COMMONWEALTH OF PENNSYLVANIA
Richard L. Thornburgh, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Clifford L. Jones, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

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OCTOBER 1980
FROM THE DESK OF THE STATE GEOLOGIST... NOT ENOUGH RESPECT FOR PENNSYLVANIA'S OIL AND GAS

Even as there has been proper recognition of the huge reserves of anthracite and bituminous coal remaining to be developed in Pennsylvania, another pair of valuable energy resources in Pennsylvania has failed to receive the public recognition they properly deserve.

Although the story of oil and gas extraction actually began in Pennsylvania in 1859, there is a general lack of awareness that our state's oil and gas production is still going strong and is actually increasing. The final 1979 oil and gas production and exploration statistics have been assembled and released by the Pennsylvania Geological Survey. These show 2.8 million barrels of oil and 96.3 million cubic feet of natural gas taken out of the ground of Pennsylvania in 1979. Even more important is the increase in both our oil and gas reserves during the year. This is a tribute to the industry's confidence in Pennsylvania's oil and gas potential and to the resulting increase in exploration and drilling. The 1941 new oil and gas wells drilled during 1979 represents an 11 percent increase over the prior year. And in 1980 we have already recorded a record number of new drilling permits, which attests to the continuing enthusiasm and activity by the oil and gas industry.

It is, of course, certain that a major incentive for increased drilling has been the rise in both oil and natural gas prices. But there is more than that to explain the growing interest in developing Pennsylvania's oil and gas resources. The fact is that despite the history of 121 years of oil and gas development and hundreds of thousands of wells which have been drilled over that period in Pennsylvania, there remains a vast volume of deeper rock formations which have not been penetrated or tested by the shallow wells drilled to date. Dr. Dana Kelley noted in 1970 that 83 percent of Pennsylvania's potential petroleum-bearing rocks remain untested. Therein lies the challenge and the promise of our future oil and gas production.

It is good to see that the new statistics of increased exploration and drilling show that the oil and gas industry is rising to the challenge of locating Pennsylvania's deeply buried oil and gas resources. And just as we take pride and hope in the existence of the vast coal resources with which we have been blessed, so too should we look with enthusiasm to the oil and gas resources which await to be developed within the boundaries of the Commonwealth. Not only every ton of coal, but also every barrel of oil and every cubic foot of natural gas which we produce within our state is a contribution to our self-sufficiency, our economy, and our security.

Arthur G. Scoblow
RECENT STORM-INDUCED LANDSLIDES,
EAST BRADY AREA,
 PENNSYLVANIA

John S. Pomeroy, U.S. Geological Survey

On the night of August 14-15, 1980, torrential rains drenched the East Brady - Brady's Bend area, which lies about 50 miles northeast of Pittsburgh. The storm intensity (a reported 4-inch rainfall during a 4-hour period) more than exceeded the infiltration capability of the soil and resulted in heavy surface runoff, subsequent flooding, and landsliding.

Nine lives were lost in the flooding along Sugar Creek, which empties into the Allegheny River opposite East Brady. The small community of Brady's Bend including PA Highway 68 was devastated by the rampaging waters of Sugar Creek. The South Branch of

Head of debris avalanche formed during East Brady storm
Bear Creek, which flows through Karns City, Petrolia, and Bruin, also overran its banks but did not cause as much destruction. Nearly $50 million damage was done in an area involving parts of Armstrong, Butler, and Clarion Counties. A 3-inch rainfall on the same general area 6 days after the storm fortunately caused no further damage.

Although several small landslides took place on slopes bordering Sugar Creek and its tributaries, most slope movements were in two major areas, each about 1 mile wide, along the Allegheny River near East Brady. One area is the east-facing slope along the west side of the Allegheny River opposite East Brady. The other is the north-facing slope on the south side of the river east of East Brady.

On the east-facing slope, landslides damaged at least two vacant trailer-mobile homes. A car was swept out into the river by a slide, and another car was damaged. Fortunately, no lives were lost because of landsliding. Eyewitness accounts established that the sliding took place during the storm.

The north-facing slope east of East Brady is devoid of any settlement. However, an unimproved road along the base of the slope was severely damaged.
At least 50 landslides were recognized on these two slopes and adjacent areas. A number of smaller scars, undoubtedly, are hidden by the forest canopy. Many of them will become apparent by early or mid-November after the leaves have fallen. The long, narrow scars on the slopes near East Brady are caused by the debris avalanches, which are rapid downslope sliding and flowage of water-saturated soil and rock debris. Scores of debris avalanches formed in the Johnstown area during the more intense storm of July 19-20, 1977. Other landslide types that originated during the East Brady storm include slumps and debris slides.

Four conditions are prerequisite for extensive slope failures in western Pennsylvania—steep hillsides, presence of both sandy and clayey weathered rock and soil debris, intensive rainfall, and an abnormally high total precipitation during the weeks preceding the storm. All these conditions were met in the East Brady area.

Scars, that in many places expose bedrock in these areas, will be seen for many years. Possibly several decades will pass before the scars "heal," and soil and vegetation once again cover the slide paths.

**scholarship assistance available for minority geoscience majors**

The American Geological Institute's scholarship program for geoscience majors of minority groups expects to offer scholarship aid for the academic year 1981-1982. Approximately 50 scholarships, ranging in value from $250 to $1,500 per academic year, will be awarded. Those eligible to apply for the scholarships are geoscience majors, currently enrolled in accredited institutions as either undergraduate or graduate students, who are U.S. citizens and members of designated minority groups. The term "geoscience" is used to include study in the fields of geology, geophysics, geochemistry, hydrology, meteorology, oceanography, and space science. The eligible minority groups include American Blacks, Native Americans, and Hispanics.

Requests for application materials and nominations for scholarships should be addressed to Dr. William H. Matthews, III, Director of Education, American Geological Institute, Box 10031, Lamar University Station, Beaumont, Texas 77710. The deadline for filing applications is February 1, 1981.
COSTS OF LANDSLIDE DAMAGE IN ALLEGHENY COUNTY, PENNSYLVANIA

This article is excerpted from U.S.G.S. Circular 832, "Estimating the Costs of Landslide Damage in the United States" by Robert W. Fleming and Fred A. Taylor, 1980.

Costs of landslide damage have been documented for several areas in the Western United States, but few studies have been completed of losses in the East. William R. Adams, Jr., of the Allegheny County Geotechnical Center, conducted a preliminary study of the costs of landslide losses in Allegheny County. His study revealed that large losses occur annually and that a more complete accounting of landslide damages could be obtained through interviews with some of the affected agencies and individuals.

Allegheny County is a highly urbanized county in western Pennsylvania, and Pittsburgh is its principal city. The county has 1.6 million inhabitants within its 728-mile area. Landslides have been a continuing problem for many years. The areas susceptible to landsliding in Allegheny County have been mapped by Pomeroy and Davies (1975).

This is a summary of the estimated costs of landslide damage in Allegheny County for the 7-year period of 1970-76. All costs are in terms of dollars expended during a given year, and no adjustments have been made for inflation. Information reported here was obtained from interviews conducted in Allegheny County during the week of August 8-12, 1977, from Mr. Adams, and with followup correspondence. Only a small percentage of all the potential sources of information was contacted. Undoubtedly a more comprehensive survey would reveal additional losses. Public sources that were contacted included federal, state, county, and city agencies such as road departments, planning departments, environmental departments, and assessors; utility companies; sewage disposal agencies; and schools. In most organizations, only one individual was contacted. A listing of organizations that were contacted or that contributed information is in table 1.
The principal problem in obtaining data on costs of damage from landslides in Allegheny County is the very large number of sources that might have information. Only the most obvious sources could be contacted in the time available. There are 129 municipalities in Allegheny County. Some of these have offices that maintain records of costs for repair of landslide damage; others contract such work through private consulting companies and may have an incomplete account of costs. At least 200 utility companies exist in the county (table 2); added to these are several railroads, various river transportation authorities, and numerous commercial concerns. Other organizations that might have information but were not contacted are the Allegheny County Assessor’s Office, Southwest Pennsylvania Regional Planning Commission, Pennsylvania Department of Mines Subsidence, and various other county and city of Pittsburgh offices. Additional federal and private costs might have been obtained, particularly for 1972, from the SBA and the Federal Disaster Assistance Administration.
TABLE 2 - Types and number of utility companies in Allegheny County, Pa.

(W. J. Adams, Jr., written commun., 1978)

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone companies</td>
<td>8</td>
</tr>
<tr>
<td>Gas companies</td>
<td>11</td>
</tr>
<tr>
<td>Electrical companies</td>
<td>3</td>
</tr>
<tr>
<td>Heating transmission companies</td>
<td>1</td>
</tr>
<tr>
<td>Petroleum transmission companies</td>
<td>11</td>
</tr>
<tr>
<td>Cable television companies</td>
<td>15</td>
</tr>
<tr>
<td>Oil companies</td>
<td>30</td>
</tr>
<tr>
<td>Water companies</td>
<td>58</td>
</tr>
<tr>
<td>Sewerage companies</td>
<td>63</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
</tr>
</tbody>
</table>

The willingness or ability to provide data varied from organization to organization. Some sources could give a fairly complete account of expenditures for landslide damage, whereas others could give only a yearly estimate. Some consultants were reluctant to release information out of concern for the confidentiality of their clients.

Most of the costs data in this report are for the calendar years 1970-76. However, because some agencies use different recording periods—fiscal year or seasonal year—some costs may not have occurred in the calendar year to which they are ascribed. This discrepancy probably does not materially affect the total cost estimates.

Two categories of costs are reported: public and private. Most of the public landslide costs is the direct expense of repairing and restoring roads. This includes expenses readily attributed to specific large landslides and an educated guess for smaller slides, as these costs are included within budgets for routine road maintenance and repair. Public costs also include damage to municipally owned utilities and sidewalks and to other publicly owned facilities. Some public costs could not be classified as federal, state, or county and were grouped as "municipal and other public funds." Items under this heading include expenses jointly funded by several levels of government, expenses of schools and parks, and those for several landslides believed to have resulted in local expenses but for which
TABLE 3 - Costs of damage due to landslides in Allegheny County, Pa. (1970-76)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Public:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$903,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$3,000</td>
<td>$921,000</td>
<td>$132,000</td>
</tr>
<tr>
<td>State</td>
<td>no data</td>
<td>319,000</td>
<td>1,801,000</td>
<td>703,000</td>
<td>290,000</td>
<td>1,768,000</td>
<td>952,000</td>
<td>5,033,000</td>
<td>833,000</td>
</tr>
<tr>
<td>County</td>
<td>no data</td>
<td>10,000</td>
<td>122,000</td>
<td>10,000</td>
<td>20,000</td>
<td>2,000</td>
<td>2,000</td>
<td>166,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Municipal and other public</td>
<td>$878,000</td>
<td>393,000</td>
<td>600,000</td>
<td>466,000</td>
<td>705,000</td>
<td>793,000</td>
<td>450,000</td>
<td>4,285,000</td>
<td>612,000</td>
</tr>
<tr>
<td>funds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$881,000</td>
<td>725,000</td>
<td>3,426,000</td>
<td>1,182,000</td>
<td>1,018,000</td>
<td>2,566,000</td>
<td>1,407,000</td>
<td>11,205,000</td>
<td>1,601,000</td>
</tr>
<tr>
<td><strong>Private</strong></td>
<td>$582,000</td>
<td>582,000</td>
<td>582,000</td>
<td>590,000</td>
<td>574,000</td>
<td>554,000</td>
<td>4,085,000</td>
<td>584,000</td>
<td>1.35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$1,463,000</td>
<td>1,307,000</td>
<td>4,008,000</td>
<td>1,303,000</td>
<td>1,608,000</td>
<td>3,140,000</td>
<td>1,961,000</td>
<td>15,290,000</td>
<td>2,185,000</td>
</tr>
<tr>
<td>Percent of total that is private</td>
<td>40</td>
<td>45</td>
<td>15</td>
<td>34</td>
<td>37</td>
<td>18</td>
<td>28</td>
<td>27</td>
<td>27</td>
</tr>
</tbody>
</table>

1Because only a few of the more obvious sources of costs-of-damage information were contacted, the authors think that the annual cost exceeds $4 million.

documentation was incomplete. Private costs are expenses to individuals and nonpublic groups.

Table 3 shows amounts attributed to both the public and private sectors for the years 1970-76. Damage repairs, including construction and maintenance costs, by the Department of Transportation are generally the highest single yearly expense. Several sources indicated that costs of preliminary design and engineering work and inspection, which are not routinely included in quoted construction costs, are almost 15 percent of the construction cost. This amount has been added to repair costs for each yearly total. Extensive federal funds were expended in 1972 to repair landslide damage caused by Hurricane Agnes.

Private costs for the 7-year period range from 15 to 45 percent of the yearly total. The 15-percent figure is for 1972, when additional public monies were spent owing to Hurricane Agnes. The yearly average of private costs is 31 percent of the total. Information regarding private expenses were provided almost exclusively by seven private consulting engineering and geology firms. More extensive participation by other such firms would have resulted in a more complete account of costs and a higher yearly total. Note that the estimated costs of damages provided by consultants is the same amount for each of the years 1970-72. This is a result of all seven consulting firms estimating that the costs of landslide damages were the same or in the same range for those years.

This study, limited in both time and in the number of sources contacted, indicates that an average of nearly $2.2 million per year is spent in Allegheny County owing to landslide damage. Studies of the San Francisco Bay region (Taylor and Brabb, 1972; Taylor and
others, 1975; and this report) have shown that preliminary documenta
tion of economic loss due to landslide damage may be less than
half the actual total. This is likely true for Allegheny County, and
landslide damage probably costs the public and private sectors there
an average of at least $4 million per year.

If the $2.2 million figure is divided by Allegheny County’s 1975
population of 1,605,016, the annual per capita cost of landslide
damage is $1.35. Using the more realistic $4 million figure would
raise this to $2.50 per capita per year.

"GEOTHERMAL ENERGY" BROCHURE

"GEOTHERMAL ENERGY," an introductory brochure on geo­
thermal science and technology, is now available from the U.S.
Department of Energy. The brochure includes information on the
location of geothermal resources, on hydrothermal, geopressured
and hot dry rock reservoirs, geothermal electric power generation,
geothermal direct heat applications, environmental effects, and
economic and legal considerations.

"GEOTHERMAL ENERGY" is available in limited quantities,
without charge, to both individuals and organizations. Please write
to: ENERGY, P.O. BOX 62, OAK RIDGE, TN 37830.

A SURVEY OF GEOLOGY STUDENTS

A recently issued report by the American Geological Institute
entitled "Student Enrollment in Geoscience Departments 1979-
1980" carries figures of student geology majors on a state-by-state
basis, with a further breakdown of the figures according to men,
women, and minority categories.

The figures listed for Pennsylvania colleges show a total of 1294
geology majors, consisting of 1006 undergraduates and 288 graduate
students. Of the undergraduates, 881 (71%) were men and 258 (29%)
were women. Of the graduate students, 125 (76%) were men and 30
(24%) were women. These figures follow the overall trend in the
nation which shows 76% men and 24% women.

With reference to minority categories (American Blacks, Hispanics,
American Indians, Oriental Americans) amongst student geology
majors in Pennsylvania, the report shows a total of only 21 such
students, equivalent to 1.6% of the total number of geology students
in the state. Of the 21, there were 7 students at the graduate level.
At the national level, of a total of 40,376 geology majors, only 2.5%
were from the minority categories. These figures help to explain why
so few from the minority categories appear on the geology lists of
the Pennsylvania Civil Service Commission. We ought to do better!
The Abington-Cheltenham, Pa. Earthquake
Sequence of March-May, 1980

by Richard E. Bischke

Beginning on March 2, 1980 and continuing thru the months of April and May, the city of Philadelphia and its northern suburbs were affected by a sequence of small earthquakes. The largest of these earthquakes occurred on March 5 and 11, had epicenters located near Abington, Pa., and had Nuttli Magnitudes of 3.5 and 3.7, respectively (Kafka and Bischke, 1980). Beginning on March 13 Lamont-Doherty Geological Observatory and Penn State University installed four portable microearthquake stations to monitor subsequent earthquake activity. One of these stations, located at the Naval Air Development Center in Warminster, Pa., recorded additional activity on April 10 (M=2.8), 16 (M=3.2), 25 and 30, and on May 2 (M=3.0), although these events have not been definitely confirmed.

Only one person living in Glenside, Pa. reported feeling the March 2 (M=2.8) foreshock whereas 1000’s of people reported feeling the main shocks on March 5 and 11. These two earthquakes were both felt and heard, and people reported hearing explosive noises as if the oil or gas “heater blew up.” The noise was described as a low distant rumbling sound, similar to distant thunder but building gradually in intensity and not fluctuating like the roll of thunder. During the March 5 earthquake, 100’s of calls flooded the Cheltenham police station and the operator noticed that at first the Melrose Park, Pa. exchange lit up busy, followed by the Elkins Park, Pa. exchange, and later by exchanges located near Huntingdon Valley, Pa. The Abington and Jenkintown police also reported receiving numerous telephone calls, and police and fire departments were dispatched to check on possible explosions. About 13 minutes later, additional calls flooded the Abington, Jenkintown and Cheltenham police stations as people called to report the M=3.1 aftershock.

Following the March 5 earthquake, several local newspapers published an earthquake questionnaire, and students from Temple University helped distribute the questionnaire across the affected areas. Of these questionnaires, 317 and 485 were returned for the March 5 and 11 earthquakes respectively, and these felt reports were used to construct two Modified Mercalli Intensity maps (Figures 1 and 2).
People described both events as the passing of a subway train or of a heavy truck hitting a pothole or colliding with another object. In one case a plant overturned; in several cases small objects vibrated and shifted slightly on their foundations, plaster cracked and pictures tilted on the walls. In general, windows and dishes rattled, and over half of the people reporting the March 11 event at 1 in the morning were awakened by the earthquake. These reports generally place the maximum intensity at IV on the Mercalli scale for both the March 5 and 11 earthquakes, although intensity V occurred locally for both events (see Figures 1 and 2). Most people who felt the two main events reported that the March 11 earthquake was stronger than the March 5 earthquake, which is consistent with the magnitudes of the two earthquakes.

**Figure 1:** Isoseismal map of the March 5, 1980 Earthquake. An isoseismal is a line of apparent equal intensity of ground shaking. The Maximum Intensity is V and the isoseismal is dashed where uncertain. Note that the isoseismals follow the general trend of the Huntingdon-Cream Valley fault line. The epicenter was determined by the Lamont-Doherty Geological Observatory in Palisades, New York.
Figure 2: Isoseismal map of the March 11, 1980 Earthquake. The largest ground shaking lies within the IV - V isoseismal zone. Also consult the explanation in Figure 1.

There are several lines of evidence which suggest that these earthquakes occurred on the Huntingdon Valley fault which runs thru the Glenside, Jenkintown, Abington, and Huntingdon Valley areas (Figures 1 and 2). First, the police departments which adjoin the fault zone reported the largest number of calls, and the highest intensities straddle and are roughly parallel to the fault zone (Figures 1 and 2). Secondly, the density of felt reports per unit area was largest in the Glenside, Jenkintown, Abington communities, although our data collecting process biases the number of returns coming from these areas. Lastly, the epicenters of all the earthquakes lie just to the north of the Huntingdon Valley fault zone. However, uncertainties as to crustal velocities in this region introduce several km's error in the epicentral determinations. Thus the Huntingdon Valley fault seems to have been responsible for at least the March 2, 5 and 11 earthquakes. This fault separates the paleozoic Wissahickon schists on the south from the Pre-Cambrian rocks to the north and represents a major tectonic dislocation extending for a distance of 78 km. The fault is vertical at the surface and brecciated serpentinites crop out just south of the fault line (Tearpock and Bischke, 1980). A pronounced fault valley with over 100 ft. of local relief typifies the fault line and offsets the Schuylkill, Wissahickon, Tacony, Pennypack, Poquessing and Neshaminy Rivers. This indicates a zone of structural weakness.
Although the east coast and particularly the Philadelphia region is not known for its earthquake activity, the area appears to be more seismically active than is generally realized. Earthquakes occurred in Philadelphia on Oct. 30, 1763, Mar. 17 and Nov. 29, 1800, Jan. 8, 1817 and on Nov. 11 and 14, 1840. These earthquakes originated in the Philadelphia area and either shook the city and/or agitated the Delaware River (Conrad and Geyer, 1971). These earthquakes were not studied and it is not known which fault or faults were responsible.

It now appears that the Huntingdon Valley fault should be classified as an active (intraplate) fault. Historical records collected from China, Japan and the Middle East indicate that active faults located within the interior or intraplate portions of the lithospheric plates tend to be smaller and occur much less often than earthquakes which are located on plate margins, such as California (Shimazaki, 1976). These intraplate earthquakes recur on the order of 1000 years and thus the historical record of eastern earthquakes is much too short to determine earthquake risk in any particular area. It is known, however, that very large intraplate earthquakes struck New Madrid, Missouri in 1811-1812 and Charleston, South Carolina in 1886 which is in a similar geologic environment. Furthermore, the magnitudes of earthquakes often correlate with the length of ground rupture (Wyss, 1979). The Huntingdon Valley fault and its continuation, the Cream Valley fault, extend for a total distance of 78 km. Thus (by this line of reasoning) the largest possible earthquake which could occur along this continuous fault line could be as large as M~7.0 (see Wyss, 1979). However, even a fault rupture of 10 kms can generate a large earthquake. Thus the risk of a major earthquake in this area at some future time seems possible, although the probability of a large earthquake occurring during one's lifetime is very small. As 8 million people live in the greater Philadelphia region it seems warranted that additional study be given to this major tectonic dislocation.

Acknowledgements

A. Kafka, E. Schlesinger, V. Sakovich, H. Bart, and A. Bacon contributed significantly to the understanding of these events.

REFERENCES

ICE AGE BORDER IN PENNSYLVANIA MAPPED

For 185 miles across Pennsylvania from Potter to Northampton Counties, there stretches a belt of glacially deposited rocks which marks the border of the last great ice age of North America. This distinctive belt of rocks is described in the Pennsylvania Geological Survey's newly published report "Glacial Border Deposits of Late Wisconsinan Age in Northeastern Pennsylvania," authored by Professor George H. Crowl of Ohio Wesleyan University and by Dr. William D. Sevon of the Pennsylvania Survey.

With a full-color geologic map (at a scale of 1:100,000) and a 68-page text, the report fully describes the physical and environmental characteristics of the glacial sediments, as well as the economic potential of some of the accompanying sand and gravel deposits. The report will be of interest and benefit to land use planners, local government officials, geologists, developers, and all those interested in glacial processes and resulting landscapes.

General Geology Report 71, "Glacial Border Deposits of Late Wisconsinan Age in Northeastern Pennsylvania" is available from the State Book Store, P.O. Box 1365, Harrisburg, Pa. 17125. The price is $9.20 (plus 56¢ sales tax for Pa. residents). Check should be made payable to the Commonwealth of Pennsylvania.

CENTRE COUNTY SUBSURFACE WATER RESOURCES

A comprehensive description and an inventory of Centre County subsurface water resources has been published by the Pennsylvania Geological Survey entitled "Summary Groundwater Resources of Centre County, Pennsylvania." The 60-page report with large full colored map was prepared by Charles R. Wood as part of a cooperative program with the Water Resources Division of the U.S. Geological Survey.

Centre County is one of the fastest growing counties in the state and an adequate water supply is the most basic requirement for such expansion. Groundwater constitutes one of the largest reserves of quality water remaining to be developed. (continued)
The new Centre County groundwater report will be of great benefit to the planners, local officials, industry, and all persons concerned with an adequate water supply.

Water Resource Report #48, Summary Groundwater Resources of Centre County, Pennsylvania is available for $8.80 (plus 53¢ sales tax for Pa. residents) from the State Book Store, P.O. Box 1365, Harrisburg, PA 17125.

MINERALOGY OF BURNING ANTHRACITE DEPOSITS

The Pennsylvania anthracite industry, which fueled the industrial revolution in this country, also left a legacy of scarred landscapes and of waste piles and culm banks. Some of these waste piles contain various amounts of fine-grained coal; in some localities the heat resulting from oxidation of the waste pile constituents has caused them to catch fire. There are places, also, where the unmined coal seam itself has caught fire, either from a burning overlying culm bank or from an accidental event in the mine itself. The burning culm banks and coal seams have given off gases which rise to the surface where they have formed distinctive and often unique new mineral occurrences.

Mineral Resource Report 78, "Mineralogy Associated with Burning Anthracite Deposits of Eastern Pennsylvania" has been published by the Pennsylvania Geological Survey. The illustrated, 82-page report was co-authored by Dr. Davis Lapham (now deceased), John Barnes, Wayne Downey, Jr., and Robert Finkleman. The report details the results of the cooperative research investigation, including detailed analyses and descriptive data. Nineteen minerals never before found in Pennsylvania are described, including six that are unnamed. One totally new mineral species has been described as an outgrowth of this investigation and lively debate developed in this profession as to what constitutes a valid new mineral. This study has stimulated research on the bituminous waste pile of western Pennsylvania.

It is anticipated that this report will be of particular use to environmentalists, mineralogists, and many others, including those interested in the revitalization of the anthracite industry, restoration of mined land, and the gasification of coal as a new source of energy.

Mineral Resource Report 78, "Mineralogy Associated with Burning Anthracite Deposits of Eastern Pennsylvania" can be ordered from the State Book Store, P.O. Box 1365, Harrisburg, Pa. 17125. The price is $2.30, (plus 14¢ sales tax for Pa. residents). Checks should be made payable to the Commonwealth of Pennsylvania.
Sentinel Rock, a 25-ft high pinnacle of Brunswick red shale (Triassic) located on the east bank of Tohickon Creek in Nockamixon State Park, Bucks County. This impressive rampart was formed by differential weathering along planar joints and irregular curved features. Photo courtesy of Jon D. Inners.

Limestone breccia in the Conestoga Formation in a small abandoned quarry about 700 feet south of Mackley’s Mill, Hellam, York County, Pennsylvania. This chaotic mass of angular and subangular blocks is part of a large submarine slide that piled up at the base of a steep Cambro-Ordovician carbonate bank. The large block on which the hammer rests is 2.5 feet square. Photo by Jon D. Inners.