THE GEOLOGY OF RIVERVIEW PARK

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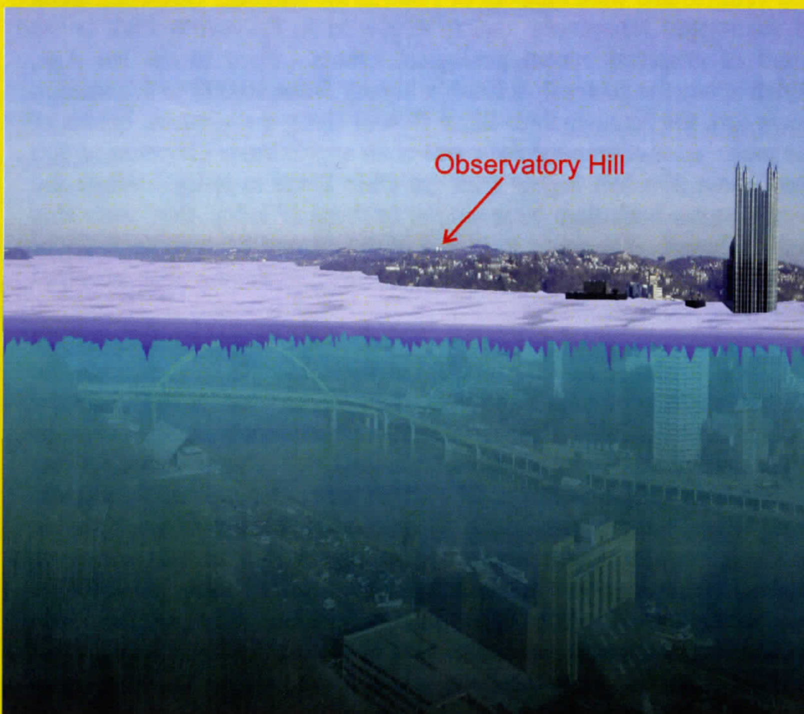

PAIS Publication Number 5
2006

YELLOWSTONE
IMAGING

INTRODUCTION

The grand vistas present in Riverview Park tell of a remarkable history that is preserved in the rocks, waiting to be discovered. The park preserves not only a history of more recent geologic events when glaciers, more than a mile thick, were situated a mere 30 miles to the northwest. It also records Earth's history from about 300 million years ago when western Pennsylvania was located in tropical setting near the equator, at a time when shallow seas and lush tropical swamps covered the region.

TOPOGRAPHY

Looking around Riverview Park one can see some landforms (hills and valleys) that were millions of years in the making. However, much of the rugged topography that is displayed in Riverview Park is the result of relatively recent geological events. Prior to the Ice Age, which spans the interval in Earth's history from 10,000 to 1.5 million years ago, the Monongahela River flowed along the southern border of the park. At that time the river was at an approximate elevation of 900 feet, about 200 feet higher than the Ohio River is today. While the river systems back then were similar to those of today, they were also very different. The route and level of the current Monongahela River system resulted from damming and course switching that occurred during the Ice Age.

Approximately 1.5 million years ago the Monongahela River did not flow to the Gulf of Mexico via the Ohio River. Instead, the Monongahela continued northward from the Golden Triangle, up the Beaver River to New Castle, and then to an ancestral St. Lawrence River confluence under what is now Lake Erie. The evidence for this ancient river course is gravel deposits that are present along the current Ohio River, but at much higher elevations than the modern-day river bed (Figure 1). These gravels mark the bottom of this old river channel. This ancestral Monongahela River flowed along the southern edge of Riverview Park parallel to Brighton Road. The gravels of this ancient river bottom are now dissected by recent stream erosion so that only parts of the gravel deposits are preserved on a flat upland area about 200 feet above the current Ohio River.

During the Ice Age when glaciers were situated near present-day Ellwood City the ancestral Monongahela River became dammed and a gigantic lake, termed Glacial Lake Monongahela, submerged all lowland areas stretching as far upriver as Morgantown, West Virginia, and as far east as Latrobe. This damming forced some tributaries to erode through their drainage divides and resulted in the shaping of the current Ohio River. Creation of the Ohio River's southward flow left a segment of the ancestral Monongahela River nearly dry. This portion is what we now know as the Beaver River. As the glaciers melted the erosion created by the abundant meltwater scoured a deep new channel for the Ohio River and a new course to the Gulf of Mexico.

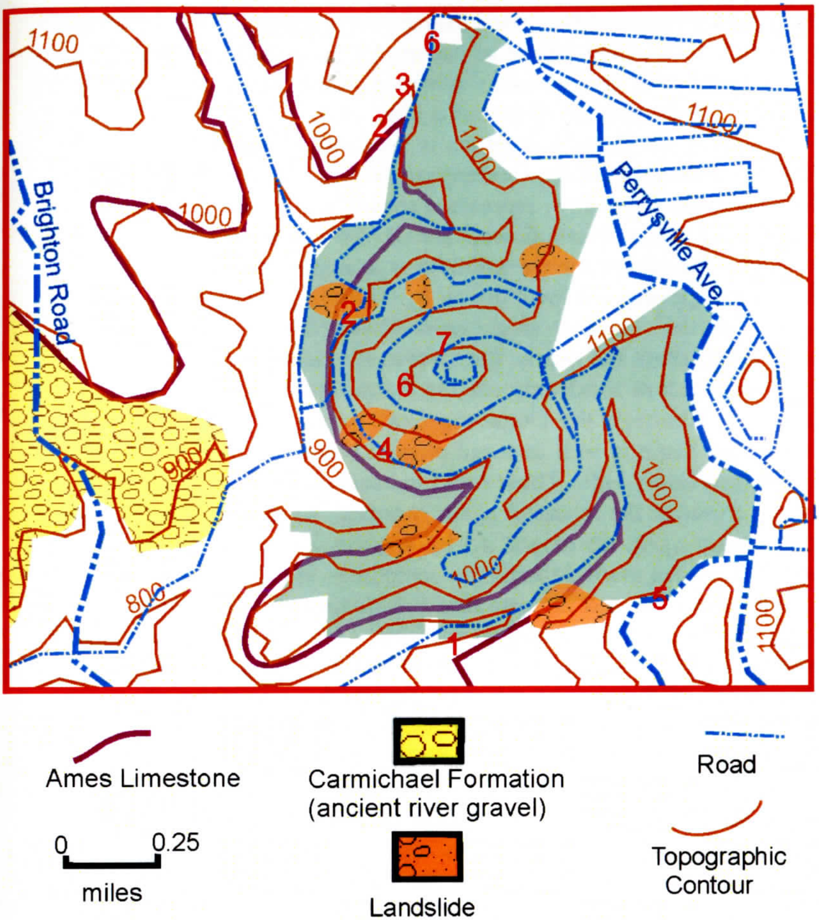

Figure 1. Map of Riverview Park with locations of key rock outcrops [red numerals], and the distribution of the Carmichaels Formation, which marks the course of the prehistoric Monongahela River. Distribution of Carmichaels gravels from Wagner and others, 1970.

With the formation of the modern Ohio River at the end of the Ice Age, local streams had to adjust their courses because the river level was approximately 200 feet lower than it had been prior to the Ice Age. As a result, streams carved out deep valleys and ravines in order to reach the new river level. The resulting steep hillsides and valley walls are generally unstable over long periods of time because erosion by water and gravity combine to smooth out sharp landscapes. In Riverview Park these forces are indicated by numerous landslides and rock slumps (Figure 1). Landslides generally form where hill slopes are too steep to support the underlying rock type. In the Pittsburgh area the rocks consist of alternating layers of sandstone, shale, and coal. While sandstone layers are generally resistant to erosion, shale layers are highly susceptible to its effects. Therefore, in areas of Riverview Park where steep slopes are underlain by shale layers, heavy rainfall or frost-wedging can soften the clay-rich rock and make the slope unstable, allowing a slump or rockslide to occur (Figure 2). These forces are not restricted to Riverview Park, but are characteristic of the entire Pittsburgh region.

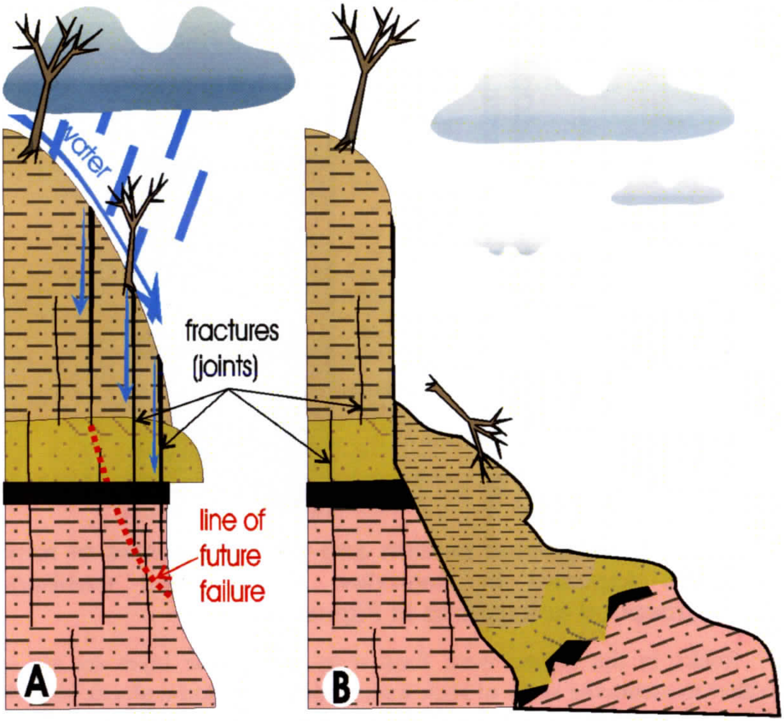

Figure 2. Idealized cross-section of how a landslide occurs. A, Steep hillsides become swollen with water along fractures in the bedrock. B, Water produces increased weight and reduced friction, allowing large masses of rock and soil to slump and slide down slope.

BEDROCK

Although the topography in Riverview Park is the result of geologically recent events, the bedrock layers that underlie the park were created more than 300 million years ago. These bedrock layers are exposed in the park and are assigned to a unit that geologists call the Conemaugh Group. The Conemaugh Group gets its name from rock exposures along the Conemaugh River, and is distributed throughout the Tri-State area. This group is subdivided into two rock formations, the Glenshaw and Casselman Formations (Figure 3). The layers of rock exposed in Riverview Park are only a portion of the Conemaugh Group.

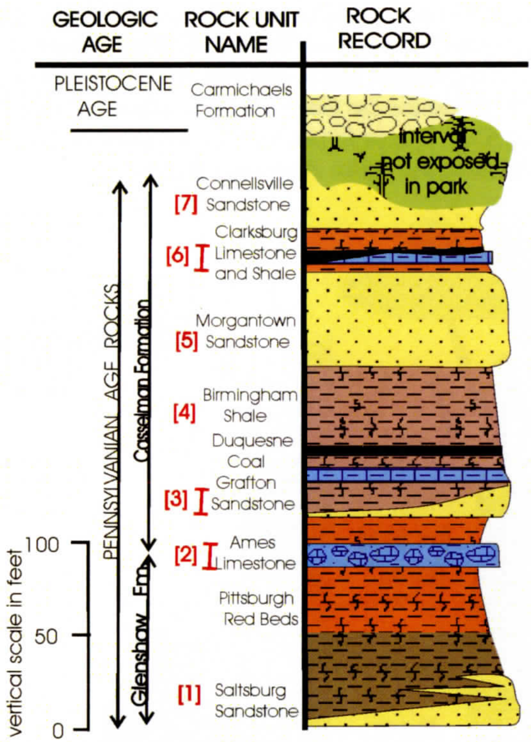

Figure 3. Stratigraphic section and geologic names of rock units exposed in Riverview Park. Red numbers correspond to locations in Figure 1.

Rocks in the region were formed by piling one layer on top of another to create the stack of rock we see today. At some places like Mt. Washington, erosion has exposed the individual rock layers, called strata, that are stacked up like layers in a cake. The first layers to form are on the bottom of the stack, and are therefore the oldest. As time passed more and more layers accumulated. Each of these layers is progressively younger in age.

The lowest and therefore oldest rocks exposed within the park are assignable to the Saltsburg Sandstone Member of the Glenshaw Formation (1). This sandstone unit represents the deposits formed within a river channel during one of the many periods of global cooling that occurred during the Pennsylvanian geologic period. Located above the Saltsburg Sandstone, and therefore slightly younger, are the red shales of the Pittsburgh Red Beds and the Ames Limestone (2). The red shales, which are poorly exposed within the park, suggest that the climate in western Pennsylvania was very warm but dry during the interval of time when they were deposited. In contrast, the Ames Limestone represents an episode of marine submergence when the region was flooded by the Ames Sea. The abundant marine creatures that lived in this sea and now are preserved in the limestone attest that the fact waters were warm and shallow. The Ames Limestone can be found over much of southwestern

Pennsylvania, eastern Ohio, and northern West Virginia. Its widespread nature suggests that this period of melting of the polar glaciers may have been lengthy, and the climatic warming must have, likewise, been substantial for the seas to cover such a large area.

Overlying the Ames Limestone is the Grafton Sandstone (3) of the Casselman Formation of the Conemaugh Group. This sandstone, like the Saltsburg Sandstone below, represents ancient river channel deposits that were formed when rivers flowed across the region as the Ames Sea withdrew. The reason for the withdrawal of marine waters from the area was a drop in global sea level driven by climatic cooling and the growth of polar glaciers. The drop in sea level allowed these rivers to flow from east to west across the nearly flat, previously submerged, coastal plain. Above the Grafton Sandstone are the Duquesne Coal and Birmingham Shale (4). Although the Duquesne Coal is not seen in the park, the Birmingham Shale is well exposed along Riverview Drive on the south side of Observatory Hill. These rocks indicate that following the Grafton cooling episode, the climate again warmed so that tropical coastal swamps once again developed across western Pennsylvania (Duquesne Coal). Nearshore marine fossils are sometimes found in the shale above the Duquesne Coal and indicate that full-fledged marine waters lay not too far to the west in southeastern Ohio. The fact that full marine conditions were not experienced in the Pittsburgh area suggests that the submergence of the continental areas during this time interval was not quite as extensive as during the Ames deposition. Situated above and chronologically following the formation of the Birmingham Shale is the Morgantown Sandstone (5). This sandstone, like the Saltsburg and Grafton sandstones below, is the result of climate changes as sea level dropped and large river systems criss-crossed the region. The Morgantown Sandstone is covered by the Clarksville Limestone and Shale (6) and in some places by the Barton Coal. These beds do not have any marine fossils, but the presence of fresh-water limestone and red shales indicates that the climate was again warm and dry during this time period. However, just as in the previous cases, the Clarksburg warming episode was followed by a cooling event that produced the Connellsville Sandstone (7). Because this sandstone is resistant to erosion, it caps Observatory Hill. The remainder of the Conemaugh Group has been eroded from the area around the park.

The rock exposures in Riverview Park represent only a small sample of the total rock record preserved in western Pennsylvania. Rocks in the park were deposited over an interval of three million years. This interval is a small part of a 20 million year span when a great ice age gripped the world during what is known as the Pennsylvanian Period.

Following the deposition of the sediments that created the area's bedrock, the entire region was uplifted as intense folding and faulting to the east marked the final stages of the formation of the Appalachian Mountains. The culmination of this mountain-building episode occurred approximately 245 million years ago. During the ensuing 245 million years, much of western Pennsylvania has been slowly, but continuously, worn away by erosion and scouring by the original Monongahela River.