

Natural Tunnel, Virginia

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Abstract: Natural Tunnel, in Virginia, U.S.A., is a 260m long cave traversed by a standard gauge railway from sink to resurgence. It is a spectacular cave curiosity, yet it remains in relative obscurity. The cave is the rejuvenated remains of a phreatic loop instigated by underground capture of a surface stream.

Natural Tunnel lies in the Allegheny Mountains about 5 km southeast of the small town of Duffield, in the western tip of Virginia, U.S.A., where it pinches out between Tennessee and Kentucky. It is therefore in the heart of the Valley and Ridge karst region of the great Appalachian fold mountains and should not be confused with the well-known but much shorter Natural Bridge, which lies 300 km to the east. The Tunnel has dimensions which are hardly remarkable, though it is a passage of considerable cross-section, and it would probably receive few visitors if it did not happen to have a main-line railway laid throughout its length.

History of the cave

It appears that Indians used the cave long ago as a route between hunting grounds, for a complete traverse is just possible without leaving at least a vestige of daylight. But it is speculated that the first white man through Natural Tunnel was Daniel Boone, soon after 1769 when he lived in the area briefly and was exploring west into Kentucky. Written descriptions of the cave date from as early as 1832, but it then seems to have

sunk back into obscurity until 1880, when an engineer, J. H. McCue came across it while surveying a route for the South Atlantic and Ohio Railroad (later to become part of the Southern Railway).

Purchase Ridge is a substantial topographic feature, essentially composed of synclinal limestone escarpments oriented NE-SW in line with the Appalachian structural trend. It separates the valleys of the North Fork of the Clinch River and the main Clinch River (figure 1), both of which drain southwest eventually into the Tennessee River. The Ridge rises to crest elevations of about 600m, 200m above the Clinch Rivers, and the modern highway has to climb to 500m to cross the ridge. However, the narrow valley of Stock Creek cuts right through the ridge at around the 400m level, and this was the route chosen by Mr. McCue. But part way through the Ridge, Stock Creek goes underground, leaving a dry saddle cresting at 448m. This is where Mr. McCue found that Natural Tunnel, the cave which Stock Creek traverses almost beneath this dry saddle, was also spacious enough to take his railway.

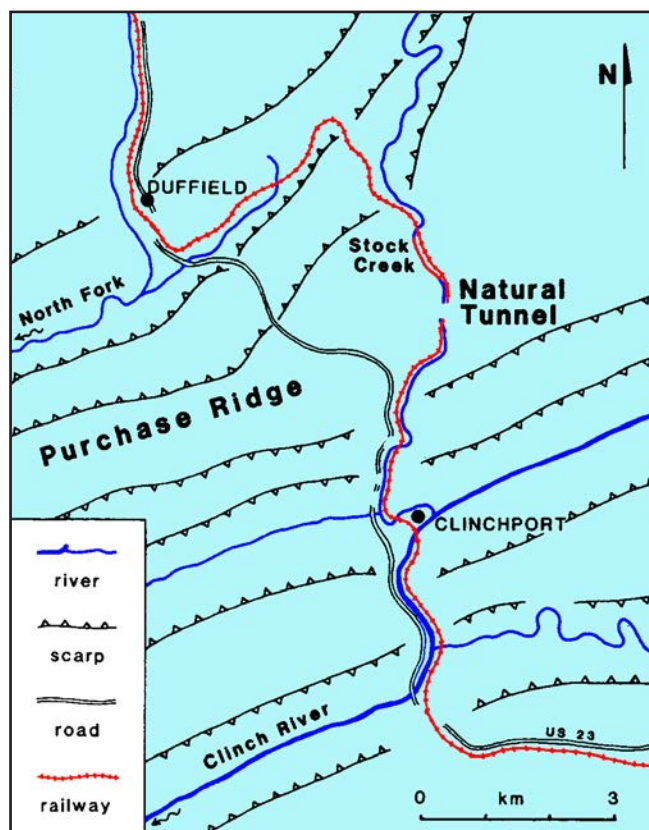


Figure 1. The area of Purchase Ridge and natural Tunnel.



The caboose of a northbound train going into Natural Tunnel.

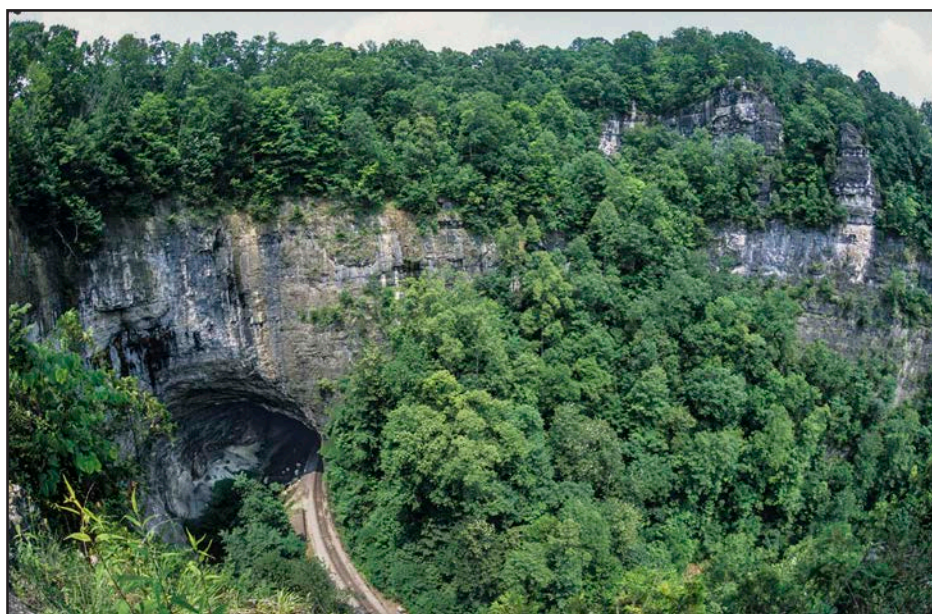
A large amount of brushwood and debris had to be cleared out of the cave, and a kink, part way through, demanded 30m of blasted tunnel. Then a low embankment was built on the firm sands and gravel of the cave sediment to keep the railway above flood levels, and, with a gentle reverse curve in its tracks, the railway gained an underground route 250m long for minimal cost.

The railway through Natural Tunnel is still in use today. This in itself is fairly remarkable in America, but the line traverses the great Appalachian coalfields and has been kept alive by coal. There have been no regular passenger trains for many years, but about 10 trains per day still pass through the Tunnel, mostly diesel-hauled very long lines of coal trucks.

Since 1971, Natural Tunnel has been a state park, though its visitor centre and tourist facilities are only currently being developed, and part of its attraction lies in the campgrounds and foot-trails on the wooded ridge. This does make the site very accessible, with laid paths to critical points including a spectacular viewpoint above

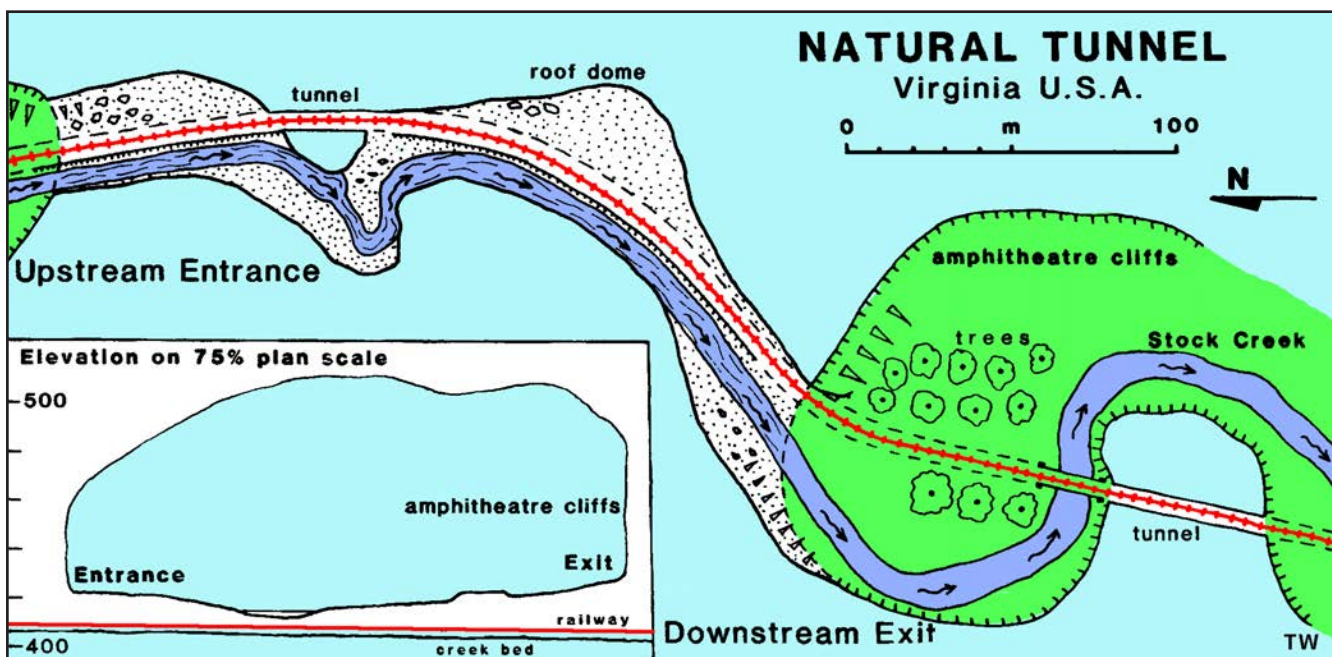
the cliffs around the cave exit. A path descends through the woods and reaches the cave after passing through another short railway tunnel. Perhaps surprisingly in a society normally zealous over safety controls, visitors can wander along the railway track through Natural Tunnel, all of which is at least gloomily lit by daylight. Signs warn to "beware of trains", but the sound effect of an approaching train makes an accident a threat only to someone completely devoid of ears or brain.

There is little existing literature on Natural Tunnel. Together with Natural Bridge (also in Virginia) it was described by Woodward (1936), but he lacked cave surveys and was a little over-enthusiastic about collapsed caverns. Since then it has achieved passing mention in various railway journals, textbooks of engineering geology and items of tourist literature (with much of the latter containing grossly distorted statistics). Then in 1977, a very detailed survey was prepared by W.C. Douty and others for the Virginia Cave Survey.



The south end of Natural Tunnel, as seen across the amphitheatre from the top of the limestone cliffs.

Figure 2. The writer's low-grade survey of Natural Tunnel. Stock Creek often runs dry through the cave during the summer months





The cave today

Stock Creek is entrenched about 100m in a narrow winding ravine which cuts through the limestone of Purchase Ridge. The stream enters Natural Tunnel where it swings gently left into the cliff forming the eastern ravine wall.

The entrance is over 20m wide and 15m high, and the railway enters on the stream's left bank, which has been modified with a low concrete wall to prevent erosion beneath the tracks. The cave is a simple arched tunnel with minimal breakdown and an undulating roof left from its phreatic origins. No rock floor is visible, and the stream is slightly entrenched in beds of sand, gravel and cobbles; there are no significant calcite deposits. There is a very gentle overall gradient, but the roof falls to a low point on an overdeveloped left bend. There the modern vadose stream swings through a meander notch cut in the rock wall. A short cut section of railway tunnel avoids both the bend and the low roof.

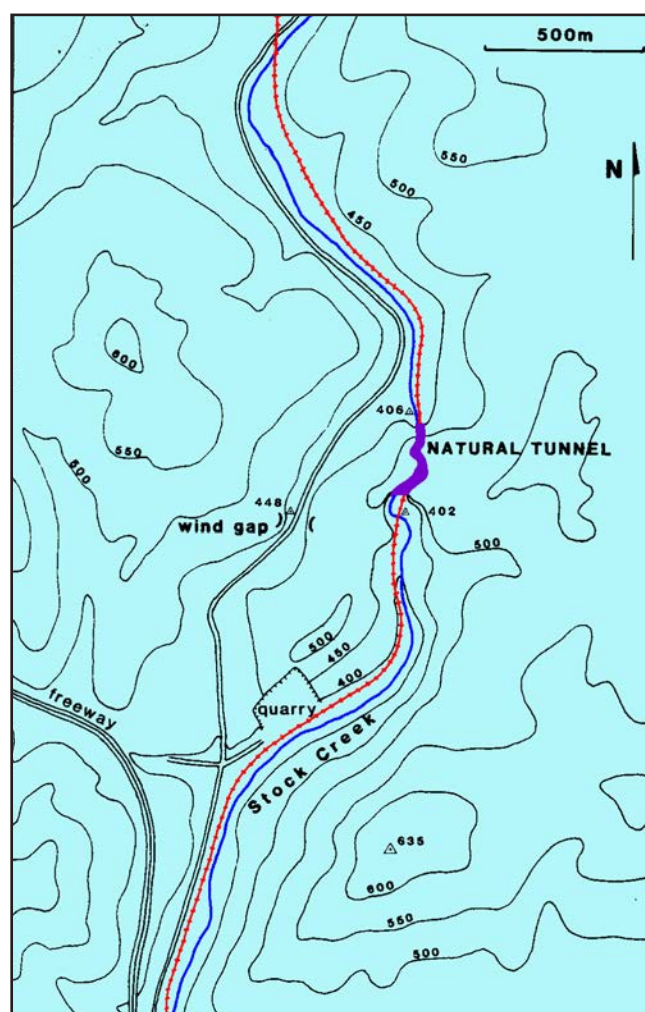
The downstream half of the cave is more spacious, with the railway on a low bank almost down its centre. The roof rises into a shallow dome, blackened by smoke from by-gone stream trains, and then rises towards the exit. The resurgence of the cave is a splendid arch 25m high and wide, which appears to have been hardly trimmed to take the railway against the left wall.

Above the cave exit, a vertical limestone cliff rises about 80m, walling a fine natural amphitheatre. Stock Creek swings round the edge of this rock bowl, before rounding a spur into a more open valley beyond. The railway uses a short tunnel through the spur, and then rejoins the creek on a daylight course.

Total length of the Natural Tunnel cave is 260m, and it descends only a few metres. The survey (figure 2) is a low-grade, one-man production, but, because of the simplicity of the cave, is a very fair representation.

The railway track inside the Natural Tunnel cave.

Figure 3. Surface features around Natural Tunnel.



Origins of Natural Tunnel

Purchase Ridge is a narrow synclinal core preserved in massive limestone with outward-facing escarpments of which the northern side rises to the higher crest (figure 1). It is part of a belt of sub-parallel structurally controlled ridges, whose pattern is complicated a little by some cross-faulting and over-thrusting. Northeast of Stock Creek, Purchase Ridge widens into a plateau as the syncline opens out. Both plateau and ridge, and also the other limestone ridges in the area, are riddled with dolines, blind valleys and sinkholes, and comprise fine karst landscapes.

Both the Clinch River and its North Fork are trunk streams flowing parallel to the structural controls. The headwaters of Stock Creek originally drained into the North Fork, and an obvious wind gap survives a few kilometres northeast of Duffield (figure 1). A tributary of the Clinch River then eroded headward into Purchase Ridge and eventually captured the head of the North Fork – to form Stock Creek along most of its present line. There is no clear remaining evidence that this initial capture involved any underground cut-offs, but the possibility cannot be ruled out. And the present drainage pattern is probably superimposed from a landscape of much less relief.

The original route of Stock Creek took it just west of Natural Tunnel, along a still well-defined valley, now followed by a minor road over a dry saddle (figure 3). A section of valley 1500m long was then abandoned when another capture took the water through Natural Tunnel; the wind gap now lies 40m above the present stream level. This capture clearly was underground, as water leaked through the initial opening of Natural Tunnel and into a short tributary valley enlarging headwards from the east bank of the valley 1500m downstream. Development of this underground loop offered hardly any shortening of the surface route, but was probably aided by following bedding planes right across the synclinal core.

Postscript

Natural Tunnel State Park has been further developed for visitor access. Pathways and boardwalks have been installed and there is now a fee for visiting. A chair lift carries people from the Visitor Centre on the limestone hill down to the level of the creek and cave. However the accessible paths end at a wooden viewing platform just inside the arch of the cave's downstream exit.

The culture of risk-aversion has caught up with the site, and it is no longer permitted to walk through the cave. The exception is on the annual Railroad Day, when no trains pass through the tunnel and it is freely open for walkers to enjoy and appreciate.

The new walkway and viewing platform that ends at the southern end of Natural Tunnel within the State Park.

The original sink into this phreatic loop was very close to the present northern entrance of Natural Tunnel. The original resurgence was a vauclosian rising with a phreatic lift of close to 40m, as indicated by the level of the wind gap, and appears to have been some short way downstream of the present cave exit. Subsequent regional lowering of both Clinch River and Stock Creek eliminated this phreatic loop, and left the roof of Natural Tunnel above water level. Vadose modification of the cave since then has been minimal except for an element of collapse back from the original resurgence. There is no evidence, nor any apparent structural control, to suggest that the initial phreatic cave rose sharply to its resurgence at the site of the present cave exit. The rock amphitheatre at the exit has vertical walls, and was almost certainly formed by collapse of the cave where it wrapped round an exceedingly sharp left bend, perhaps leaving a cave pillar of inadequate strength. Failure of the roof, itself thinning as the surface slope descended to the south, occurred a long time ago. Stock Creek has since removed the breakdown and graded its course, to leave a spectacular exit to Natural Tunnel.

Acknowledgements

The author thanks Tammie Heazlit for chasing various reference items in America, and acknowledges source data from NSS files.

Reference

Woodward, H P, 1936. Natural Bridge and Natural Tunnel, Virginia. *Journal of Geology*, **44**, 604-616.

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