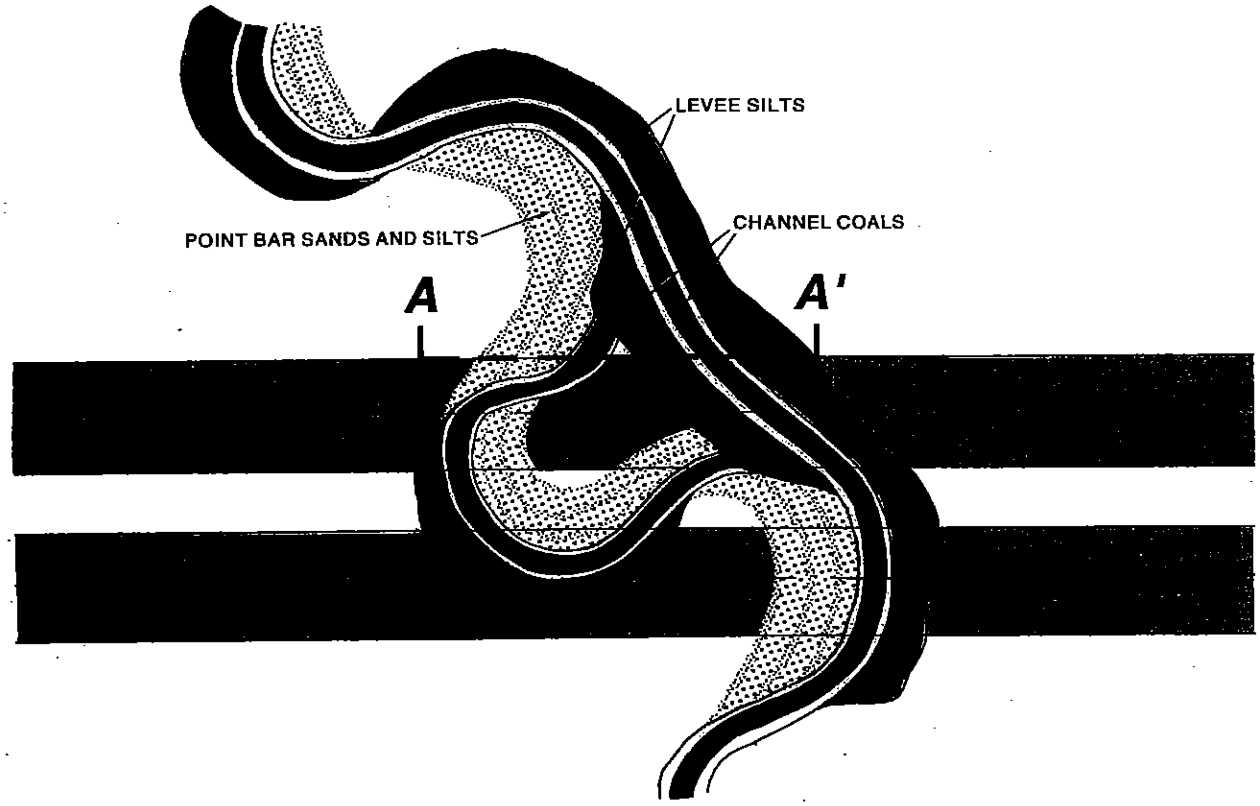

PITTSBURGH GEOLOGICAL SOCIETY
GOLDEN ANNIVERSARY (1945 - 1995)
FIELD GUIDE BOOK
1995

PITTSBURGH GEOLOGICAL SOCIETY GOLDEN ANNIVERSARY (1945 - 1995) FIELD GUIDE BOOK

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Cover Drawing by V. Skema, Day One, Stop 2

THE PITTSBURGH GEOLOGICAL SOCIETY
GOLDEN ANNIVERSARY (1945-1995)
FIELD TRIP

Peter J. Hutchinson, The Hutchinson Group, Ltd.
Field Trip Coordinator and Editor

This year we are celebrating the Golden Anniversary of the Pittsburgh Geological Society and in honor of this occasion the Board of Directors is sponsoring this three-day event. The idea for the field trip originated nearly one year ago and with diligent efforts we have prepared what we hope will be a learning adventure for all attendees. The original intent was to present as much information as possible in a one-day field trip; however, we soon found that western Pennsylvania had too many features to package into a one-day field trip. With job constraints and other commitments, we felt that three one-day field trips would be the best solution for all of our members' busy schedules.

Each day focuses on one topic of geology, and in a different portion of the Pittsburgh area. The first day examines economic geology and includes a quarry, a stratigraphic analysis of coal, and a visit to a gas storage field all in Westmoreland County. The second day presents geotechnical and engineering geological solutions for several unusual projects. This trip concentrates on the west side of Pittsburgh and examines Little Blue Run dam, the new Pittsburgh International Airport Mid Field Terminal, a stabilized slide, and coal-mine seals. The third day will combine interesting stratigraphic analyses with some of the geotechnical hazards associated with these units. This trip will also provide some of the better fossil collecting localities in the Pittsburgh area.

I would like to personally thank the coordinators of each field trip for the enormous effort they have expended to produce the Golden Anniversary Field Trip: Ray Follador, Viktoras Skema, Karen Rose Cercone, Chris Ruppen, Charles Shultz, John Harper and Judy Neelan. They have worked together to produce a wonderful set of field trips, that we know you will enjoy.

Acknowledgments

The Pittsburgh Geological Society would like to thank Mr. George Hospedar and the Davison Sand and Gravel Company for granting permission and arranging a tour of the Torrance Quarry and Mr. John Graham and Mr. Thomas Sokol of the Pennsylvania Turnpike Commission for granting permission for stopping along the Amos K. Hutchinson highway (new Route 66) to view outcrops. The Society would also like to thank Mr. Rick Lynch and the Consolidated Natural Gas Transmission Company for granting permission and arranging a tour of the Oakford Storage facility. A special thanks goes to IUP for supplying hard hats and Mr. Dale Cunningham and Halliburton Services for supplying ear protection. A final thanks goes to the Hutchinson Group, Ltd. for donating the drinks.

Geology of Western Pennsylvania

John A. Harper, Pennsylvania Geological Survey

Introduction

Southwestern Pennsylvania lies within the Appalachian Plateau Physiographic Province, an area having a generally level surface at an altitude great enough to permit erosion of deep valleys by streams. This level surface results from the essentially flat-lying nature of the bedrock near the earth's surface. The area around Pittsburgh, including Allegheny, Beaver, and most of Westmoreland counties, is assigned to a subprovince called the Pittsburgh Low Plateau Section. The topography in this section is characterized by a relatively small amount of relief. The hilltops in this area stand at about the same elevation, approximately 1,100-1,300 ft (335-400 m) above sea level, or about 350-550 ft (105-165 m) above the level of the rivers. By comparison, relief in the neighboring Allegheny Mountain Section to the east (eastern Westmoreland and Cambria counties) commonly exceeds 1,500 ft (460 m) in the vicinity of the prominent high ridges that characterize that section, Chestnut Ridge and Laurel Hill. Most of the hilltops of western Pennsylvania are the remnant of an ancient, relatively broad, relatively flat surface that has been highly dissected by numerous antecedent streams, many of which became established during the Mesozoic or Cenozoic. This surface sloped very gently toward the northwest, toward the area of the present-day Great Lakes. At least the larger streams probably meandered in broad, shallow valleys cut only a little deeper than the surrounding landscape. Once this drainage pattern was established, the topographic relief gradually increased as the streams cut down into the rocks of the plateau, until the present-day relief of western Pennsylvania became established.

Stratigraphy

Most of the surface rocks in the Pittsburgh area belong to the Conemaugh Group (Figure 1). The rock record in this area has many gaps owing to erosion or non-deposition that took place in the myriad depositional environments present between and 315 and 290 ma. Figure 1 represents a composite stratigraphic section prepared by piecing together many smaller sections exposed at different localities around the tri-state area. This figure is highly generalized -- although each rock unit in the section is shown as though it had a specific thickness and vertical distance from every other unit, in reality these are just averages. Real changes in thickness and interval are too variable to be shown in a single illustration.

The Conemaugh Group is the thickest sequence in the Pennsylvanian System of western Pennsylvania, commonly containing more than 600 ft (180 m) of sandstone, mudrock, limestone, and coal. Coals consist of a few thin seams that are mined only in limited areas. The top of the Upper Freeport coal and the base of the Pittsburgh coal form the boundaries of this group. The top of the Ames Limestone Member divides the Conemaugh Group into

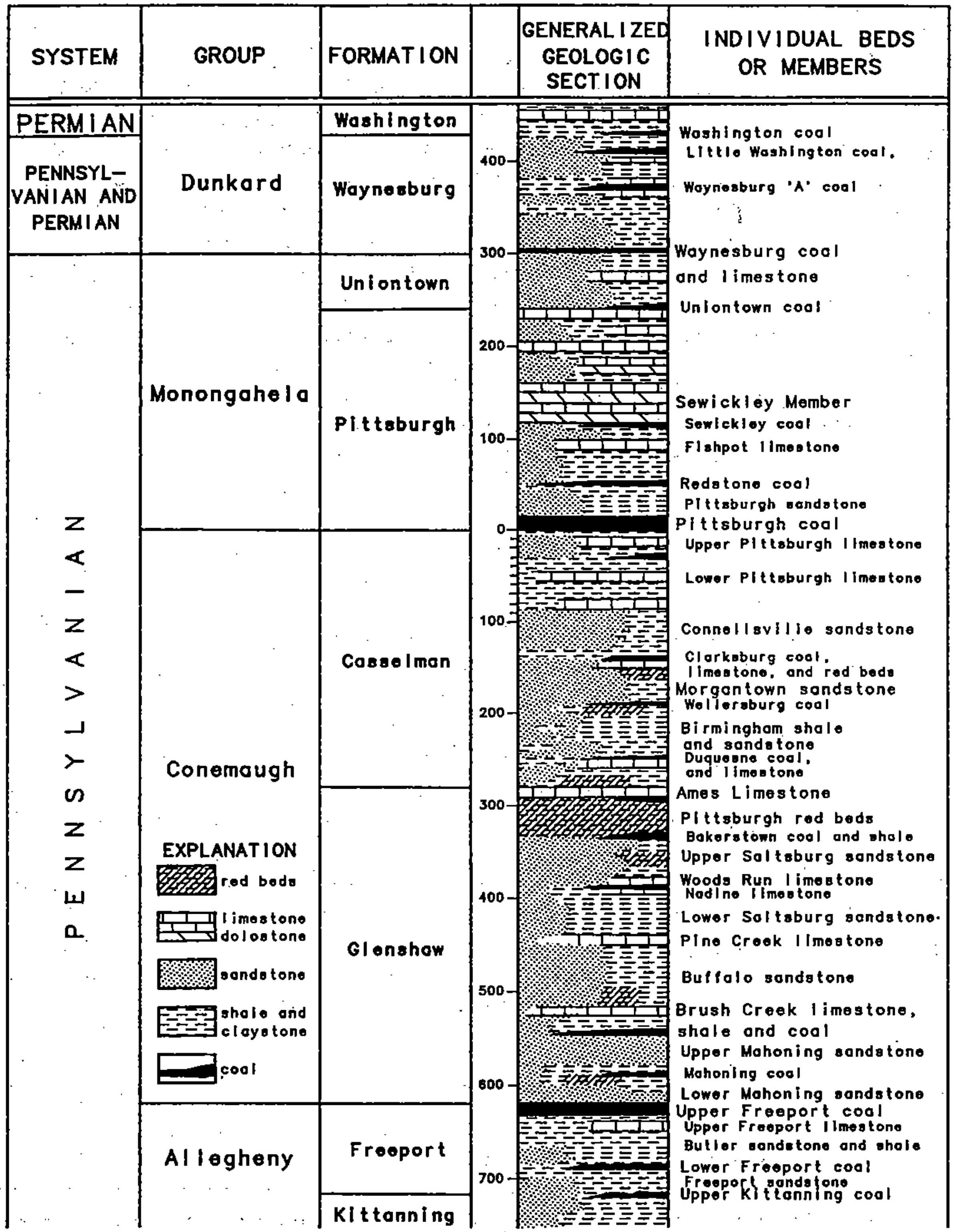

Figure 1 Generalized geologic column of the exposed rocks of Allegheny County (from Harper, 1990).

two formations, the older Glenshaw Formation and younger Casselman Formation. Each of these formations is about 300 ft (90 m) thick, dividing the group into two roughly equal subdivisions.

The Conemaugh Group underlies almost all of the Pittsburgh area, but because of regional dip to the southwest, the Conemaugh crops out mostly in stream valleys in the southern half of Allegheny County (Figure 2). The Glenshaw Formation is well exposed north of the Allegheny and Ohio Rivers whereas the Casselman Formation is best seen south and east of the two rivers. Although no one has seen a complete, uninterrupted section of the Conemaugh from top to bottom, there are places in the county where large portions of it can be seen in a single outcrop or roadcut. Notable examples include: 1) along Route 51 on the southwest side of the Ohio River, across from Sewickley, exposing an almost complete section of the Glenshaw Formation, from thick Mahoning sandstone at the bottom of the roadcut to the Ames Limestone Member near the top; 2) the extensive roadcut along Route 28 southwest of the Harmarville exit, that exposes the section from the Lower Saltsburg section (Middle Glenshaw) to the Connellsville sandstone (upper Casselman); and 3) in excavations behind stores lining approximately 1.5 mi (2.5 km) of Banksville Road (US 19) between the Parkway West and Wenzell Avenue that expose the middle Casselman to the lower portion of the Monongahela Group (Morgantown sandstone to the Pittsburgh coal).

Depositional Environments

During the much of the Pennsylvanian Period, western Pennsylvania was situated close to the edge of an epeiric sea. Climate shifts at the poles created alternating periods of glaciation and global warming which, in turn, led to periodic episodes of eustatic sea-level rise and fall. As such, western Pennsylvania became subject to periodic shifts of the coastline. At any particular time during the Pennsylvanian, northern Allegheny County could be: 1) several tens of feet below the surface of an ocean teeming with a myriad of fish and shellfish; 2) a swampy tropical rainforest of fern-like trees and scouring rushes up to 100 ft (30 m) high; 3) a large lake filled with calcareous phytoplankton and the almost microscopic crustaceans that ate them; 4) an alluvial plain with large, exotic amphibians and reptiles scampering after prey along the banks of a sluggish meandering stream; or 5) a vast delta of steaming swamps and distributaries, home to foot-long cockroaches and dragonflies the size of falcons. It was the shifting and intermixing of these environments that was responsible for the repetitious sequence of rock types that compose western Pennsylvania.

Structure

Southwestern Pennsylvania lies within the Pittsburgh-Huntingdon Synclinorium (also referred to as the Dunkard Basin) because the axis of the structure trends northeast-southwest between Huntington, West Virginia and Pittsburgh (Figures 3 and 4). Most of

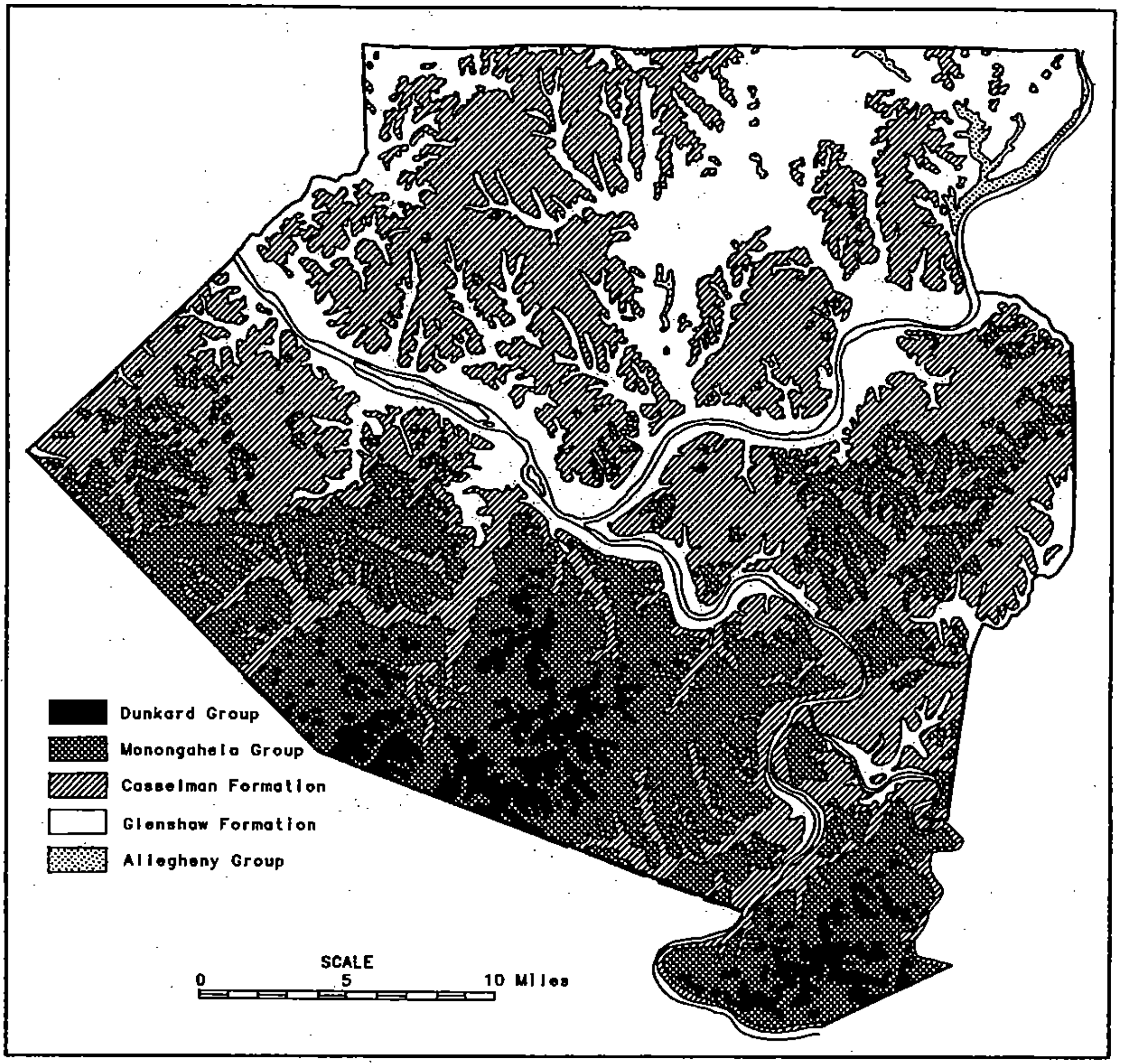

Figure 2 Geologic map of Allegheny County. The combined Casselman and Glenshaw formations comprise the Conemaugh Group.

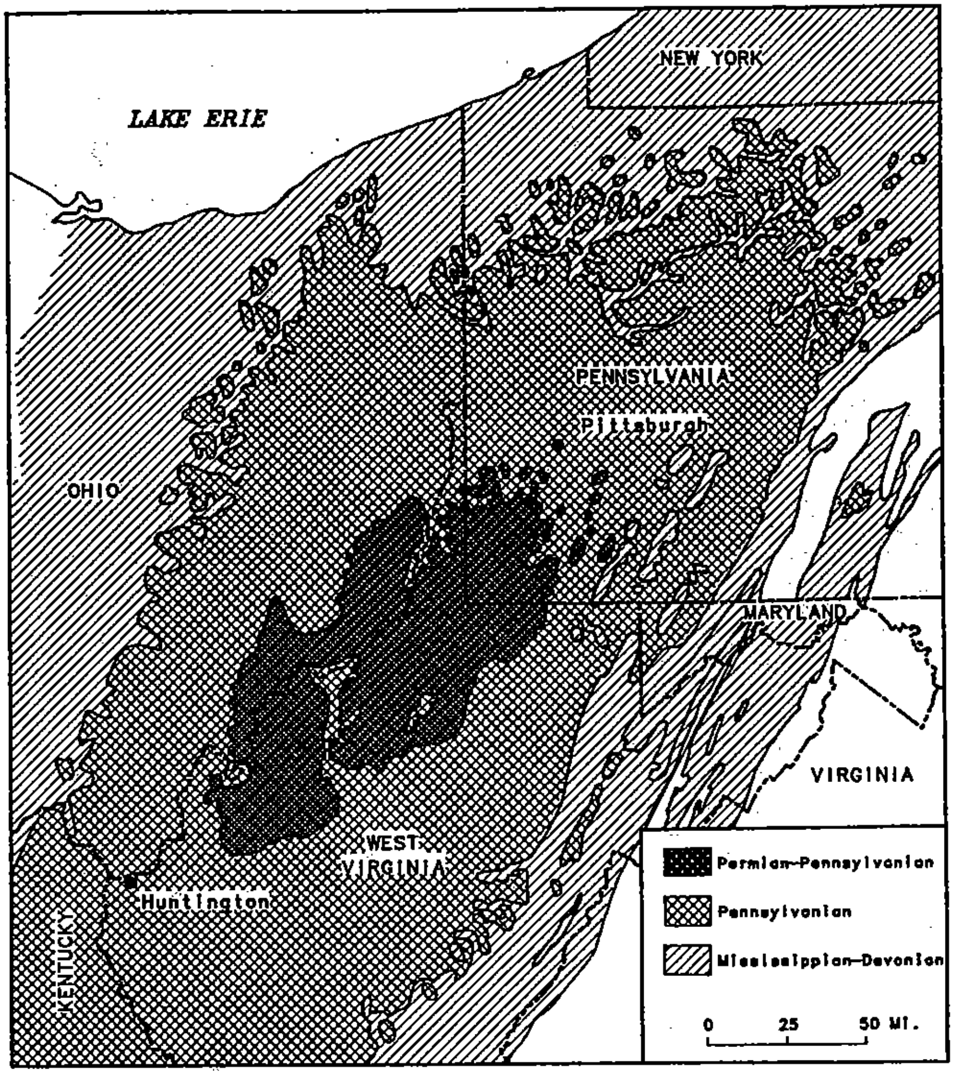

Figure 3 Generalized regional geologic map of the tri-state area. The configuration of rocks defines the Pittsburgh-Huntington synclinorium or Dunkard basin.

the strata in the basin dip gently toward this axis. The Permian System occupies the center of the basin, and progressively older rocks crop out towards the basin margins.

The strata of southwestern Pennsylvania are very gently folded, with axes trending approximately N35E (Figure 4). The anticlines typically have flanks dipping less than 20 ft/mi (3.75 m/km), although some of the "more pronounced" folds in the Pittsburgh area have dips in the neighborhood of 200 ft/mi (38 m/km), an amazing 2° slope! The typical fold tends to curve horizontally as well as vertically, resulting in serpentine structures marked by very gentle domes and saddles. Westward from the center of the Dunkard basin the folds become open and discontinuous. Eastward from the basin center the rocks become increasingly distorted by both folding and faulting, and the folds have more steeply dipping flanks and higher structural relief. Outstanding among these are Chestnut Ridge, Laurel Hill, and Negro Mountain anticlines. The principal surface fold axes in Allegheny County are shown in Figure 5, and a cross section illustrating the relation of structure to topography (at a GREATLY exaggerated scale) has been included as Figure 6.

Jointing is very common in southwestern Pennsylvania outcrops. The preferred orientations of the two principal joint sets, as measured in shales and sandstones, range from N10E to N40E and N50W to N80W (Nickelsen and Hough, 1967). Vertical joints lie nearly at right angles to bedding planes. Joints also form approximately parallel to valleys, regardless of valley orientation as a result of the release of stress. We will have the chance to see some of these valley stress-release joints during the field trip, especially along I-279 (Day Three) where the roadcuts are still fairly fresh. In addition, two well-developed vertical and intersecting cleat sets have develop in the local coals. The face cleat, which formed perpendicular to the regional fold trend, is the best developed, whereas the butt cleat, formed parallel to the regional fold trend, is less well developed. Joints have influenced the surface drainage patterns and subsurface water accumulations. Although the major drainage pattern in western Pennsylvania is dendritic, many of the streams in the region have long, straight segments that are oriented northwest-southeast or northeast-southwest, the same orientation as the major joint sets. A good example of this phenomenon is the Ohio River which flow in an almost straight channel from downtown Pittsburgh to Beaver. Jointing in the rocks created an easily eroded pathway that the rivers followed as they cut down into the folds. Jointing also plays an important role in landsliding by separating large blocks of rock, some the size of buildings, from the main bedrock layer on unstable slopes. Once gravity takes over, a rockfall is inevitable.

Faulting is not a common feature of the surface rocks of southwestern Pennsylvania, but faults do occur as we shall see. Normal faults are the most common fault type present in the surface rocks of southwestern Pennsylvania. Good examples of these occur at numerous localities around the Pittsburgh area; Wagner et al., (1970, figs. 3 and 37) illustrated normal faults with a considerable amount of displacement along Banksville Road and in a railroad cut across the Youghiogheny River from McKeesport. Most, if not all, of these faults occurred penecontemporaneously with deposition as glide planes of slump

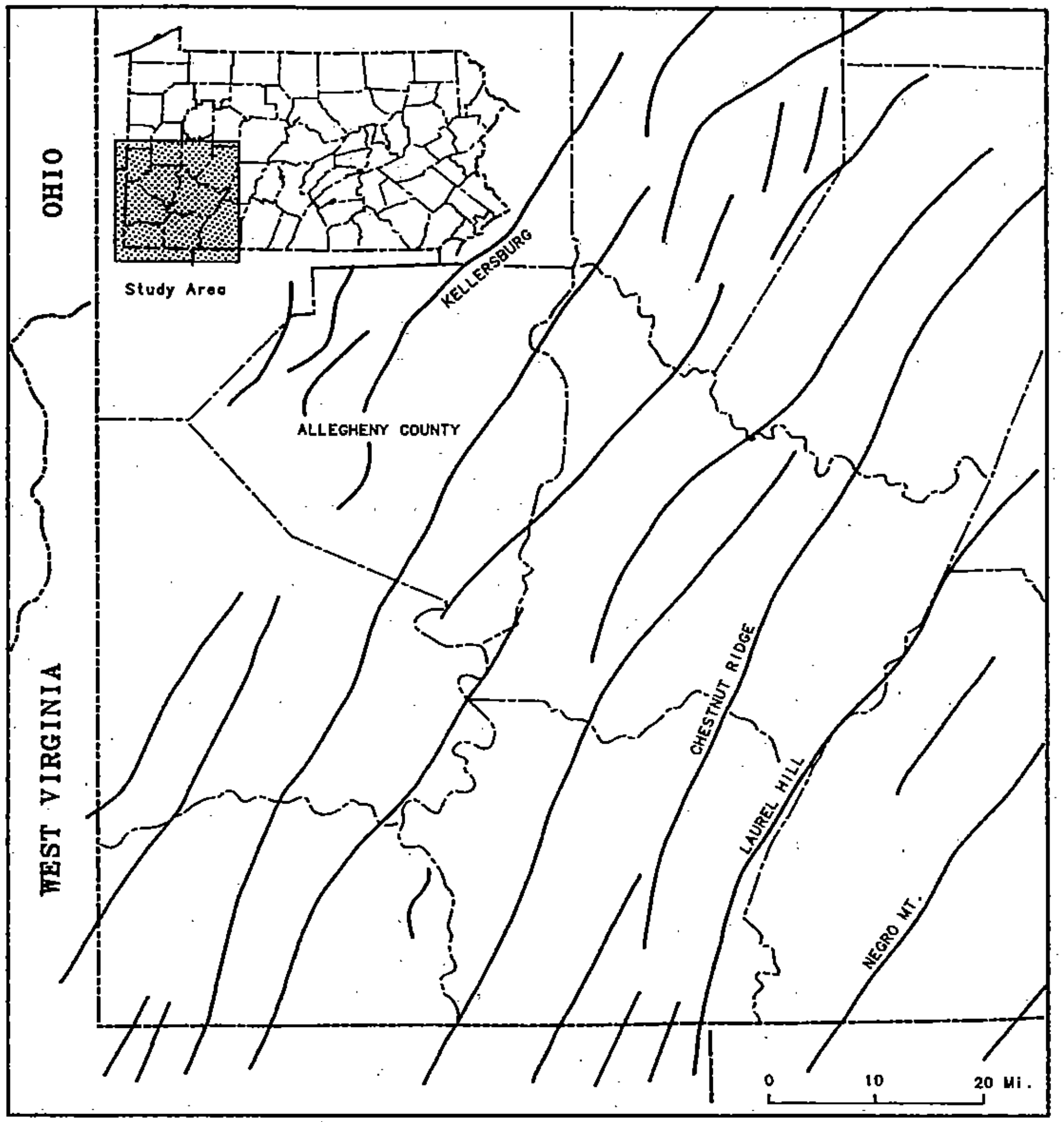

Figure 4 Map of southwestern Pennsylvania showing the trends of the major anticlinal axes. The three most prominent, Chestnut Ridge, Laurel Hill, and Negro Mountain anticlines, form high, deeply dissected ridges.

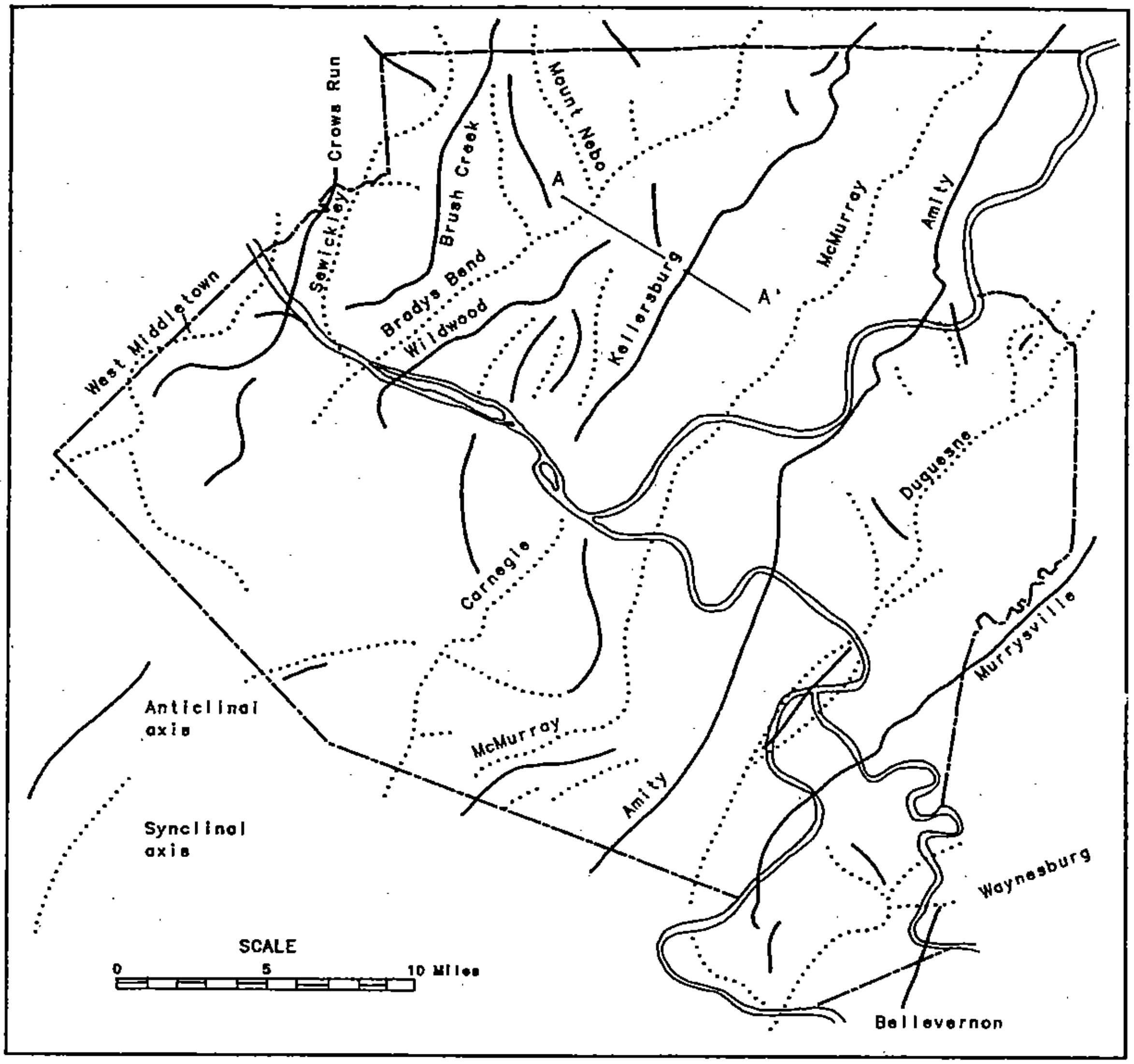

Figure 5 Map of Allegheny County showing structural axes (compiled from Dodge, 1985). Cross section A-A' is shown in Figure 6.

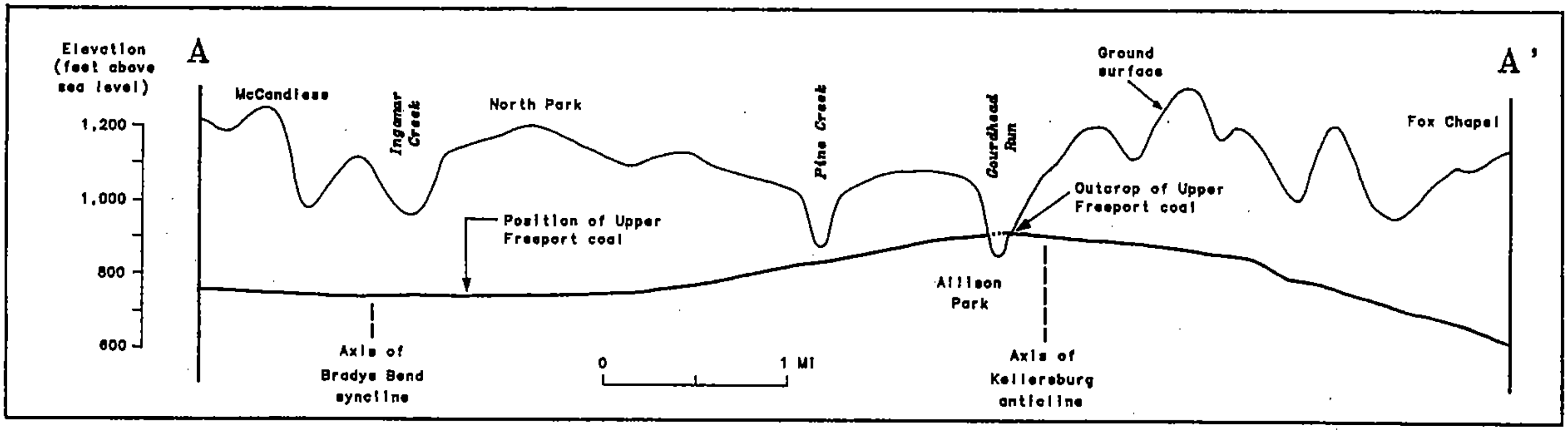

Figure 6. Cross section A-A' across the Bradys Bend syncline and Kellersburg anticline in northern Allegheny County. See Figure 5 for location.

blocks associated with stream-bank landslides. Several small normal faults cut the Ames Limestone Member in a roadcut along Route 28 near Creighton, creating a small graben. Reverse faults are far less common in southwestern Pennsylvania than normal faults,except in the more highly distorted rocks to the east. One good example can be seen in the roadcut along the southbound ramp to and from Route 28 at Tarentum where a portion of the Mahoning sandstone has been thrust upwards.