Photographic Essay

The Fossil Cliffs of Joggins, Nova Scotia

by Ian A. Juby*

Figure 1. Joggins is an old coal mining town located on the shore of the Bay of Fundy, Nova Scotia. Fossil cliffs there, first brought to the attention of the scientific community in 1851 by Charles Lyell and William Dawson, are known for their many polystrate fossil lycopods and calamites.

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Figure 2. A polystrate fossil is one that cuts through multiple layers of rock. Over the course of three summers (2002–2004) I have studied these fossil cliffs, documenting well over 30 polystrate lycopods and dozens of polystrate calamites. In addition to the polystrate plant fossils, Joggins has many other fossils and unique geological features.

Figure 3. Because of the unique shape and direction of the Bay of Fundy, its tides are among the highest in the world, rising and retreating up to 14 meters (48 feet) twice daily. These tides continuously erode the cliffs at Joggins, constantly exposing new fossils.

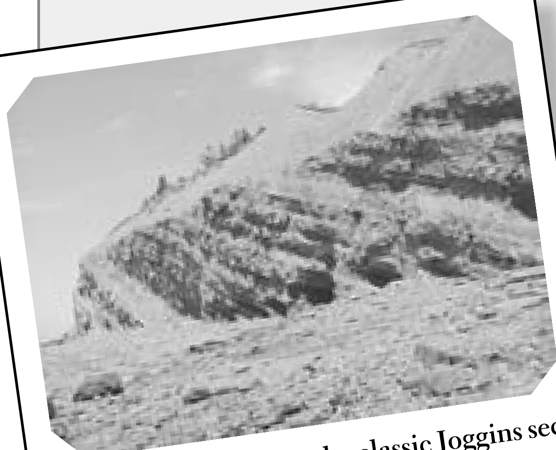

Figure 4. The cliffs in the classic Joggins section average 25 m (80 ft) high. The strata are tilted approximately 20° S. This tilt causes a 4.5 km thick section to be exposed for study along the beach between Boss Point and Ragged Reef. This section is nearly three times the thickness of strata exposed in the Grand Canyon.

Figure 5. Lycopods and calamites were giant, hollow reeds. Both are present in a much smaller modern form. While this lycopod cuts through over 7.5 m of strata, its modern counterpart, the clubmoss, seldom exceeds 0.5 m in height. Scale in left hand is in 10 cm increments; right hand is pointing to a cavity left behind by the top of the lycopod.

Figure 6. This photo shows one of dozens of crushed petrified trees, none of them polystrate. This is consistent with my observation that hollow reeds that preserved their shape during burial are upright to subvertical, while solid tree trunks are buried horizontally. In at least one instance, a layer with horizontal tree trunks is cut through by polystrate calamites. In three years, I have seen only one lycopod that was parallel to the bedding plane, yet not crushed.

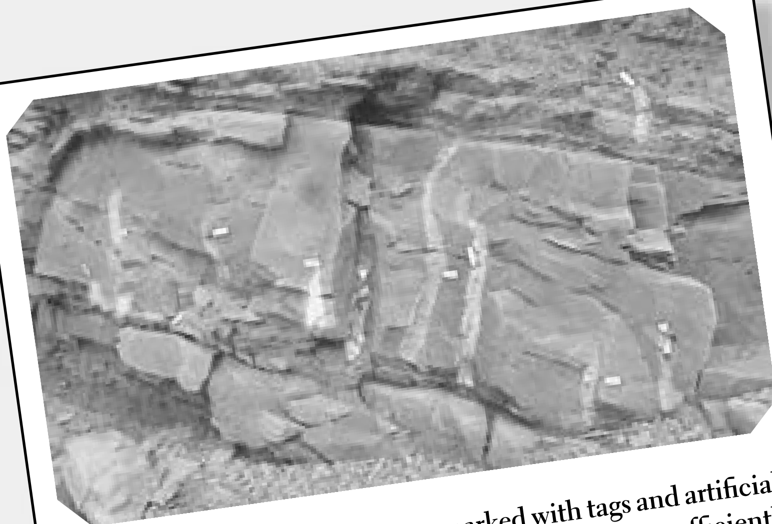

Figure 8. Polystrate calamites are marked with tags and artificially highlighted for visibility. At least six of the ten are sufficiently exposed to show that they were deformed similarly to the two in figure 7, which are just right of center in this photo.

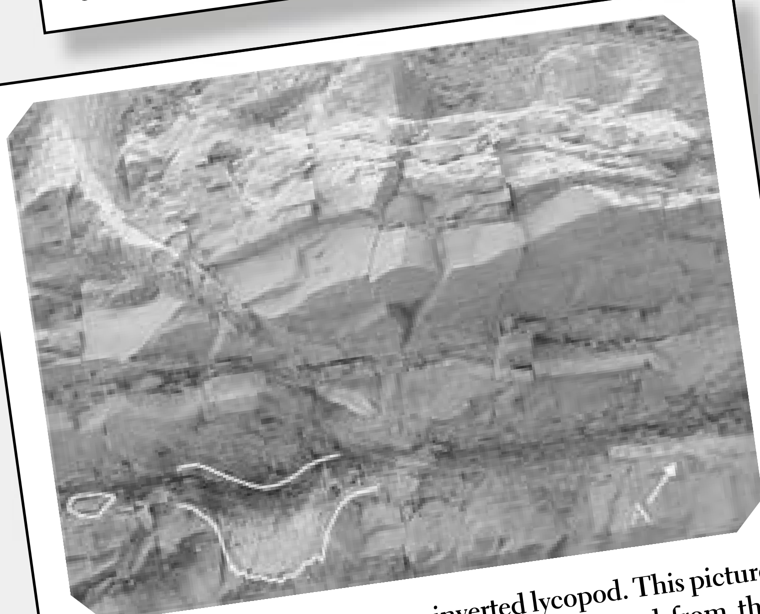

Figure 9. I observed at least one inverted lycopod. This picture shows a cavity from a lycopod already dislodged from the cliff. At least one of its roots, called stigmaria, is still in place. The inverted stump and its associated stigmaria are outlined to the lower left. The stigmaria at (A) may also have been attached to the inverted stump, or may be from the upright stump above. Any inverted stump refutes the hypothesis of Lyell (1882) that these plants were buried in their growth position. Dr. Harold Coffin (1983) also documented an inverted stump at Joggins.

Figure 7. These two polystrate calamites, bent concordantly, were a remarkable find. They corkscrew up along a radius of about 25 cm, oriented N. Then they ascend vertically through the rock roughly 30 cm, then bend back E along a tighter radius of about 15 cm. Finally, they curl S, following a 25 cm diameter, vertical spiral path for roughly 25 cm. In experiments, I found that hollow tubes (calamites are hollow) kink when bent this tight, yet the fossils are not kinked. Therefore, these plants had to have been buried and infilled before they were bent. These two plants were part of a group of at least ten polystrate calamites (see next figure). Scale is 12 inches.

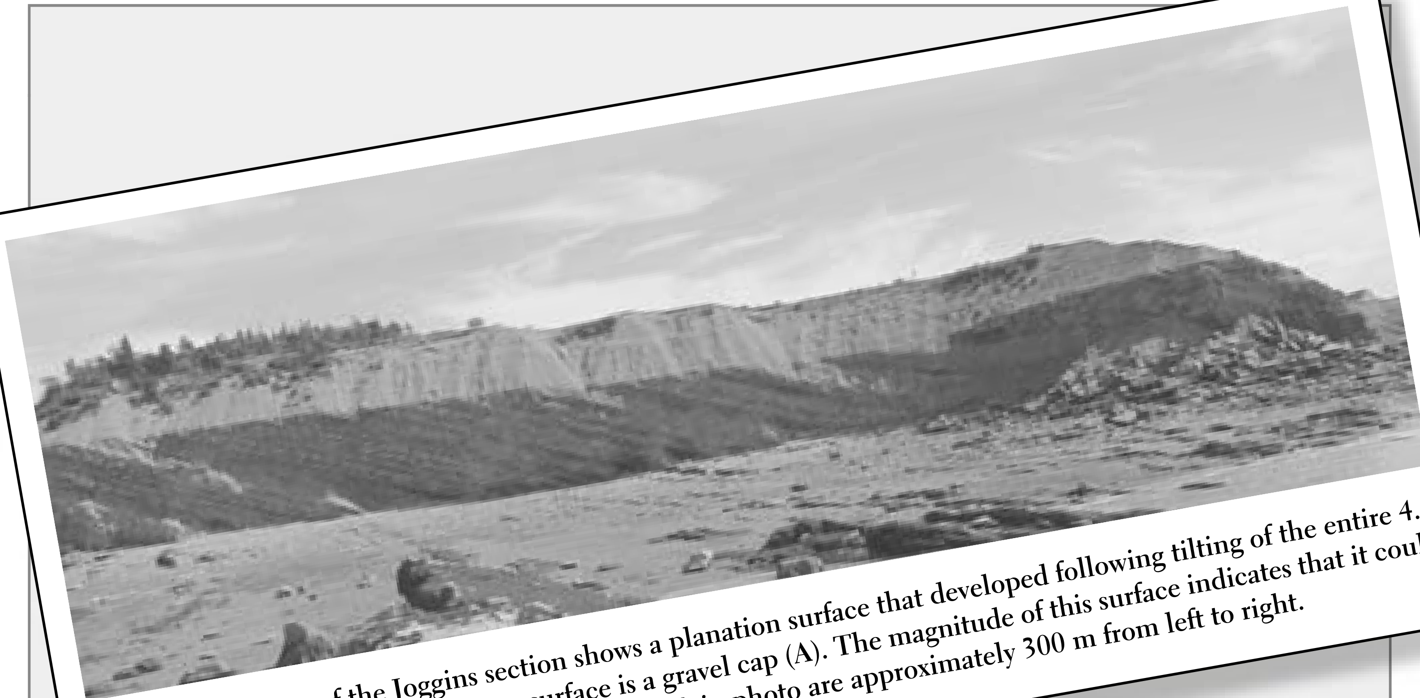

Figure 10. The top of the Joggins section shows a planation surface that developed following tilting of the entire 4.5 km-thick sequence. Atop the erosion surface is a gravel cap (A). The magnitude of this surface indicates that it could have formed during recession of floodwaters. Cliffs in photo are approximately 300 m from left to right.

Figure 11. In addition to the polystrate fossils, the sediments at Joggins contain spectacular fossil tracks. The horseshoe crab trail in this photo is approximately 2 cm across. Currently it is legal to collect fossils from the beach, but these regulations will probably change in the near future.

Figure 12. These impressions have been called fossil rain drop pits. This specific example was originally thought to be a cast of the rain drop layer, as it is raised bumps, not craters. After quite a bit of detective work, I finally located the original layer in situ. It turns out this was not a cast, but the top of the actual formation. Clearly rain drops are not going to produce bumps in the mud, so an alternative explanation is required. The sample provided courtesy of Laurence Tisdall.

Figure 13. Also common in the Joggins formation is the fossil Spirorbis, a marine tubeworm. Seen here as spirals on a fossil cordaite leaf, this is one of the many evidences of a marine origin for the Joggins formation.

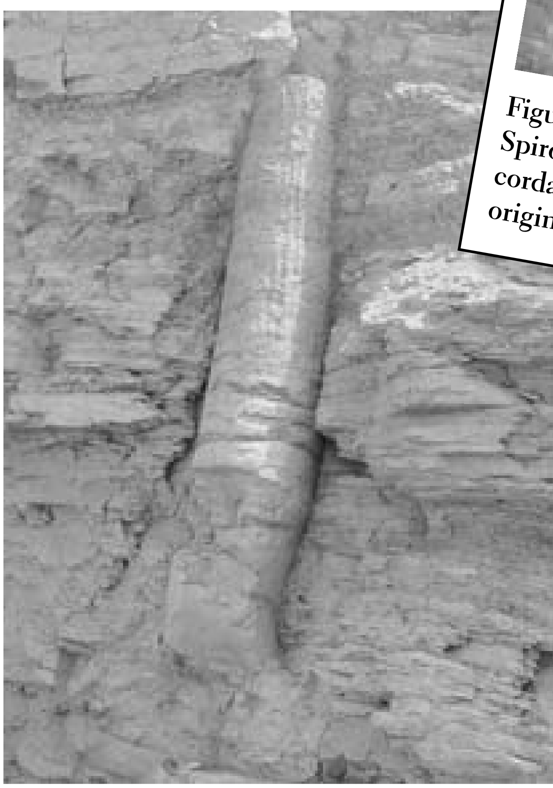

Figure 14. Regardless of how the Joggins formation came to be, it is very clear that great thicknesses of sediments do not require long periods of time. A lycopod, like the one pictured here, will not remain standing while partially buried for even decades, let alone thousands or millions of years. Additional interesting features at Joggins will be the subject of future articles for the Quarterly, but those shown here provide creationists with a brief overview of the fossil and geological evidence for the Genesis Flood at Joggins, Nova Scotia.

References

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Lyell, C. 1882. *Elements of Geology*. Harper and Brothers, New York, NY.