The Geology and Botany of Spruce Flats Bog

(Westmoreland and Somerset Counties, Pennsylvania)

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INTRODUCTION

Peat bogs are intriguing geological and ecological features that record a climate setting very different than what we see today. Scattered throughout the Appalachian Plateaus Physiographic Province of western Pennsylvania, Maryland, and northern West Virginia, these marshy areas are relics of the geologic period termed the Pleistocene, which is more widely known as the *Ice Age*. Bogs reflect the ancient environmental conditions that occurred during the Pleistocene, and preserve localized pockets of unusual plant communities as refuges. Spruce Flats bog is only one of numerous bogs that sustain such relict communities in western Pennsylvania. Most Pleistocene bogs become filled, through time, and take on a grassy or even a arboreal biota. Once this occurs they are commonly referred to as meadows. One such example is the *Great Meadows* of Fayette County where Fort Necessity is located. However, Spruce Flats bog, by virtue of its position at more than 2700 feet in elevation, has maintained much of its original marshy character and botany as a result the colder climatic conditions that prevail at this elevation.

GEOLOGY

Spruce Flats bog owes its origin to geologic causes, and its history to geologic events. This bog is located at the crest of Laurel Hill on what is known as Spruce Flats. Laurel Hill is a large up-bend in the Earth's crust that geologists call an *anticline* (*anti*=oppositely, *cline*=inclined). Within anticlines, the rock layers are inclined, or *dip* away from the central high area, called the *axis*. At the axis, individual rock layers are nearly flat-lying. Because the bog on Spruce Flats is located very near the axis of the Laurel Hill anticline, the immediate area is flat. This is the reason Spruce Flats is flat. Rocks west of the bog and the axis are inclined westward; those to the east are inclined eastward.

The bedrock exposed at the crest of the Laurel Hill anticline at Spruce Flats is comprised of alternating shale and sandstone belonging to a rock unit called the Allegheny Formation. A thick sandstone layer within the Allegheny Formation forms the flat area at the crest. Immediately below the Allegheny Formation are thick sandstone layers of the Pottsville Formation. Because these sandstones are very resistant to erosion they allow Laurel Hill to form the ridge that it does. The individual sandstones layers of the Allegheny Formation have been partially eroded, leaving a bowl-shaped depression at Spruce Flats. This depression accumulates water because an impervious clay or shale seals the base of the bowl and prevents the water from infiltrating into the underlying rock layers. This depression, in essence, has dammed the drainage within the Spruce Flats area and allowed the bog to form (Figure 1).

Deep within the Laurel Hill anticline the arched rock layers at the axis are common sites where natural gas accumulates. The upward bend in the rocks allows gas to migrate higher until, at the axis, it accu-

mulates where it meets an impenetrable capping layer. The subterranean spaces where gas accumulates are known as traps. Throughout the Laurel Highlands several anticlines (such as Laurel Hill, Chestnut Ridge, and Negro Mountain) are areas of extensive natural gas accumulation and production. One can see evidence of this production by the numerous gas well sites.

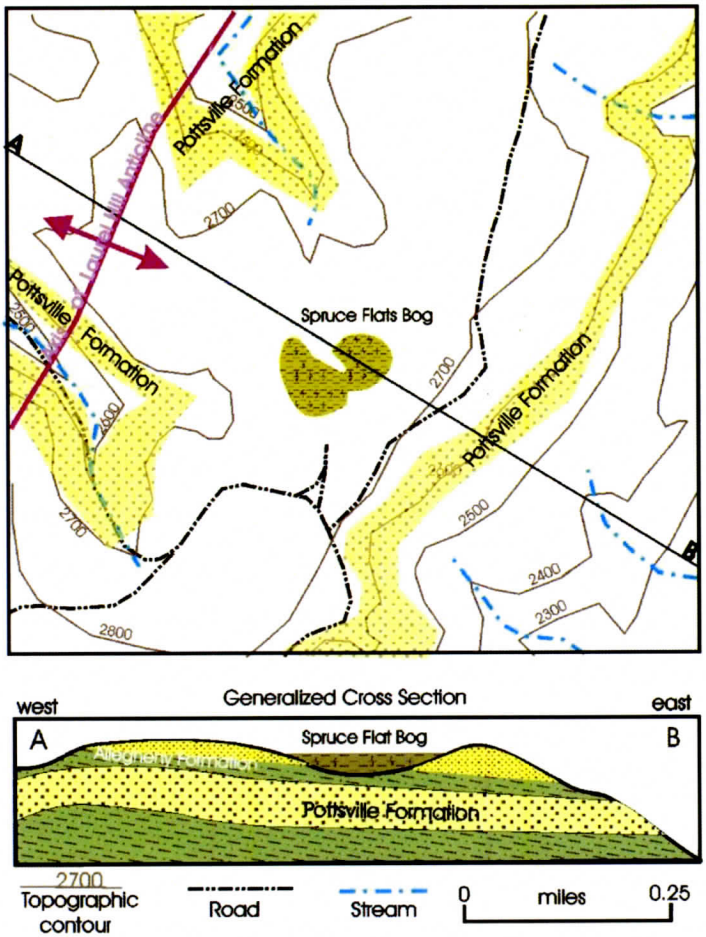

FIGURE 1. Location map with idealized geological cross section for Spruce Flats at the crest of Laurel Hill. Note how gently inclined sandstone layers create a damming effect and poor drainage to allow Spruce Flats Bog to form.

GEOLOGICAL HISTORY

The geologic time interval known as the Pleistocene Period spans the portion of Earth's history stretching from about 2 million years ago to about 10 thousand years ago. During this interval of time, cooling of the global climate prompted the growth of immense glaciers that moved southward from the polar regions into the temperate zones. This widespread distribution of continental glaciers gives the Pleistocene its more common name the *Ice Age*. In western Pennsylvania, glaciers, as much as a mile thick, extended over much of the northwestern part of the State. With a southeastern edge that stretched from near Bradford to Ellwood City. Along with the southward movement of the glaciers, climate and vegetation zones were forced southward as well. The parts of Pennsylvania that were not covered in ice were a frozen tundra with permafrost and sparse vegetation.

Along with the cold temperatures, the glaciers brought with them a significant increase in rates of rain and snowfall. Throughout this tundra zone any low-lying areas that had poor drainage were submerged owing to the unusually large amounts of precipitation. Soon, all of these areas became glades--shallow lakes that were frozen in the winter and open water in the summer. The cold water that filled these glades supported only specialized plants that were able to withstand the intensely cold conditions. A key element of this flora was sphagnum moss. This plant grew along the margins and surface of the glade where the water warmed in the summer and there was enough sun light to grow. Through time the sphagnum moss grew over the entire glade, totally covering it and leaving no open water. The abundant plant material died and fell to the bottom of the lake, but because of the cold conditions it failed to decay, and slowly but continuously peat filled the glade. Many western Pennsylvania bogs continued to developed into grassy or forested areas, but logging has commonly allowed the bogs to revert to an earlier ecological stage. This reversion is aided by the acid environments produced by the peat which has impeded the growth of more temperate plants.

BOG BOTANY

Bogs typically have low diversity of plant species because plants that live in bogs must be able to endure extreme temperatures and acidic water conditions. Additionally, they must be able to overcome constant soil saturation as well as nutrient-poor environments. Plants have adapted special features in order to succeed in these conditions. Many of the shrubby plants that grow in bogs have woody stems and firm leathery leaves that they retain throughout the year. This helps to conserve nutrients that would be lost with shedding leaves. Trees and other woody plants that grow in bogs also typically show stunted growth forms and develop shallow spreading roots. This is a result of the lower level of nutrients available to the plants as well as the lack of support due to generally unstable ground.

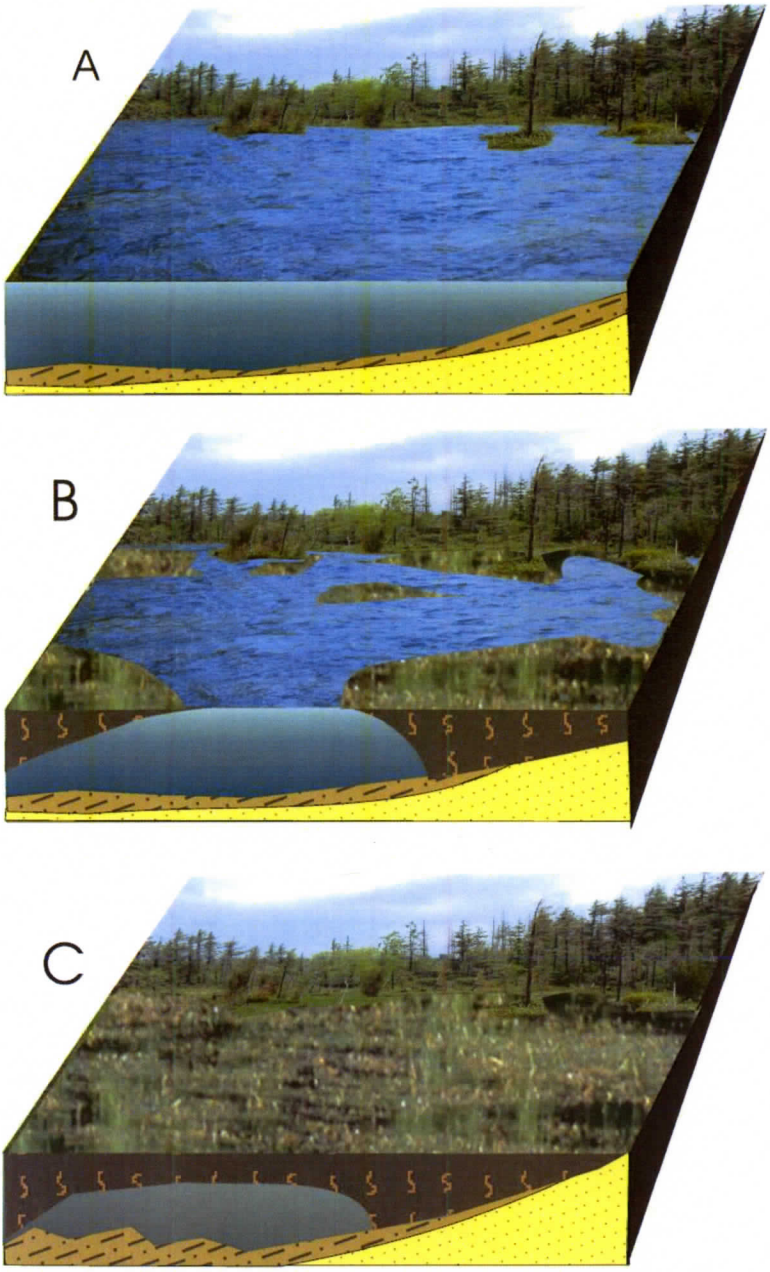

FIGURE 2. Sequence of events leading to the creation of Spruce Flats Bog. A, Ice Age glade is formed by increased precipitation and poor drainage. B, Aquatic plants such as sphagnum moss grow along margins and surface of glade. C, Glade is covered and filled by plant growth to form bog.

Carnivorous plants are among the most unusual plants found in bogs. These plants include the pitcher plant and sundew which occur at Spruce Flats. They have evolved to feed on small insects to supplement their supply of nitrogen, and other nutrients that are found in limited quantities. The pitcher plant has a highly specialized leaf that forms a cup with downward pointing hairs to trap prey. The leaves have colored veins to attract insects to them. Once inside, the prey falls into the liquid in the cup, which contains digestive enzymes. Sundews have sticky hairs on their leaves, similar to flypaper, with which to trap small insects. Once an insect is captured the sundew wraps its leaf around the victim and begins to digest it.

Special Plants of Spruce Flats Bog

Large cranberry	*Vaccinium macrocarpon* Ait.
Pitcher plant	*Sarracenia purpurea* L.
Sundew	*Drosera rotundifolia* L.
Cotton grass	*Eriophorum virginianum* L.
Peat moss	*Sphagnum* spp.
Bushy St. Johns-wort	*Hypericum densiflorum* Pursh
White beaksedge	*Rhynchospora alba* (L.) Vahl
Brownish beaksedge	*Rhynchospora capitellata* (Michx.) Vahl

Peat moss, one of the most prevalent plants found in bogs, forms a dense floating mat on the bog, which accumulates over time and produces thick deposits. Peat moss is very good at absorbing water and can tolerate full sun as well as shady conditions. Cranberry plants and sedges are opportunistic and grow on top of other bog surface vegetation such as peat moss. Bog plants are fragile and especially susceptible to trampling so please tread lightly.

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