of this cave runs through the village of Hanover, and then turns capriciously towards the Wabash, from the very banks of the Ohio.

Some of the streams of the region, after receiving tributaries and increasing in volume, suddenly sink into the sand or leap down a gorge and disappear, as

> "Alph, the sacred river, ran
> Through caverns measureless to man,
> Down to a sunless sea."

One such stream is significantly named the Lost River. It is in Orange county, where it sinks and rises five times before finally emerging a mile below Orangeville. These

"rises" are generally marked by gulfs denoting the fall of superincumbent rocks; and at one of them a small boat has been put upon the stream, it having been found to be navigable for a long distance under ground. It is certainly remarkable to see a stream 45 feet wide rise quietly, as if from a great depth, at the bottom of a wild forest ravine. Should Lost River ever find another channel, the cave that would remain might equal in size any hitherto discovered.

The stream flowing from Hamer's Cave, in Lawrence county, turns a mill-wheel 22 feet in diameter. The water fills the floor of the archway so that a boat is needed to make an exploration. After proceeding thus, for perhaps three-quarters of a mile, we reach a place where the whole body of water rushes violently down a passage only 3 feet wide, and with a noisy uproar. Carrying the boat around this fall, we can go on, 300 feet further, to "the grand cascade," beyond which progress is difficult.

Donelson's Cave, in the same county, also discharges a large mill-stream from its wide and lofty mouth. A light canoe is of service in making explorations, although in many places the stream is shallow enough to be waded easily. "Within is a magnificent cascade, where the stream rushes and leaps down a narrow passage with such violence that the rumbling noise is heard at the entrance. This passway is known to extend through Dalton's Spring, three-fourths of a mile to E. S. E. Near the entrance a dry cave is seen opening to the east; directly opposite, a lofty corridor leads to the west, and in less than 100 feet enters a grand hall 12 feet high, 300 feet long, and 40 feet wide." The upper chambers are frequented by bats, and the soil is rich in niter, which supplied a powder mill that formerly stood in the vicinity. Both these caves contain eyeless fish, crawfish, and insects.

Other caverns in Lawrence county are: Connelly's, Grinstaff's, Campbell's, Dry, Buzzard, Shiloh and Blue Spring (see Geol. Survey of Indiana, 1873, pp. 280–310). Nearly all of them contain blind animals, niter-beds, bats, and Indian relics. Of Shiloh Cave, Prof. Collett gives a

glowing description, mentioning lofty halls and black depths, a "natural fountain which pours three jets of pure silvery water, from which a cloud of spray arises," festoons of stalactitic drapery, "giant corrugations," and many varieties of pure and beautiful ornamentation, leading him to say in his enthusiasm, "This cavern far exceeds Mammoth Cave in beauty, and rivals any that I have ever seen, though only one mile has yet been explored." It should be added that the entrance is through a sink-hole, and the tunnel may be followed through to its exit near Salt Creek.

I had the pleasure of exploring several of these caves myself, a few years ago, and was especially interested in one that did not seem to have been named, but that certainly deserved it as well as others that have been admired in print. From a great gate-way, perhaps 80 feet wide, the passage dwindled to a point where we could barely stand erect. This colossal trumpet magnifies the human voice to a deafening volume; and the name of the Trumpet Cave would not be inappropriate. A large swift stream issues from Blue Spring Cave, near Mitchell, whose current at high water is said to sweep completely across the White river into which it empties. It has been explored for about 3 miles, and contains great basins cut down 100 feet into the rock and overflowing with limpid water.

In the summer of 1854, having already explored a score or more of smaller caves, I joined a scientific party to explore the great Wyandot Cavern,* in Crawford county, of whose magnitude and beauty we had seen accounts in Silliman's Journal and other periodicals. Our journey

*The earliest account published was probably that found in Flint's Geography, (1831) pp. 384–5. He calls it "The Epsom Salts Cave."

The first official report of Wyandot Cave was that made by R. T. Brown, M. D., of Crawfordsville, Ind., to his Excellency Gov. J. A. Wright, and published in the Transactions of the Indiana State Agricultural Society, for 1853, pp. 309, 310. Dr. Brown found the temperature of the cave 53 deg. Fah., the number of avenues then known 21, and their combined length 19½ miles, as far as they had been explored.

was on horseback, and led us through a region that was at that time wild and uncultivated, until, after a series of adventures, we reined up in front of the log cabin of Mr. Henry P. Rothrock, the proprietor of the cave and 4,000 acres of land around it. To this gentleman and his sons we are indebted for facts as to the history of their underground territory.

It seems that the original name was "The Indiana Saltpeter Cave," and that a certain Dr. Adams, who had preempted the land, manufactured saltpeter here, from 1812 to 1818, at the same time Gratz and Wilkins were doing so at the Mammoth Cave. When the war with England was over, the demand for the manufacture falling off, Dr. Adams relinquished his claim, and Mr. Rothrock, who had just emigrated from Pennsylvania, bought the property of the U. S. Government in 1820, the same year that Indiana was admitted to the Union. The "Old Cave," as the portion then known is called, to distinguish it from more recent discoveries, had long been an object of local interest, and had been visited by several persons of distinction, among whom were President Harrison and his officers. But there is significance in the peculiar law passed by the legislature in 1843, compelling Mr. Rothrock to fence in his cave to keep his neighbors' cattle from going into it and injuring themselves by licking the Epsom salts that abounded there! The fact is that the cave was such an annoyance to the owners that, although hospitable people, they felt obliged to decline entertaining the guests, who had therefore to find lodgings elsewhere; generally at a Mr. Sibert's. Thus it came to pass that, when a party from Fredonia, Ind., namely, Messrs. O'Bannon, Cummins, and Collingwood, turned up a flat stone 1,000 feet from the entrance, and discovered the New Cave, the news was a long time in reaching those most concerned. Indeed the owners regarded it as a hoax until Mr. Norman J. Coleman* came

*The New Albany *Ledger*, as quoted by the Am. Jour. Sci. and Arts, March, 1851, accredits Mr. Coleman with being the discoverer of the aperture admitting an exploring party into the New Cave. The explanation may be that this gentleman found the "Augur-hole."

and awoke them to a sense of its importance. That was in 1850, and the first discovery did not extend beyond the place now known as Rothrock's Cathedral. A few months later attention was directed to a small orifice through which there came a strong current of air, and it was enlarged from 10 to 22 inches. That was "the Augur-hole," and it admitted the explorers to the northern extension of the new cave.

PLAN OF WYANDOT CAVE.
By H. C. Hovey.

Several different persons had a hand in making a map of Wyandot Cave. The bearings and distances were taken, in 1852. by my lamented friend, Mr. H. C. Grosvenor, of Cincinnati, who afterwards was killed by the Indians in Arizona. The notes of his survey are in my possession, and also his report read before the Jefferson Historical Society of Virginia, and published in their proceedings. Another survey was made, in 1853, by D. L. Talbot, M. D., of Jeffersonville, Ind. At Mr. Rothrock's request, in 1854, I revised Talbot's map, using the notes of Grosvenor; and this revised map, a curiosity in its way, is still extant. Mr. G. I. Langsdale laid down some later discoveries, and the map thus jointly constructed, was finally published in 1860, in Owen's "Geological Reconnoissance of Indiana."

I may add, concerning the explorations made by our party, in 1854, that most of us wielded the pen, and reported the wonders that we saw, the writer's description of them appearing in the New York *Tribune*, and the Indianap-

olis *Journal.* The first visit was so delightful that it was followed by others. The last of these was in company with Barton, the artist, in 1878, for the purpose of obtaining sketches of remarkable views to illustrate a descriptive article to appear in *Scribner's Magazine.* Subsequent to the acceptance of said article, including the map that went with it, but before its actual publication, Prof. Collett's report of the Geological Survey of Indiana for 1878, was issued, describing the geological peculiarities, scenery, traditions, and animal life of Wyandot Cave, together with a new and beautiful map drawn from a totally new survey under his own direction.

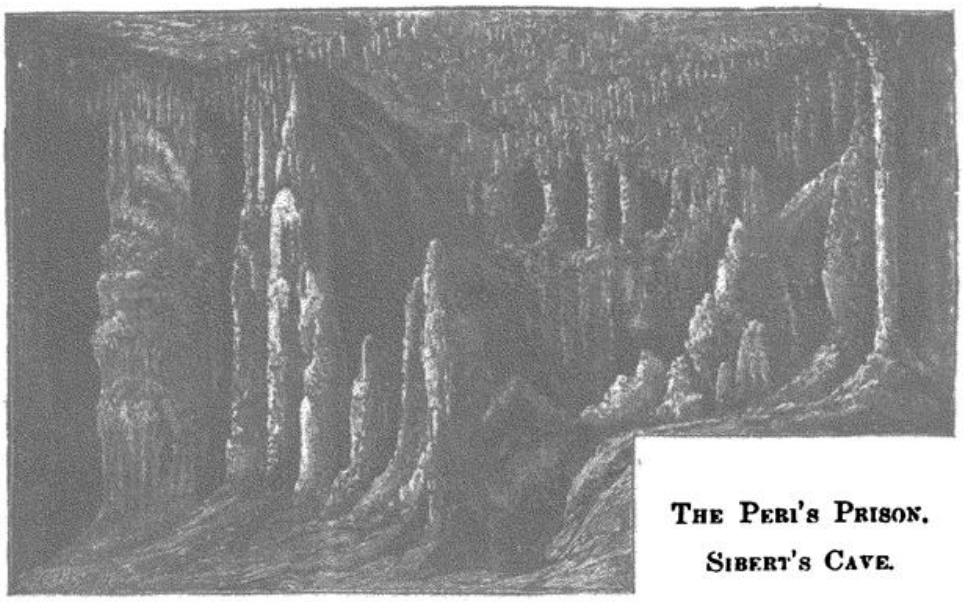
Barton and I left Louisville on one of the fine steamboats that ply between that city and Evansville, and landed, after a trip of sixty miles, at Leavenworth, whence we were taken by hack to the Rothrock farm, five miles from the Ohio river. We found a comfortable inn in place of the old-time log cabin, and Mr. H. W. Rothrock in place of his father, who had passed away, leaving the cave to this son, in trust for his grandson, Frank. Thus the property is entailed, somewhat as is the case with Mammoth Cave.

From the door of the hotel are well-worn paths leading to two caves that were probably once connected. The main cavern is the far-famed Wyandot, and the smaller one, only about 2,000 feet long, is Sibert's Cave, or, as it is often called, the Little Wyandot. We concluded to pay our first visit to the latter.

SIBERT'S CAVE.

A narrow path, along a ridge shaded by oaks and beeches, led us to a sink, at the bottom of which was a shaft. Descending into this by a ladder, we picked our way through a narrow passage, obstructed by Pompey's Pillar, and entered Cleopatra's Palace, where there are hundreds of fine stalactites. Beyond this room there are two pits, flooded, it is said, in the winter, and about 60 feet deep. On the rounded, slippery wall between them, and apparently but a foot or two thick, we creep along,

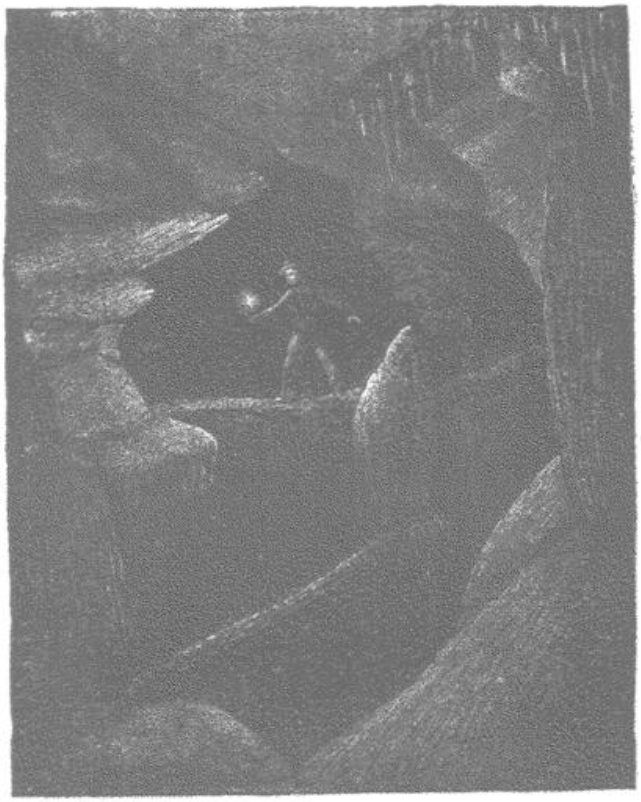
conscious that a misstep would be fatal. Midway we clamber over a smooth, wet stalagmite. On leaving this natural bridge we follow a slender ledge that skirts the left-hand pit. Next we squeeze past a ponderous stalactite that has fallen and lodged against another. The level gallery above can only be gained by laboriously climbing up a treacherous slope. As this offers nothing to be grasped as a safeguard against sliding into the abyss, nicks have been cut to afford foot-hold in the precarious passage. The risk is compensated for by admission into



THE PERI'S PRISON.
SIBERT'S CAVE.

a wilderness of beauty and grandeur. A stately pillar guards the way, ten feet thick and as many high, and its base expands in huge masses of dripstone overlapping the edge of the pit. Nestling by its side, as if for protection, equal in height, but only three inches in diameter, rises a slender shaft of semi-transparent, snow-white alabaster. The floor beyond is strewn with stalagmitic nodules and cones, and occasionally a prostrate column. One of these once bore the name of the Pillar of Thunder, because, when struck by the open palm, it emitted a loud musical sound, but the last blow detached it from its pedestal, and now it thunders no more. We wander on, beneath a ceiling fretted with glistening pen-

dants, amid pillars and pilasters, flying-buttresses and interlacing arches, with here a cascade in mid-air transmuted into stone, and there a sculptered cell amid clus-



A Perilous Pass.—Sibert's Cave.

tered columns. This gallery of marvels ends in the Peri's Prison, an exquisite grot, not more than five feet deep, crossed by a row of pillarets, like the bars of a cage. Red-fire burned within this dainty cavity produces a magical effect, throwing roseate hues over the fantastic and snowy piles.

Slowly returning to the pit, we find it more gloomy than ever. But there is no other exit. Steadying myself for a moment on the brink, I turn face downward and search with the right foot for the first little notch, barely big enough for the toe of my boot. Then, letting go the ledge above, I cling to the naked rock with one hand, the other holding the torch, and cautiously lower my left foot to the next notch. Step by step the narrow shelf is gained,

beyond which, balancing like an acrobat, I move along on the perilous ridge between the chasms to a place of safety. Looking back to see how it fares with my artistic comrade, I behold him coolly sketching my underground gymnastics!

Every lover of the beautiful, who can do so, should by all means visit Sibert's Cave; for it certainly excels any other display of stalactitic grouping in this country, with the single exception of what may be seen in Luray Cavern, in Virginia. Perilous as the path through its fairy-like scenes may seem, no accident has ever happened there; and even ladies, in a few instances, have conquered their fears sufficiently to cross the narrow bridge and climb to the lovely gallery beyond the frightful chasms.

It will be well to take a survey of the region immediately around Wyandot Cave before beginning our exploration of the interior. According to Collett's observations, the Cave House is "situated on a commanding eminence, 573 feet above tide water, 270 above low water in the Ohio river, and 220 above Blue river," across whose narrow valley "Greenbriar mountain, with sharp conical peak and steep faces belted with massive rings of rock, variegated with evergreen cedars, affords a scene of quiet, stately beauty. The mountain is capped with Chester rocks, and in the background knobs are seen reaching from 200 to 250 feet higher than the hotel."

From the same authority we may quote the following geological

SECTION AT WYANDOT CAVE.

Slope and Loess	20	feet.
Buff sandstone with fossil plants	75	"
Gray limestone with *Archimedes*, etc	6	"
Brown limestone and shale	40	"
Gray limestone and shale	50	"
Lithographic bands	34	"
White oolitic St. Louis limestone	4	"
Gray, cherty, encrinital limestone	220	"
Blue river		"
Total	449	"

The scientific reader may also be interested to know that Prof. E. T. Cox has analyzed samples of the various earths, water, and bat guano found in Wyandot Cave. (See Geol. Sur. Ind., 1878, pp. 162–4.)

Frank, whom Barton styles "the heir apparent," had for his playmate a tame wolf, at the time of our visit; and this led us to inquire of his father if any wild beasts were ever known to make the cave their resort. He assured us that none were to be seen in summer, though in winter a few wild cats, raccoons, opossums, foxes and wolves, had been known, at one time and another, to take refuge there. He claimed to have proof that bears had formerly frequented this cave, and promised to show us their wallows and places where they had amused themselves by sliding down hill on their haunches, till the rocks were blackened and polished by their fur.

Preparation for a trip through Wyandot Cave consists chiefly in donning a suit of old clothes and a pair of stout shoes. Ladies will find a gymnastic dress convenient, as there are cliffs to climb and holes to crawl through. The guides carry a supply of candles and a few bengal lights; but it is well to take along, as we did, a roll of magnesium ribbon, and materials for red and blue fires. There are 23 miles to be traversed in order to see the entire cavern, and 144 places are named as noteworthy in Mr. Rothrock's "Table of Distances;" and therefore the visitor is advised not to hurry through this succession of wonders. Three distinct routes are marked; the first 2 miles, the second 5 miles, and the third 2½ miles long, *one way*; and the distance traveled is, of course, nearly double these figures. Then there are special trips that will interest one who has leisure to make them. Hence it is well to plan for at least two days' stay at the cave; although a resolute pedestrian can see much in a single day.

CHAPTER X.

WYANDOT CAVE—*Continued.*

Entrance—Temperature—Saltpeter Works—Wyandot Indians—Bandits' Hall—Old Cave—Jacob's Ladder—Senate Chamber—Pillar of the Constitution—Rate of Stalagmitic Growth—An Alabaster Mine—Ancient Pounders—Bat's Lodge—New Cave—Counterfeiter's Trench—South Arm—Indian Relics—Creeping Avenue—Pillared Pallace—More Pounders—"Bear Wallows"—Flint Mines—Around the Continent—The Alligator—The Throne—Diamond Avenue—Helen's Dome—Hovey's Point—A Grand Council-Room—Wolf's Lair—Northern Arm—Rothrock's Straits—Bear Slides—Rothrock's Cathedral—Transformation Scenes—Augur Hole—Slippery Hill—Eyeless Crawfish—Wabash Avenue—Frost King's Palace—Snowy Cliffs—Marble Hall—Oulopholites—Worm Alley—Milroy's Temple—Chaos and Paradise.

As we drew near the entrance to Wyandot Cave, the next morning, the artist espied an inscription over the arch, and repeated in the Italian Dante's

"Abandon hope who enter here."

Imagine his chagrin at finding it but an advertisement of some sort of "magic oil," instead of the famous line from the Divine Comedy! Before plunging into darkness, we took a farewell survey of the upper world, bright in the brave sunshine. We stood on a platform about 200 feet above Blue river, visible near the picturesque old mill half a mile away. Around us the primeval forest lifted its aged arms overhung with matted vines. The rocky ridge rose above us, and the mouth of the cavern yawned at our feet. This was 4 feet high by 7 broad, when first found; but has been enlarged to a width of 20 feet and a height of 6 feet. The current of air flowing outward, though less strong than we had observed at Mammoth Cave, compelled us to guard our lamps, and as we entered the mercury in the thermometer fell at once from 80° Fah. to 60°,

and further in to 54°. A series of careful observations was made, showing that, while in a few localities the mercury rose to higher markings, the temperature of all the large rooms, without exception, was uniformly 54°; thus being identical with that of Mammoth and Luray. Rothrock informs me that the temperature is the same in winter as in summer, and that the breeze is into, instead of out of the cave, when the outer air is colder than that within.

As we pass through the vestibule our attention is directed to several barrels of epsom salts and saltpeter, showing what can be done in that line of manufacture from the nitrous and magnesian earths of the cave; and there is no doubt that the works were once important and extensive. In this outer room arrangements are made for seats, should they be required for any kind of public gathering. At the farther end of it is what is known as "the outer door" in distinction from another within.

The breeze dies away as we go by a rapid descent through Washington Avenue; but, however deep we may go into the earth, we shall experience every-where the benefits of thorough ventilation, and the mild exhilaration of an atmosphere wholly cleansed from noxious gases and surcharged with the vital elements.

And now gigantic forms loom through the darkness. Here is a fallen rock, fifty feet from the roof where once it had a place, and the edges of the immense block are as fresh and sharp as if it had been dislodged but yesterday, instead of ages ago. Overhead is a shadowy outline that is called the Wyandot Chief, and it naturally awakens discussion as to the history of the tribe of Indians whose name has been attached to this great cavern.

The original hunting-grounds of the Wyandots (or Wyandottes, as the name is often written), was along the St. Lawrence river. Subsequently they removed to the shores of Lake Huron, where they had the name of Hurons. Still later they lived near Detroit, where the village of Wyandotte is their memorial. Thence they removed to the portion of Ohio now known as Wyandotte county. I have not been able to learn how their poetic name came to

belong to the cave we are exploring, except that it was formerly attached to what is now called Blue river, and a Mr. Wallace transferred it to this cave. Some of the tribe, in their wanderings, may have roamed through this part of Indiana. The major portion of the tribe was removed from Ohio to the mouth of the Kansas river, where I once had the pleasure of seeing and conversing with a genuine Wyandot chief, who, as I regret to say, had not the slightest resemblance to the figure on the wall that started us on this digression. The remnant of the Wyandots, again leaving their name to be perpetuated in the flourishing city of Wyandot, Kansas, were finally removed to the Indian Territory, where they may be found to-day. It may be added for the benefit of those who disagree as to the spelling of their name, that they themselves spell it "Wundat" and pronounce it accordingly.

There is a gradual declivity from the Fallen Rock to the second door that closes the entrance to the so-called New Cave. By Grosvenor's measurement, this point is 118 feet lower than the mouth, and 113 below the continuation of the Old Cave. The distance from the outer to the inner door is 1,000 feet. The grandeur of the Bandits' Hall is frequently lost on visitors who are in a hurry to explore more remote regions underground. Light it up by fire works, and how finely the ruddy glow brings the rugged rocks into bold relief from the deep shadows beyond, reminding one of Miller's lines:

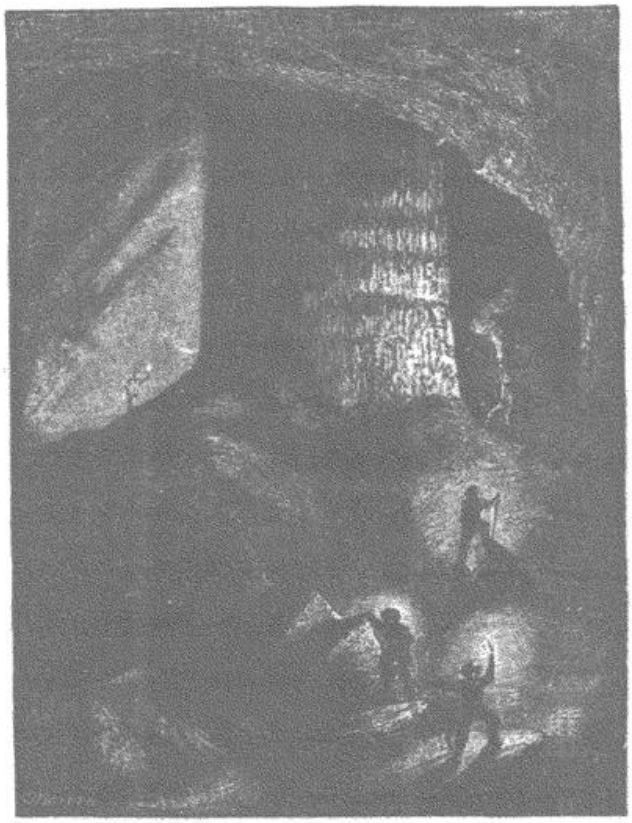
> "Down in a cañon so cleft asunder
> By saber-stroke in the young world's prime,
> It looked as broken by bolts of thunder
> And burst asunder and rent and riven
> By earthquakes driven, the turbulent time
> A red cross lifted red hands to heaven."

Thus far the three routes have a common beginning. We decide to see the Old Cave first, leaving the newly-discovered portion till another time. Climbing up through the sulphurous wreaths of smoke, and turning from the rocks still red with their outlines of fire, we mount Jacob's Ladder, steps that have stood there since 1812, and find the cave curving to the N. W. and then back to the

N. N. E., which is its general direction throughout. The height is very irregular, varying from 3 feet to 60 or 70; and the windings from right to left, and the undulations up and down, are such as to make you feel as if you were climbing a spiral staircase. As we pass along, Rothrock calls out the names of the different places, and gives us their dimensions. The most noteworthy are the Continued Arch, a tunnel 600 feet long; Lucifer's Gorge, 40 feet deep; the Odd Fellow's Hall, 210 feet long, 100 across, and 80 high, "the walls built up of massive ledges, thinning toward the top, and thus, by perspective, exaggerating the dim height." Near this hall is the western entrance to Rothrock's Straits, a narrow passage leading into the New Cave, where we shall see it again. Conrad's Hall is 200 feet long, 25 wide, and 20 high. The path leads on under cliffs and beside pits and chasms. A fine fringe of stalactities used to be the Giant's Epaulette, but has been re-named the Falls of Minnehaha. In Fossil Avenue one can study the corals and crinoids characteristic of the St. Louis Limestone. The top of the highest rock in this avenue is said to be only 10 feet below the hotel. The warm air from lamps, fireworks, etc., rises to this place and brings the mercury up to 66° Fahr.

At length, about two miles from the entrance, we twist ourselves through the Screw-hole, in doing which a complete revolution is necessary, and then stand literally breathless in a vast amphitheater, formerly called "The Circle of the Union," but now known as the Senate Chamber. In the center of this hall, "estimated to be 600 feet long and 150 wide," rises a rocky pile crowned by an incredibly ponderous mass of snowy alabaster. Chief marvel in all this temple of wonders is the Pillar of the Constitution, about 40 feet high, 75 feet in periphery, and with an enormous base, whose girth is over 300 feet! This differs from other pillars with which it has sometimes been compared, in being not merely incrusted with a veneering of alabaster, but of a solid, homogeneous mass. This material, sometimes called "Oriental alabaster" (to distinguish it from the softer kind composed of the sulphate of

lime), is a hard, white, striated, translucent mineral, the purest form of carbonate of lime. The shaft itself is irregularly fluted from top to bottom, and is girdled by three narrow belts that give it a jointed appearance. The base is studded with blunt stalagmites of various sizes, whose shining tops, as Barton said, reminded him of the cypress-knees of the Dismal Swamp.



PILLAR OF THE CONSTITUTION.

A brilliant gallery of ornaments, of the same fine material, extends beyond the Great Pillar. A farmer who came in with us compared them, with rustic wit, to huge beets and parsnips, garnished with sprigs of celery, and suggested that this might be the under side of a petrified garden. The Chair of State and Stalasso Monument are remarkable stalactitic formations.

We slaked our thirst at a crystal reservoir, scooped from the crown of a stalagmite, and filled by falling drops. A goblet rested on the rim of this dainty fountain, which

each tried in vain to lift from the stone to which it was sealed by a transparent film. This is one of several experiments for measuring the rate of calcareous deposits, with some hope of estimating the age of the cave. Their growth is found to vary according to the strength of the lime-water and the rapidity of evaporation. In this locality points of stalactites, marked 25 years ago, have advanced, during that period, one inch, while stalagmites have grown but one-fourth of an inch. But this can only be taken as the rate for this place.

A Cave Flower. (See page 151.)

The weight of the immense mass of alabaster composing this pillar and its adjuncts, caused the pile of rocks that had previously fallen, to settle beneath their burden; and this, in turn, cracked the base, opening in it crevices many yards long, and from an inch to a foot in width. Starting from some of these cracks, a segment with an arc of 30 feet was cut from the base, and a cavity was made in the shaft itself about 10 feet wide, 7 high and 5 deep. No one doubts that this was done artificially; and the work has long been regarded as a deliberate plan of the old saltpeter miners to fell this noble pillar. I have offered a different explanation, which is now accepted by many.

The right edge of the incision runs underneath a stalagmitic wrapping 8 feet wide and 10 inches thick at its thickest part. Inspection shows that drippings like those now healing this wound were at work before it was inflicted, and that the cut was primarily made through a mass like that by which it is now overlapped. The region above ground is still covered by forests. Hence, as there has been no change of conditions, there has been constancy of stalagmitic growth. At the known rate of increment, it must then have required 1,000 years for the wrapping to attain its present thickness of 10 inches; and that length of time has therefore elapsed since this alabaster quarry was worked. Confirmatory of this calculation is the fact that some of the fragments thrown out from the pillar, and rolling down as a talus of pure white stones under the ledges of black limestone, are cemented over cavities where clusters of exquisite stalactites have had time to form, like fingers of opal.

Further search by me, in 1878, revealed the implements with which the ancient quarrymen wrought; namely, round or oblong bowlders of granitic rock, extremely hard, and of a size (from 4 to 10 inches), suitable to be wielded by hand, or twisted in a withe and swung as a maul. Rothrock denies having at any time carried such stones into the cave, or that any one else has done so to his knowledge. The customary tool for getting specimens is a hammer or a hatchet; and these clumsy stone pounders would be used only by those who had no better tools.

The theory that these pounders were swept in here by some underground stream is untenable for several reasons. One is, that the place where they were found is 20 feet higher than the entrance. Another is, that there are here no beds of sand or gravel or other indications of recent fluviatile action. The entire region, moreover, lies below the line of glacial drift. Prof. Collett assures me that the cave is at least 100 feet below any drift he has yet discovered in Crawford county. It is certain, therefore, that these small bowlders were brought by hand from a long distance. They seem to have been carefully selected as to their shape

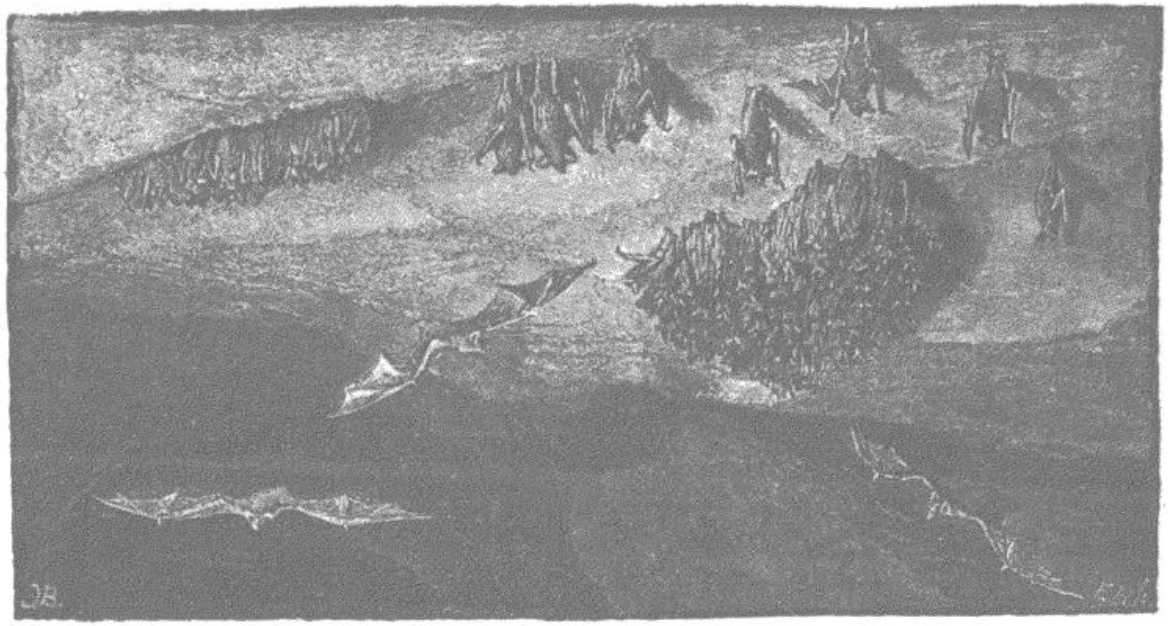
and fitness for use. Hard as the material is, their ends are battered and whitened by pounding. It is my conclusion that they were used by Indians in breaking from this alabaster quarry, more than 1,000 years ago, blocks of a portable size and convenient shape.

Quite probably the place was resorted to by successive generations for material to be made into amulets, ornaments, disks and images; such as we are told by Dr. Joseph Jones have been repeatedly exhumed in the Southern States, and also, according to Prof. S. F. Baird, from tumuli in Illinois. Hence they should be looked for in Indiana; and if not found abundantly, the reason may be that, although this kind of alabaster is hard and durable when not exposed to the elements, it is fibrous in its structure and liable to decay amid the open air, sunshine and rain, as was proved by fragments found in a crumbling condition just outside the cave.

The next morning we crawled through the low door that we had observed at the right of Bandits' Hall, and by a rapidly descending path were led into Bat's Lodge. This is considered the lowest point in the whole cavern, being more than 400 feet beneath the crest of the hill and only 20 feet above the high-water mark of Blue river. Grosvenor's statement is that "the lowest point in the cave is, by close measurement, 285 feet below the entrance, and the greatest altitude is 46 feet above the entrance; and 331 feet is the vertical distance between the extremes."

When the Fredonia party, in 1850, found the New Cave, they perceived at once signs of previous occupancy. On removing the loose stones through which they had felt the current of air, and had seen the bats fly in and out, the scuttle was visible through which we had just gone. It had every appearance of having been long used, but afterward closed up, either purposely or accidentally.

Bat's Lodge, to which I referred, is a spacious room where the bats cling in clusters to the walls, like swarms of bees, especially in cold weather. They are to be seen, however, at any season, and we had no difficulty in finding a cluster containing several hundred bats as close to each other as



A Colony of Bats, Wyandot Cave.

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possible, and all hanging head downward. The general semblance was that of a mass of brown fur. Rothrock rubbed his hand over the mass, thus causing every little red mouth to fly open, displaying needle-like teeth. The transformation of color was startling. A chorus of quaint cries now arose from the little colony thus rudely disturbed; and several of the winged gnomes, unhooking themselves from the wall, flew about our heads. The result was that we left them alone in their lodge. It was interesting here, and elsewhere, to watch the queer little creatures as they flew through the darkness without hitting the projecting rocks. But it is said that when the proprietor fixed an oak door into this lower entrance (now removed) the bats flew against it with such force as to kill themselves in large numbers. Their instinct did not seem equal to this emergency!

Some men came one day and asked for work, and the elder Rothrock set them to dig a trench through a clay-bank beyond Bat's Lodge, where the roof and floor came near together. The excavation they made is 2 feet wide, 3 deep and 80 long, and facilitates progress. It was afterward discovered that the men were counterfeiters and fugitives from justice! Climbing a rugged hill under the Rotunda, that is beyond the Counterfeiter's Trench, we reached a spacious hall, and the Delta Island, whence two main arms branch in opposite directions. It is customary for the visitor to explore the Northern Arm first; but we changed the order in fact, and it also suits the convenience of description to make a like change. Accordingly we followed the guide into

THE SOUTH ARM.

Here the original white explorers found a well-beaten path, smoke-stained walls, charred bits of hickory bark, hundreds of poles from 5 to 8 feet long, and other proofs that the red men had preceded them. Some of these relics we picked up for ourselves. We were fortunate in finding a number of the poles, although many had been removed. They are saplings, pulled up by the roots, and the branches twisted off. No sign of an edge-tool

could be found upon them, but many prints of sharp teeth probably left there in some combat of yore between savage and brute. None of them were hickory, oak, or any hard wood; but soft wood, such as poplar, sassafras, paw-paw, etc. The inference is that those who used them had inferior tools.

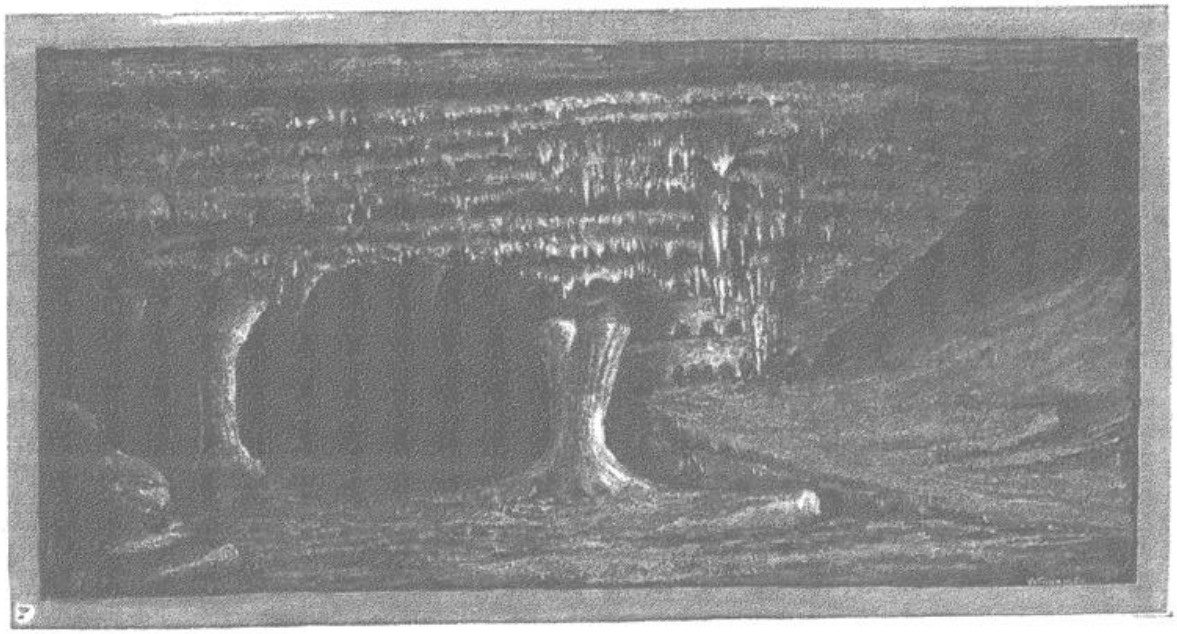
We had now crossed two halls of considerable size, whose walls and ceiling were almost as smooth as if finished by the trowel and float. The cave subdivides and reunites three-fourths of a mile beyond, thus encircling the Continent—a huge mass of cave-girt rock. Smaller masses are designated as islands, around which the ancient subterranean river ran. Creeping Avenue has a clean, level floor, but the roof is less than three feet above it, and progress has to be made for about 65 yards on one's hands and knees. When, at last, we can stand erect, we find ourselves in a place of singular beauty, namely, the Pillared Palace. Here the stalactites have clasped the stalagmites, thus forming snowy pillars. These support an entablature of alternate belts of marble and flint, over which are graceful pendants. Fragments of fallen columns encumber the floor, among which we found pounders like those before mentioned, and which probably were used to break down the pillars.

While Barton was sketching the Palace, the guide showed the rest of us some remarkable depressions, about twenty in number, each being a yard wide by a foot deep. These, as he said, were bear-wallows. But we were growing skeptical, and disposed to judge for ourselves, without regard to what had been told to travelers for the last quarter of a century.

"Bear-wallows," said I, repeating his words, "what would bears want to wallow in here for, all in the dark, when there were plenty of sunny banks outside?"

"These places have always been called so," said he, and they must have been made by something or somebody; and my father always told me they were bear-wallows."

"No doubt," I replied, examining one of the depres-



THE PILLARED PALACE, WYANDOT CAVE.

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sions critically, "but can you tell me why there should have been a little pile of charcoal on one side of each bear and a heap of flint-chips on the other?"

The answer to this query was a general and eager search, with interesting results. Bands of flint had already been noticed, sometimes in continuous belts, but often in rows of nodules, varying in diameter from one to ten inches. Rarely they have a geodetic form and a crystalline center, showing that the silicious particles had collected about a nucleus. Between these belts or rows there is usually a chalky substance, easily cut with a knife, or even by the finger-nail. The wallows, or depressions, are where the flint is most abundant and of the best quality. Here also pounders had been used to crush the nodules. The latter are coated with some gray mineral (that may be discolored flint), but on fracture a bright black surface appears. Further search brought to light hundreds of oblong flint blocks, each having parallel faces, and about four inches long by one or two in width, and half an inch in thickness. These were dingy and faded, the change of color being due to the gradual removal of the traces of iron found with the silex. The blocks may have been rejected cores, but more probably they were split in this form simply for convenience in transportation. The existence of such quantities of chips shows that arrow-making had gone on there to a certain degree. The only manufactured article we found there was a little stone saucer, containing a soft black substance—perhaps a rude lamp. Subsequent search at the mouth of the cave unearthed from the *debris* numerous finished arrow-heads and quantities of chips, such as the old arrow-head makers used to spring off from the block by adroit handling of creased tips of buck-horn.

From the Pillared Palace we pass among grotesque and beautiful shapes, now under a smooth ceiling glittering with crystals, and then among ribs of limestone upholding a deeply corrugated roof, till we reach the lower end of the Continent. A branch on the left leads to a few small but very pretty rooms. A large mound is in front of us

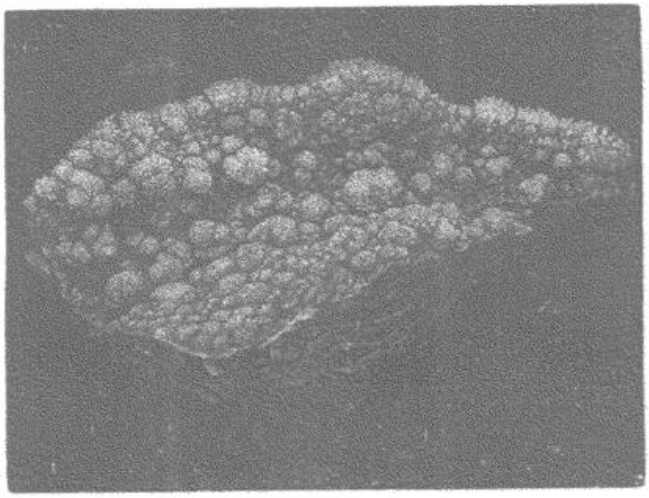
that is surmounted by detached rocks, one of which has a whimsical resemblance to an alligator, while another is like a hippopotamus. The "nest egg" near by is a singular concretion.

THE ALLIGATOR.

By traversing a long hall, we reach a pile of slippery rocks, on top of which is a circle of small rounded stalagmites cemented together, and six feet above this is a corresponding circle of broad, leaf-like stalactites, shooting over from a shelf near the ceiling, and hanging like drapery. This is the Throne! On each side of the canopy described is a continuation of the fern-like stalactites in a reflex curve, the edges all being turned outward, and the leaves thickly crowded together.

OULOPHOLITES, OR CURVED CRYSTALS OF GYPSUM.

Crossing now the deserted beds of one or two streams, we are in Diamond Avenue, where nature asserts her power to work miracles of beauty from cheap materials, transforming gypsum and epsom salts into lustrous crystals that sparkle on the walls and lie on the floor. The guide digs up from the earth, as carelessly as if they were potatoes, crystals like nails and needles, and others as fine as spun glass; sometimes they are exquisitely curled and wreathed.



CALCITE CRYSTALS.

"There seems to be an opening beyond," said I to Rothrock, as we stood by a deep flint-pit, not far from this mine of gems. The orifice to which I pointed was midway between floor and roof, and plainly in view, but visitors have been deterred from entering, because of a fallen stalactite weighing several tons, that hangs over it, caught by its tips.

"Let us explore," said the artist. "A rock that has hung for so many years like Mahomet's coffin, is not going to be so spiteful as to crush us at last."

We crept under the impending mass, without giving it the slightest touch, and entered a wild, lofty vault, extending upward for eighty feet through the solid stone, enlarging itself here and there into cells and grots, all splendidly draped and festooned. We named it "Helen's Dome," in honor of one of our party.

The terminus of the South Arm is at Hovey's Point,

where the way is blocked by a huge mass of alabaster, curiously carved in concentric rings. It is plainly the base of a pillar that rises into an invisible chamber, to which no entrance has yet been found.

Returning on the west side of the Continent, we cross several large rooms, the finest of which is the Wyandot's Grand Council Room. By burning red fire and other illuminants, we made its dimensions visible, and estimated it to be 700 feet in circumference—an unbroken arch, without a supporting column. Belts of black flint stand out in sharp contrast with the whitish-gray walls.

On the right is a heavy clay-bank, deposited long ago by some stream that has ceased to flow, and all now is as dry as a brick-kiln. Through this bank the guide dug a narrow trench, and we were the first visitors to enter. Flat on our faces, we sprawled and twisted our way through for 20 yards, and had our reward. We found ourselves where I am confident no white man had ever been before, in a small room, 40 feet across and 8 feet high. Two entire torches, the ends only being charred, projected from a crevice overhead. Who can tell when those extinct flambeaux had last been handled? We left them as they were found. There were quantities of charred bark on the floor. Wolf-tracks were seen, and also what was once the den of some animal. Hence we named the chamber "the Wolf's Lair." The original entrance was probably at the side opposite to our trench, where the strata curve down to the floor, as if the rocks had at some time tumbled in. The place can hardly be more than 1,200 feet from the mouth of the cave, though now reached only by a long detour. Anciently it may have been a locality of easy and frequent resort.

THE NORTHERN ARM.

Leaving the Delta Island where the cave divides, and turning northward, we cross a smooth sandy plain, 900 feet long by 40 wide, the roof being 10 feet above our heads. Here were the ancient sand-bars along which the cave-river once rippled.

The plain ends abruptly, being obstructed by fallen fragments. On our left is the crevice by which Rothrock's Straits may be entered, leading across to the Old Cave. Here, again we found several poles, like those already discribed. "Bear-slides" were pointed out to us near the Straits, and during the ascent of the Hill Difficulty. It may be true that bears, as well as boys, like to slide down hill; and Dr. Kane and others claim to have witnessed the feat as performed by polar bears. But our previous examination of the "wallows" makes us look suspiciously at those blackened and mysteriously polished rocks. We are inclined to hold the Indians responsible for them! The slides are certainly there, and with sundry slips and bruises we clamber over them.

Suddenly the low roof is lifted, and the rocky pile grows to mountainous proportions. We have entered the solemn precincts of Rothrock's Cathedral. Toiling up the steep, 135 feet in height by actual measurement, our lamps shine across the jutting points a little way, and then lose their rays in Stygian darkness. The summit is crowned by an irregular inclosure of stalagmites, rising, at the farther end, into an alabaster pyramid, on which stand three statuesque figures that are respectively 6, 7 and 8 feet in height.* The tallest one is quite dark, while the other two, on lower pedestals, are draped in spotless white. (See cut p. 152.)

In the side of this natural pyramid is an incision like that in the Pillar of the Constitution; and searching amid the *debris* below, I found similar fragments of alabaster and granitic pounders. At the farther base of the hill lay a detached stalagmite that had evidently once been a figure on the monumental pile, but had been wrenched away from its place. It is noticeable that all the fractures, instead of showing a sharp edge and a bright face, have a discolored, corroded appearance befitting their antiquity.

*As these are my own measurements they are confidently given as correct. But it interests me, on looking over Grosvenor's observations in 1851, to find him giving the size of these figures as only 4 feet in height and 6 inches in diameter. Is it possible that they have doubled their dimensions in 30 years?

Mounting on top of the pyramid and igniting magnesium, we made this part of the cave as light as day, and brought to view the proud arch springing 50 feet above us, and from 185 to 200 feet from the base of the mountain, according to the place you measure from. This is Wallace's Grand Dome. It closes around a smooth elliptical slab of oolitic marble, 60 feet long by 30 wide, finely contrasting with the darker limestone, from which it is divided by a deep rim, fringed with long stalactites curling like leaves of the acanthus. Far around us, with strongly marked strata, varying in hue and thickness, bends the massive wall of this venerable cathedral in a symmetrical oval 1,000 feet in circumference!

Piloting us down the northern side of the hill, the guide left us conveniently seated at the foot, and collecting our lamps returned to the summit. Then followed several extraordinary transformation scenes. By concealing 50 or more lighted candles around the pyramid and behind adjacent rocks, he made us fancy that we saw a city by night, with castellated walls, illuminated windows and flame-lit spires. He next grouped the lights in a cavity, and by a skillful use of red-fire and Roman candles simulated the appearance of a volcano in active eruption. But his masterpiece was a lavish blending of colored fire-works, creating a magical scene of enchantment. Near us lay a craggy wilderness, above which towered the pyramid, whose spectral figures stood out in relief against the oval dome; the general background being the great wall with its variegated belts, encircling the entire basilica, amid whose arches ascended roseate clouds of smoke wreathing the twisted stalactites and curling acanthus leaves, in bewildering contrast with the black shadows cast by the beetling ledges—an indescribable vision, as if an opening had been made into realms of supernal splendor.

"Beyond the magic of Aladdin's lamp!" cried Barton.

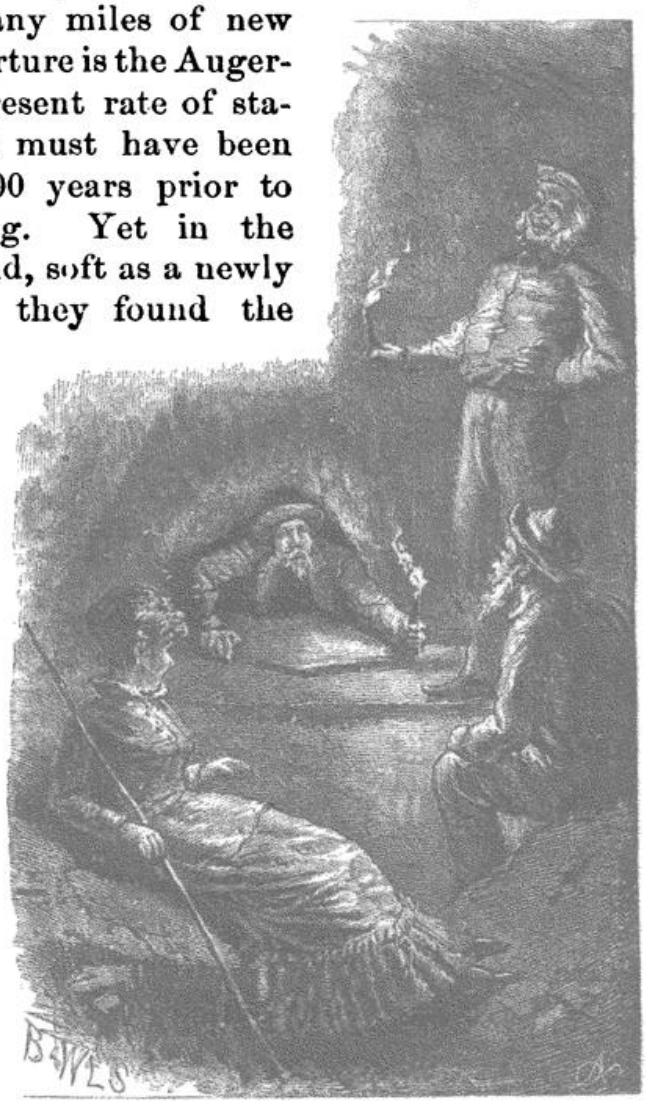
"A petrified sunset!" exclaimed a Professor who had joined us.

"The gate-way of Heaven!" said his wife.

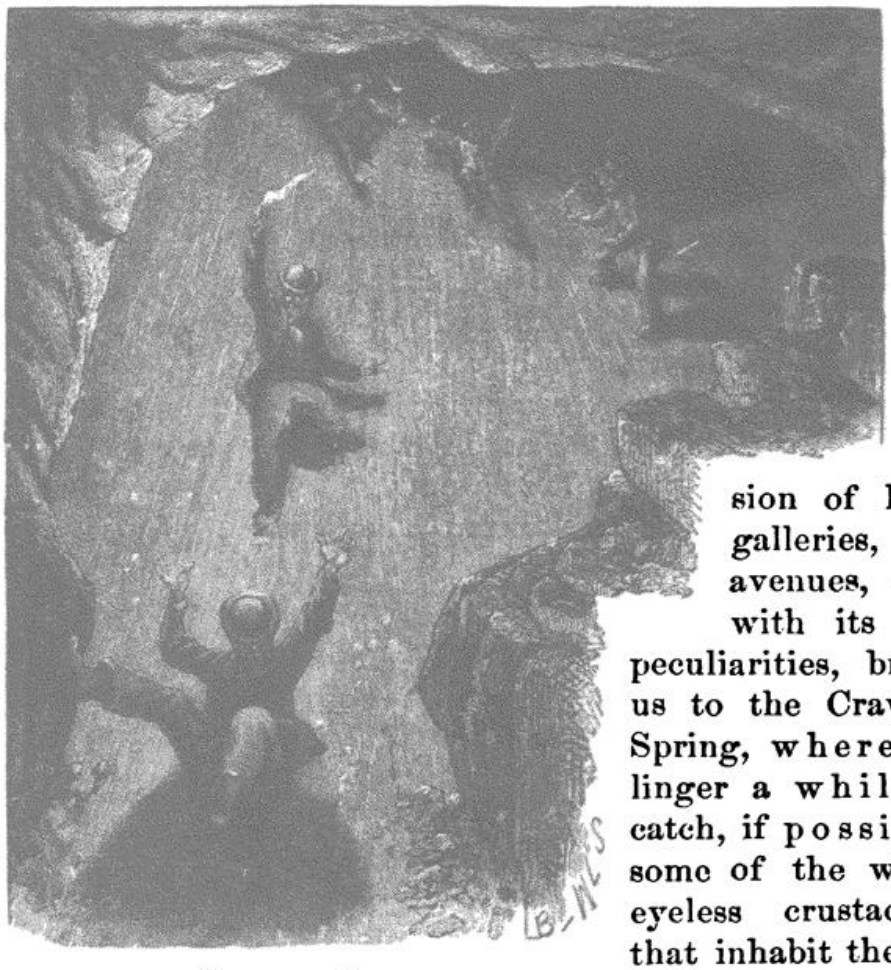
"Rothrock's Cathedral forever!" shouted the guide,

descending with our lamps, and conducting us to a spring, beside which lunch had been spread by a servant.

Amid a group of bulky stalagmites crowded against the wall, and a hundred feet to the right of the rubbish blocking the original way, an orifice was detected in 1850, which, on being enlarged from 6 to 21 inches, admitted the owners to many miles of new territory. This aperture is the Auger-hole; and at the present rate of stalagmitic growth it must have been impassable for 1,000 years prior to its recent widening. Yet in the nitrous earth beyond, soft as a newly raked garden-bed, they found the moccasin tracks of a party of Indian explorers who had once searched the avenues, going up one side and down on the other. The opening is far from inviting, as it is splashed by the overflowings of the spring. We have to descend as Bruin slips down a hollow tree, but fortunately the passage is only 10 feet long, and all are soon safely through. After admiring Lilliputian Hall we come to another place of merry difficulties—Slippery Hill, about which many a racy story is told. Then on through the Hall of Ruins to the White Cloud Room, 300 feet long, 30 wide, and 20 high, where the roof resembles billowy clouds. Then a succes-



THE AUGUR HOLE.



SLIPPERY HILL.

sion of halls, galleries, and avenues, each with its own peculiarities, brings us to the Crawfish Spring, where we linger a while to catch, if possible, some of the white, eyeless crustaceans that inhabit the water. The fauna of Wyandot Cave has the same general features as that of Mammoth Cave; but its special points of difference have been so thoroughly indicated by Professor E. D. Cope, that the reader is referred to his observations, which may be found in the Geological Survey of Indiana, for 1878, pp. 487–506. Wabash Avenue runs on beyond this spring for perhaps a mile and a half, and terminates in Butler Point.

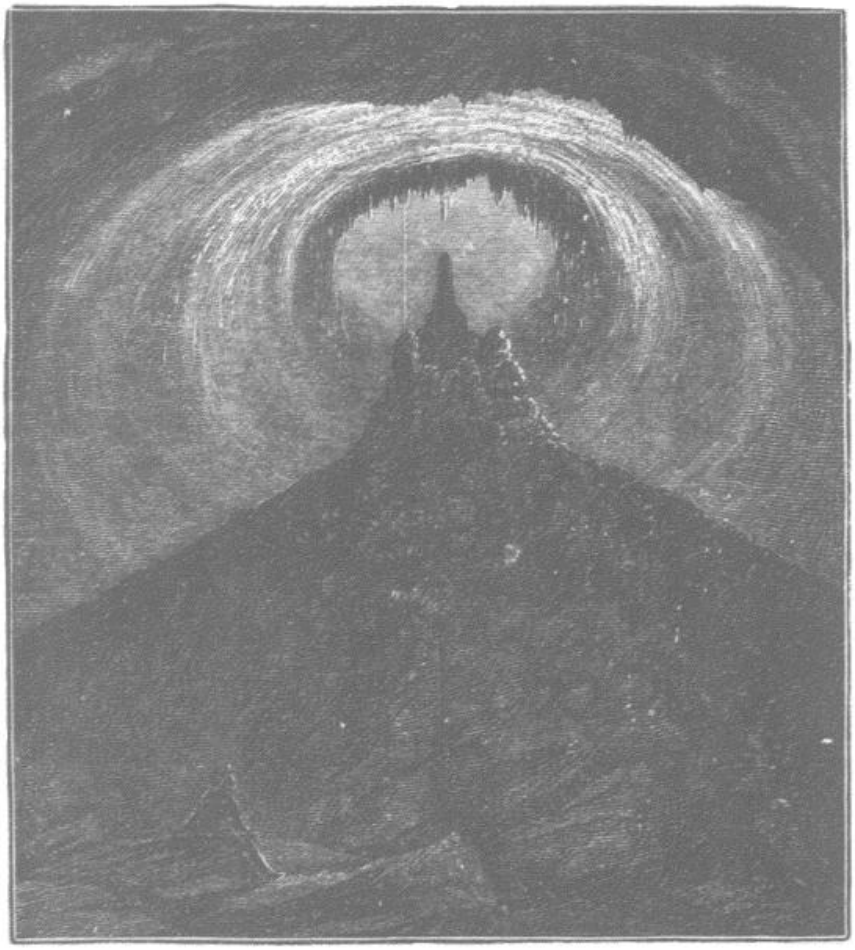
Returning as far as a stone seat known as the Arm Chair, we diverge from the line of our previous exploration, and from a curiously water-carved vestibule, enter the Frost King's Palace, where every object, large and small, is crustated with sparkling gypsum. Down a

steep path we go to the Snowy Cliffs, 400 feet long, 30 wide, and 15 high. The same snowlike formation, with balls of flint set in it like jet, is continued for 600 feet more through Morton's Marble Hall. We ramble on environed by a bewildering variety, of which the memory only retains a rich medley of charms. Some of the incrustations were tantalizing counterfeits of dainty confections, and it seemed as if they might melt away in the light of our lamps. Others were floriform crystals, "oulopholites" (curled-leaved stone), produced, it is probable, by the crowding of fibrous gypsum, that abounds in these dry halls, through crevices too small for the crystals to grow in; their efforts to spread apart starting curves that are continued by a larger number of atoms being supplied to one side than to the other. (See cuts, pages 138, 144.)

We fairly had a surfeit at length of sparry splendors and gleaming efflorescence; and felt a sense of relief when told by the guide that Wild Cat Avenue, and Little Giant Avenue beyond it, although abounding in objects of interest, were not yet open to the general public.

Milroy s Temple was reserved for our last trip into the cave. A party of students from Wabash College discovered it in 1878, and it is entered by Worm Alley, a crooked passage 50 feet long. After painful crawling, pushing and pulling, we emerged through a fine gate-way into a place more like chaos than a temple. We seemed to have been suddenly transferred to some half-finished planet. A long slope of slate-colored mud stretched away to invisible regions below. In this water-soaked floor lay masses that may have fallen yesterday, overhung by huge blocks that may fall to-morrow. A cascade fills the air with melancholy sounds. All seems treacherous and frightful; yet the danger is chiefly imaginary. A rough but safe path leads us down the slope to the depths of a pit, whence we make our way beneath an immense formation of drip-stone, like a congealed cataract, through whose great icicles we climb to a ledge leading on to novel attractions. One of them is a row of musical stalactites, broad and thin, on which a melody can be played by a

skillful hand. We wander on beneath creamy stalactites, vermicular tubes strangely intertwined, convoluted roots, mural gardens, galleries gay and grotesque, The finest of all is Bailey's Gallery, overhanging the portal and commanding a view of the entire scene within the Temple. Chaos was changed to Paradise.



ROTHROCK'S CATHEDRAL. (See page 147.)

On taking our leave of Wyandot Cave as we did in the gray twilight of the early dawn, and considering how simple the components were that went to make up the miles of wonders through which we had wandered, we enjoyed renewed admiration of Creative wisdom and skill. The myriad miracles in stone whereof

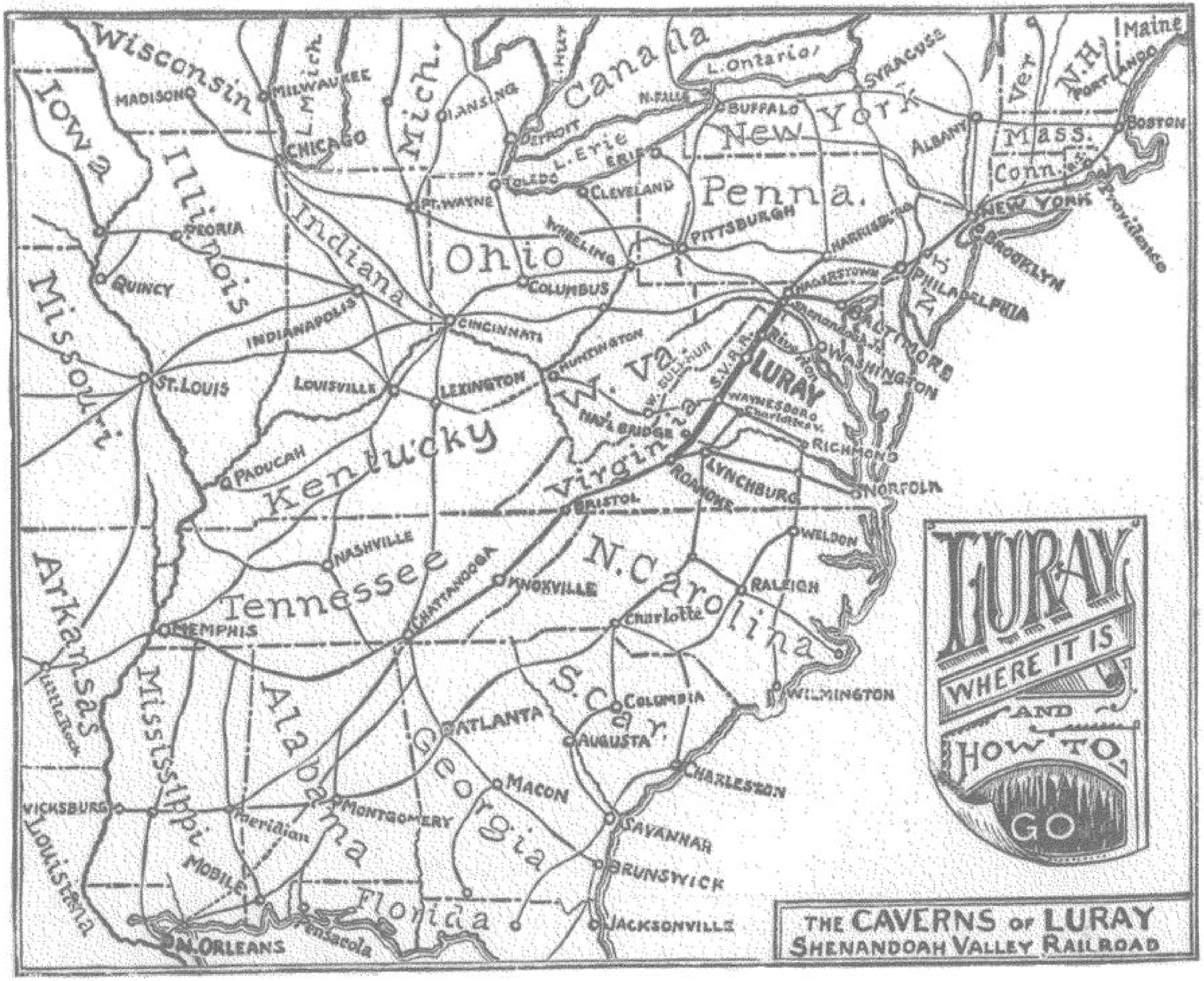
we were the witnesses, were wrought by One to whom darkness and light are alike, aud who loves beauty, whether in the tropical forest, in the sunset sky, or in the marble halls and crystalline gardens of this deep and lonely cave.

CHAPTER XI.

CAVES OF THE SHENANDOAH VALLEY.

Geological Features—Signs of Fire and Flood—Limits of Cave Possibilities—Early Descriptions of Virginia—Madison's Cave—The Organ Cave—Hot Springs—Weyer's Cave—Its Discovery—Its Beauty—Its Size and Location—Kaiser's Cave—An Indian Grave—Queer Rats—Water Cave—An Old Hair-Covered Trunk—Zirkle's Cave.

A CURSORY glance at the geology of Virginia, so far as the lime-stone regions are concerned, will aid us to understand some of the peculiarities of its caverns. The traveler by rail, as he scans the beautiful and diversified scenery along the Shenandoah, can hardly fail to notice how the rocks have been displaced, their general dip being at an angle of 30° eastward. And should he ride or walk, as I have done, over some of the lofty ridges that lie in vast folds and wrinkles, parallel to the direction of the Appalachian mountain range, he will see many and impressive signs of the stupendous forces that have been at work. The original strata are not only modified, but often tilted vertically, and sometimes even *inverted!* The Massanutton mountain gives fine opportunities for studying the local geology. Amid all the rugged violence that has assailed it, the general symmetry of periods has been preserved. In riding over it from New Market to Luray, you can see the formations rising from the Silurian limestones, through sub-carboniferous rocks, to thin deposits of coal on the highest peaks, and then descending in reverse order down the eastern slope. This arrangement (known as synclinal) brings to view, on both sides of the range, and along both branches of the Shenandoah, a compact, fine-grained limestone in which many caves, large and small, have been found. It is designated in Rogers' Survey as Formation II., and is regarded as


LURAY
WHERE IT IS
AND
HOW TO
GO
THE CAVERNS OF LURAY
SHENANDOAH VALLEY RAILROAD
Wisconsin
Iowa
Illinois
Missouri
Indiana
Ohio
Mich.
Canada
New York
Penna.
N.J.
Mass.
Conn.
Ver
N.H.
Maine
Kentucky
W. Va.
Virginia
Tennessee
N. Carolina
S. Car.
Georgia
Alabama
Mississippi
Arkansas
Louisiana
Florida
L. Ontario
L. Erie
L. Mich.
MADISON
MILWAUKEE
CHICAGO
LANSING
DETROIT
TOLEDO
ERIE
BUFFALO
N. FALLS
SYRACUSE
ALBANY
BOSTON
PORTLAND
NEW YORK
BROOKLYN
PROVIDENCE
PHILADELPHIA
BALTIMORE
WASHINGTON
HARRISBURG
HAGERSTOWN
PITTSBURGH
CLEVELAND
WHEELING
FT. WAYNE
COLUMBUS
CINCINNATI
HUNTINGTON
PEORIA
QUINCY
INDIANAPOLIS
ST. LOUIS
LOUISVILLE
LEXINGTON
PADUCAH
LURAY
S.V.R.R.
W. SULPHUR
NAT. BRIDGE
WAYNESBORO
RICHMOND
NORFOLK
LYNCHBURG
ROANOKE
BRISTOL
NASHVILLE
KNOXVILLE
CHATTANOOGA
MEMPHIS
WELDON
RALEIGH
Charlotte
WILMINGTON
COLUMBIA
AUGUSTA
ATLANTA
MACON
CHARLESTON
SAVANNAH
BRUNSWICK
JACKSONVILLE
MONTGOMERY
Meridian
MOBILE
VICKSBURG
Little Rock
N. ORLEANS
Pensacola

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"lower Silurian, probably belonging to the Trenton period." It has been called a dolomite; and yet an analysis of five specimens from different localities showed only a single one in which there was not an excess of the carbonate of lime.

The loose rocks lying on the surface are chiefly calcareous, often stained by oxide of iron, with here and there a quartzite bowlder, or even a cluster of quartz crystals. The limestone in place breaks with sharp edges and varies in color from light brown to a deep blue or black, with numerous veins of milk-white spar. This veined condition is due to volcanic disturbances, by which the rock was cleft into countless fissures that were afterward filled with calc spar and silicates, and occasionally with metallic ores. Action of this kind has been so recent, geologically speaking, that masses of igneous rock are thrust through the sedimentary rocks, and there is actually a dyke of trap within a mile of Weyer's Cave!

Elevations found in the valleys are, of course, such masses as had coherency enough to resist the wear of retreating waters by which gaps were opened in the mountain chains. Yet, as might be supposed, these lower hills were repeatedly pierced by the action of those mighty floods; and it is not necessary to refer any of these tunnels and grottoes to the operation of volcanic forces. Water is as energetic as fire!

The geological conditions thus hurriedly described, are in marked contrast to the vast, undisturbed and homogeneous limestones of Kentucky and Indiana; which usually lie so nearly now in their original position as to cause the surface above to take the form of broad table-lands broken only by the sink-holes characteristic of all cavernous regions. Virginia can not have such immense caves as Mammoth and Wyandot, for the same reason that you could not cut a monolith like the Obelisk from a block 10 feet long. The process of excavation is limited by the dimensions of the rock. The rapidly succeeding undulations of the surface and the numerous seams and rifts dividing the strata, making it simply impossible that there should be

such vast domes and pits, interminable avenues and long navigable streams as those found in the western caverns mentioned above. And yet the tourist who misses these attractions, finds himself often compensated by the surpassing beauty of the caves of the Old Dominion. He, indeed, who has seen the one should see the other also, to make his knowledge of "caveology" complete.

Jefferson was probably the first to direct the public attension to the caves and other natural curiosities of his native state, and his account of the Natural Bridge, "the ruin of a cave," and of the Blowing Cave in Panther Gap, have been already referred to. Among other early explorers may be mentioned Richard Harlan, M. D., "Tour to the Caves of Virginia," 1831; Rogers and Fontaine, the geologists, whose accounts appeared in the State Reports, and who also published descriptive articles in various scientific journals; Nicklin, or "Perigrine Prolix," whose charming letters on Virginia appeared in 1834; and, among illustrated papers, those by Porte Crayon, in *Harper's Magazine*, and in Appleton's Picturesque America (Vol. 1. pp. 210–216), are noteworthy. Some of the earliest published accounts came out in the first volume of the *American Journal Science and Arts*, and there have been subsequent communications printed in the same periodical.

Madison's Cave, three miles from Waynesborough, had the honor of being described by Jefferson; was one of the first to attract visitors, and was, like many others, worked for saltpeter during the war of 1812. Its entrance is about 100 feet above the Shenandoah river, and the ascent to it is very precipitous. Dr. Harlan had the slaves who accompanied him, dig through the floor to the bed rock, hoping to find fossil bones, but without success. He describes the rooms as capacious, and the high, narrow gallery beyond them, as leading down to "a body of crystal water, said to be of immeasurable depth, and beyond which no one had explored; some terrible tale of silent suction existing in this water, having become prevalent, effectually paralyzing the efforts of the exploring *Homo troglodytes.*"

The Organ Cave, fourteen miles from the celebrated White Sulphur Springs, is described in Nicklin's Letters as "a black and yawning chasm in a romantic and wooded ravine." His guide was John Rogers, and his torches were little faggots of pitch-pine splinters. Led and lighted thus he made his way through apartments paved with rough rocks, and "full of gulfs and dangerous passes and awful pits," into which he had evidently some fear of falling. At length, after sundry adventures, they reached the great Organ Room, "the jewel of the cave," and what gave it a name. The understanding was that, upon gently striking certain parallel stalactites, they were forthwith to emit Memnonian music. But, alas, barbarians, unknown to the guide, had invaded the recess, broken the pipes, and the concert was indefinitely postponed. This cave is about three-quarters of a mile long, and was also once mined for saltpeter.

The same letter-writer just quoted also describes what he calls "a wonderful labyrinthine cave," near the Hot Springs, having five divergent avenues, each leading to a distinct chamber of ample dimensions. One that was measured was reported to be 100 feet long, 60 high and 35 wide. In these chambers are openings down to deeper rooms below, and in one place a pit supposed to be 100 feet deep.

Weyer's Cave, however, cast all others in the shade—so to speak—until the recent discovery of Luray Cavern, and it is well worth visiting, even though its patronage may have somewhat fallen off of late. The story goes, that Mr. Bernard Weyer was greatly annoyed by a ground-hog (*Archtomys Monax*), and set a trap for the creature. The bait was taken, and so was the trap, which had been dragged into a fissure in the rocks. Not to be outwitted by such a beast, Mr. Weyer pursued the lawless depredator with spade and pick, and presently found what he was *not* looking for—the splendid cavern that has borne his name ever since. That was in February, 1806, and the historian has not told us, to this very day, whether the ground-hog was caught, or if he made good his escape!

Weyer's Cave is located in Augusta county, Va., 17 miles from Staunton; and its entrance is in the eastern side of a ridge running parallel to the Blue Ridge, from which it is distant four miles. It is in proximity to Madson's Cave, the mouths being only 300 yards apart. A zigzag path leads up the hill-side to the entrance, which has been enlarged since the days of the ground-hog. Guides are in waiting to escort visitors, who are admitted through a small wooden building set against the hill-side. Fidelity to the reader compels the admission that tourists have sometimes expressed a degree of disappointment in this celebrated cave. "The entrance is difficult of access," observes Dr. Harlan, "the floors are constantly interrupted by precipitous risings and depressions, and by large broken masses of the limestone in which the caves occur. In some of the chambers the floors are loaded with wet, tenacious clay, and the stalactites are for the most part discolored by the water, which percolates the rock from the red sandstone above." But it should be stated, *per contra*, that the gentleman, with his retinue of slaves, was digging for fossil bones and found none. What charm has a cave without bones? Then, again, it is not given to every one to appreciate cave scenery. The fact is that, although its pristine freshness is somewhat dimmed by the smoke of torches, and marred by the rude touch of many fingers, enough remains to delight and instruct the visitor, and Weyer's Cave is to be numbered among the things worth seeing.

Any lingering doubt on this point should instantly vanish on perusing the model manual prepared by the proprietor, Mr. J. L. Mohler, who assures us that this is "the most remarkable cavern at present known!" The Grotto of Antiparos is splendid, but too small; the Nicojak Cave, in Georgia, 12 miles long, and the Mammoth Cave, with its boasted scores of miles, are too big. "Even Niagara Falls affords the beholder but two or three varied views, while Weyer's Cave presents to the riveted gaze of the enraptured visitor a thousand!"

Thus encouraged, the tourist allows himself to be led

down into the cavern's dark throat, and after getting his "cave eyes," sees himself to be surrounded by grotesque and wonderful shapes, whose resemblance to human figures gives the first room the name of the Hall of Statuary. A circular opening over-head exhibits a curtained dome fringed with stalactites. Proceeding through a narrow passage and down a flight of steps, a room is entered bearing the venerable name of Solomon's Temple. Massive and richly fluted columns rise from the floor to the ceiling and seem to support the rock-ribbed roof. Glittering stalactites hang in thick clusters, and the lively imagination traces all sorts of lovely imitations of objects appropriate to regal halls. By one of those odd incongruities not uncommon in cave nomenclature, the next place is the "Meat House," where hams and shoulders hang along the wall, and the guide explains that these provisions were for the King in proximity to whose temple they are placed. The entire room is but 45 feet long and 30 feet wide, and is irregularly shaped. On its right is the Cataract; not a veritable Niagara but a mass of wavy terraces of alabaster, like great sheets of congealed foam and billow caught and held on the broken ledges of limestone. Mr. Mohler, ever on the look-out for objects of interest, points out the figure of a man in the act of leaping the frozen falls and says it is Sam Patch. At the eastern extremity is a beautiful column of snow-white stalactite, named Solomon's Pillar.

Passing the variegated charms of the Shell Room, whose roof is thickly set with stalactites like the lips and spines of sea-shells, and passing also many fancied resemblances to fish, flesh and fowl, we visit the Pantheon, with its assemblage of "gods of stone," and then, by a change of religions, enter the Cathedral, with its ecclesiastical decorations. In this part of the cave the "Geyser" is located, a huge glittering stalagmite like a great boiling spring. There is, of course, a "Ball Room," with a tradition that some merry company once tripped to music over its cold and earthen floor—a thing that may have been. The Gnome King's Palace is an admired spot; where "pillared

walls, hung with long, sweeping folds of tapestry; banners flaunting from overhanging galleries; canopied niches filled with shadowy sculpture; the groined and vaulted ceiling dimly appearing at a majestic height; and long pendants dropping from out the thick darkness that the feeble torches can not penetrate," are said to impose so completely on the senses that it is difficult not to believe the white robed statue in the center of the Hall to be the living King awaiting our homage. Since Port Crayon wrote these words, the place has been patriotically metamorphosed into Washington's Hall, and the statue transformed from the Gnome King to Pater Patriæ. It is claimed that this splendid room is 257 feet long, 30 feet wide and as many high. Jefferson's Hall is the room farthest from the entrance, and also the lowest beneath the surface. Its length is said to be 230 feet, and the thickness of the arch above to the surface is 200 feet.

There are numerous objects curious and beautiful, besides the ones mentioned—such as the Enchanted Moors, the Spear and Helmet, the Garden of Eden, and last, but not least, the Mammoth Oyster-Shell, said to be exactly 1,650 feet from the entrance, and which marks what is regarded as the end of the cave. Statements that Weyer's Cave is 3 miles or more in length are made by enthusiastic visitors, not by the proprietors, and are due to the fact that one who winds his way through galleries and archways, really doubles his distances and in imagination trebles them.

The temperature of Weyer's Cave is uniformly 54° Fah., and the air is pure and dry. Those wishing to pay it a visit can reach it easily by the Shenandoah Valley R. R., on which it is 129 miles by rail from Hagerstown.

Numerous small caves have long been known in the vicinity of New Market and Luray, into which explorers have repeatedly gone, without chronicling their discoveries. One evening, while chatting with my friend, Mr. Andrew J. Campbell, of Luray, mention was made by him of 20 or more of these grottoes that he himself had examined. I took the names of some of them. Several

were worked for saltpeter during the Rebellion, and others were supposed to have been made available as hiding-places for treasures in times of insecurity.

Kaiser's Cave, 8 miles north of Luray, is a single chamber about 40 feet long, entered by a low passage perhaps 20 feet long. Here was found an Indian grave, 5 by 8 feet square, and 8 feet deep, in which twelve bodies were piled, one on top of the other. Several of the skulls and bones were imbedded in dripstone.

Robert's Cave is also 8 miles north of Luray, but the only fact (if it be a fact) noted concerning it is, that "a responsible party killed a rat therein, whose whiskers were measured and found to be just 18 inches long."

In Count's Cave, 3 miles north of Luray, rats have been frequently caught that were perfectly white, and with large protruding eyes; evidently modified from outside varieties.

Lauler's Cave, on the Shenandoah, 2½ miles north of Luray, has two mouths half a mile apart; so that you can go in at one and come out at the other.

Without wearying the reader with details that might prove monotonous by their similarity, let me relate a singular adventure met with by Campbell in one of his exploring tours under ground. He had long known of Water Cave, less than a mile from Luray, from which a considerable stream issues that falls into the Hawksbill, a large tributary of the Shenandoah. Contriving to pass the wet and slippery entrance that had hindered previous explorers, he delighted himself a while with what he called "a water-piano," where charming echoes were awakened by tossing pebbles into a crystal pool that nearly filled the room he had found within. While thus engaged he noticed a low, small aperture at the farther end of it, and his curiosity led him to stoop down and hold his candle so as to light up whatever might lie beyond. To his surprise an object was thus brought to view that was large and hairy. Our explorer was not easily frightened, and accordingly, observing that the object did not stir, he crept up to it, and found—an old hair-covered trunk!

"Now my fortune's made," said he to himself, "for this can be nothing but some kind of treasure concealed during the war. Probably a lot of gold and silver, or valuable jewelry!"

The trunk was carefully dragged out from its hiding-place. It was found to be securely locked. Using the end of a stalactite for a hammer, Mr. Campbell forced open the lid, and there, before him, lay exposed to view, in the gloom of that dim ante-chamber—*a skeleton!*

Zirkle's Cave, about 6 miles south-east from New Market, has attracted many visitors, who pronounce it to be very fine. It was found in December, 1879, and explored by Mr. Reuben Zirkle and his two sons. The particulars were published in the New York *Herald*, January 17th, 1880. From this account, which Mr. Zirkle himself assures me is correct, the portion explored is about one mile long, and contains several rooms of magnitude. There are many stalactites, and the walls are, in some chambers, decorated with countless limpid crystals, probably of gypsum. The Diamond Room, called so on account of the brilliancy of the incrustations, is 225 feet long, 50 feet wide, and 40 high, opening to another hall equal if not larger in size. One room is perfectly circular, and with a smooth, level floor; while others are cumbered with huge blocks of stone, amid which the visitor makes his way with difficulty. There is, in one of the halls, a fissure about 50 feet deep, down which one can go by steps to a flowing stream, 6 feet wide. Zirkle's Cave may certainly be classed among the newly-found wonders of the Old Dominion.

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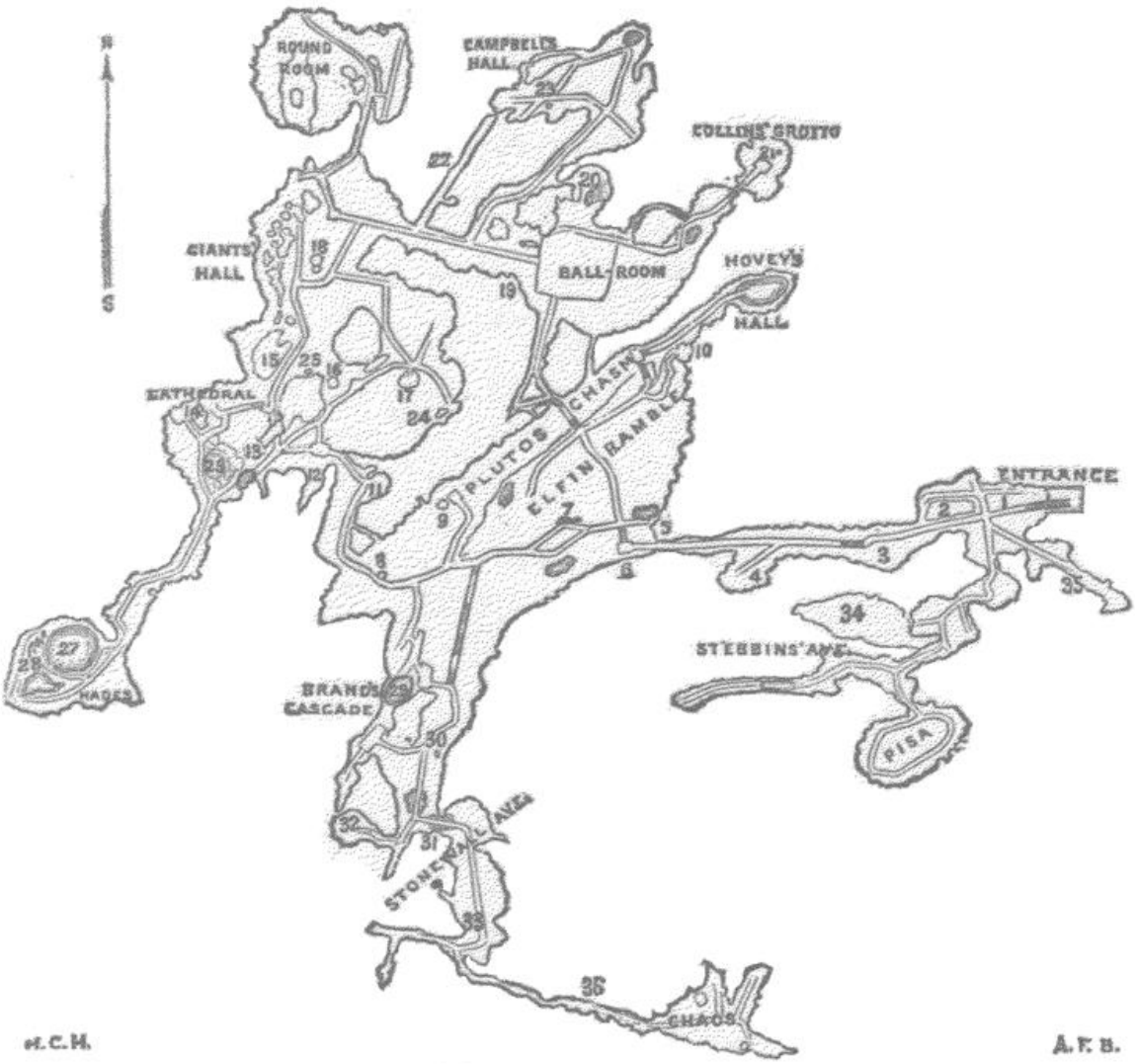


1. The Vestibule.—2. Washington's Pillar.—3. The Flower Garden.—4. The Amphitheater.—5. Natural Bridge over Muddy Lake. 6. The Fish Market.—7. The Crystal Spring.—8. Proserpine's Pillar. 9. The Spectral Column.—10. Hovey's Balcony and Scarfs.—11. Oberon's Grotto. 12. Titania's Vail. 13. Saracen's Tent, 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. Broaddus 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.

CHAPTER XII.

THE CAVERNS OF LURAY.

Scenery of the Luray Valley—the Blue Ridge—Cave Hill—Ruffner's Cave—Cave-hunting—A Dark Secret—Sale of the Luray Cave—Systematic Exploration—Electric Lamps—The Vestibule—Bone-hunters—Washington's Pillar—Making Tracks—Muddy Lake—Elfin Ramble—Crystal Springs—Pluto's Chasm—Hovey's Hall and Balcony—The Chimes—Alabaster Scarfs—Proserpine and the Specter—Oberon's Grot—The Poor Man's Bacon—Temperature—Fallen Column—Unwritten History—The Hollow Column—Angel's Wing—Saracen's Tent—Stalactitic Age—Subterranean Music—The Cathedral—Tower of Babel—Giant's Hall—Empress and Sultana—Swords of the Titans—Double Column—Round Room—Ball Room—Collins' Grotto—Campbell's Hall—Toy Shop—Lost Blanket—Helen's Scarf—Broaddus Lake—Castles on the Rhine—Down in Hades—Skeleton Gorge—Animal Remains—Fauna and Fungi—Helictites—Stebbins' Avenue—Leaning Tower—Stonewall Avenue—Imperial Spring—Brand's Cascade.

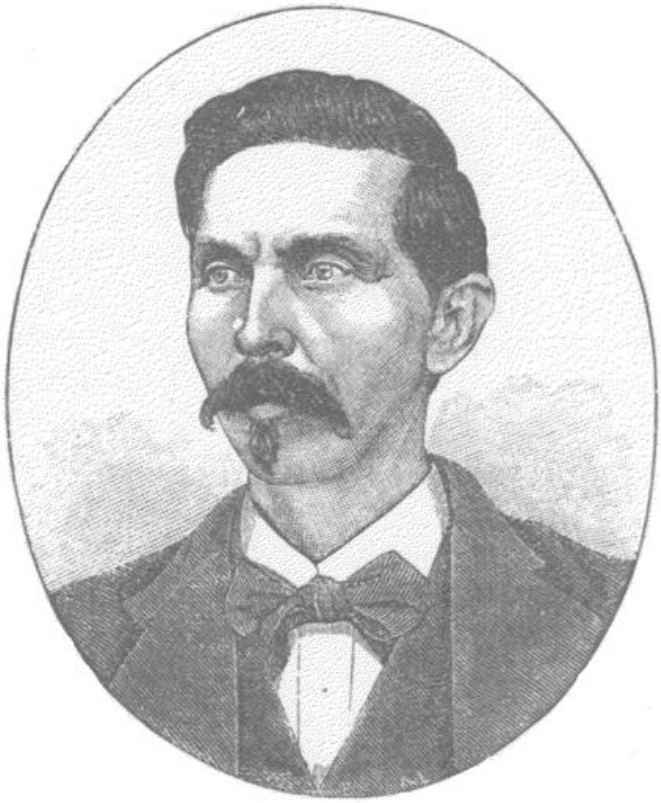
THE village of Luray, the county-seat of Page county, Va., lies on the Hawksbill, a tributary of the Shenandoah, 39° 35′ N. latitude, and 78° 17′ W. longitude, 82 miles W. S. W. of Washington, D. C., and 88 miles S. of Hagerstown, on the Shenandoah Valley Railroad, and is 800 feet above the sea. The Luray Valley, as it is called, is about 10 miles wide, extending from the Blue Ridge to the Massanutton Mountain, and the village is midway between these lofty heights. The scenery is remarkably fine, and were there no other attractions, few inland resorts could boast more diversified charms than those to be seen from the broad veranda and tower of the elegant Luray Inn. One after another, as the eye scans the forest-crowned hills, there come into view Mary's Rock, Stony Man, Miller's Head, Naked Top and Franklin Cliffs—the lowest of which is 3,000 feet high, and the highest 4,500 feet. With

a good glass one can discern the bold escarpment of granite, rising on top of some of the peaks like a formidable fortress. There are wild crags accessible only to the eagles and other birds of prey. The more distant spurs soften the lines of their gigantic folds, until they melt into the sky with as bright a blue as its own, showing why the chain is called the Blue Ridge. The locality is rich in historic associations, for up and down this lovely valley rode the brave men of two armies, led by heroes whose names will live as long as history shall be written, or the exploits of daring souls be woven into the pages of romance.

Luray itself keenly felt the disastrous effects of the war, and is just beginning to feel the wave of returning prosperity, and to launch forth into enterprises that promise large results. The population does not exceed 1,000, but is destined to increase as the charms of the locality, now made accessible by the new railroad, become better known. To the observing tourist there is a certain interest aroused by the quaint peculiarities of the Old Dominion, nor is he impatient to have them lost in modern ideas and manners.

For more than fifty years an eminence one mile west of Luray has been known as Cave Hill, on account of a pit hidden in the noble grove of pines and oaks on its top. Into this hollow, long ago, a young hunter named Ruffner ventured, leaving his gun above ground, a hint that led his friends, who had missed him, to go down in search of the lost. They found him nearly dead with hunger and fright, and ever since the cave has gone by the name of Ruffner's Cave. Curiosity induced the author to explore it once, but without finding much to repay him for his trouble.

One day in July, 1878, Mr. B. P. Stebbins, who had a photograph gallery in the village, proposed to Mr. Wm. B. Campbell and others, a visit to this old cave for the purpose of examining it and possibly opening up new portions. They afterwards invited Mr. Andrew J. Campbell to accompany them on a second trip. This gentleman manifested no interest in the further exploration of Ruff-



A. J. Campbell.

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ner's Cave, but indicated his willingness to join them in hunting up a new one. It should be stated that Cave Hill is about 300 feet above the water level, sloping gradually toward the river; and is hollowed out by several large oval depressions known to have subterranean outlets. After about a month's hunting elsewhere, Mr. Wm. B. Campbell suggested that they should examine a sink-hole about 70 feet lower than the summit of the hill and 320 paces N. E. of the mouth of Ruffner's Cave. The hole was badly choked with rubbish, briars, and stones; but they could feel a current of air rising as an indication of a cavity beneath. After five hours of hard work, in clearing away obstructions, they had an opening large enough to admit a man's body. Mr. Andrew Campbell then taking a rope in one hand and a candle in the other, ventured into the dark and unknown vaults. He was followed by his nephew. The two men, on returning, said nothing to the crowd of lookers-on from whom they had borne no little ridicule for what was generally regarded as a chimerical project. But when the opportunity offered itself, they informed Mr. Stebbins of their truly wonderful discovery; and, that same night, they returned and made an exploration as far as what was then termed Muddy Lake, 200 hundred feet from the entrance, beyond which they could not go without a boat.

Thus, on the 13th of August, 1878, was discovered the Cavern of Luray; and Mr. Andrew Campbell was the first to enter where so many thousands have entered since. The site, however, was part of a bankrupt estate, and the claim had been purchased by a non-resident. For reasons into which we need not enter here, the county court ordered a new sale the ensuing fall, and the discoverers of the new cave were the purchasers, bidding it in at public auction, and paying for it what was considered a round price, namely, $17 an acre, which was double what it had brought at a previous sale. Meanwhile they had kept their own counsel as to their fine discovery, and when the former claimant learned the underground value of the estate (which it is said that he has never yet seen) he sued for its re-

covery, and won his suit after two years of litigation. Meanwhile the cave had been made extensively known, and capitalists stood ready to buy it as soon as a clear title could be had. Accordingly, when the final decision of the court was rendered, the property was purchased for $40,000, and is now held, together with lands since bought, about 100 acres in all, by the Luray Cave and Hotel Company. The general manager is Mr. Robert R. Corson; and Mr. Andrew J. Campbell is retained as the local agent.

The Luray papers first spread the news of the great discovery, and an early account appeared in the Baltimore *Sun*. But special credit is due to Major Alex. J. Brand and J. J. Collins, C. E., for their graphic letters in the N. Y. *Herald*, in October and November 1878, with a map by Mr. A. Y. Lee. These glowing descriptions led the author to visit Luray in December of the same year, in order to see for himself if what he had heard was true. The results of his observations appeared in the *Scientific American*, and also in *Frank Leslie's Weekly*, with full page illustrations by Mr. Joseph A. Becker. About the same time Mr. Lee's pictures came out in *Harper's Weekly*. Among those who have since written up this cave may be mentioned a commission from the Smithsonian Institution, whose report was officially printed; Mr. S. Z. Ammen, by whom a guide book and map were prepared; the editor of the Reading *Times and Despatch*; and Mr. Earnest Ingersoll, whose account, with illustrations, appeared in the *Century Magazine* for January 1882. Besides the above, a legion have written more or less about the same subject for other papers. My last visit to Luray was in February 1882, in order to perfect the map that accompanies this volume, and that is pronounced by the manager to be "the only correct map of the Luray Cavern ever published," being taken from the survey made by order of the Company. Another object I had in view was to see how the cavern looked when lighted by electric lamps; and to witness the process of taking photographs by this brilliant light, in which Mr. C. H. James, the artist who

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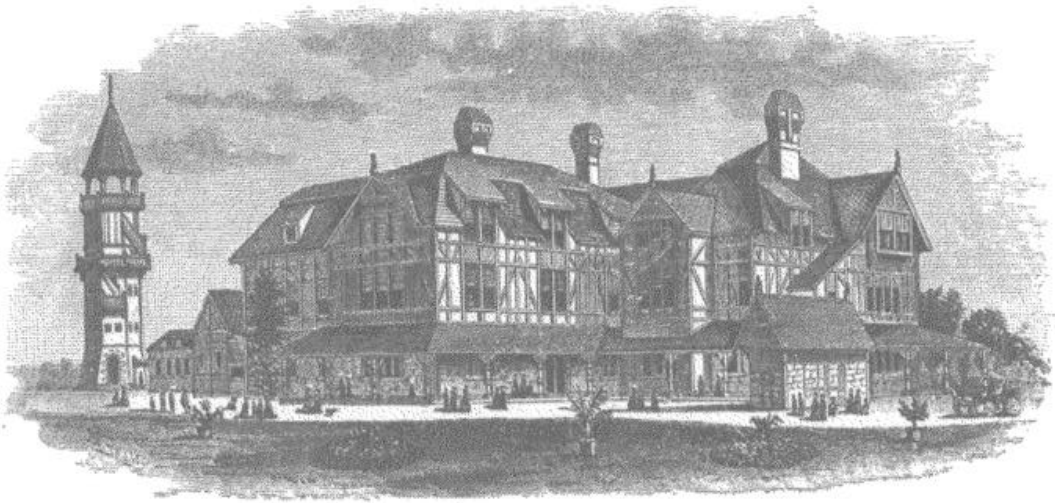


LURAY INN.

undertook the task, succeeded perfectly, although, as I regret to say, his views were finished too late to be made available for this volume.

Imagine these preliminary remarks to have been made while we were sitting comfortably on the spacious veranda of Luray Inn, sipping our lemonade (the strongest drink to be had lawfully in Page county); and now Mr. Corson telephones to Mr. Campbell out at the cave, telling him that we are coming, and gets his prompt reply that he will be ready for us by the time of our arrival. Before leaving the grounds, our attention is called to the steam engine by which the hotel and the railroad station are supplied with water, and we are informed that it also furnishes the power for the electric lamps in the cave a mile or more away. The expense of putting in the works, aside from the engine, was about $3,500, and the power required for each light is three-fourths of one horse power. 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*, supposed to be the longest current yet attempted with a single engine. Automatic regulation is of importance in managing so long a circuit; and this is secured by a system that allows any number of lamps to be turned on or switched off, without any change in the running of the engine. In other words, the current regulator is actually an electric governor.

The drive through the village is not without interest. The extensive tannery on our right is a new enterprise, and the largest of its kind in the country. The bridge over the Hawksbill, the old mill on the left, with its great water-wheel; the red brick houses built directly on the line of the street; the laborers and the loungers, of all colors, from the fairest Caucasian to the most swarthy African; the churches, taverns, stores and academy, all come in for a passing comment. We leave the pike beyond the town, turning to the left by a new road, and in a few moments are landed at the Cave-house. This is a conveniently arranged building, with a parlor, dressing-room, cloak-room, lamp-room and office inside; and por-

ticoes all around it, from which we may take a farewell view of the hills and dales lying in the brave sunshine, before going below. In front of the house is an enormous sink-hole, 1,000 feet across, and an equally large one is behind it. The ridge between the two extends up the hill to the grove around Ruffner's Cave. Having registered our names in a big book prepared for 25,000 names, which the manager thinks will be filled in a single year, and paying the moderate fee of one dollar to cover all charges, we are ready for subterranean adventures.

No change of dress is needed for visiting the portion of the cave open to the public; and for exploring other portions one only needs to provide himself additionally with a cap and stout shoes. Although the larger halls are lighted by electric lamps, it is customary for each visitor to take a tin reflector holding three candles furnished by the guide, in order to peer into the dark corners. These were, until recently, the only means of lighting the cave, except that on special gala days it was illuminated by fixed chandeliers, 10,000 candles having been thus consumed on a single occasion. Red fire and magnesium were also sometimes burned, with fine effect. But now the electric lamps are available for any party of more than four, and the carbons used last for about an hour and a half.

A stairway of solid masonry leads from the office down to the Vestibule (the dimensions of the Vestibule are, width 80 feet, height 20, length 100), where is fixed the first electric lamp and the only one requiring a shade. This is on account of the strong draught, in or out according to the season. We are surprised on being told that 2,000 candle-power is claimed for each lamp; for it does not seem to be half that amount. The explanation lies in the fact that the cave atmosphere, being *optically as well as chemically pure*, does not carry the rays as effectually as would be done by air in which motes were floating. The effect, however, is very brilliant, and far ahead of any thing heretofore attempted.

Seldom does a cave have so fine an ante-chamber as this! The visitor is startled by the formations that at

once surround him. On the right is the adit, now closed, through which the original explorers forced their way. On the left is Specimen Avenue, 100 feet long, from which visitors were formerly allowed to take whatever mementoes they pleased. This practice is now forbidden under strict rules that are invariably enforced. Stebbins Avenue has three large rooms underneath, that have never been explored as yet by any one except Mr. A. J. Campbell. It has, besides the objects already noticed, a natural Blacksmith's Shop, with two anvils, and a heap of cinders. The Cannon-ball, in Cannon-ball Spring, is about as large as a 54-pounder.

Only 10 paces in front of us is Washington's Pillar, broader at the base than at the top, a stalagmitic mass, rising from floor to roof, with a long diameter of 30 feet and a short one of 14, and 20 feet high. Its sides are fluted and jointed, and the material, though now somewhat smoked outside, is pure white carbonate of lime, fine-grained and beautiful. A basin filled by trickling rills lies alongside the pillar. Against the opposite wall are rounded masses reminding one of glyptodons and other fossil monsters, while brown buffaloes seem to hang from the roof. The latter are found, on inspection, to be spongoidal in appearance and blackened by iron. They are really the net-work of silicious veins running through the limestone and remaining after this has been dissolved by acidulated water that would not affect the silex.*

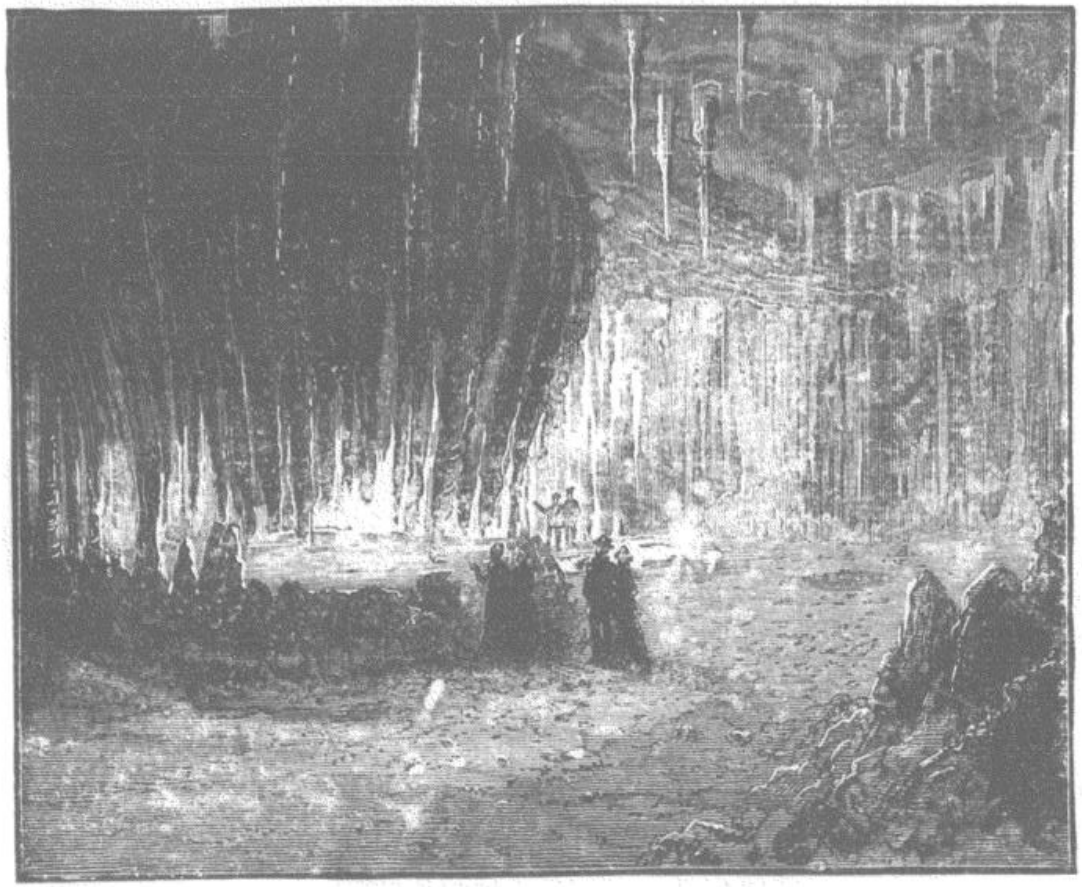
Between a petrified cascade and a fossil flower-garden, we descend 18 steps to a lower floor; the roof meanwhile retaining its altitude, being seemingly supported by long slender shafts of alabaster. The entire floor was once much lower than it now is, having been filled in by debris and washings from without. Here and there bone-hunters have dug through to the true floor below, reaching it at various depths, but thus far finding no remains of

* The author finds himself obliged to reclaim as his own some of the comparisons made, and scientific explanations suggested, in the articles originally prepared by him for the Scientific American, and that have since been borrowed by others.

special interest. These pits were afterwards filled up again. Further experiments might be more fruitful, if made in the lowest chambers. That powerful beasts once made this their den is proved by the long scratches on the rounded surface of a stalagmite on our right as we descend to the Amphitheater, and that might have been made by a bear or some other imprisoned carnivore. They were there when the cave was discovered. We saw likewise, in 1878, thousands of tracks of different kinds of animals, some of which we recognized as those of raccoons, rabbits, rats and smaller creatures; while some larger tracks seemed to have been made by wolves or panthers. All these impressions looked as fresh as if they had been recently made; which could not have been so, however, as it is many years since any wild beasts have appeared in the vicinity. The feet of thousands of visitors have obliterated many of these impressions, but they are still to be found in unfrequented portions of the cave, and in places covered by shallow pools.

Muddy Lake, which stopped the progress of discovery until the explorers could cross it by means of a boat, and which lay in a chasm from 12 to 30 feet wide and 75 long, is now filled up; and its former bed is traversed by a substantial concrete walk. A fine effect is produced by the second electric lamp, placed at its farther end and that shines through the graceful arch of a natural bridge. This same lamp also lights up the Fish Market, one of the greatest curiosities here. It gets its name from the rows of folded stalactites, wet and shining, like long strings of black bass and catfish, and that seem to be waiting for some purchaser.

Our path now turns at right angles, up a flight of steps to a floor that is on a level with that of the Vestibule. The roof for some distance is nearly bare of ornaments, and it is almost the only place in the cave that is so; the ceiling elsewhere being ribbed and fretted with innumerable stalactites. The distance from the floor to the roof here is but about 5 feet or less. Trenches have been dug on the line of travel to enable persons to walk erect, who



A Scene in Luray Cavern.

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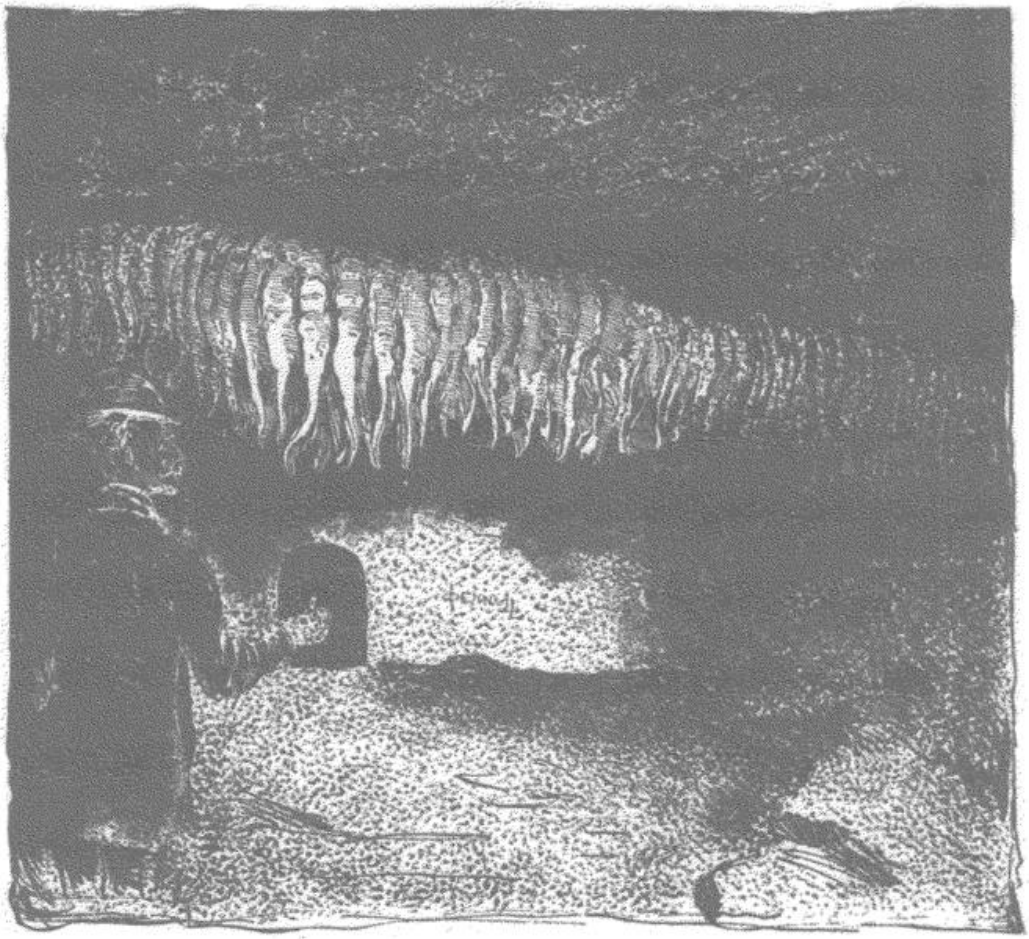
prefer doing so to groping around on all fours spying out the secrets of the gnomes. The floor itself is a bank of chalky substance, the product of disintegrated carbonates. The width of these galleries is immense. We dispersed our lights here and there, in order to get an idea of their extent, and judged it to be 200 feet in one direction and 500 in another. Rambling to and fro we find many water-worn stalactites and columns half eaten through. This was once a spacious hall, though now nearly obliterated by calcareous deposits and debris. We named it the Elfin Ramble.*

Following one of the trenches we find on our right the Crystal Spring, whose bright waters are held by a basin built of crystals deposited by itself and rising several feet from the floor. Near it are several others half concealed by the crystal crust that like an icy film has shot across the surface. These are all really one body of water, as is shown by the fact that any agitation of one is extended to the others also. The brim of this spring almost meets the bulky stalactites that hang over it, like a curtain with ornate fringes. The water is as refreshing as it is pure; which, indeed, is true of all the springs in this cavern.

Crossing the Elfin Ramble, we find a profound gulf from 50 to 70 feet in depth, and a rift above it reaching upwards quite as far, making the entire distance from top to bottom as much as 140 feet; while its length, including an extension, is thought to be nearly 500 feet. This is Pluto's Chasm! Here, on its margin, stands Proserpine's Pillar, one half brown and the other half white. Down the dark gorge a specter waves its arms—only another white column. We can reach it, if we wish, either by a rough scramble down the ravine, or by a detour and a flight of steps. Still further on the chasm is bridged, and those who wish to do so can take a short cut to the Ball Room. In the Ball Room is exhibited an exact resem-

* Perhaps it was because "christening" is in the author's line, that he was requested to *name* most of the objects and localities of special interest in Luray Cavern.

blance to a lady's riding-whip, delicately tapering from the ornamented handle to the short braided lash at the tip. Electric lamps are placed so as to illumine the entire length of Pluto's Chasm. Following its margin we find its character changing. Alabaster cascades (there are no others here) spring from the bare and gloomy walls, and finest drapery hangs amid broad brown sheets that look like sides of sole-leather. Down still another stairway we reach a substantial plank walk, leading to Hovey's Hall, amid an innumerable variety of singular and beautiful formations. Here are tattered banners, relics of ante-diluvian hosts; there are gay pennons that might grace "the masts of some tall admiral;" on the right is a queer concretion called the Broom Column, from its fancied resemblance to that noble and useful weapon; while on the left grim old warriors, armed with spear and halberd, stand as faithful sentinels, keeping ceaseless vigil through the ages. On an inaccessible ledge far above all this rugged scene, an object is descried over which the ladies always are in raptures, although not entirely agreed as to whether it is a dear little Cupid, or a lovely angel in alabaster, its white wings folded as if at rest; while still beyond it the great stalactites crowd the roof as far as the eye can reach. As we walk under them we presently observe a spot where one weighing 1,000 pounds has been lately removed. It was done for the Smithsonian Institution, and the process was singularly ingenious. Mr. Campbell, in his anxiety to transfer the fine specimen unbroken to Washington, first wrapped it in cotton cloth, winding each pointed tip separately; then fitted between the tips bits of wood to prevent any injury from some sudden jar; and to complete this preparatory work he built a box around it as it stood; and after all this, he carefully sawed it from the neck by which it hung, and had it lowered by men standing on a scaffold made for the purpose, who also removed it from the cave. Advancing farther in this Hall we come to the Major Chimes, six blades disengaged from each other for about 12 feet, which emit most harmonious tones when struck by the hand, the vibrations being prolonged for



THE FISH MARKET.

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from 60 to 90 seconds, and ringing so as to be heard in distant parts of the cave. Among the diversified formations here should be mentioned the Bronze Columns, rich and bright as if actually cast from metal. During part of the year this room is occupied by a lake; but at the season when it is most generally visited it is quite dry. And, indeed, the wet spots are bridged so as to make it accessible at all seasons.

Evidently the entire chasm was at one time, ages ago, but long after its original excavation, filled with acidulated water by which the old set of stalactites was singularly eroded. These decayed forms remained after the flood had subsided. Threading our way amid a grove of these worn and ancient growths, at the end of the Elfin Ramble, we could not help admiring their wavy surface, so yellow and wrinkled, the layers of which resembled the gnarled grain of precious woods. Rising from among them we discovered a cluster of more modern stalactites inclosing a balcony to which it pleased Mr. Campbell to attach the author's name, in 1878, as well as to the hall below, and of whose proportions, lighted by the electric lamp, it commands a splendid view. Hovey's Balcony contains rich marvels from Nature's loom. Sixteen alabaster scarfs hang side by side, of exquisite color and texture. Three are snow white, and thirteen are striated like rich bands of agate, showing every imaginable shade of brown, and all are translucent. The shape of each is that of one wing of a narrow lambrequin, one edge being straight and the other meeting it by an undulating curve. The stripes follow the curves in each detail. The scarf most admired resembles a white crêpe shawl, both in size and in its graceful, wavy folds, excelling the most artistic creation of the sculptor's chisel. Down the edge of each piece of drapery trickles a tiny rill, glistening like silver in the lamplight. This is the ever-plying shuttle that weaves the fairy fabric.

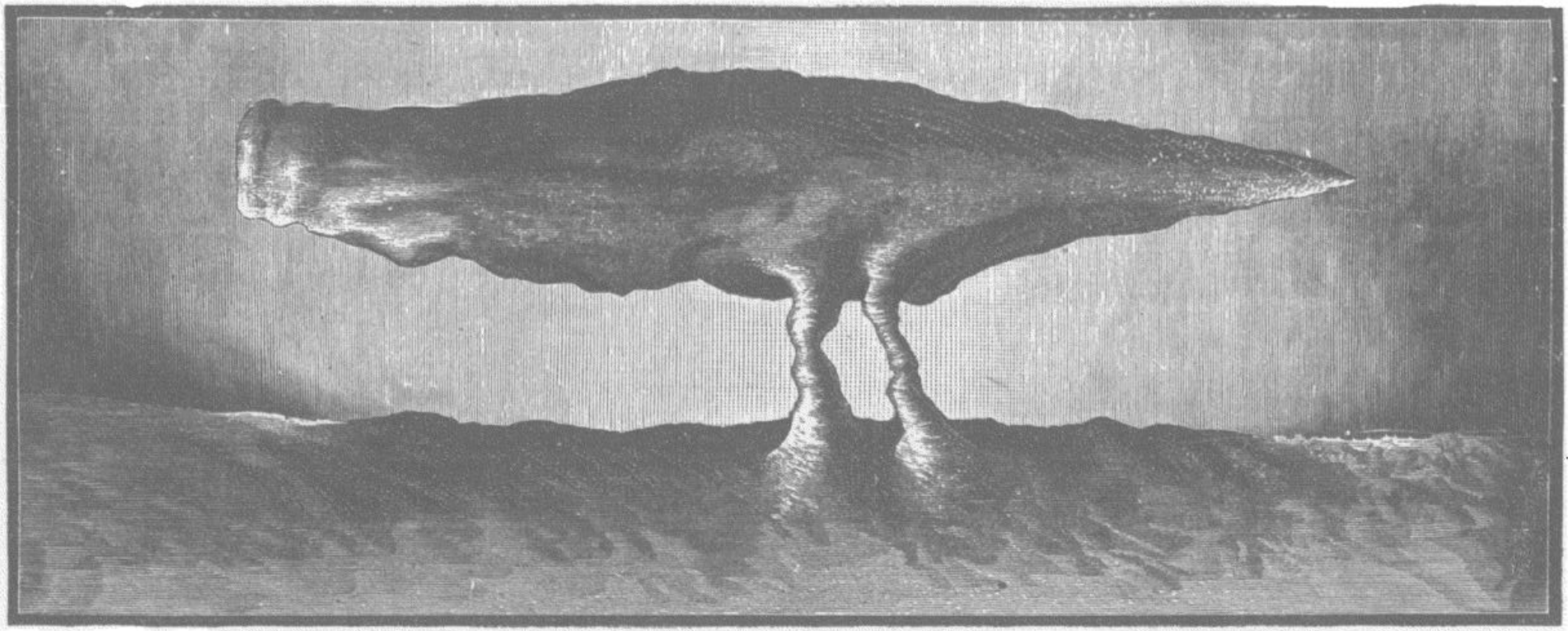
Returning now to the upper end of Pluto's Chasm, and paying our respects once again to Proserpine and the Specter, we pass by a curious palisade of small stalagmites that grow to bulky dimensions on the further margin. On

our left, beyond the chasm, which is crossed by a bridge, a sloping ascent of red clay, deeply furrowed, shows that we are not far from the surface. Once, as a visitor was writing up his notes, near this point, a rabbit sprang by, upsetting his lamp, and disappeared up the slope!

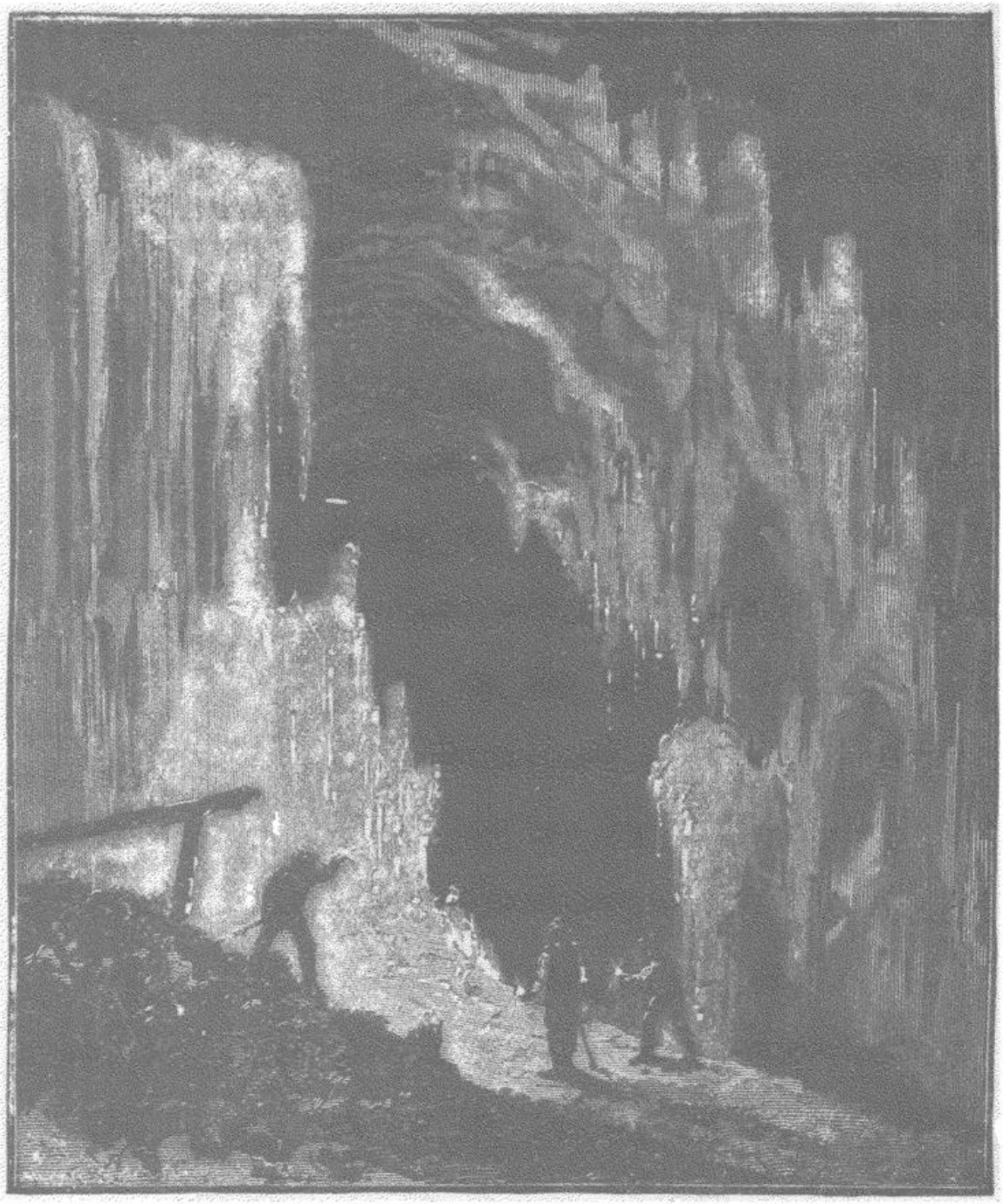
Oberon's Grot contains a limpid pool guarded by numberless stalactites that shine and sparkle with singular beauty in the rays of light with which it is flooded. Just beyond it is what is now known as the Bridal Chamber. The *old* Bridal Chamber was a room near the Hollow Column, but it was desecrated by muddy feet that spoiled its fair white floor; hence, as no genuine cave is complete without a place thus named, the title was transferred to these delicately draped walls near Oberon's Grot.

What idea is conveyed to your mind by the name of the next object of interest, namely, "The Poor Man's Bacon?" It is an exquisite bit of drapery, at first called "The Fairy Veil," until some wag saw a resemblance in it to a slice of lean bacon, and *presto!* the change was made. The guides take satisfaction in telling every visitor about the tip of this pendant. Some man broke it off one day, and it was found in his possession. He was duly fined by the magistrate and went his way sorrowing. The thought occurred to the manager that possibly the broken piece could be grafted on again. Accordingly it was fixed to its place by wire; but it had only been there a day or two before it was stolen again. Again the offender was caught and fined. The fragment will no doubt be wired on again, and may serve as a trap for many "a poor man" who would be glad to save his "bacon." At any rate it has answered as a warning to many.

Titania's Veil and Diana's Bath are next exhibited—objects of much beauty and interest. The temperature of the bath, as tested by me in Mr. Campbell's presence, is exactly 52° Fahr., while the air above it is 54°; agreeing with my observations in Mammoth and other caves, and showing this to be the mean temperature of the earth over a wide area. These observations were taken with a standard thermometer, and can be relied upon as correct.



CURIOUS STALACTITIC GROWTH.



THE SENTINEL AND THE SPECTER.

The Frozen Fountain, pointed out near by, has nothing to do with this matter of temperature, but is an exquisite mimickry of a *jet d'eau* congealed amid its play.

Passing through an opening in a stalagmitic curtain, only 6 inches thick at its edge, but 30 feet wide and 50 high, we are beside the Fallen Column. Seating ourselves on its trunk, which looks like that of a prostrate and moss-grown oak in the forest, let us look around us and see where we are, and what has been going on in this realm below ground.

The impression generally made on the visitor is that some tremendous earthquake must have shaken the rocks asunder, and toppled the ponderous fragments down in this wild confusion that we behold. But the truth is that such upheavals have had little to do in bringing about the results observed. Earthquakes may have opened the original rifts; but all else was done by the chemical and mechanical action of acidulated water. It was this subtle and silent agent that sought out the joints, seams, and other lines of weakness till the water-swept channel deepened into what is now called Pluto's Chasm. Softened ledges were dislodged, successive floors undermined and cut through, walls between chasms broken down and worn away, until the cavities finally scooped out were far more prodigious than any now visible. The axis of erosion was from S. W. to N. E., as it also was in Ruffner's Cave. Branches at different levels were also excavated.

Room was made by this means for calcareous deposits; and the vast halls began to be slowly filled up by stalactites and stalagmites, many of them growing to great size.

Then came a catastrophe, possibly due to an earthquake, by which the outlet of the subterranean stream became obstructed, and the pent-up waters were accumulated till the entire cavern was filled from the lowest pit to the loftiest gallery—a fact proved by the earthy deposits amid the highest clusters of stalactites, as well as by the uniform erosion of dripstone. During this period, whose duration we have no means of determining, the carbonic acid absorbed by the water was held in contact with the calcare-

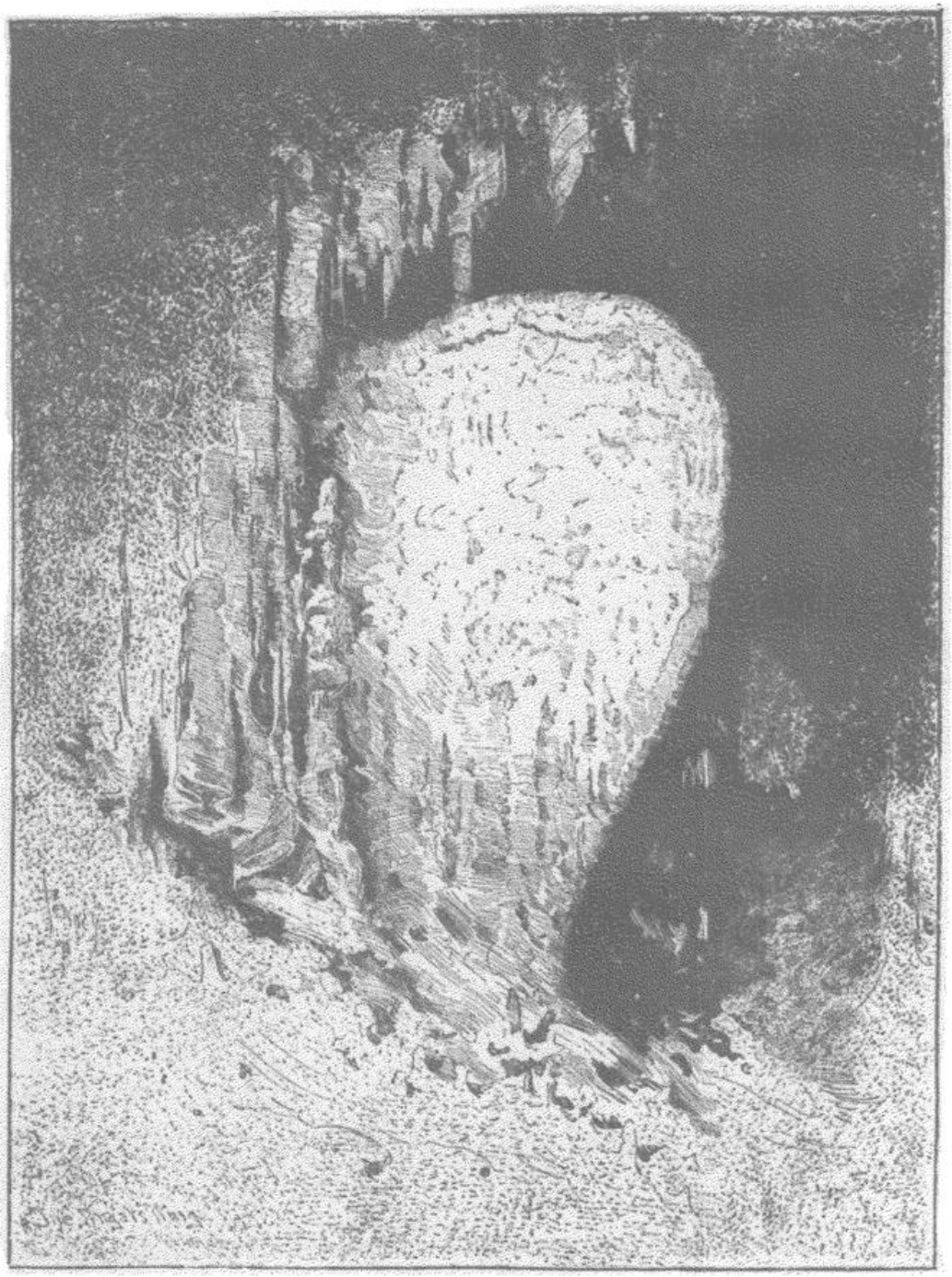
ous deposits, destroying their texture and causing a species of decay. Under the blackened exterior of this Fallen Column is what was once alabaster firm as ivory, but is now transformed into a chalky substance in which a knife blade can be thrust to the hilt.

Finally a new outlet was found, independent of the original system of drainage, and supposed to be in the deep spring near Blackford's Furnace. This spring has long been regarded as unfathomable, a 50 pound weight attached to a cord 80 feet long having failed, it is said, to reach the bottom; a legend having also gained circulation that a wagon with four horses and a driver was once swallowed down here without a vestige remaining! Doubtless it is really very deep, extending down to the level of the Hawksbill, and the volume it pours forth may be the drainage of all the cavities in the hill. However that may be, there is every indication that when the flood left the cave it did so with violence, tearing down loosened rocks, hurling stalactites to the ground, and felling huge columns like trees in the tornado's path.

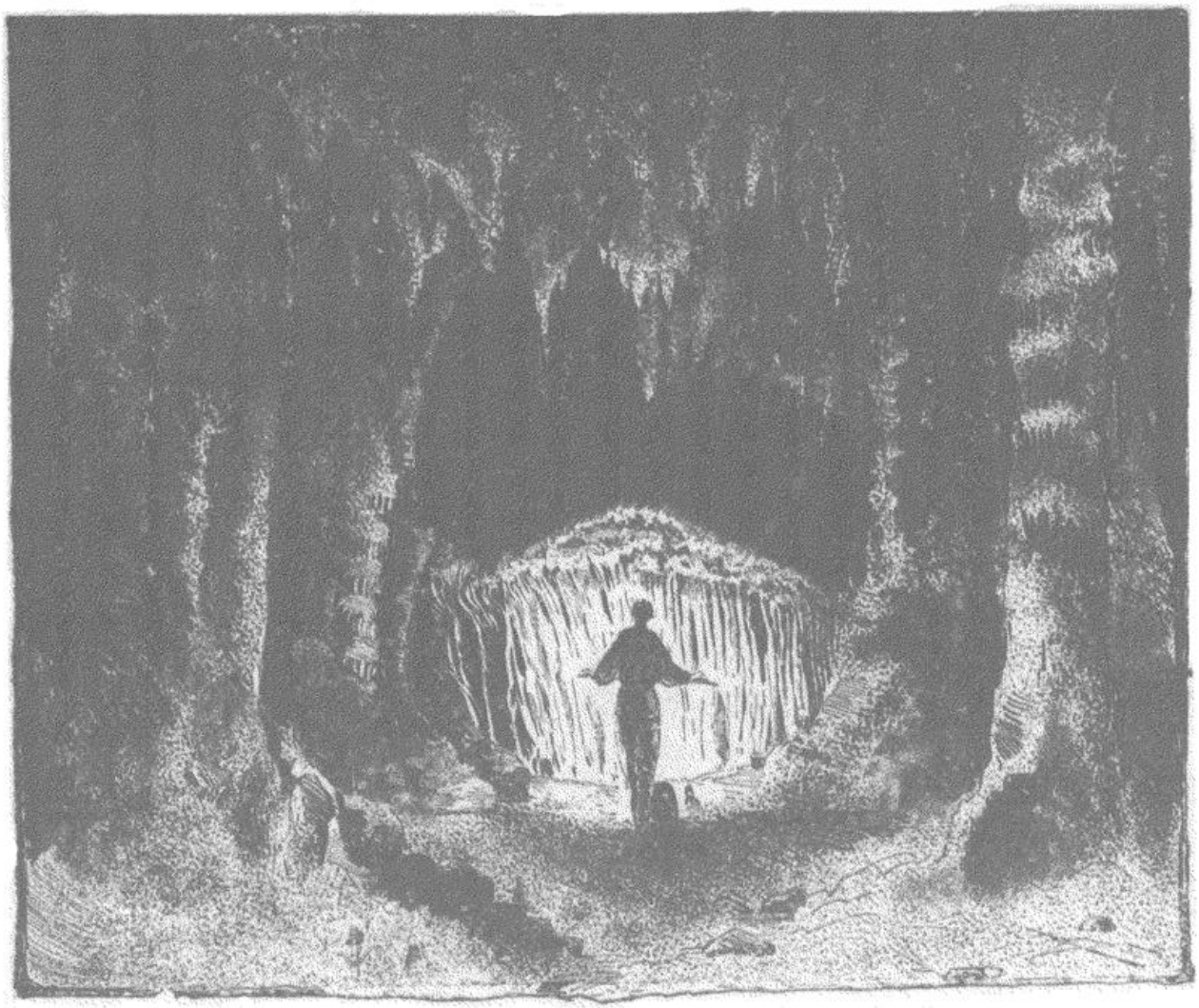
On an eminence to our right stands a sublime monument of aqueous energy. It is the Hollow Column, 100 feet in circumference and 40 feet high. Finding it too rugged and compact to be overturned, the fierce waters pierced its marrow, leaving a tubular passage from top to bottom, through which one may climb up to the extensive galleries above the Giants' Hall, the distance from whose ceiling to the floor below, as measured by Mr. Collins, was found to exceed 160 feet.

The flow of the subsiding waters became gentler toward the last, merely removing the softened exterior of the dripstone, leaving a wavy surface with sharp angles and polished sinuosities. As has been already intimated, a totally new set of stalactites then came into existence; some of which were formed from the crude materials furnished by the limestone, but others from the refined substance that had already once been used in the older formations.

Thus originated striking contrasts. How grandly the



THE ANGEL'S WING.



THE CATHEDRAL AND ORGAN.

Angel's Wing, with snowy plumage, sweeps out from the dingy and corroded mass whose inner substance it only recasts! Those softly-draped and delicately-tinted figures in the Saracen's Tent really owe their being to the grim ogres that guard them. Finer still, if possible, is Corson's Candy Column, hidden around the corner, and only shown to special admirers of beauty; and its rippled and dimpled contour is because the pellucid alabaster has so faithfully followed the wrinkles, while rounding the angles of the ancient form it wholly encases and conceals.

Many have asked the age of the Fallen Column, but the answers are generally wild, running up into the millions. The electric light shows, far above our heads, the scar left when the great stalactite (for it was *not* a column) was wrenched away; and its position as it lies, with its butt lower than its tip, and shortened by at least 15 feet, proves that it fell swaying to and fro. *When* was all this done? The rate of stalagmitic growth in Luray has not yet been determined, though some experiments have been made. But we may apply tests from other caves. Measure the group of stalactites that have had time to grow from the end of the Fallen Column that is now uppermost. They are 4½ feet long and 11 inches wide. At the rate known to be true for Howe's Cave, their age would only be 72 years, suggesting the possibility of the fall being caused by the great earthquake of 1811. Or, at the rate known to exist in Wyandot Cave, their age would be 1,350 years. These are the extremes, and the room between them is ample for guess-work without going outside the limits! But if there is so much uncertainty about the new, how much more as to the old!

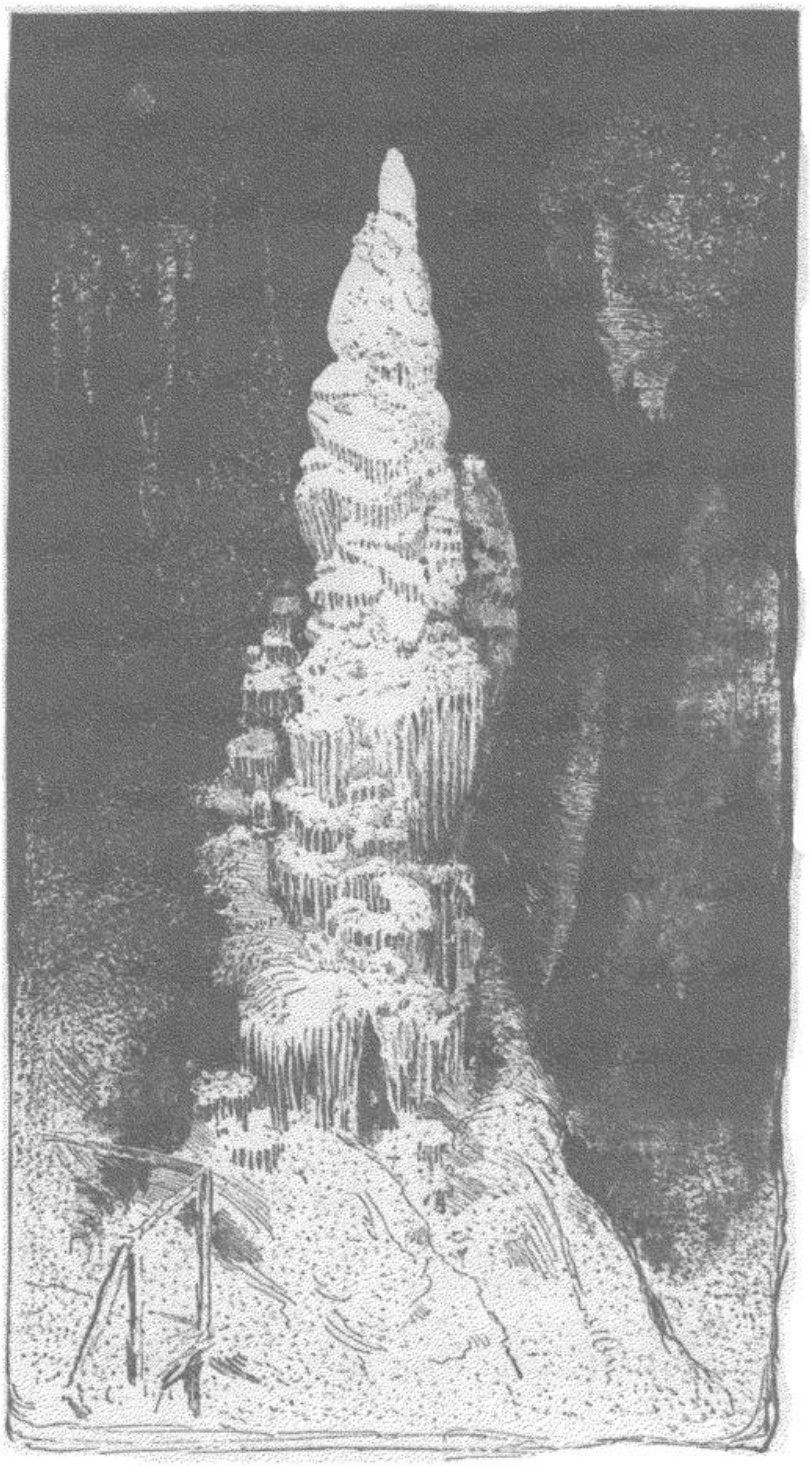
Music may be had in these subterranean halls. In the room on our left, as we go on, is a large group of stalactites that fell, points downward, in the mud, and forthwith became an Organ with 56 gilded pipes. Who credited that marvel when first told of it? Yet there it is, with its pipes great and small, solid, not tubular, and to be played by blows of the fist instead of the bellows. By striking selected stalactites one of our party played for us

Yankee Doodle, My Maryland, the Sweet By and Bye and several other simple airs. Behind the Organ stands the Throne and the Minor Chimes, the clear and bell-like sounds of which can be heard far away.

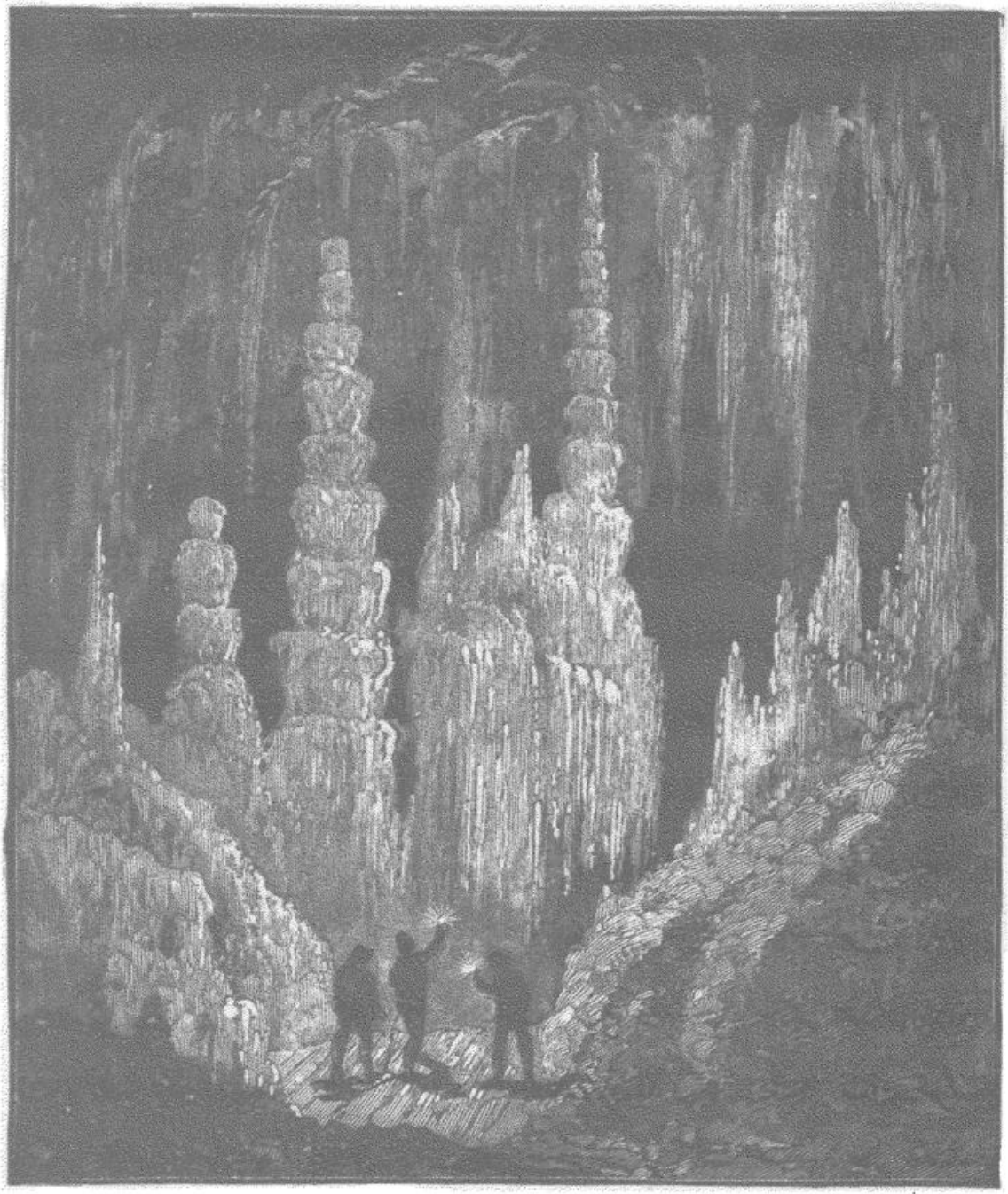
Leaving the Cathedral and following the main path, we pass around the Tower of Babel, with its 22 stories of dwarf colonnades, and behold before us a wondrous grouping of glittering pillars rising from the gloom in every direction. Only a few of them have been named, hundreds of graceful creations awaiting in obscurity the names yet to be given them by the lively imagination that shall detect some fancied resemblance. Among the more conspicuous objects pointed out in the Giants' Hall, the most lovely of all is the Empress Column, 30 feet high, with rich flutings and carvings, dark-shaded near the ground, but growing white as it rises, and in the upper portion changing to the pink tint of a most delicate sea shell. A shapely bronze statue near by serves as its foil. On the other side is the Sultana, less finely colored, but very symmetrical, its head wrapped in a turban. A lower pillar bears the image of an Indian squaw; and still another lifts aloft the likeness of a crowing chanticleer. Shafts, domes, minarets, slender and lofty spires, long and twisted pillars shoot up from amid great blocks of limestone and car-loads of red clay. On the return the Comet Column, like a white flame from a lurid cloud, should be noticed near the Hollow Column; and a little further on is the suspended Camel—name fruitful in atrocious puns at the expense of the guide.

A secret way is said to lead back from the Empress Column to the Specter and on to the Ball Room; but we leave these hidden tunnels to Campbell, who delights in them and knows them all.

Advancing a few paces in the Giants' Hall, we come to the swords of the Titans, monstrous blades 40 or 50 feet long, broad and hollow, yet keen of edge, and returning a deep echoing peal when struck by the hand. A section of one of them was broken off at some unknown time, and is completely buried in the floor. Their origin, as also



THE EMPRESS OF LURAY.



IN THE GIANT'S HALL.

that of the delicate scarfs already described, is in trickling lime-streams running together on a sloping surface, and then growing downward till the curved sides meet in one edge. In the Giants' Hall should be mentioned a facsimile of the Dome of the Capitol at Washington; built on a mass of fallen stalactites. It is near the Empress Column.

The guide calls our attention, before going further, to a sort of inverted formation in which the stalagmite is above and the stalactite below, making a very queer pillaret, 15 feet high and 6 inches through, hugging the wall with no visible means of support.

A few steps beyond stands the Henry-Baird Column, so named in honor of Professors Henry and Baird, of Smithsonian fame. This double column, which is guarded by the "Lion of Luray," is made of companion stalagmites, one rising in stories for 30 feet, and the other ascending in unbroken longitudinal grooves till its top is lost to view among the stalactites of which it was long thought to be one itself. By mounting to a platform on the way to the Round Room you can look directly over the Double Column, and see that there is space enough for a man to stand erect on top of it. The height is estimated at from 45 to 60 feet.

My first visit to the Round Room was not by comfortable steps and a prepared way, but by the use of ladders, and much creeping. We had to break our passage through hundreds of delicate stalactites that it seemed a pity to disturb, unwinding a ball of twine as we went, as a clew by which to find our way out again. Emerging at length on an eminence, we had some difficulty in getting down into a ravine below. And there, by digging in the dry bed of an old torrent, we unearthed an arrow-head and a quantity of charcoal. A rudely fashioned spear-head has since been found near the mouth of the cave; and there are moccason tracks near the Hollow Column, covered by shallow water and incrusted by a thin coating of lime.

In the Round Room stands a beautiful column variegated in its colors, and about 70 feet high. It is perhaps

the most symmetrical pillar in the whole cavern. This room is also remarkable for the groups of fallen stalactites, not thrown down by any convulsion but evidently crowded off from a ceiling too chalky and soft to retain them. A new set has grown since the old were dislodged, and their length in some instances exceeds three feet. Some of the old stalactites fell upside down, and stalagmites are now formed on their inverted points!

We next make our way to the Ball Room, as people persist in calling it, because as it is said "there are special occasions when the citizens of Luray here assemble to 'chase the glowing hours with flying feet.'" This is a large pavilion, about 100 feet across, and a portion of it is floored for the use of assemblies. Notice Mahomet's Coffin at the entrance of the room; and on the opposite side of the gateway, the Chalcedony Cascade. The former is a rock seeming to be suspended in mid-air. The latter is a mass of mammillary alabaster, 25 feet high and 30 wide, and a continuation of a similar formation above, that can only be reached by climbing. It is remarkable for its variegated hues; brown, yellow, steel-gray, ashes-of-roses, drab, milk-white and blue. It is a new formation upon the old, and a row of stalactitic teeth 4 feet long, ancient relics, skirts the base. The colors do not seem now as bright as when the cave was first explored.

In making the circuit of the Ball Room various "robed and spangled forms" are pointed out, the most striking of them being Cinderilla Leaving the Ball, her trailing garments and slender figure being much admired by visitors. Not very far distant, and as if in solemn rebuke of the levity of the gay, are the Tombs of the Martyrs. Tara's Harp is another curiosity. The Bird's Nest is still another. It is concealed under a flat stone. On lifting it you see four tiny eggs in an oval nest. These are "cave-pearls," gems of calcite polished by attrition with each other in agitated water. Elsewhere they are found of all sizes, from a pin-head to a canon-ball. On fracture the interior exhibits a shining, radiated structure. When the water remains quiet for a time, they become attached to

the bottom of the pool, and often grow up into cones; which explains the fact that stalagmites are sometimes seen rising from below the water to a considerable height above it.

The Coral Spring, in a corner of the Ball Room, is a beautiful series of terraces, each being in turn filled to the brim with the overflow of the one above it, and each building up its own ruffled and incurved rim.

On the right are steps leading up to Collins' Grotto, named for J. J. Collins, C. E., of New York, whose graphic letters were among the earliest and best descriptions of Luray, and who has since won wide and deserved fame at the cost, alas, of his life, in connection with the Arctic voyage of the ill-starred Jeanette. In this grotto is the Dragon of Luray, of which the picture gives a sufficient description. Here, too, is the Snow-ball Spring.

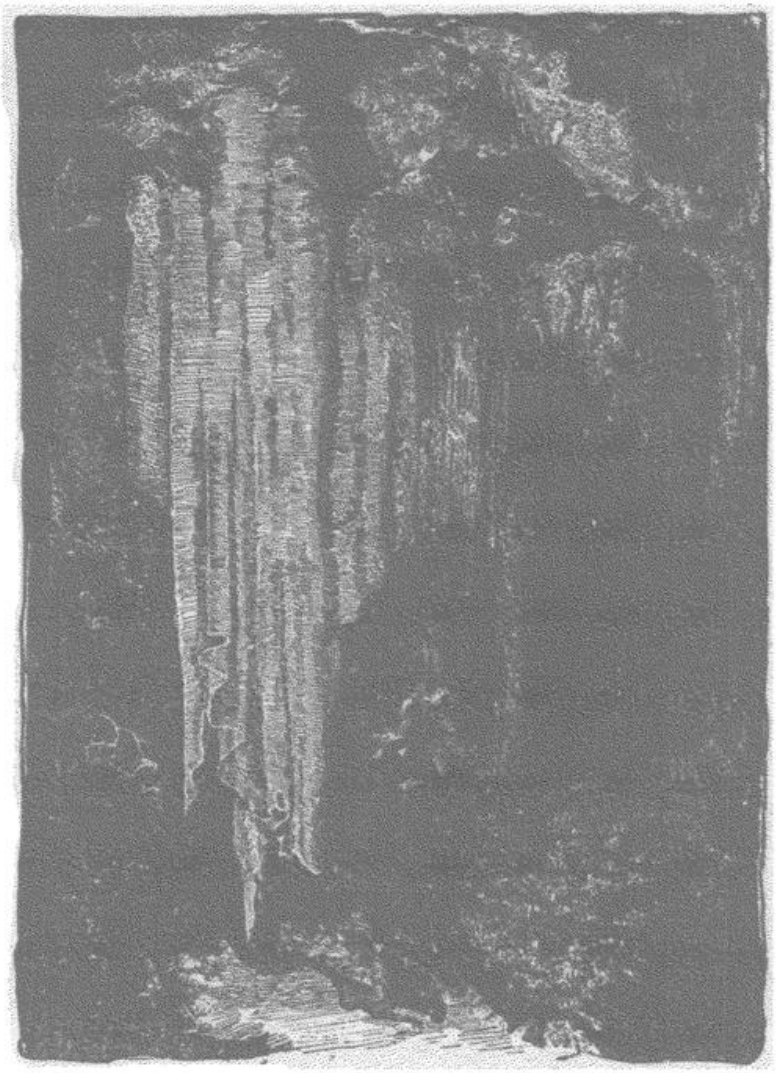
Returning now as far as the Chalcedony Cascade, look up to the precipice on the opposite side, and observe those stubby stalagmites protruding from its face, like so many excrescences. It was by climbing over those that Mr. Campbell and the author first gained access to an apartment about 150 feet in diameter and 35 feet high, which it gave the friends of the discoverer sincere pleasure to name for him "Campbell's Hall." This place may now be entered by a plank walk leading through a wild ravine, and mounting two successive stairways, thus proving its claim to be one of the upper stories of the cavern. The beautiful and diversified formations well repay the trouble of a visit, although the locality is not ordinarily shown to large parties. Alcinda's Basin, or as it is sometimes called, the Fountain in Tiers, is like the Coral Spring, a series of six or seven ruffled terraces, each being a receptacle for the overflow from the one above it, and each being lined with fern-like calcite crystals, white and clear. The Mermaid, or the Scaly Column, is 5 feet high, tapering from 2 feet at the base to 1 foot at the flat white top. Strings of shining beads adorn the sides downward, growing into scales like those of a pine cone, only pearly instead of brown, and with pink edges. Increasing still in

size, they turn to a lead-blue. Dispersed about the base are little white stalagmites seeming to float on milk. Brown mossy crystals of calcite and arragonite grow in clusters near this marvel of beauty.* Campbell's Hall can also be entered by Boot-jack Alley, provided one does not stick fast in the wet and tenacious clay that gives the passage its prosaic title.

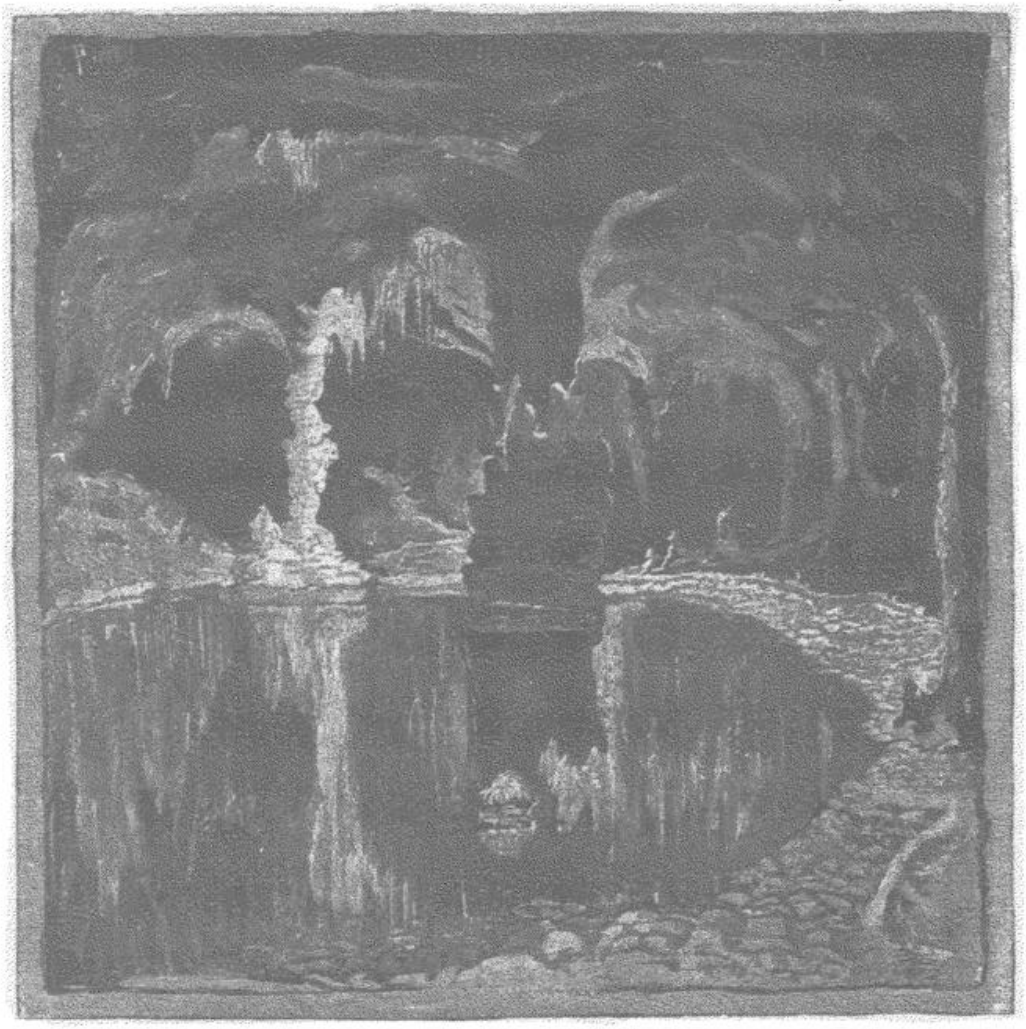
Among such a variety of objects there are always many that are overlooked on a first trip, and hence it is well to return slowly, taking observations as you go along. In one place the guide will step aside to exhibit what he calls "The Toy-Shop," a collection of stalactites twisted in every conceivable manner, and bearing a resemblance to the familiar display of toys by which the children are delighted on Christmas Day. In another place he shows a singular piece of drapery called variously the Wet, the Torn, or the Lost Blanket, and admirably represented in the accompanying sketch. Behind it is a dainty scarf, in brilliant colors, styled the Fairy Handkerchief. On the lofty ceiling, near by, is Helen's Scarf, through which a ray shines from the electric lamp, showing its lovely transparency. The body of it is spotless white, and the wavy border is a rich crimson.

Leaving the Cathedral by a path skirting the border of Chapman's Lake, we laugh, as hundreds of others have done, at the distinct impression left by the unfortunate gentleman when, long ago, he ran over the bank and fell at full length in the bed of the lake. One of the distinguishing peculiarities of Luray Cavern is the existence of these limpid pools, hundreds of them, varying in size from a diameter of 6 inches to one of 50 feet, but all of absolute transparency, so that others beside Mr. Chapman have walked directly into one of them, and thus first learned of its existence; and on the other hand we have several times

*I have retained the description given in 1878, although this beautiful column has been much defaced, because it was then regarded as one of the most curious objects in the cave. Mr. Collins was in ecstacies over it. The fact of crystals of calcite and arragonite being found together was shown by analysis.



AN ALABASTER SCARF.—THE LOST BLANKET.



BROADDUS LAKE, LURAY CAVE.

tried to drink from one of these natural bowls that, to our surprise, we found had run dry!

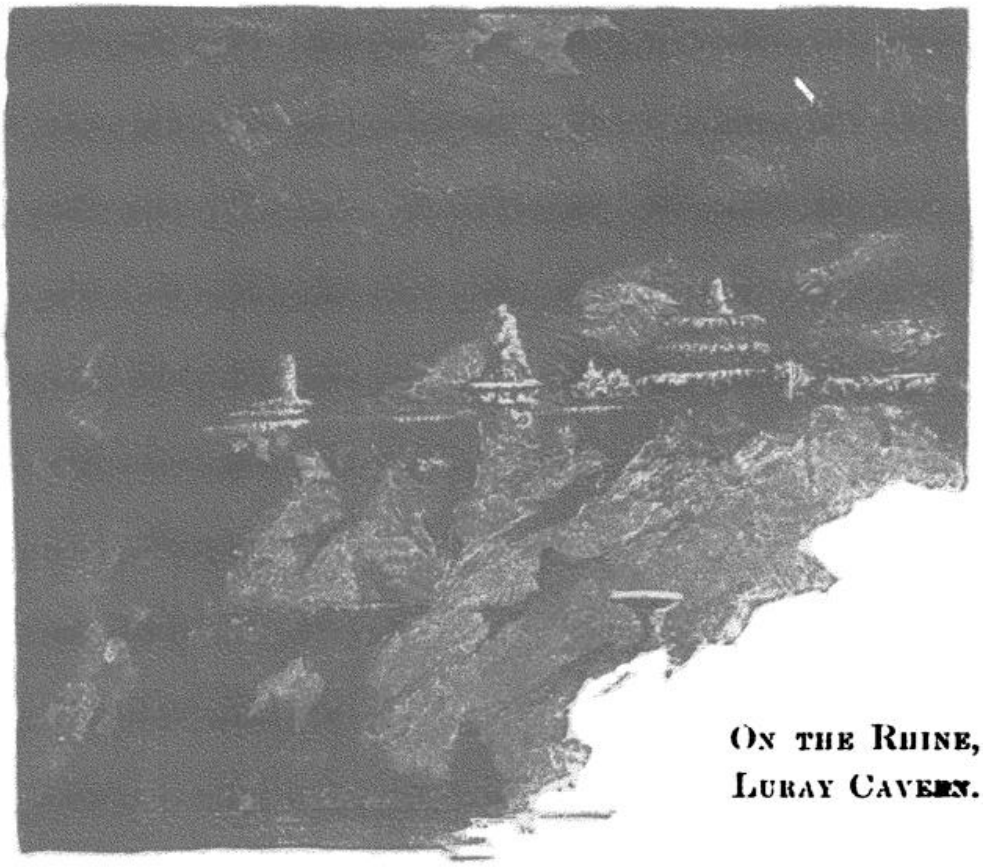
The variations of water level are strongly marked by rings or ridges, especially in some of the larger pools. Broaddus Lake, for instance, not only reposes on a bed of crystals, overarched by a vault bristling with stalactites, but it is girdled by a crystalline strand once entirely covered by the bright water. It is now about 40 feet across in winter, but it was formerly twice as wide and 5 feet deeper than now, judging from the curved rampart whose margin we know it must have touched, and whose horizontal folds clearly indicate the change of level. To the same cause are due the outgrowths about the roots of some rich buff stalagmites slashed with white, and others less conspicuous. These are flat on top and rounded underneath, like specimens of woody fungus, and some of them have a velvety coat of olive-tinted crystals, and are tipped with red and purple.

Climbing over the rampart mentioned above, we find ourselves in the basin of what was once a considerable lake. The sides are crystal and ornamented along the top by rows of stalagmites, to which the name of the Castles on the Rhine has been appropriately given.

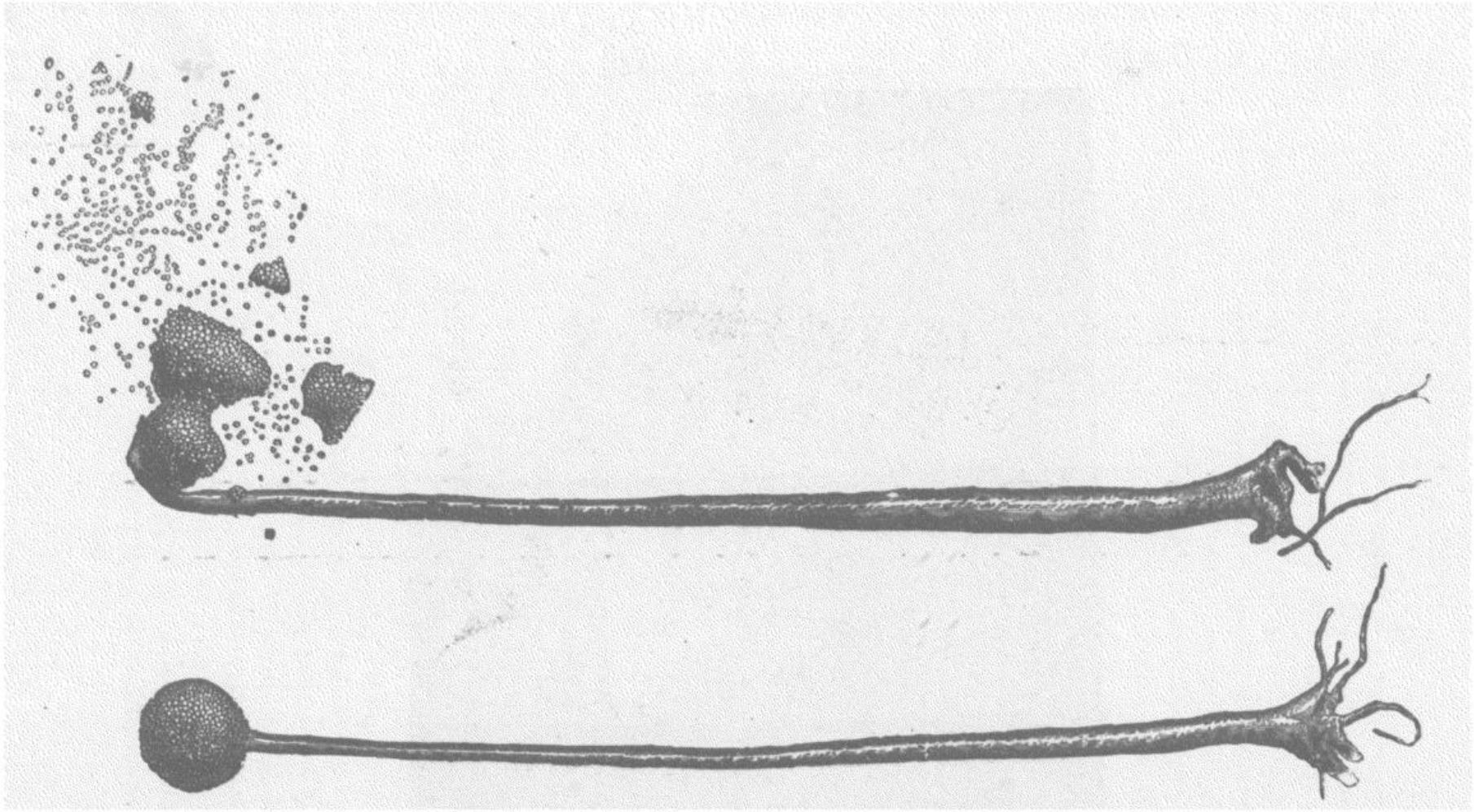
There is an extraordinary rift near Broaddus Lake, which bears the suggestive title of Hades, because of its depth. We traced it for more than 400 feet, although its width is only from 1 to 3 feet. It seems to have been caused by the settling of the rocks, in consequence of having been at some time undermined. Interiorly it slopes at an angle of 30° from the perpendicular. Mr. Collins held the rope while Campbell let himself down for 50 feet without touching bottom. In my company two other trials were made at points seemingly more favorable, and without a rope; but in each instance the edge of a pit was reached whose depth was not ascertained, but was thought to be not more than 30 feet. Could this lowest floor be reached, which must in the nature of the case be nearly if not quite down to drainage level, we anticipate the discovery of running streams, containing perhaps

blind fish, and other forms of subterranean life. As matters now are, the known springs and pools of this cave seem to be wholly uninhabited. It should be stated for the relief of any timid visitor, that the portion of Hades along which the regular pathway lies, has been securely blocked up with fragments of stone, so that he need run no risk of falling into a crevice from which extrication might be difficult. The fresh surfaces of some of these fragments, by the way, are very beautifully striated, and blocks from this locality have been worked into tiles and ornamental tablets with fine effect.

Making our way back to the Elfin Ramble, and crossing to its southern end, we are introduced to one of the former occupants of the cave, the nameless explorer who perhaps made the original discovery. Down in a deep ravine lie the bones of a human being entombed in dripstone. They are not now in a very presentable condition, the fragments have been some of them taken away, and the place having been trodden by many feet. But, in 1878, there were visible the jaws and teeth, the femur, tibia and ribs, the latter fractured as if by a fall from the over-hanging cliff. The remainder of the skeleton could no doubt be obtained by careful digging, and it is proposed that this should be undertaken by the Smithsonian Institution, and whatever may be found subjected to scientific examination. The supposition is that these are Indian remains, as the skull is firmly held by the mass of alabaster formed around it and that must have required several centuries for its deposit. The unlucky adventurer has been made the subject of several grim jests. On his first finding, word was sent to the coroner to come and sit on the body. The legend that this may have been a soldier in the late rebellion led to some enthusiastic lover of the Lost Cause depositing a wreath here on Decoration Day. And, unkindest cut of all, Mr. Ammen solemnly assures us that the man's trouble was due to the fact that he did not have a copy of his guide-book when he entered on his explorations. A romantic story has been woven to the purport that these are the remains of a lost maiden of Luray, who being crossed



ON THE RHINE,
LURAY CAVERN.



Mucor Stalactitis—From Luray Cavern.

NOTE.—The lower specimen shows the sporangium entire. In the other it has burst, scattering the sporidia.
(Magnified 80 diam.)

in love sought a place to hide her sorrow, and perished miserably amid the intricacies of this gloomy cave. Among the stories told me by the villagers, suggested by the skeleton of Luray, was one of thrilling interest concerning two Confederate soldiers who actually perished in a cave near Harper's Ferry. The added statement that they were found 90 miles under ground must be taken with a grain of allowance!

A few large bones of animals have been found in different places, among which we recognize the skull of a wolf, a deer, and a panther, all somewhat gnawed by rodents. We found also the bones of mice, rats, bats, a squirrel and a raccoon. Thick layers of excrementitious matter were also noticed, called "bat-guano." But all animal remains thus far found are geologically recent, and of known existing species. In Specimen Avenue there are several wallows made perhaps by bears. The numerous tracks of one kind and another have already been mentioned; and in out of the way places these are still to be seen. But the living fauna of this cave is meager, so far as at present known; being limited to a few bats, rats, spiders, flies, and a single myriapod (*Syngopus whitei*). The vegetable growth is still more limited. I found a new species of fungus, in 1878, and described it under the name of *Mucor stalactitis* (with a figure magnified to 80 diameters), in the *Scientific American* for March 8, 1879. Under the bridges and stairways, of which there are many in the cave, the long white mold hangs in hoary festoons that shrivel before the blaze of the candle.

Stalactitic distortion is a new and fascinating study. It is attributable to some extent, in my opinion, to lateral outgrowths, having fungi for starting points. In other cases the cause may be due to crystals shooting from the side of a growing stalactite, and thus transforming it to some grotesque shape. Delicate tassels are found on the tips of stalactites that are part of the time submerged. The mossy wrapping of others may be ascribed to the same cause. Distortion sometimes uncouth is again fantastic

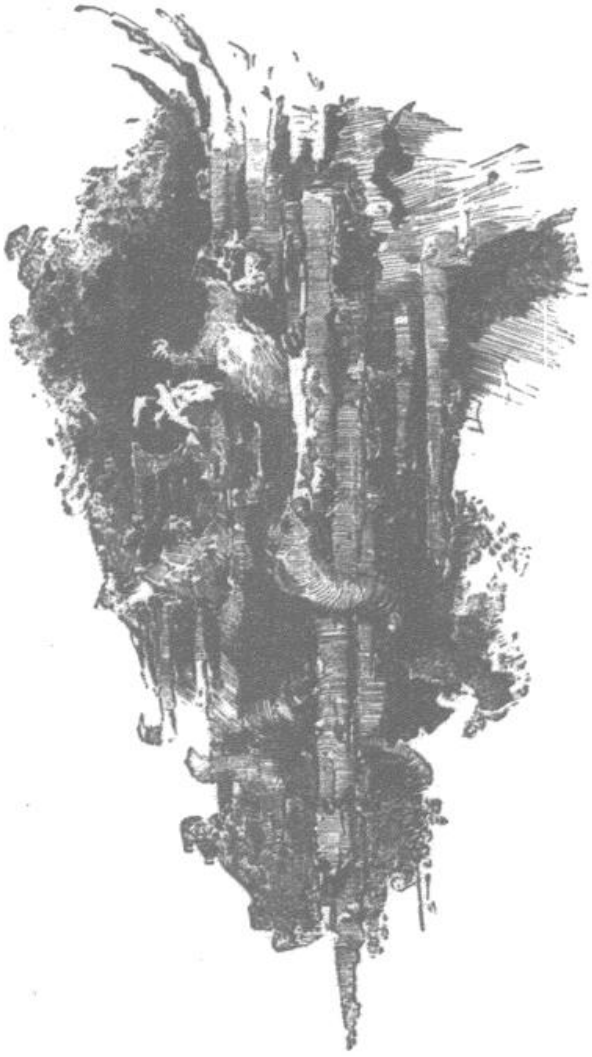
and beautiful, resembling vines, twigs and tendrils. The term "Helictite" has been suggested as appropriate to these contorted growths.

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; intending to have their trip neither fatiguing nor uncomfortable. Work is constantly in progress to facilitate 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 500 feet south of the entrance.

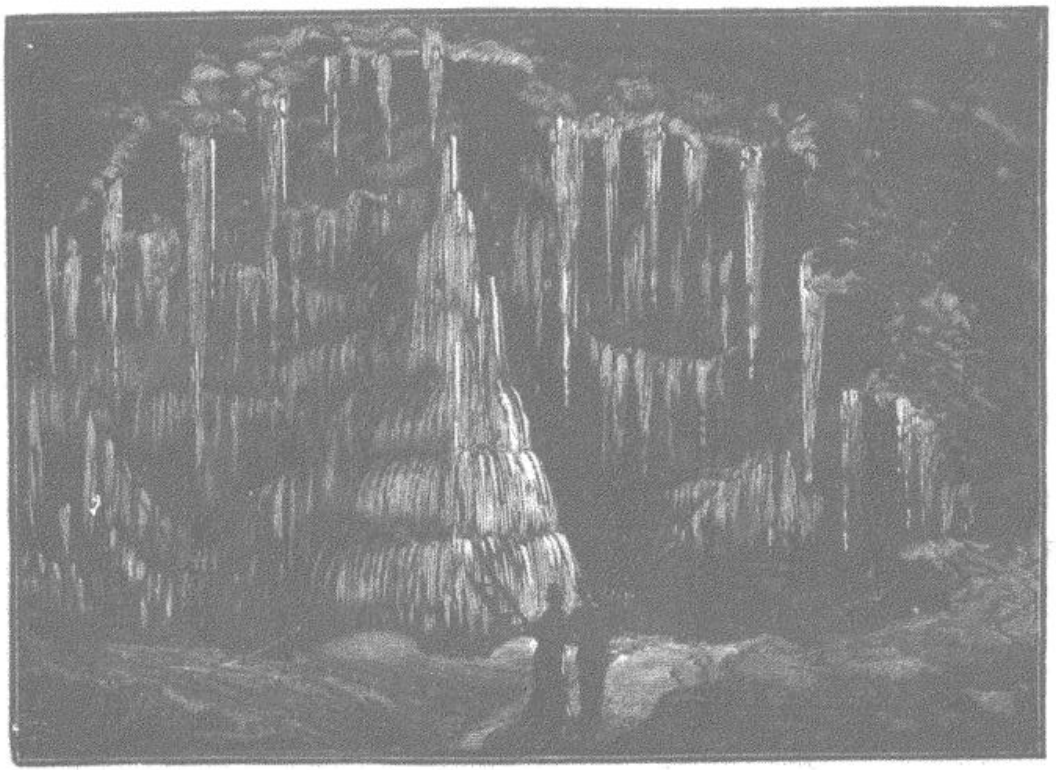
Stebbins' Avenue requires a little stooping to go through some of its passages; still its contents are well worth seeing. Here are the only gravel-cut domes in the cave. They are 6 in number and seem copies on a reduced scale of those lofty domes for which the Kentucky caverns are famous, and that cut through all tiers from the soil to the drainage level. By other means we satisfied ourselves of the existence of four distinct levels or cave-floors in Luray cavern, and that the vertical distance from the highest gallery to the lowest pit is about 220 feet, the lowest point below the surface being but 260 feet.

The Silver Lake, in Stebbins' Avenue, is probably the deepest body of water in the cave. This lake is 40 feet long, 9 wide, and 10 deep. The Cannon-ball Spring is also here, remarkable for a large concretion in it, round as a shot. Hawes' Cabinet, named for Prof. Hawes, of the Smithsonian Institution, is a fine large room, accessible at present only by a small aperture. In the room, called Pisa, may be seen the Leaning Tower, a mass of stalagmite that persisted in growing till its enormous weight broke down the ledge, three feet thick, that supported it. Then it fell about six feet into a hollow, where it now stands, tilted, like the celebrated campanile of Pisa for which it is named.

Stonewall Avenue, named for the valiant Stonewall Jackson, begins in the deep gorge where we left the skeleton a while ago, and contains as interesting objects as any others in the cavern. But few of them, however, have



THE DRAGON OF LUBAY.



AN ALABASTER CASCADE.

been named as yet. The Twin Lakes are two adjacent pools connected by a tunnel, and the whole double basin is lined with crystals like others already described. There is a lovely pavilion provisionally named Stonewall's Tent, that is of rare attractions. The Engine Room contains a massive rock like a locomotive and tender, only twice as large as any that ever ran, and completely covered with elaborate decorations. Miller's Room is named for the lamented William Miller, M. D., of Luray, whose science and zeal have both deserved this recognition. The immediate occasion of calling this place by his name, is that, while he had control of the property, for only a short time, he undertook to enlarge the passage-way by firing a charge of dynamite. The huge blocks thus dislodged still lie as they were left and exhibit materials of remarkable fineness of texture. Slabs could be cut, with suitable tools, large enough for table-tops or mantel-pieces, and quite equal in beauty to the celebrated Mexican onyx (so-called), though more like great blocks of precious agate.

On returning from the Stonewall Avenue, we cross a natural bridge and soon find ourselves beside the Imperial Spring, a clear, beautiful pool, 6 feet deep, lying in a grotto 35 feet long and 25 feet wide. Brown columns form the wall, with white stalagmitic statuettes set in niches, and between them snowy alabaster gushes out and over the rocks below. The roof slants from front to rear, and is set as thickly as possible with stalactites from an inch to a foot in length, and averaging by count 64 to the square foot. On this basis we calculate that there are within this little grot 44,800 pendants, each tip glistening with a silver drop, and all reflected from the face of the placid basin below, as they are illuminated by the electric lamp that shines in through an arch beyond.

Now stepping back a few paces, and out on a platform built over the ravine, look at the scene which the guides mean to have you take away with you as a lasting impression of Luray Cavern—BRAND'S CASCADE. This, it should be understood, is not a real waterfall, but a mass of spotless alabaster that seems to gush from the side of

the Imperial Spring, and to have been frozen in the act of falling. Imagine, if possible, a great cataract of milk 30 feet wide and 40 high, rushing and copious, suddenly caught in mid air and polished to a wax-like luster; and beyond it another smaller one as yellow and golden as liquid amber. And then fancy this whole shining and glorious mass flooded by the dazzling brilliancy of electric lamps, and confess that it must rival the most wonderful scene ever pictured by pencil or pen.

The feeling on emerging from the cave, is as if some one had waked you from a strange and marvelous dream. If asked how far you have journeyed, no definite answer can easily be given, perhaps 3 miles—5—7—no matter! Here's a man who has measured the distance by his pedometer; but no one inquires for his report, and his expression of countenance as he puts the little watch-like instrument in his pocket again, shows us that he wishes he had not consulted its too faithful record. Luray Cavern has been compared to the Centennial Buildings in their glory, through which the delighted visitor could ramble for many days, and see at each turn some new object to kindle his admiration; and yet from which, on growing weary, he could at any moment withdraw, hoping to come again.

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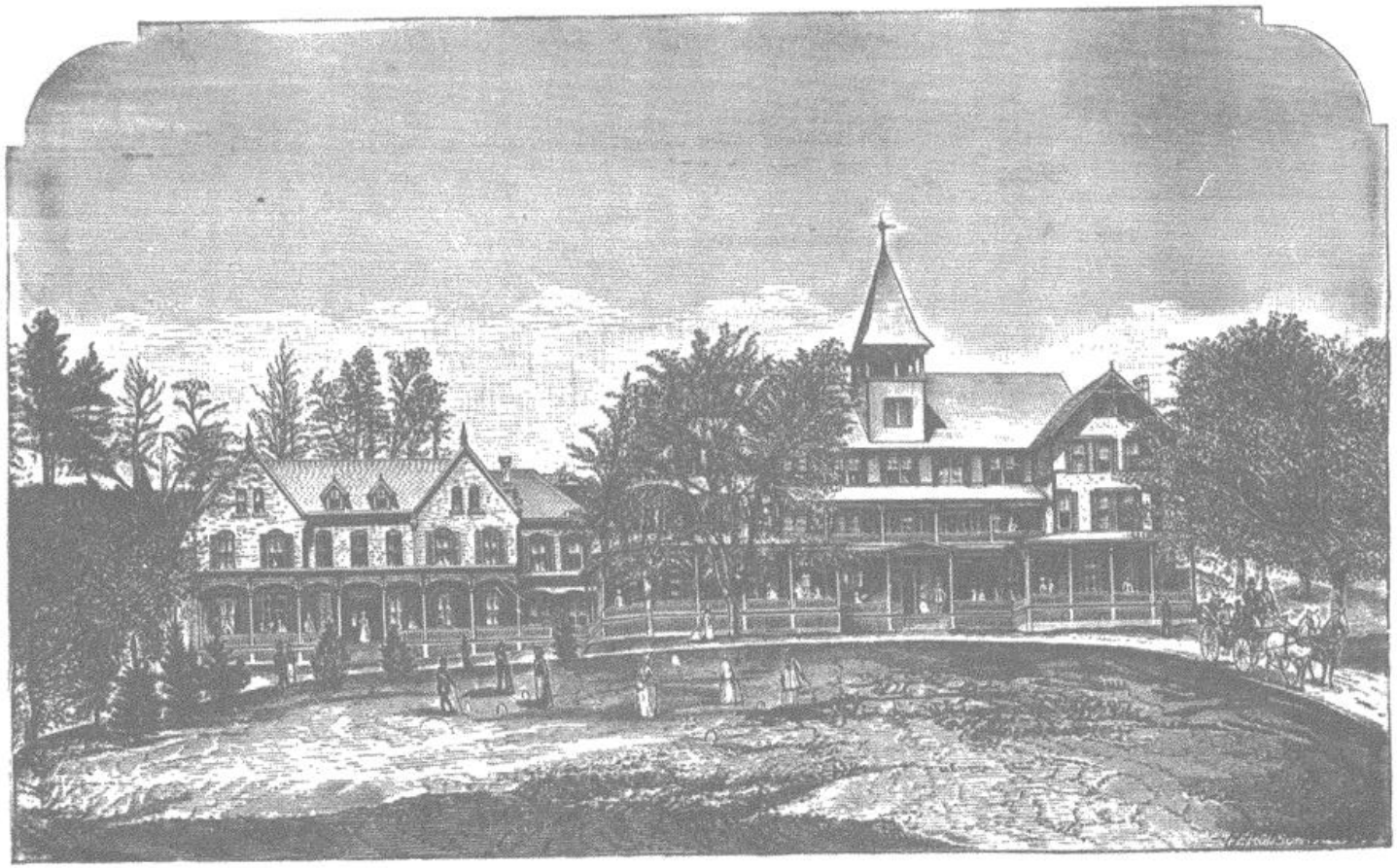

Hotel at Howe's Cave, N. Y.

CHAPTER XIII.

HOWE'S CAVE, SCHOHARIE CO., N. Y.

Rocks of the Helderberg—Ball's Cave—The Otsgarage Cavern—An Ingenious Plan—The Whirlpool—Lighted by Gas—Bridal Chamber—Sanitarium—Giant's Chapel—Howe's Pillar—Haunted Room—Music Hall—Crystal Lake—Underground Railroad—Uncle Tom's Cabin—Winding Way—Ramsay's Rotunda.

THE most massive and prominent rocks in Schoharie county, N. Y., are, first, the Water limestones, then the Pentamerus limestone, and above that the Delthyris shale. These all belong to the Helderberg division of the Silurian system. From the Water limestones immense quantities of cement are made. The rock lies in rather thin strata, and is easily acted on by the elements. The Pentamerus limestone is firm and compact, and abounds in fossils. The Delthyris shale is really granular gray or blue limestone, rich in coraline remains. These formations are so related to each other as to favor the excavation of deep valleys, flanked by cliffs and mural escarpments, the hills rising by successive terraces to mountainous proportions.

Several caves had already been found in this region, the largest of them being the one known as Ball's Cave, when in May, 1842, Mr. Lester Howe resolved to open what had previously been called the Otsgarage Cavern, but which now bears his own name. A stream of considerable size had long been observed flowing from it by several outlets. This subterranean river was the agent that had made the cavern; but it had afterward obstructed it by *débris*.

Mr. Howe hit on an ingenious plan for utilizing the water. He first loosened the clay, gravel, and broken rocks; then stopping other outlets he flooded the main channel, and thus forced the stream to sweep out its own deposits.

This having been effectually done, he reopened the side passages, and made a dry path for 350 yards to Cataract Hall, where the waste water is now chiefly drained away through a transverse crevice. Another drain is at the Whirlpool, 100 yards beyond. These seem formidable terms to be applied to localities not in any way frightful to those visiting the cave in summer; but the guide assured me that during a rainy season the names were appropriate, and that there were times when the whole cavern would be filled, and, as he said, "pour forth a mighty flood."

The pathway beyond the drains crosses and recrosses the rapid, musical stream by stepping stones, until at a point about 1,350 paces from the entrance a double dam has been built, forming a pretty reservoir of extremely pure and limpid water. Iron pipes convey it out to supply numerous dwellings, a large mill, the hotel, and the tank at the railroad station. The supply has never been exhausted.

So much digging and blasting have been done between the entrance and the reservoir as to detract from the primitive wildness of the cave, and it too much resembles an unfinished railway tunnel. Gas, also, has been introduced, thus far with a pleasing effect ordinarily, though far less picturesque than torches and not free from danger. This appeared on the occasion of my first visit, which was in company with a party of 400 excursionists, many of whom caught hold of the pipes overhead to steady themselves along difficult paths. This procedure disturbed the flow of gas. A number of jets were extinguished; and although frequently relighted they could not be kept burning.

The next day we examined critically the whole system of lighting up the cave in company with Dr. Lewis, the chemist of the Boston Gas Works, our couclusion being that it is safe enough, if the pipes and jets are not tampered with nor allowed to be eaten through by rust. We recommended the substitution of electric lights, which are now used.

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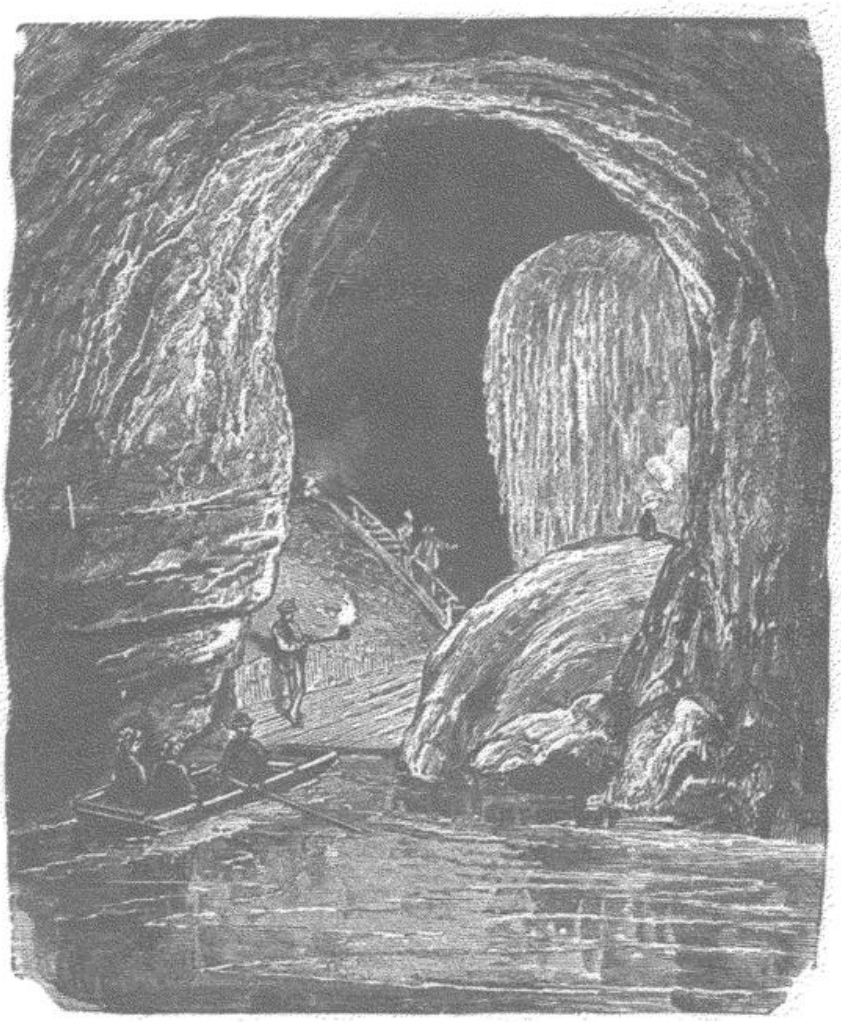


The Landing—Crystal Lake.

It is due to Hon. J. H. Ramsey, the present owner of the cave, and Mr. J. M. Russell, the lessee of the premises, to say that every consideration is shown for the safety and comfort of guests, and that especial facilities were granted to us as explorers.

Our guide, Van Dyke, pointed out noteworthy objects, having an incident or legend to tell associated with each. Several romantic people have been married in a room 150 yards within the cave, called for that reason the "Bridal Chamber." It is reached by a long flight of steps, and ends in two or three interesting domes about 40 feet high. The temperature, which was 63° Fah. at the entrance, had here fallen to 50°, and that was found by repeated experiments to be the mean temperature of the cave. The mercury rose in certain places to 52°, and in others fell to 48°, the variation, being probably attributable to atmospheric currents. The average is about 4° colder than the temperature of Mammoth Cave, nearly corresponding in each case with the mean temperature of the earth.

The currents of air vary considerably in intensity and direction, owing in a measure to the proximity of outlets and the windings of the cave stream. The air is chilly, and I missed the charming sense of exhilaration noted by every visitor to Mammoth and Wyandot Caves, and rightly attributed to the natural oxygenation produced by chemical changes.

An incredible story is told of a young man from Georgia who was cured of pulmonary disease by dwelling three months in a dreary place called the Consumptive's Chamber. Beyond this is a large hall called the Giant's Chapel. Howe's Pillar is a mass of yellow alabaster, 12 feet high, reached by a side passage from Cataract Hall. From a point 1,000 paces within, a stalagmite was removed in 1874 and set up as an ornament in front of the hotel. This fact I have from the guide. Applying my pocket-rule to the new stalagmite that has grown up in its place within six years, it was found to measure 13 inches in thickness and 4½ inches in height. This is a remarkably rapid growth, compared with rates observed in other cav-

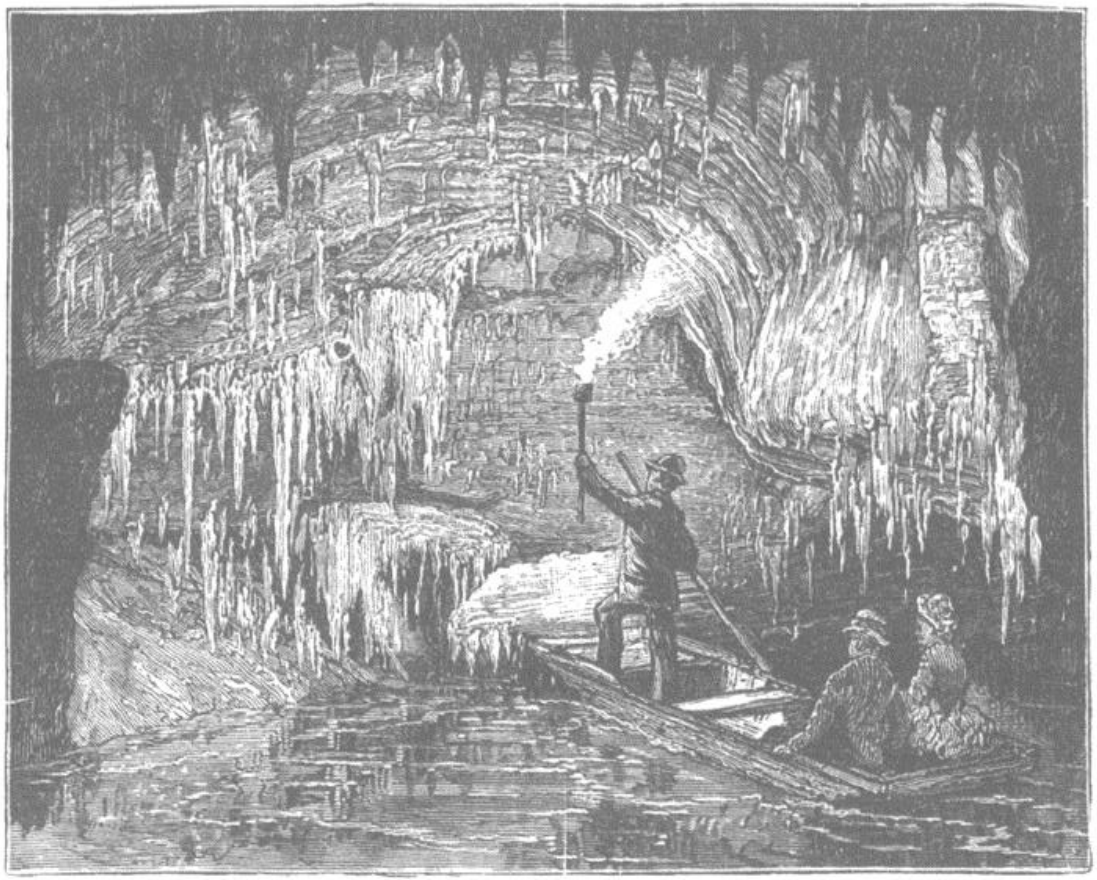
erns, and will probably constrain us to modify our estimates of their antiquity.

In the Haunted Room the imagination may decry spectral forms. But more interesting is the strong draught indicating the nearness of some large apartment, into which an entrance has not yet been effected. The echo in Music Hall prolongs aerial vibrations for about five seconds. The resonance of the floor as we tread upon it, again suggests a hollow place underneath. It is asserted in a pamphlet, published fifteen years ago, that there are fractures opening "into a giant cavern below." None were pointed out to us; and if such are known it would be well to explore them, for the present cave floor is far above the natural drainage level.

The reservoir, to which a narrow-guage railroad now runs, is called the Crystal Lake, and is navigable by a small boat. It is about 16 feet deep when full, and is remarkably transparent. Among the numerous stalactites pendant from the roof, the guide singles out the Harp, which emits musical sounds on percussion. The lake is said to be a quarter of a mile long, though its width does not exceed 40 feet at any point. The sheet of water looks finely when illuminated with magnesium or by red fire.

Just beyond the landing-place the passage is obstructed by a huge stalagmite reaching from floor to ceiling, and about 30 feet in diameter. Climbing around its upper portion by a narrow pass, we find ourselves on the edge of a pool that is apparently a continuation of the lake. It is surprisingly deep. We sounded to the depth of 35 feet without touching bottom, and took Van Dyke's word for its being 60 feet deep. As the surface of the water is only 45 feet above the level of the hotel, the bottom of this pool must be lower than the mouth of the cave; and the pit it fills may have been the former passageway of the stream to lower tiers of caverns underneath.

The cave now grows wider and with larger chambers as we follow the windings of the rivulet. Uncle Tom's Cabin stands 500 yards from the lake, and is a unique stalagmite of great dimensions, through whose base the flowing water



The Harp—Crystal Lake.

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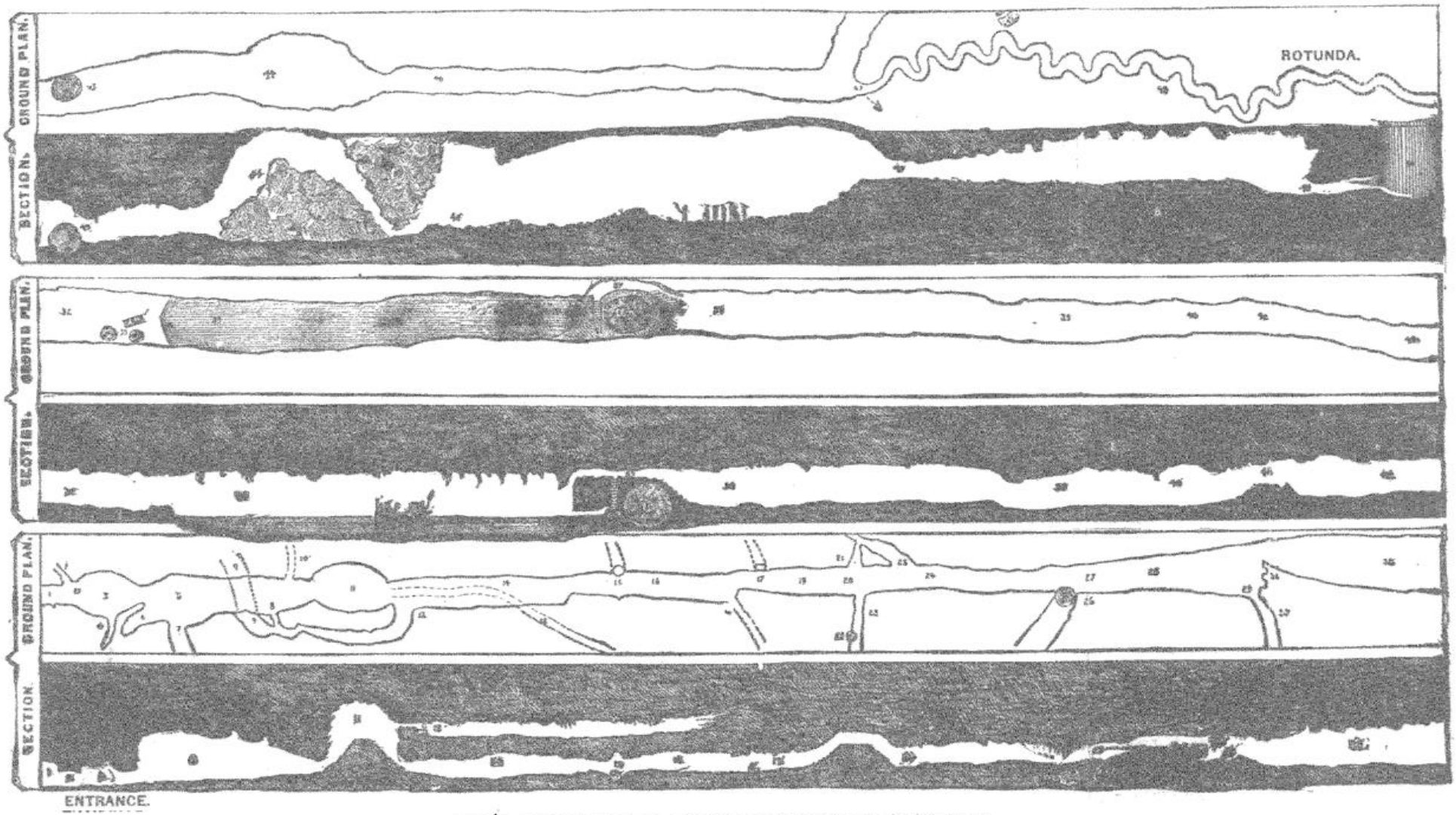
has cut a tunnel by which one can gain the pathway beyond. Next is a hall about 200 feet long and 80 feet high, extending to a gigantic pile of rocky fragments, surmounted by several large stalagmites bearing fanciful names.

Descending from this eminence, we find ourselves in a valley only about ten feet wide, but of remarkable height. Masses of broken stalactites incumber the way, and 60 feet overhead is a projection 25 feet square, called the Table Rock, accessible by hard climbing. The guide told us that this valley is 1,100 feet below the surface, a fact explained by saying that the cave pierced beneath a lofty hill, a spur of the mountains. We had no means at hand for either verifying or disputing this extraordinary statement; but we were led to doubt it because of the immense quantities of miry clay obstructing several branches that we attempted to explore.

The Winding Way trends to the right from the main cave line, and, together with what it leads to, is the most remarkable portion of the entire cavern. The ground plan of this underground cañon would resemble the peculiar articulation of the suture joining the bones of the skull. The Winding Way is from 2 to 4 feet in width, from 3 to 30 feet in height, and, as measured by us, about 550 feet in length. It is so crooked that it seems as if one changed his direction at every step. The walls are coated with translucent stalagmite equal in beauty to Mexican onyx, which it much resembles. I saw nothing finer in quality, even in Luray Cavern, where the display of Oriental alabaster is so exceedingly diversified and beautiful. The cañon is here and there curiously spanned by stalactitic arches. Having gone about two-thirds of the way through this bewildering passage, we come to a large cavity formed by the dislodgment of a triangular mass of rock which has wholly disappeared under the clay. The Winding Way ends in a circular aperture, through which one can barely crawl, by lying flat on the ground. This, of course, is called the Fat Man's Misery, a name without which the nomenclature of no cave would be complete.

Beyond this place of merry difficulties is the Rotunda, that ends the cave in this direction. There are many excavations in Mammoth Cave of the same nature as the Rotunda, the local name for them being "domes." Some of them are far larger, but none are more symmetrical. They are caused by the rotary action of whirling water freighted with sand and gravel, thus transformed into a powerful cutting engine. The diameter of the Rotunda is 25 feet, and its height was said by the guide to exceed 300 feet, in proof of which he alleged that rockets had been fired upward in it warranted not to explode until they had reached such an elevation. Moreover, it is said, and commonly believed, that no mortal ever saw the apex of the dome. It is a pity to break in upon such pleasant delusions, but regard for the truth compels me to say that by burning common red fire I saw the apex with distinctness, and comparing it with domes in Mammoth Cave, whose height is definitely known, I should say that the Rotunda does not greatly exceed 100 feet in height. But it is, without exaggeration, a very remarkable dome, and it pays the visitor for all the trouble taken in reaching it.

A degree of disappointment must be confessed as to the entire dimensions of Howe's Cave. Some enthusiastic letter-writer once said that it was twelve miles long. The report on the geology of New York states that it has been "explored to a distance of seven miles, and seems to extend farther." A clerical friend assured me that it was at least six miles long. It is recorded that one avenue "has never been explored to its full extent, although a party once spent eighteen hours in it, traveling the whole time, and not reaching the end." Finding that the proprietors themselves discredited these statements, and had no objection to my measuring the cave, I accordingly undertook the task, assisted by my son, with this result: that the total combined length of all avenues open to the public is only *one mile and three-quarters*, and that there may be a mile or more additional of by-ways and tortuous crevices never shown to tourists; hence the owners are warranted



MAP AND PROFILE OF HOWE'S CAVE NEW YORK.

1. The Entrance.
2. Barytes Mine.
3. Reception Room.
4. Store Room.
5. Washington Hall.
6. Bridal Chamber.
7. Wine Room.
8. Old Cave.
9. Lower Gallery.
10. New Cave.
11. Giant's Chapel.
12. Upper Gallery.
13. End of Old Cave.
14. Narrow Way.
15. The Conduit.
16. Cataract Hall.
17. The Sluice.
18. Clay Cave.
19. Whirlpool.
20. Indian Ladder.
21. Deep Pit.
22. Right Angle Avenue.
23. Tower of Babel.
24. Franklin Avenue.
25. Walled Way.
26. Penn's Monument.
27. Flood Hall.
28. Congress Hall.
29. Haunted Castle.
30. Ghost Room.
31. Magical Niches.
32. Music Hall.
33. Twin Stalagmites.
34. Crystal Lake.
35. Plymouth Rock.
36. Mount Ararat.
37. Creeping Gangway.
38. The Museum.
39. Geological Cabinet.
40. Uncle Tom's Cabin.
41. Giant's Studio.
42. Giant's Nursery.
43. Hottentot's Tent.
44. Rocky Mountains.
45. Hanging Rocks.
46. Valley of Jehosaphat.
47. Winding Way.
48. The Silent Chamber.
49 Fat Man's Misery.
50. Ramsey's Rotunda.

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in their honest advertisement that the entire length is about three miles.

The swiftness of the cave stream, and its liability to sudden overflow, must have prevented the aborigines from making this cavern a place either of residence or sepulture. It may be doubted, indeed, if they knew of its existence. Few animal remains have been found here. Large numbers of bats, however, hibernate in its chambers, clinging in clusters, like swarms of bees. No fish inhabit the lake or the stream, except such as have been put there by the hand of man, and even these forsake these subterranean waters when the spring freshets give them the opportunity to do so.

It should be said, in conclusion, that while Howe's Cave is surpassed by several caverns in the subcarboniferous limestones of Virginia, Kentucky and Indiana, it is one of the largest in this country excavated from the rocks of the Silurian period. Its attractions are very considerable, and some of them are unique and highly remarkable. The cave is well worth visiting, especially as it is so easily reached from New York and the New England States. Its environs are picturesque, and from the piazza of the hotel a wide and beautiful view is commanded of the fertile valley of the Cobles-Kil, beyond which rises the wooded summit of a spur of the Catskills.

CHAPTER XIV.

OTHER AMERICAN CAVERNS.

Judges' Cave—Simsbury Caverns—Moodus Noises—Pictured Cave of La Crosse—Pickett's Cave, or the Cave of the Winds—Cave of Cacahuamilpa—Canadian Caverns—Cliff-Dwellers—Conclusion.

THERE are hundreds of imperfectly explored caves concealed amid the forests and crags of sparsely inhabited regions in the Western and Southern States. It is obviously impracticable to mention, however, every one that may even have acquired local celebrity. Published accounts are frequently too meager to be interesting, or else are exaggerated beyond belief. Hence it is difficult to obtain reliable data concerning some that are really noteworthy. The author takes this opportunity to say that he will gladly welcome information as to any portion of subterranean America, and may make use of it in some future publication. It is particularly desirable to collect facts concerning the various forms of cavern life, and those bearing on the manners and customs of the ancient lords of the soil. Many of the most interesting problems of geology and archæology are yet to be solved by secrets now locked up in the bosom of unexplored caverns.

It remains, in this concluding chapter, to group together accounts of several caves, alike merely in not having been already described in these pages.

THE JUDGES' CAVE.

The Judges' Cave, near New Haven, Conn., may properly be mentioned among celebrated American caverns; although, strictly, it is *not a cave*, but merely a shelter among some huge fragments of trap rock. Here, however, from May 15th to August 19th, 1661, Cols. Whalley

and Goffe, two of the Regicides who once sat in judgment on King Charles I., and whom British spies were hunting to the death, found a safe refuge. The spot is a lonely one even now. It is in the dense woods that crown West Rock, and, at the time the Judges were in hiding, there was not a house within a mile of it, the nearest being the dwelling of Richard Sperry, a trusty friend With a small hatchet they had found in the wilderness, they cut hemlock boughs to roof over the space amid the rocks. And there for a whole summer they lived securely guarded in their privacy by those whom no amount of British gold could buy. When the search for them abated they ventured to leave the cave that has ever since borne their name. Once afterward they sought its protection, in 1664, when royal commissioners came again to hunt them down. But some roving Indians found them after they had lodged there for a week or so, and they were constrained to find another retreat so very obscure that not even the red man should ferret it out.

THE SIMSBURY CAVERNS.

The tourist who has occasion to visit East Granby, Conn., finds himself within two miles of a spot of great historic interest, known as the Simsbury Caverns, or the Newgate of Connecticut. The exact dimensions of the original caves are not known, but they were, at an early day, much enlarged by mining operations for copper ore. Hence they are often mentioned as the Simsbury Mines, and the eminence from which they are excavated goes by the name of Copper Hill. They were operated by private enterprise from 1705 till 1773, a period of 70 years; when they were purchased by the Colony and used as a penitentiary, the price paid being $375, including the expense of fortifying the place so that "it would be impossible for any person to escape." Mining operations were continued for the next five years, the convicts being the miners. Other modes of penal labor were then substituted. Tories, as well as burglars, robbers, and counterfeiters, were penned up in these dismal caverns. Although the prison

was regarded as impregnable, the very first one imprisoned made his escape within eighteen days; the three next within six weeks, and another took his leave four days after being immured. Additional precautions taken were so effectual that no more escapes were made for two years, when the wretched inmates set fire to the wooden doors that confined them, and were so nearly suffocated by the smoke that one of them actually died, and five were supposed to be dead but revived. As the war with England increased in its fury, the number of prisoners was also greater, and more than one scene of violence and bloodshed was witnessed by this extraordinary cavern. Three times in five years the block-house built over the mouth of the dungeon was destroyed by fire. Many of those confined there were men of talents and political influence. Gen. Washington himself sent a number of convicts there, to whom he applied the epithet "flagrant and atrocious villains." And they, and others in confinement there proved it true by plotting for his assassination, along with that of other leading "rebels."

The place finally won a terrible name throughout the thirteen Colonies, and Congress applied to Gov. Trumbull for the use of this cavern "for the reception of British prisoners of war, and for the purpose of retaliation." In 1790 the Simsbury Cave was permanently established as a State prison, and continued to be used as such until 1827. Many thousands of dollars were expended in perfecting the arrangements of this American Bastile, and, judging from official reports, it had as large a number of visitors as more agreeable places of resort; the number reported for 1810 being 5,400 persons! The number of prisoners that year was 46, and they were said to be in good health and well cared for. The locality, aside from the vastness of its solitude and impenetrable darkness, and dripping water "trickling like tears from the walls," was regarded as "extremely favorable to the health and longevity of the occupants, which is attributed to some medical quality in the mineral rock."

The following extract from Kendall's Travels sets the

matter in a different light: "This establishment is designed to be, from all its arrangements an object of terror; and everything is accordingly contrived to make the life endured in it as burdensome and miserable as possible." As we read his account, apparently accurate, of the deep pits, the rugged dungeons, the beds of wet straw, the convicts kept night and day in shackles, we can hardly wonder at his conclusion that "without any extraordinary cruelty in its actual operation, there is something very like it in the device and design."

After having been used as a dungeon for 54 years, this cave had but a brief resting spell before, to the surprise of everybody, it was purchased of the State by a mining company that carried on active operations there, digging, crushing and smelting the ore. They reported an average yield of 10 per cent. of copper, and some masses of ore yielded over 40 per cent. of the metal. It has now been allowed to repose in quiet for a number of years, except as the curiosity of tourists leads them to pay it a visit.

The extent of the Simsbury Caverns, in their present condition, is from north to south, 800 feet, and from east to west, from 250 to 800 feet, with 3 parallel galleries and numerous cross-cuts. The old guard house, tread-mill, watch towers, and other structures of historic interest, remain, though in a dilapidated condition. The romantic scenery and rural attractions of the vicinity, make the locality to some extent a place of resort. The queer legends of the Simsbury Caverns, together with the poems, etc., that have been suggested by its peculiar history, have been collected in a volume by Mr. Richard H. Phelps, of East Granby, Conn., under the Title of "The Newgate of Connecticut," Hartford, 1876, pp. 117.

THE MOODUS NOISES.

Certain inexplicable sounds have mystified the inhabitants of a portion of the Connecticut valley for more than a century. From the fact that they were first heard at Moodus, a quiet little hamlet beside a trout stream, they

have been called Moodus Noises. In 1729 these detonations were so remarkable as to have caused consternation. A clergyman of that day writes: "Whether there be any thing diabolical in these things I know not; but this I know, that God Almighty is to be seen and trembled at." "I myself," he adds, "heard 8 or 10 sounds successively, and imitating small arms, in the space of 5 minutes. I have, I suppose, heard several hundred of them within 20 years, some more, some less terrible. Oftentimes I have heard them to be coming down from the north, imitating slow thunder, until the sound came near, or right under, and then there seemed to be a breaking, like the noise of a cannon shot or severe thunder, which shakes the houses and all that is in them."

These strange sounds have been recently heard, as late as 1881, at Salem, Conn., New London and elsewhere, and have caused renewed interest in the subject. Their starting point seems to be Mount Tom, and in March, 1881, it is affirmed that the faint rumbling sound rising to a rattling peal was heard for several hours and by many people. The reason for referring to them here is that, in the opinion of some persons the Moodus Noises are due to explosions of gases in subterranean cavities, and indicate the existence of a large vacuity underneath Southern New England, which would not be suspected by a survey of the granite hills and smiling prosperity of the region thus threatened.

THE PICTURED CAVE OF LA CROSSE.

This interesting and spacious cave was found Oct. 1878, by Mr. Samuel, on his farm 8 miles from La Crosse, Wis. The material from which it was excavated is Potsdam sandstone. It had evidently been an open cavern as recently as within 150 years, about which time its entrance was closed by a land-slip. On being re-opened as stated, the discoverers found the walls marked by numerous pictures and hieroglyphic characters and charcoal drawings, plainly of considerable antiquity. Rev. Edward Brown, in company with Mr. L. C. Draper, the Secretary of the State Historical Society, and others, made a thorough and

systematic examination of this cave in June 1879. Four layers of ashes, each from four to six inches thick, separated by layers of sand a foot thick, indicated four distinct periods of occupancy. Fragments of pottery and shells found in the second and third layers presented marked points of difference. In the upper layer they found a few animal remains, but nothing of special importance.

"The pictures," observes Mr. Brown, "are mostly of the rudest kind, but differing in degree of skill. Except several bisons, a lynx, rabbit, otter, badger, elk and heron, it is perhaps impossible to determine with certainty what were intended, or whether they represented large or small animals, no regard being had to their relative sizes. One picture, perhaps, suggests a mastodon; another, the largest, a hippopotamus." In numerous instances the erosion of the sandstone has marred the sketches beyond identification.

Copies of the best pictures were made and published by the Historical Society of Wisconsin, and are considered valuable contributions to archæology.

Similar pictured caves are said to have been found in Tennessee, though the accounts of them are not in the author's possession.

PICKETT'S CAVE, OR THE CAVE OF THE WINDS.

Every one who visits Colorado is surprised at certain features of scenery, to be accounted for only by considering the peculiar geological structure of the region.

The vast plains, sweeping from the Missouri valley westward to the foot-hills of the Rocky mountains, have a gradual upward slope from an altitude of only 770 feet above the sea, at Kansas City, to an elevation of 6,000 feet, at Colorado Springs. The underlying rocks, resting on one another in broad sheets, are varieties of sandstone, limestone, slate and shale, mostly belonging to the cretaceous formation.

A glance at the geological map of Colorado shows that large areas of the mountain region are marked as "eruptive," which means that, at some period later than the

formation of the plains, there was a great upheaval of the earth's crust, causing the lower rocks to appear at the surface, sometimes by volcanic violence, and at others by the slower process of denudation. These rocks are granite, gneiss, trap and other hard species, capable of resisting the ordinary action of the elements.

Along the border line, between the plains and the mountains, is a comparatively narrow but highly interesting region, lying nearly north and south, where the rocks of the plains, instead of being flat, are turned upward and broken off by the same force that lifted the mountains themselves. It is the opinion of the geologists that these sedimentary beds once extended much further up the mountain sides than now, being gradually worn down by the retreating waters of the primeval ocean and the subsequent erosion by running streams.

One of my summer vacations, not long ago, was spent amid the mazes of this border land, and I found it a geological paradise, where the explorer may, by guiding his course intelligently, cross the edges of all the strata, from the Archæan rocks to the Tertiary, studying the entire history of their folding and erosion, to better advantage perhaps than anywhere else on the continent.

The Monument Group of red sandstones has been repeatedly described by pen and pencil. The fanciful columns of loosely cemented sandstone, each capped by a layer of tough ironstone, that are, in Monument Park, only 10 or 20 feet high, rise to lofty castellated forms in the Garden of the Gods and Glen Eyrie, some of the needle-like spires shooting 300 feet above the green meadows at their base. These grotesque pillars are produced not only by the flowing water, but by the cutting action of whirling sand blown about them by the dry winds of summer.

Frequently, instead of standing in isolated masses, the red sandstone runs in ribs parallel to the chain of adjacent hills. These ridges are cut through at intervals, by arches, gateways, caves and tunnels, with very picturesque effect.

The width of this border region varies from 1 to 12

miles. Nearest the Granite Hills its rocks seem to have been sufficiently modified by heat to acquire an obscure columnar structure, thus opening lines of weakness, which have been sought out by the water, aided by insinuating roots and the power of frost, until one columnar mass after another has been pried off and finally removed by the further action of the elements. This process results in a deep and narrow valley known as a *cañon*.

Hundreds of cañons are found in various parts of the Rocky mountain region, some of which are of enormous dimensions. But those visited by me lie along the course of Fountain creek, at the base of Pike's Peak, and are interesting, aside from their wonderful scenery, because affording such an excellent opportunity to examine not less than 4,000 feet of sedimentary rocks. In many of them the torrent had plowed down into the underlying feldspathic granite, giving an amazing exhibition of aqueous energy.

Williams' Cañon, near Manitou, was the last one visited, and on some accounts I found it the most interesting of all.

The mouth of this cañon is cut through the red sandstone to a limestone, at first yellowish and sandy, but improving in quality as one goes deeper into the gorge, until it is of a good quality for all purposes to which limestone is ordinarily put, and large quarries have been opened, to which a wagon road leads.

The walls rise for 400 or 500 feet on each side, in many places absolutely perpendicular, and sometimes so close to each other that both wheels of the lime carts would graze the walls in passing.

I found but few fossils, and they seemed to belong to the Silurian formation; a conclusion verified by Hayden's report, which speaks of these beds as being decidedly referable to the Silurian group. Professor Hayden adds: "I have never known of any Carboniferous fossils being found here, but am confident that there are 1,000 to 1,500 feet of these beds between the Silurian and Triassic."

On his geological map, 1876, he assigns a portion of these rocks to the Carboniferous, and also marks high

ridges of Silurian limestones on the side of the mountain about 4 miles north.

The existence of heavy deposits of nearly homogeneous limestone under circumstances so favorable for excavation excited my curiosity as to the existence of caves in that locality. But after following the cañon for two miles or more, towards its head, nothing of the sort presented itself, except an open gorge, to which visitors had given the name of "The Cave of the Winds."

An entrance was discovered in June, 1880, through this very gorge to a cavern of large dimensions, named for the boys who found it, Pickett's Cave, and described in the *Congregational News* for March, 1881.

"The Boys' Exploring Association," to whose diligence this discovery is due, is an organization of young mountaineers living in the vicinity of Pike's Peak, whose laudable purpose it is to combine the enjoyment of camping out with the study of botany, geology and mineralogy, amid the hills and valleys of that remarkable region. In this they have been encouraged by Rev. R. T. Cross and President Tenny, of Colorado College, who have accompanied them on some of their excursions.

One of their earliest fields of exploration was Williams' Cañon, into whose crannies and crevices the boys penetrated under the direction of their leader; and two brothers, John and George Pickett, climbing up a path no one had ever tried before, crept into an opening only 4 feet high and 10 feet long, which proved to be the antechamber of a cavern of huge dimensions.

Fortunately the boys had candles and matches along, and proceeded at once to explore room after room, each decorated by beautiful stalactitic folds and pendants. The largest then entered was about 60 feet high, irregular in shape, and described as resembling the bed of some river that had suddenly frozen while leaping down successive cascades. In a room to the right of this the boys were dismayed to find themselves on the brink of a pit, 50 feet deep, into which they were not prepared to descend.

Retracing their steps, they found a narrow passage

leading up to a chimney-like opening and here ended their first underground tour, whence, with great difficulty, they made their way back to the bottom of the cañon.

The report they gave of course stimulated further exploration.

Through this chimney a passage was forced by Messrs. Reinhart and Snyder, who now own the cave. They found at its upper end a spacious hall about 200 feet long, decorated with a profusion of stalactitic formations, in some instances translucent and in others varying in color from red to pure white, sometimes coated by delicate frost-work.

A canopy was observed on one side of this hall perforated by the rotary action of water, near which was a pit partly filled, on whose sides there were singular markings caused by calcareous deposits from the evaporation of water.

Crawling for thirty feet through an "auger-hole," admittance was gained to a series of rooms containing many curious and beautiful objects, including a set of musical stalactites!

Through a deep pit they descended by means of a rope into other apartments; while to reach others still they had to climb steep acclivities, or worm their way through passages nearly filled by *débris* or obliterated by dripstone.

Ninety rooms in all have thus far been explored; and according to the accounts given the attractions increase as exploration penetrates the mountain side. Shining crystals, tufts of satiny fiber, slender arms mimicking growths of coral, rams' horns twisted and intertwined in every conceivable way, pillars and pendants, statuettes and grotesque resemblances of life, are among the charms of these enchanted halls.

The presence of extensive beds of ocher indicates that the subterranean stream flowed from the granite mountains above, bringing the decomposed materials of the fieldspathic rocks in the form of these ferruginous clays, which are so hard and compact as to take a fine polish.

Other evidences of former streams are furnished in the

beds of rounded pebbles, often coated by stalagmitic deposits. It is an interesting fact that similar smooth pebbles are found in the *open* gorges or "caves," as they are incorrectly called, cutting through the walls at a height sometimes of 200 feet from the bottom.

The opinion is advanced that these caves and cañons were made when the ocean washed the foot of Pike's Peak, but that is hardly probable, in view of the fact that the geological formation is Silurian limestone, through which, as in the case of Mammoth and other caverns, the acidulated rain water could have eaten its way *since* the elevation of the region above the sea level. The swirling of a subterranean stream could round the fragments of granite into pebbles as readily as the wash of the waves.

In some instances we know that what now are open cañons were once caves, a striking example of which is furnished by the famous natural bridge of Virginia, the arch being merely the remnant of an ancient cave roof; and the combination of a cave, chasm, and natural bridge, on Hudson's Brook, Mass., is even a better example of the same thing.

We can not draw the conclusion that *all* cañons were once caves, but the subject is worthy of more careful investigation, and we commend the problem to the consideration of the "Boys' Exploring Association."

Among mineralogical peculiarities noted in Pickett's Cave is the occurrence of oulopholites, or curled crystals of gypsum, often mimicking floral forms; likewise acicular crystals, probably of Epsom salts, both of which abound in Wyandot and Mammoth caves.

No inhabitants have yet been observed except bats and rats. And it is the opinion of the discoverers that no human beings ever penetrated to these subterranean rooms before. But it is so uniformly true, in respect to other caves, that careful examination has brought to light vestiges of aboriginal occupancy, that I am inclined to think it may prove so here.

It is stated that "after entering the cave it takes about two miles of travel to explore every part of it." But the

proprietors have built stairways and enlarged the narrow places, so as to enable visitors to go the round without serious fatigue. The trip consumes about two or three hours. Guides and an outfit can be had at the cave, and the number of visitors is represented as very great. This may well be so, for this is probably the only cave of magnitude in Colorado, and its location makes it very easy to be reached by tourists. Hereafter no description of the wonderful region grouping Monument Park, Glen Eyrie, the Garden of the Gods, Manitou Springs, Pike's Peak—all within a radius of ten miles—will be complete without mentioning the Cave of the Winds.

THE CAVE OF CACAHUAMILPA, MEXICO.*

The author has read with great pleasure the account of this wonderful cavern, as given in diffuse and ornate Spanish by Antonio Garcias Cubas ("*Escritos Diversos*," Mexico, 1874), and has also, for the benefit of the reader, tried to render it, in a condensed form, into plain English. Many pages are taken up by the journey from Mexico to Cacahuamilpa, with statistics of Mexican towns, plantations and other matters that need not be introduced here. Suffice it to say, that the road runs through a region remarkably diversified as to its scenery and geological features. Lofty mountains are continually in sight, the most noted of them being the snowy and majestic Popocatapetl. There are arid hills whose eruptive rocks show the energy of former volcanic action, and deep ravines that plow

*Since this great cavern was described by Cubas it has bean more thoroughly explored by Mr. Porter C. Bliss, the last time in February, 1875, with a party of 600 persons, provided with scientific appliances. It is said that after reaching a level at 50 feet depth, they proceeded for nearly four miles into the interior, finding chambers of lofty altitude, and labyrinthine passages leaving the main hall in every direction. They also state that the mountain above the cavern is an extinct volcano, whose crater is still to be seen. Below the main cave, and at a great depth, are two other immense caves from which issue rivers, that are known to enter the mountain at a point five miles distant, running through parallel subterranean channels, and unite after emerging, as already described, to form the Amacusac.

the surface toward the valleys below. The ascent to the Divide is very difficult, but one is rewarded by seeing at one glance the whole valley of Mexico in most beautiful perspective.

Cuernavaca, 18 leagues south of the Capital of the Republic, and lifted nearly 5,000 feet above the sea, occupies a slope between adjacent heights, either of which commands a view of the entire State. Broad plantations of cane, groves of plantains, and other forms of tropical vegetation, embellish the plains that spread out below, in what is significantly called the *Tierra caliente*, or the Hot Lands. The route to Cacahuamilpa winds through the villages and farms of Cuernavaca and Tetacala. The lands are singularly productive. Next you come to the picturesque village of Coatlan, where tall cocoa-trees are grouped around the parish church, and the dwellings are hardly visible for the dense foliage of the plane-trees, mangoes, oranges, lemons and limes. From this charming neighborhood, the road turns in a southern direction and runs among sterile hills, with only here and there a fertile valley.

About 30 miles from Cuernavaca, and perhaps 84 from the city of Mexico, one enters a beautiful valley between opposite heights, and climbs along a pebbly path for a mile and a half, till a cluster of huts and a dilapidated temple, on the hillside, is pointed out to him as the village of Cacahuamilpa. Following a path through narrow defiles, and continually descending, he finds himself amid a group of high hills, in one of which he suddenly descries the mouth of the great cavern to which this pilgrimage is made. In descending it is necessary to support oneself by the trunks and branches of the trees in order to escape a fall into the ravine below. It is an extremely rugged spot. Furrowed rocks rise above the abyss, while the splendid foliage of the forest hides the cavity itself. Leaping from one large rock to another, and forcing a path among the branches of the trees, the tourist finally reaches a place in the midst of a crystal stream, where instinctively uttering a cry of surprise, he pauses to admire *two* colossal

caverns visible at the same moment, from whose floors issue, with winding and rapid current, the two streams that feed the Amacusac. The limestones forming the arches seem to have been arranged by art, while the stalactites, hanging in disorder from the fissures, serve to heighten the charms of the scene. The vault diminishes as it recedes into obscurity, where the bright stream, by its reflected light, seems to be trying, in vain, to dissipate the gloom. Multitudes of guacharos, frightened by the traveler's presence, forsake their nests and cleave the air in rapid flight, as they leave the ash-colored rocks and soar into the blue sky. These streams are said to rise in the heights of Tenancingo, whence they flow amid these hills, only to be lost in them, gushing forth anew in the manner just described. A narrow path, of no great length, conducts the visitor to the broad mouth which he is to enter in order to see the marvelous crystallizations imprisoned in the galleries within. The superb portal measures, at the base, about 120 feet, and its height is about 66 feet. Its rhumb is 19° S. E., and its temperature at noon, in the shade, is 27° Reaumer.

The existence of this cavern was wholly unknown till 1833. The very Indians, before that time, had not dared to enter it; being deterred by the superstitious notion that a stalactite near the entrance, shaped like a goat with horns and a long beard, was the incarnation of the Evil One. An accident revealed it to the civilized world. It seems that a fugitive from justice took refuge here, who, after his danger was over, went home again and astonished his neighbors by his fantastic stories, who immediately fitted out an expedition to ascertain their truth or falsity. Since then it has been visited by many travelers. Some of these have had their own adventures. An exploring party that passed a night in the first *sala*, 200 feet long, 170 wide, and 150 high, were charmed as twilight fell upon the green and orange-tinted walls, the silvery stalactites, the phantoms of palm-trees, and strange unknown flowers, and soothed by the rippling stream that sought its way out the broad entrance still in sight. But

when at midnight a fierce leopard awoke the echoes by his roarings, and came near enough to let them see his eyes, as he gazed at them by the light of their torches, they were only too glad to see him stalk back again majestically into the darkness.

Concerning the theories given in full by Cubas to account for the formation of caverns, and of this one in particular, it need only be said that he probably over-estimates the share taken by earthquakes and other dynamic agencies, and regards the copious stream issuing from its depths an accidental circumstance, having little to do with opening either the main tunnel or its lateral branches. Doubtless the original fissures were attributable to a shock that rent the rocks apart; especially as we know the general region to be volcanic in its nature. But the result of observations made elsewhere is that limestone caverns are caused by the slow action of acidulated water; and this has probably been the main agent here, availing itself however of the crevices that it found.

The first hall, as has been intimated, is lighted naturally throughout its entire extent. The broad proportions, the walls of furrowed rocks, the enormous ridges that rib the roof, the festoons of stalactites, the capricious stalagmites, and the gloom of the next gallery, is a combination to arrest the attention of the most careless, and awaken the admiration of him who enjoys the sublime and the beautiful. The "Enchanted Goat" unfortunately has lost his head, but is still an object of interest. Among other formations should be noticed a noble column, with a graceful capital fashioned like a crest, sustaining the keystone of the arch over-head, and suggesting a new style of architecture in imitation of Nature; just as the basket with precious leaves of acanthus inspired the ancient Greeks with the idea of the Corinthian capital..

Climbing over the fallen rocks that obstruct the way, we next enter the Pulpit Hall, which Sr. Cubas would prefer to have called the Throne Room. Here the darkness is complete, and one can hardly distinguish by the slender blaze of the torches, the lovely concretions, whose beauty

and size seem to be increasing continually. Elegant works of lace and fillagree embroider the ground, and twine around the erect stalagmites; while incrustations white as marble of Carrara, clothe the walls and reflect the light from their many crystals. A cluster of stalactites hangs from the roof, in the form of elegant curtains dextrously folded by some master artist around a form rising among them from the ground. This is the Pulpit (or Throne) that has given a name to the hall.

The main cave runs nearly due west, and is divided up by natural arches and large groups of colossal stalagmites. At one point, however, in passing from one gallery to another, the direction abruptly changes from W. to S. E., thus making an acute angle.

In one of the galleries are large, massive stalagmites, that when lighted by candles and seen in perspective, resemble the fine houses of a great city. First you see a marble palace, its windows all aflame, and on its left amid the shadows a temple, in whose proximity two or three straight pines lift their heads. The illusion does not vanish till you touch the concretions with the hand. Then, like a phantasmagoria, the buildings disappear, the palace being transformed into an elegant winter-fountain. From two mimic basins, the frozen spray is dispersed, the reservoir below being ample with its embankments perfectly, though irregularly, defined. This is the Gallery of the Fountain. The effect of the entire room is greatly heightened by burning Bengal lights. Doing so, one sees against a vivid back-ground of light, the towers of a cathedral, and fancies himself contemplating from a hill-top, the city of Strasburg by the kindling of early dawn. Meanwhile the shadows cast amid the great ridges and deep fissures resemble the clouds of a tempestuous sky.

The Hall of Death gets its somber name from the tragic fate of a traveler who once came in here without a guide or clew, and perished in the greatest anguish while trying to find his way out. His torch having been consumed, he tore his clothing to shreds to supply light by being burned,

and when that was gone he wandered at random from one black labyrinth to another.

Madame Calderon de la Barca, the wife of the first Spanish minister to Mexico, tells the story vividly, and closes thus: "I can imagine the unhappy wanderer lost amid obelisks and pyramids and alabaster baths and Grecian columns; amid frozen torrents that could not quench his thirst, amid trees with fruits and leaves of marble and crystal, vegetables that mocked his hunger; amid pale phantoms that could not succor him in his anguish; and then I seem to hear his outcries and prayers, where every voice provoked an echo, as if the ghostly inhabitants of the cavern were answering in mockery—and at last, his torch being extinguished, he himself exhausted and in despair, would lie down near some inhospitable marble portico to die."

The Organ Hall is without doubt the finest for stalactitic display, and for stalagmites like crystalized cactus. The various figures and their complicated grouping in great masses give to this gallery the appearance of a Gothic edifice. The arrangement of stalactites like the pipes of an organ is the prominent feature of the place; and on percussion, they give forth musical sounds, high or low according to the size of the pipes.

Other halls surprise one by concretions like lamps, candelabra, tall obelisks and graceful palms. Nature's three Kingdoms are all represented: here is vegetation, from the little cauliflower to the colossal juniper, with its floating streamers of parasitic plants transformed into threads of crystal; there a reptile or a mammal; and, of course, minerals from the oolites to the monoliths. M. Virlet refers the oolites "to the consolidation, or fixation, of carbonate of lime around the eggs that are deposited in prodigious numbers on the bottom of pools by hemipterous insects;" but Sr. Cubas sensibly suggests that grains of sand, or bubbles of air, or any small object would do for a starting-point, from which the concretions could increase in time to the size of paving-stones!

The floor of this cavern rises continually from one gal-

lery to another, and a fine effect is produced as the torch-light is cast from the lower to the higher levels. On returning from the remote galleries, a magical effect is produced by the first rays of natural light. After having been plunged in darkness on which the torches have about as much effect as so many glow-worms would have in a wide meadow, the sudden apparition of the solar rays causes the most vivid and agreeable impression. The soft, green light penetrates, as with a subtle gas, the protruding rocks, the pilasters, arches, and every grotesque object, until the traveler imagines himself to be witnessing preparations for some fantastic scene that is to be brought upon the stage of a theater.

The entire length of the cave is not known, although it is asserted that all who visit the Organ Room have seen the end. Various circumstances show this to be untrue. The mountain of Cacahuamilpa is probably pierced in all directions by lateral galleries as interesting, it may be, as the portions already known. Yet some have gone to the opposite extreme of greatly exaggerating their ideas of its ramifications, claiming that they reach as far as the mountains of Tasco, and even communicate with the cave of Teutli in mountains bounding the valley of Mexico on the south. Statements of this nature are incredible because impossible.

From other sources of information it may be concluded that the cave of Cacahuamilpa is about three miles long, or more correctly, that it has been explored for that distance.

Sr. Cubas boasts that this cavern is peculiarly free from hurtful gases, can be explored without risk or fatigue, and in a word, "presents no difficulties and inspires no terrors." And yet, in 1881, an excursion party of 500 persons narrowly escaped suffocation and death from an attempt to spend a night in the grand Organ Hall. The statement is that the Governor of Morelos, being desirous of paying attention to the distinguished visitors, had a banquet spread in the room mentioned, and as an additional attraction, had it illuminated by electric lights. There were

also a large number of resinous torches burning, and the supposition is that the smoke vitiated the atmosphere. Most of the party were asleep, some on mattresses, and others simply reclining on blankets, but a few of the more animated guests were lingering around the tables, until about 2 A. M., when suddenly the Governor fainted away. It was also ascertained that many of the sleepers were asphyxiated, and a general panic ensued. There were ladies and children in the party, and those who were sufficiently awake to comprehend the danger were in a high state of excitement. General Diaz ordered an instant retreat from the cavern, and General Ord (for there were several distinguished Americans in the company) called in the military guard and bade them carry out the persons who were insensible. The result was that after what seemed a very long time, the entire party was rescued and safe in a purer atmosphere.

CANADIAN CAVERNS.

My attention has been recently called by Dr. J. W. Dawson, Principal of the McGill University, in Montreal, to a valuable list of Canadian caverns made by Dr. George D. Gibb, of London, England, and read before the British Association, Sept. 1859. An abstract appeared in the *Canadian Naturalist*, Vol. VI., p. 184, 1861.

Dr. Gibb divides the caves of Canada into two classes. "The first comprises those which are at the present time washed by the waters of lakes, seas, and rivers, including arched, perforated, flower-pot, and pillared rocks, which have at one time formed the boundaries or walls of caverns, and all of them unquestionably the result of aqueous action. The second comprises caverns and subterranean passages which are situated on dry land."

His list is as follows:

Of the First Class.

1. Caverns on the shores of the Magdalen Islands.
2. Caverns and arched rocks at Percé, Gaspé.
3. Gothic arched recesses, Gaspé Bay.

4. The "Old Woman," or flower-pot rock, at Cape Gaspé.
5. Little River Caverns, Bay of Chaleur.
6. Arched and flower-pot rocks of the Mingan Islands.
7. Pillar sandstones, north coast of Gaspé.
8. Niagara caverns.
9. Flower-pot Island, Lake Huron.
10. Caverns of Michilimacanac, Lake Huron.
11. The Pictured Rocks, Lake Superior.
12. St. Ignatius Caverns, Lake Superior.
13. Pilasters of Mammelles, Lake Superior.
14. Thunder Mountain and Paté Island Pilasters, Lake Superior.

Of the Second Class.

15. The Steinhauer Cavern, Labrador.
16. The basaltic caverns of Henley Island.
17. Empty basaltic dykes of Mecattina.
18. Bigsby's Cavern, Murray Bay.
19. Bouchette's Cavern, Kildare.
20. Gibb's Cavern, Montreal.
21. Caverns at Chatham, on the Ottawa.
22. Colquhoun's Cavern, Lanark.
23. Quartz Cavern, Leeds.
24. Caverns at Kingston, Lake Ontario.
25. Mono Cavern.
26. Eremosa Cavern.
27. Cavern in the Bass Islands, Lake Erie.
28. Subterranean passages in Great Manitoulin Island, Lake Huron.
29. Murray's Cavern and subterranean river, Ottawa.
30. Caverns in Iron Island, Lake Nipissing.

Several of the localities included in this list are plainly not such as we should ordinarily class as caverns; and yet it may be proper to do so, on the ground that they are the remains of them. Numbers 21, 24, and 30 are marked as "probable caverns," a term not very clear. No animal remains have been found, with a single exception, and then

not imbedded in stalagmite; and no worked flints, or other signs of ancient occupancy.

The Canadian caverns are, for the most part, in Silurian limestones, and they seldom attain very great size, although there are some quite spacious chambers, *e.g.*, those of the Mono and Eremosa, in the Niagara limestone, and Bouchette's Cave, thirty-five miles north of Montreal, in the township of Kildare.

Concerning the caves in the Magdalen Islands, in the Gulf of St. Lawrence, Dr. Gibb says: "The soft and friable brick-red cliffs forming the shores of these islands, with their remarkable capes and headlands, have in many places yielded to the force of the waves, and have become worn into caverns and arches. This is most strikingly manifest at Bryon Island, which is nearly surrounded by perpendicular or overhanging cliffs, which are broken into holes and caverns, and fast giving way to the action of the waves. From the same cause are to be seen detached peninsular masses in a tottering state, which now and then assume grotesque forms."

The caverns and arched rocks at Percé, Gaspé, also in the Gulf of St. Lawrence, afford many picturesque scenes. The Split Rock is a continuation of the limestone cliffs of Barry Cape (Point Percé). It is 500 yards long and 100 broad, and is pierced by holes or arches, "through one of which a sloop at full sail can pass at high water!"

THE CLIFF-DWELLERS.

A marvelous region, including several thousand square miles in Colorado, Utah, Arizona and New Mexico, was found and explored by the Hayden Survey. Countless ruins in bottom lands, along terraces, on dizzy heights, and in caves cut in the face of lofty cliffs, attest the existence of ancient civilization, of which there is no record in history. Abundant relics of a departed people were brought to light, such as stone implements, pottery elaborately decorated, matting, stuccoed walls, pictures and hieroglyphics; but, of all the myriads that must have swarmed through these cañons and scaled these cliffs, it is

said that "there have been no bodily remains found which could be identified as those of the cliff-dwellers!" The indications are that they were worshipers of the Sun and of Fire, and that they cremated their dead. Their survivors are probably the Pueblo Indians, about 10,000 in number, and still living in New Mexico, occupying most singular houses, unlike any other habitations on earth except those of the ancient cliff-dwellers. Consequently scientific men have devoted much study to the manners and customs of the Pueblos, hoping thus to gain light concerning their mysterious ancestors. The results are voluminous and hardly fall within the province of the present investigation. The conclusion that most concerns us is that these cave-homes "were probably built from 300 to 500 years ago, by peaceable, quiet Indians, who originated in the far south of this continent, or in South America, and were disturbed by the incursions of the northern red Indians."

It appears that the cliffs held by these ancient people are of limestone, or sandstone, with alternating strata of softer shale or clay, liable to removal by rain or frost, leaving a shelf or a shallow cave, suitable, by a little artificial fortification, as a place of refuge. The more inaccessible such places were, the more acceptable they seem to have been to the persecuted race that sought their protection. Along the cliffs of the Rio Mancos there are single dwellings, and even villages, built on shelves 700 or 800 feet above the river flowing below! The zigzag paths and footholds by which they were formerly reached are now worn away. Other cliff-dwellings, however, are within easier reach, and have been carefully examined. Fine illustrations of many of them have been published in connection with the Government Report, and others also in *Scribner's Magazine* (Dec. 1878), and elsewhere, from which one can really get a much better idea of the grandeur and beauty of these "munitions of the rock" than can be conveyed by words.

What can be more picturesque than the Battle Rock of the McElmo, unless it be the ruins of the neighboring Ho-

venweep Castle? The interesting fact is stated that the ground around these strongholds is covered with flint arrow-heads, all pointing significantly towards the ruins!

Some of the cliff-dwellings were of small dimensions, like the tiny home in a cave on the West Montezuma, of which Mrs. Hardacre quaintly says, "the dwelling, 6 by 10 feet, is as securely tucked away from the sun and rain as a small boy under an umbrella. The space between the side of the house and the inclosing rock forms a nice little shady piazza. Who knows but from this eyrie, some dusky bride watched for her lover, when the evening shades settled dark in the cañon lane?"

On the other hand, the magnitude of some of those ancient works, as described by Prof. W. H. Jackson and other explorers, is surprising. We are told of stately piles rivaling in size the Capitol at Washington or the Colliseum at Rome. The Hayden party found 11 immense structures in the Chaco Cañon, whose ruins were visible 7 miles away. The circuit of Pueblo Blanca restored is 1,200 feet, and its interior court is 346 by 269 feet, while the indications are that its original height was 5 stories. Another measures 440 feet in length and 250 feet in width, and must have included in its massive walls, 6 feet thick and 40 feet high, about 315,000 cubic feet of stone! A stone house built in a cave hollowed out from the cliff over-hanging the Rio de Chelley, was 550 feet long, had 76 rooms on the first floor and was 3 stories high. The Casa del Echo, one of the many ruins along the Rio San Juan, is built in a huge circular cavern, 200 feet high, and was evidently the abode of the ancient aristocracy.

One of the latest and most interesting of all these wonderful discoveries was made in 1880 by Prof. James Stephenson, of the U. S. Geological Survey in New Mexico. Guided by the Indians, he visited a locality 40 miles from Santa Fé, which he is satisfied was never before seen by a white man. In a cañon ten miles back from the Rio Grande, is a cliff-town, "a succession of excavations in the solid rock for 30 miles?" Many of the houses are in-

accessible from the plains; but to others the explorers climbed at some risk. They found them to be from 15 to 30 feet deep, and to contain numerous articles left either by the original tenants or by their conquerors. The entire region, indeed, is rich in antiquarian wealth.

The religion of the cliff-dwellers had features of singular sublimity. In many of their dismantled homes the tripled-walled *estufa* still is to be seen, in which holy fire was kept alive from day to day, and from one generation to another. The heaps of ashes under monumental stones on their burial hills, show it to have been their custom to burn the dead, in the hope that the soul would fly with the flame and leaping sparks heavenward to shine on forever in the bosom of the Sun. It was also their practice —beautiful, if pagan—to watch for each rising Sun from the battlements of their lofty abodes, and on his appearing to hail the blazing Orb with eager demonstrations of joy.

Let us, who worship at a holier shrine, emulate, or excel, their fervid devotion.

We have wandered through the caves of many lands, admiring miracles of beauty and wonders of dynamic energy and skillful design. And now that our underground journey is done, and we emerge from dark subterranean realms, whose sparry splendors are visible only by artificial light, let us hail the pure and golden sunlight. Let us adore the Supreme Being whose throne outshines the Sun; and whose infinite wisdom is displayed alike in the stalactite and the star.

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APPENDIX.

SUBTERRANEAN FAUNA.

The following list includes all the species of true cavern fauna known to the author, and is made after a careful comparison of the papers published by others who have given more particular attention to this obscure, yet important, branch of zoology:

VERTEBRATA—

1. *Vespertilio?* (M. Cave.)
2. *Mus rattus?* (Partially blind.) (M. Cave and elsewhere.)
3. *Amblyopsis spelæus*, DeKay. (Large blind-fish.) (Subterranean streams of Kentucky and Indiana.)
4. *Typhlichthys subterraneus*, Girard. (Small blind-fish.) (Subterranean streams of Kentucky, Tennessee and Alabama.)
5. *Chologaster Agassizii*, Putnam. (Subterranean streams, Tennessee.)
6. *Chologaster papilliferus*, Forbes. (Springs in Illinois.)

INSECTA—

7. *Anophthalmus Telkampfii*, Erichs. (M. Cave.)
8. " *Menetriesii*, Motsch. (M. Cave.)
9. " *interstitialis*, Hubbard. (M. Cave.)
10. " *tenuis*, Horn. (W. Cave.)
11. " *eremita*, Horn. (W. Cave.)
12. " *striatus*, Motsch. (M. Cave.)
13. " *ventricosus*, Motsch. (M. Cave.)
14. " *pusio*. Horn. (Erhart's Cave.)
15. " *pubescens*, Horn. (Cave City Cave.)
16. *Adelops hirtus*, Telk. (M. Cave.)
17. *Quedius spelæus*, Horn. (W. Cave.)
18. *Lestiva*, n. sp. Horn. (W. Cave.)

19. *Raphidophora subterranea*, Scudd. (M. and W. Caves.)
20. *Phora*, n. sp. (M. and W. Caves.)
21. *Anthomyia*, n. sp. (M. and W. Caves.)
22. *Machilis*, n. sp. (M. and W. Caves.)
23. *Campodea Cookei*, Pack. (M. Cave.)
24. *Campodea*, n. sp. (W. Cave.)
25. *Myopsocus* (*Elipsocus*), sp. (M. Cave.)
26. *Atropus divinatoria*, Muell. (M. Cave.)
27. *Tipulid.* (W. Cave.)
28. *Catops* n. sp? (W. Cave.)

ARACHNIDA—

29. *Acanthocheir armata*, Telk. (M. Cave.)
30. *Phrixis longipes*, Cope. (M. Cave.)
31. *Erebomaster flavescens*, Cope. (W. Cave.)
32. *Anthrobia Monmouthia*, Telk. (M. Cave.)
33. *Anthrobia*, n. sp. (W. Cave.)
34. *Chthonius Packardi*, Hagen. (M. Cave.)
35. *Acarus?* sp. (M. Cave.)
36. *Mite* (parasite of Anophthalmus.) (M. Cave.)

CRUSTACEA—

37. *Cambarus* (*Orconectes*) *pellucidus*, Telk. (M. and W. Caves.)
38. *Asellus* (*Cæcidotea*) *stygia*, Pack. (M. Cave.)
39. " " *microcephala*, Cope. (W. Cave.)
40. *Stygobromus vitreus*, Cope. (M. Cave.)
41. *Cauloxenus stygius*, Cope. (W. Cave.)

MYRIAPODA—

42. *Spirostrephon* (*Scoterpes*) *Copei*, Pack. (M. Cave.)
43. " " *cavernarum*, Cope. (W. Cave.)
44. *Sygonopus Whitei*, Ryder. (Luray Cave, Va.)

VERMES—

45. *Nematode?* (intestinal parasite of larva of Adelops.)
46. *Leech?* (in pools in M. Cave.)

There have also been described by Ehrenberg 8 or more kinds of subterranean infusoria, 1 Polythalmia, 5 Phytolitharia, and various plant forms. (See *Microgeologie*, 1856.)

A few flies, spiders, etc., have been found in Luray Cave, but I am not aware of any published account of them, although one is looked for from Prof. Packard.

It should be remarked that, while the aquatic animals described have usually been first found in some large cavern, like Mammoth or Wyandot, they abound in smaller ones, and even in wells and springs that have communication with caves.

The question of the probability of the origin of blind cave animals has been discussed with animation by numerous scientific authors, and the conclusion generally arrived at is that they have descended from external species having eyes. The bearing of this upon theories as to the evolution of species by acceleration or retardation is obvious. It is interesting to note that while some of the outside congeners of the blind animals are found in fresh water (*e. g.*, the crawfish in the brooks of Indiana and Kentucky is identical with the Orconectes of the caves, except for peculiarities arising from a change of conditions) others are evidently allied to marine forms.

What do the cave animals feed upon? The crickets, beetles, centipedes and small crustaceans are herbiverous, and subsist on the various forms of plant life, including fungi, the germs of which are swept in from the outer world. Acorns, nuts, etc., are carried in by water flowing down through sink-holes, and also by rats and other rodents. Carniverous insects find sustenance in the dead bodies of various animals, large and small, that die in the caves. In caves visited by human beings there are remnants of lunches, as in Washington Hall, in Mammoth Cave, that supply the larder of the humbler forms of life. Floods would plentifully supply the cave waters with fresh-water algæ and considerable quantities of vegetable *debris*. Thus the smaller creatures are kept alive, and in turn, as in the upper regions, are preyed upon by those that are larger.

As to the habits of the blind-fish, Prof. Cope says: "If the Amblyopses be not alarmed they come to the surface to feed, and swim in full sight, like aquatic ghosts. They are then easily taken by the hand or net, if perfect silence be preserved, for they are unconscious of the presence of an enemy except through the sense of hearing. This sense is, however, evidently very acute, for at any noise they turn suddenly downward, and hide beneath the stones, etc., on the bottom. They must take much of their food near the surface, as the life of the depths is apparently very sparse. This habit is rendered easy by the structure of the fish, for the mouth is directed upward, and the head is very flat above, thus allowing the mouth to be at the surface."

Blind-fish are seldom seen of greater length than four inches, though instances are on record of five, or even six inches. It is said that the largest specimen of Amblyopsis ever caught was taken

in 1871, "and sold for ten dollars to a person who was so desirous of securing the precious morsel that he had it cooked for his supper!" The specimens in vials of alcohol and offered for sale at Mammoth Cave, are usually from 2 to 3 inches long, and can be bought for a dollar apiece. The smallest I have seen, and which is now in my possession, measures exactly 1 inch and three-eighths. This is less by half an inch than any other that has been measured. Dr. Hagen mentions, however, the birth of 8 little blind-fish in a jar in which the parent had been placed, together with three other specimens. It is interesting to know that they were *born blind!* This event took place in October, 1871.

Among authorities may be mentioned the names of Craige, DeKay, Wyman, Thompson, Telkampf, Owen, Dalton, Agassiz, Wood, Tenney, Girard, Gunther, Cope, Putnam, Packard, S. I. Smith, Hubbard and Forbes. The reader will find the published accounts of their investigations in the *American Journal of Science and Arts*, the *American Naturalist*, the proceedings of the various scientific societies, and the geological reports of Kentucky and Indiana. The most full accounts are probably those by Profs. Packard and Putnam, in a pamphlet printed at Salem, Mass. 1879, and entitled, "The Mammoth Cave and its Inhabitants;" and Professor Cope's "Observations on Wyandot Cave and its Fauna," in Report of Geological Survey of Indiana, 1878. Hubbard's "Two Days Collecting in the Mammoth Cave," appeared in the *American Entomologist*, February and March, 1880, and is a valuable contribution to cave literature. Prof. Felipe Poey describes the blind-fish in the caves of Cuba, in the second volume of his "Hist. Nat. de la Isla de Cuba." He calls the two species named, *Lucifuga subterraneus*, and L. *dentatus*, and regards them as allied to the great family of the cod-fishes.

Many discoveries, besides those already recorded, may yet be made in this admirable field of investigation; and certainly more light is desirable on the whole range of questions concerning the mysterious organic life now known to exist in American caverns.

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