THE FISH RIVER CAVES, NEAR SYDNEY, AUSTRALIA.

BY J. E. RICHTER.

These caves are situated about 80 miles west of Sydney, Australia, and are some 3,000 feet above sea level, in an interesting mountainous locality. They were first discovered by a party of settlers in 1866, while in pursuit of bushrangers.

Apart from the cave sights, that attract so many visitors, the locality surrounding affords an interesting study to the geologist and student of nature. A wall or ridge of limestone, hard as flint, and several hundred feet in height, stretches across country for several miles, sometimes as a ridge, at other places as an arch or bridge spanning streams. One of these creeks, containing a stream measuring several square feet in section, disappears under the limestone, embouching again a mile or so further down. Its subterranean course has never yet been traced. Contiguous to its course, little doubt exists of many undiscovered caves, possibly surpassing in beauty those at present shown to delighted visitors. In ages past this ridge of limestone, now so high above the sea, and 80 miles from it, was the bottom of the warm ocean, the abode and regenerative ground of the myriad tribe of shell fish. Unearthing a detached piece of limestone at grass from the red soil, different forms of shell are discernible over the surface of it, a substance in the soil eating or corroding certain parts of the limestone more than others, leaving the shell forms raised above the surface of it. Viewing these forms, it is significant that none of the shells originally forming a part substance of this limestone were larger than 1½ inches in any section. The line of junction of the limestone with other rocks is visible at several places. On the western side an indurated Silurian schist formation closes in upon it. At the other, softer schists. Another creek, after having worn out a passage for itself through this wall of limestone, immediately joins the stream aforementioned; and it is near the junction of these streams the caves are situated, so far discovered, and as shown to the visitor by the caretaker--the caves having been wisely reserved by the government of New South Wales from any private proprietary speculation or interference. Where these streams have bored a passage through several hundred yards of this wall of limestones, traces are left sufficiently numerous to show that said streams had originally worked through at a much higher level; in after ages grinding deeper to the present bed.

These caves are singularly attractive. The intricate galleries, halls, and passages in their subterranean scenes are so truly magnificent that a person having once seen them is desirous of viewing them again and again, new features being presented to his view at each visit and at every turn. The strange forms that have been assumed by the drippings from the limestone are almost infinite, and are in beauty unsurpassable in their own character elsewhere. When lighted up by the incandescent magnesium wire or other strong light, these sublime chambers, so strangely formed by nature's hands, present a gorgeous spectacle, filled as they are with drooping sprays, coral growths, delicate pendants, gigantic columns, handsome shawls, huge curtains, and shadowy arches of the most fantastic kind. There is a good coach road from the railway at Tarana to the caves, 36 miles.

The cavernous limestone of the Fish River is bluish-brown in color, compact, and hard; fractures easily under the hammer, leaving an edge sharp as that of flint. It is capable of taking a high polish, almost equal to that of the New Zealand greenstone, so much used in jewelry ornamentation at the present time in Australasia. At different places about the caves, where the configuration of the surface has forced the many animals of the kangaroo species, large and small, to travel on any narrow trail, the limestone is worn so smooth and polished by the feet of these indigenous animals that the face of the visualist is reflected to him as in a mirror at favorable spots.

The length of the numerous caves in their various turns and curves, ascents and descents, would probably measure several miles, taking about three days to view, while the student may spend three days more to advantage inspecting the many strange overground features of the neighborhood, including the unique surrounding woodland scenery, typically Australian.

The fissured condition of some of the limestone in this locality is due to volcanic upheaval disturbance. Many of the smaller fissures have been filled since the upheaval by silicates and spar, some colored, denoting the presence of oxides of iron and probably other metals, from which also the hard carbonates deposited in such lovely and various forms on the walls, or dependent from the domes and arches of the caves below, have obtained their variegated and diversified colors. Some of these silicates present an example of that rare combination, stratification and crystallization.

For two or three years after discovery the more accessible caves were partly despoiled by iconoclastic inclined visitors breaking away the best stalactites and carrying them off to adorn their homes. Then the government assumed charge of these marvels of nature, since which time the caves are locked at their various entrances by iron gates, and can now only be seen by the guidance of the caretaker, whose service is free of charge, the material for displaying light and cost of sustenance while there being the only charges made. Much improvement has been and is being made throughout to enable visitors, including ladies, to better see the many wondrous sights without the physical exertion that was necessary in former years.

Trenches have been dug in many places, so that one can now walk along upright where once it was necessary to crawl along on hands and knees, or wriggle along, caterpillar fashion, through passages that measured but 10 or 12 inches from floor to roof. Bridges have been thrown across chasms and pools, wire ladders and stairs have been fixed at difficult ascents or descents, iron or wire rope railing guards the more dangerous side lines and pits, and rocks and other obstructions have been cleared away.

It would be difficult, as it would be unwise, to compare these caves with the Mammoth Caves of Kentucky or the more recently discovered Luray Caves of Virginia, each having its own characteristics—the Mammoth, for their vastness and rosette covered walls; the Luray, for their tessellar pendent features; the Fish River, for their spiked and filigree glasswork and shawl-draped roofs and walls.

The student of nature, accustomed to find the most exquisite symmetry, form, and color where light and warmth are in most abundance, is surprised to find here, as in other caverns, that the most charming forms, figures, and colors have been slowly created in these underground corridors, in a temperature not more than 60° F., and in darkness as intense as that of some parts of the Black Tartarus, as believed in by the ancients. This silent, enduring evidence rather upsets the assertions of those theorists who assert that the richest colors are not producible except by the aid of light or heat, or both conjointly.

In some of these caves we were often confronted by what at first sight has the appearance of the filigree work of the glassblower, as if a member of that craft had traversed with a portable apparatus, and had in a haphazard fashion practiced his art here and there in the most whimsical places, on walls, stalactites, in niches, on arch under one's feet, and on dome 50 feet above.

In some places our attention was attracted to side floors apparently thickly strewn with potatoes or turnips, covered by a half inch of what appeared newly fallen snow. It is not snow, but a soft fungus or down closely resembling it; and, unlike a few minutes' fall of snow, is the gradual growth or decay of ages, no doubt the product of disintegrated carbonates, the potatoes being concretionary nodules, probably formed from the same substance. Near these and at other places the walls present the appearance of an irregular patchy Beton concrete work, or the whitewashed dab plastering to be met with on the outside walls of the houses of the German peasant—at other places as if boys had been throwing small snowballs at the walls, which had stuck there, white as snow, a portion of it as soft too.

As illustrating the indestructibility of matter, the limestone, extremely hard though it be, wastes away in the presence of aqueously saturated air, and under certain conditions on contact with water, and is deposited at lower levels in all those strange and curious forms that so exult visitors.

The caves that have their entrance from outside are but four or five in number: The Elder Cave, Nettle Cave, Lurline Cave, Lucas Cave. The Imperial Cave, the finest of all the number, was discovered but two years ago. All other caves are but sub-caves of these. The Lucas Cave is singular in its form, winding downward as it does until, at its further end, we find ourselves directly under the entrance portion, but 200 feet lower.

Let us pause a little, and think over the evidently extraordinary slow growth of that grotto of stalactites before us. From long continued observation, extending over a century, in the limestone caves of Europe and America, the results go to show that it takes a thousand years to make a foot in length of the slowest forming stalactites. It is equally certain, however, from the results of observations in the same caves, that the same length has become aggregated in 100 or 200 years, but the conditions under which each were formed being different. From one falls a drop of water but once in two or three minutes, much of the water previous to its falling as a drop being evaporated on its coming in contact with air or a current of air. From the other the water falls in an almost continual trickle. At the Fish River Caves the only observation as yet taken was by the guide, who informed us that, at the entrance to the cave, and previous to the path being lowered, he had accidentally broken the tip off a stalactite 8 inches long by striking it with his head sixteen years ago. The new growth, the growth of sixteen years, was but ⅜ of an inch in length by ⅛ in thickness, the thickness of the stem where broken off being about ⅜ of an inch. At the time of our visit, one to two minutes elapsed between the falling of each drop of water from it. At this rate it must have taken 360 years to form this stalactite of 8 inches length previous to its breakage.

At one place, measuring about 150 square feet, we counted 36 stalactites to the square foot, from an inch to fifteen inches long, making about 5,000 delicate pendants in this sequestered nook. The longest stalactite noted in these caves was about 20 feet or less, and the tallest stalagmite about 10 feet, many of the latter assuming most peculiar shapes, as of human-like figures, hooded monk and nuns, of robed statues and statuettes, of fish standing on their heads or tails, of candlesticks, as in Fig. 2, to the right in Nelly's Grotto.

Throughout our subterranean travels, numbers of pools and basins from 4 inches to 20 feet in diameter, filled with water as clear as the distilled element, continually met our view, and in the strangest and most unexpected of places too; on top of a mound, on shelves or ledges, on terraces, or in niches, while in vicinity of Fig. 6 is a sheet of water usually less than 6 inches in depth, 100 feet long, its bottom glistening with pearls and other concretionary forms like nodules, marbles, birds' eggs, etc., interspersed with patches of diminutive coral forms, a sight so dazzling to the eye that if continued becomes almost painful.

The Shawl Cave, Fig. 5, nature has devoted to the display of shawls, and there are curtains from 10 to 20 feet long, ¼ to ½ inch thick, and 2 to 5 feet wide. Some are nearly white, while others are more or less beautifully striated in white, pink, yellow, and brown, like the markings visible in agates and other precious stones. A light placed behind these curtains reveals some to be opaque, others translucent, and all extremely handsome. A tiny stream of water trickles down the edge of each shawl.

The Crystal Salt Pans, Fig. 6, are a number of shallow basins filled with beautiful semicircular sheets of gleaming water (basins dry when photographed), each basin being a terrace, and catching the overflow of water from the one above it. It was only after a second investigation that we could realize that the ruffled margins and corrugated brims to these calcareous pools were built up by deposition of material contained in the water itself, the deposit strangely taking place only at the point of overflow. These basins are sometimes dry, when they present the appearance of a number of evaporated salt pans at a salt factory, the bottoms of the basins being then covered with shining crystals. Viewing the pillars to the left reminds the visitor of the ruined monumental columns met with in Italy, Palestine, or Greece.

Fig. 1, Lolly Cave, is an overcrowded curiosity shop, the most splendid gems hidden from view by inferior articles.

Nelly's Grotto, Fig. 2, is an assemblage needing no comment.

Solidified or petrified cascades and waterfalls are numerous throughout the caves. A few are spotless white in color, others leaden blue, some striated in various shades of white, pink, and yellow, while more are of a transparent black or brown. The latter is also the prevailing color about the diamond wells, where the carbonates are coated with a surface of crystals, the crystals being large.

Dr. Schliemann's Archæological Discoveries.

"We may communicate," says the *Academy*, "a few more details in regard to Dr. Schliemann's important discoveries at Tiryns. The walls of the prehistoric palace he has disinterred there are formed of limestone and clay; the latter has been turned into brick by the action of fire, while the stone has been burned into lime. In some places the surface of the walls had been coated with stucco, on which traces of painting can still be observed. The colors used in these paintings are black, red, blue, yellow, and white; and Prof. Virchow has pointed out that the blue is composed of pulverized glass mixed with copper, but without cobalt. One of the paintings represents the same pattern as that found on the roof of the *thalamos* attached to the Treasury of Minyas at Orchomenos. Another depicts a man riding on an ox, whose tail he holds. The artist has made three attempts to draw the tail, and has forgotten to obliterate the two unsuccessful ones. The paintings have been carefully removed and sent to Athens. Among the ruins of the palace twenty-seven bases of limestone columns have been discovered, but no drums, besides a sandstone capital in the old Doric style. The chambers of the building were full of objects of all kinds, including pottery, obsidian knives, rude hammers of diorite, and grapestones. No iron has been met with, and but little metal of any sort, though lead is relatively plentiful. All traces of writing are equally absent. The pottery resembles that of Mykenæ, but the presence of obsidian and the scarcity of metal imply that Tiryns was the older city of the two. As has already been observed in the *Academy*, the scale and arrangement of the newly found palace, with the two temples within it, are almost identical with those of the palace and two temples discovered in the second prehistoric city of Hissarlik."

Painting Tin Roofs.

Tin on a house top should be well painted once in four years. For roofs, light, cool colors are preferable, because they reflect the warm rays of light, and thereby lessen the expansion and contraction of the metal and the shrinking of the boards underneath, and so lessen the liability of the tin to crack in the seams. The temperature of attic rooms in summer will be materially lower if the roof be painted with a light rather than with a dark color. The writer has learned from long experience that the finest French ocher is the most economical pigment that can be used for that purpose. If, as is sometimes the case in country houses, where the roof is a conspicuous object in the architecture of the building, a dark color be indispensable, the use of pure Venetian red darkened with lampblack is recommended as the most durable and economical. If by some process the oil used in roof painting could be prevented from becoming hard and brittle, it would be a great gain. The poorest oil paint, however, is better than neglect; and the best economy consists in keeping tin entirely and thoroughly protected from the corroding influence of dampness. Old paint, which has become "fatty" from exposure to the atmosphere, is better than new for roof painting. Not a drop of turpentine should be used for such work.—*The Metal Worker.*

SIR FREDERICK PELGRAVE BARLEE, Governor of the British island of Trinidad, and a distinguished man of science, died recently. His valuable services in promoting the prosperity of Belize, Honduras, are well known.