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### **ON THE COVER**

Scanning-electron photograph of a bryozoan nodule exterior surface, greatly magnified (x130), showing zooecial openings of the predominant species *Diplotrypa franklini*; from the lower part of the Keyser Limestone (latest Silurian) at the Mexico railroad cut in central Pennsylvania (see article on page 2).

### PENNSYLVANIA GEOLOGY

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Contributed articles are welcome. For further information and guidelines for manuscript preparation, contact D. M. Hoskins at the address listed above.

Articles may be reprinted from this magazine if credit is given to the Bureau of Topographic and Geotogic Survey.

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## We're on the WEB!

We have joined the many organizations who are using the Internet. While we will continue to publish reports and maps using standard printing and graphic reproduction, we are beginning to use the Internet's WWW (World Wide Web) as a method for distributing information about the geology of Pennsylvania and the Bureau of Topographic and Geologic Survey. Those of you who have computers connected to the Internet may examine our home page and additional pages by typing the Universal Resource Locator (URL) http://www. dcnr.state.pa.us/dcnr/ deputate/topogeo/default.htm. Make sure you have all of the periods and forward slashes in their correct place or it won't work.

We plan to make our WWW pages informative, interactive, and visually pleasing. To do this, we will need your comments, evaluations, and recommendations for the types of information that you wish to receive using this new technology. So tell us what you would like to see in these pages, and we will strive to meet your needs.

If you search our present pages, you will be able to search on a number of maps showing the locations of the many libraries throughout Pennsylvania, the United States, and in foreign countries where our publications are reposited. These maps were created for us by a geology student intern, Mike Cypcar, from Indiana University of Pennsylvania.

Present plans include remodeling of our "front page" and creating an interactive physiographic provinces map of Pennsylvania (the physiographic provinces map was recently revised and is also being printed in full color at page size). The Internet version will include connections to pages which portray scenes and text descriptions of places to visit that clearly demonstrate the nature of the physiography (landform) of each province and section. To each of these pages we plan to add individual descriptions of specific localities where geologic features may be examined, as well as sites to visit for fossil and mineral collecting.

If you have any comments you wish to send to me via e-mail, my address is hoskins.donald@a1.dcnr.state.pa.us.

See you on the WWW!

Somalel M. Hookins

Donald M. Hoskins State Geologist



# FOSSIL "ROLLING STONES": Bryozoan Nodules in the Keyser Limestone (Latest Silurian) at the Mexico Railroad Cut, Central Pennsylvania

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**INTRODUCTION.** "Rolling stones" conjure up musical connotations for most people, but fossil "rolling stones" also exist (though silently) and represent a highly unusual kind of geological occurrence, one that has now been found in central Pennsylvania.

These unusual fossils are actually nodules built by species of Bryozoa, one of the major animal phyla. These rounded, unattached masses were rolled around on shallow sea bottoms by waves or currents, and are sometimes termed "bryoliths" or "ectoproctaliths." Each nodule consists of concentric bryozoan encrustations, much like a tiny reef structure, except that the nodules were passively mobile instead of firmly fixed in one place. Because of this type of internal construction, such bryozoan nodules can be best understood by comparing them with bryozoan reefs and reef-rock (Cuffey, 1977, 1985).

Thus far, few nodule occurrences have been analyzed, and so the discovery of numerous bryozoan nodules or "lumps" in the Keyser Limestone (uppermost Silurian) at the Mexico railroad cut in Juniata County, central Pennsylvania, is of great paleontologic interest. Moreover, because these fossils are so similar to certain living counterparts, their study makes it possible for us to envision ancient central Pennsylvania quite vividly.

**LOCATION AND HORIZON.** The bryozoan nodules are found in the northwest corner of the large railroad cut at 40°31′55″N/77°21′09″W, Mexico 7.5-minute quadrangle, Juniata County. The locality is 1.6 mile (2.9 km) along the Conrail mainline tracks, southeast from the bridge



Figure 1. Location (X) of bryozoan nodules in the Mexico railroad cut southeast of Port Royal, Juniata County. Base map from U.S. Geological Survey Mexico and Mifflintown 7.5-minute quadrangles.

in Port Royal that carries Pa. Route 75 over the railway, and is directly south across the Juniata River from the small village of Mexico (Figure 1). Note that this is a major rail line—CAREFUL ATTEN-TION TO SAFETY is necessary when visiting this locality! Permission to visit the site should be obtained from Conrail.

The nodules occur in the lower part (Byers Island Member) of the Keyser Limestone (Figure 2), which here is latest Silurian in age, about 400 million



Figure 2. Northwest face of the Mexico railroad cut, showing the lower part of the Keyser Limestone. The in-place bryozoan nodules are scattered through the middle strata exposed here. Nodules can also be found weathered free along the foot of the cliff.

years old. The nodules are embedded in gray-weathering, thin- to nodular-bedded, micritic to calcarenitic to bioclastic limestones, separated by calcareous shale laminae. Branching, bifoliate, and encrusting bryozoans, along with strophomenid and atrypid brachiopods, are the predominant fossils at this outcrop, although rarely other groups are also seen.

**NODULE CHARACTERISTICS.** Superficially, the bryozoan nodules look like rounded stones (Figure 3A). However, close examination shows that the exterior surface is covered all the way around with pinprick-sized zooecial openings (see cover photograph). This results from the nodule having been overturned periodically by waves or currents. The surviving zooids grew around onto the newly exposed surfaces of the mass during the quiet intervals between overturnings.

The nodules vary from elongated, flattened, or ovoid to almost spherical; some have distinct lobes along their margins. Each nodule consists of from three to seven concentric layers (Figure 3B); each layer and lobe exhibits finely radial structure due to the upwardly and outwardly radiating zooecial tubes. Many nodules show distinct white and brown layers, the result of preservation by calcite and silica, respectively.

**SPECIES COMPOSITION.** The bryozoan nodules contain nine different species (Table 1), of which only one is dominant; their descriptions are detailed in Bolton (1966), Ulrich and Bassler (1913),



Α

В



Figure 3. The largest bryozoan nodule found at the Mexico railroad cut. A. Exterior view of the flattened side. B. Polished cross section through the longest dimension (13 cm).

Table 1. Bryozoan Species in Nodules, Mexico Railroad Cut           (**Abundant; *common; all others rare)							
TREPOSTOMIDA	TREPOSTOMIDA (cont.)						
Monotrypidae	Halloporidae (cont.)						
Cyphotrypa corrugata (Weller)	Leioclema subramosa Ulrich and						
Cyphotrypa expanda Bassler	Bassler						
Diplotrypidae	Leioclema tenuirama Bassler						
** Diplotrypa franklini Bolton	CERAMOPORINA						
Trematoporidae	Ceramoporidae						
Stromatotrypa globularis Ulrich	Ceramopora incondita Ulrich and						
and Bassler	Bassler						
Halloporidae	FISTULIPORINA						
Leioclema pulchella Ulrich and	Fistuliporidae						
Bassler	*Fistuliporella constricta (Hall)						

and Bassler (1923). Some nodules consist entirely of one species, others two, and some three (not always the same three).

Abundant and nearly ubiquitous in the nodules are crustose, massive, and hemispherical colonies of the trepostome *Diplotrypa franklini* (Figure 4A and 4B), characterized by subcircular, large (0.5 to 0.6 mm in diameter), thin-walled zooecia (the tubes secreted around the polyps), containing few diaphragms (cross-partitions) and separated by small mesopores (spaces between the polyp tubes), which are angular in tangential section to bubblelike in longitudinal section.

**NODULE PALEOECOLOGY.** Recent regional studies (Smosna, 1988) indicate that the Keyser Limestone was deposited around the margins of a shallow bay, in a complex of semi-enclosed lagoons, interconnecting channels, mud flats, and sandy shoals along the ancient coast. The nodular-bedded micritic limestone of the lower Keyser, just above the flat-bedded Tonoloway Formation, suggests deposition in an ancient coastal lagoon (Brezinski and Kertis, 1982).

Dominance by bryozoans and calcareous brachiopods further implies essentially marine waters, but the scarcity of other phyla (especially echinoderms) may indicate slightly reduced salinity compared with the open sea, or extreme seasonal variations in salinity, as would be expected in coastal waters diluted by rainfall and runoff. The same salinities are also suggested by the fact that only one of the several bryozoan species, *Diplotrypa franklini*, is abundant or dominant in the nodules.

The similarity of the paleoenvironment of the Keyser bryozoan nodules to modern counterparts along the Delmarva coast (Dade and Cuffey, 1984) permits visualizing Pennsylvania during Silurian-Devonian time much more vividly than is ordinarily possible in geo-



Figure 4. Tangential (A) and longitudinal (B) peel sections (both x18) of the important or dominant nodule bryozoan species, Diplotrypa franklini. Specimens are in the Paleobryozoological Research Collection at The Pennsylvania State University, State College.

logic studies. Thus, Figure 5 shows a nodule-forming coastal lagoon, flanked landward by tidal flats and seaward by barrier islands, visible in the distance. During the mid-Paleozoic, this is the sort of view that someone standing at Port Royal or the Mexico railroad cut would have had if facing southwestward, toward Altoona, out across the open shallow sea beyond the barrier islands.

**CONSTRUCTIONAL IMPLICATIONS.** The bryozoan nodules at the locality examined confirm the broad constructional capabilities of bryozoan colonies and demonstrate that those capacities extend well back into geologic time. The bryozoans here were the principal frame-builders of the nodules; they formed a series of concentrical-ly nested, shell-like crusts, the kind of limestone reef-rock known as a cruststone (Cuffey, 1977, 1985).



Figure 5. During latest Silurian time, the area of the Mexico railroad cut in central Pennsylvania might have looked like this present-day coastal lagoon containing bryozoan nodules, along the Atlantic coast of the Delmarva Peninsula.

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# An Unusual Occurrence of Ooids in the Speechley Sand of Western Pennsylvania

by Christopher D. Laughrey and Robert M. Harper\* Pennsylvania Geological Survey

**INTRODUCTION.** While doing routine microscopic examinations of rock samples as part of a reconnaissance study of Pennsylvania's petroleum reservoir rocks, we found an unusual occurrence of calcite ooids in the Speechley sand of the Bradford Group. Ooids are spherical or subspherical, sand-sized carbonate particles consisting of concentric lamellae around a nucleus, often a fossil fragment or a sand grain. When ooids are found in rocks, they are a valuable constituent because they form in a narrow range of environments and are thus useful for interpreting the depositional setting in which they originated. The Bradford Group is Late Devonian in age and comprises an entirely subsurface sequence of lenticular sandstones and siltstones interbedded with marine shales. Speechley sand is an informal name used by drillers for one of the more widespread sandstone and siltstone gas reservoirs within the Bradford Group.

In central-western Pennsylvania, the Speechley typically is a light-gray, well-consolidated sandstone interbedded with dark-gray shales (Glohi, 1984). The sandstones display low-angle to parallel laminations, cross-stratification, ripples, and trace fossils. Erosional basal contacts and related sole marks are common, as are shale intraclasts and coquina hash (Glohi, 1984; Greenawalt, 1984).

We found the ooids in samples of the Speechley sand taken from a core recovered from the Wilda M. Stewart gas well in Cowanshannock Township, Armstrong County. Twenty-nine feet of the Speechley sand interval was retrieved from this well (Figure 1). Ooids occur within a 2.25-foot interval of the core, between 2,865.75 and 2,868 feet. This interval consists of medium- to light-gray, bioturbated and wave-ripple-laminated sandstone.

**THE SPEECHLEY OOIDS.** Ooids make up 10 percent of the bulk mineralogy of the sandstones. Ooid grain sizes range from 0.15 to 0.4 mm in diameter. The outer coat of the ooids consists of concentrically lamellar microcrystalline calcite (Figure 2). Within this coat, the nucleus is mostly detrital quartz, but feldspar and rock fragments \*Deceased.

	ONMENTAL	n deposits or less srgy conditions with lesser	n of high-energy associated with n and storm- currents	∕, basin-margin					
	ENVIR	Distal storr intense en associated storms	Combinatio conditions wave actio generated	Low-energ surface					
	PROCESS INTERPRETATION	Graded lenses deposited from sus- pension; variable cross-laminations and wave ripples represent upper- llow-regime conditions followed by wave reworking; bioturbation during fair weather	Combination of bedload and suspen- sion deposition of sand; currents of decreasing strength	Deposition from suspension		<b>STIC FACIES TYPES</b>	ndstone and mudrock	e-dominated	ie layers in marine mudrock
	INTERNAL STRUCTURES AND FEATURES	Bioturbation, graded sandstone lenses, scour surfaces, low- angle and paralell laminations, wave-ripple cross-lamination, ooids	Low-angle and trough cross- laminations, parallel to cross- laminations	Graded, bioturbated sandstones and laminated mudrock		SHALLOW-MARINE SILICICLA	Heterolithic facies; mixed sa	Heterolithic facies; sandston	Mud facies; graded sandstor
	FACIES	£	На	Ма			qн	Ha	Ma
DEPTH (feet) GAMMA-RAY LOG -			fred 1	2300 - 2300	1		CORED	INTERVAL	
	DNA	SPEECHLEY SAND							

Figure 1. Gamma-ray log of the Speechley sand interval in the Stewart well showing the core interval, the oolitic interval, and an interpretation of the depositional environment in which the rocks formed.



Figure 2. Ooids in the Speechley sand.

such as chert, shale, dolostone, metamorphic and volcanic chips, and even accessory sand grains like zircon also serve as nuclei. A few ooids appear to have nuclei comprised of crystalline calcite or

single dolomite rhombs, but we suspect that these are replacement minerals. The ooids contain organic matter, located mainly between lamellae and in microcrystalline layers. Most of the ooids have micrite envelopes and encrustations, that is, rinds of cryptocrystalline calcite which formed through postdepositional diagenetic alteration of the original calcite grains. About 95 percent of the ooids are elongate and elliptical in shape. They show evidence of strong deformation; many exhibit concentric laminae sheared from the nucleus. In some instances, strong compression has sheared off the cortex of the nuclei and produced calcite grains that no longer resemble ooids. Carbonate cementation in the sandstones appears to postdate deformation. Many ooids are in pressure-solution contact with other constituents of the sandstones.

Most modern ooids form in marine environments within or near the intertidal zone where waves break and pound. In such an environment, ooids might form inorganically as cooler water from adjacent deeper areas spreads across shoals and warms; carbon dioxide is presumably removed from dissolved calcium bicarbonate, and a rim of calcium carbonate is precipitated as a coating on available nuclei. Some investigators suspect that this mechanism is too simple and suggest that blue-green algae may be involved in the precipitation of ooids (Friedman and Sanders, 1978). Although less common, ooids also form in the quiet waters of lagoons, lakes, and rivers, and on tidal flats in fresh and hypersaline waters. Laboratory synthesis of ooids has suggested that organic compounds are instrumental in the formation of quiet-water ooids, but that ooids formed in turbulent, agitated waters are precipitated inorganically (Davies and others, 1978). In all cases, ooids have a relatively simple transport history, usually growing at or near their site of deposition (Heller and others, 1980).

**SIGNIFICANCE OF THE OOIDS IN THE SPEECHLEY SAND.** Two types of depositional environments have been suggested for the Speechley sand in central-western Pennsylvania. Greenawalt (1984) proposed that the Speechley sand in the Cherry Hill gas field of Indiana County was deposited as a turbidite channel fill. He based his interpretation on sand-body geometry and the presence of a down-cutting erosional contact with underlying marine shales. Greenawalt reinforced this interpretation with core descriptions in which he documented incomplete Bouma sequences and fining-upward grain size trends. Glohi (1984), on the other hand, interpreted the Speechley sand in the Indiana gas field of Indiana County as a nearshore marine deposit. He suggested deposition of offshore sandbars in a deltamargin environment. Glohi (1984) cited the presence of fossils and biogenic structures, glauconite, minor conglomerate accumulations, and gamma-ray-log signatures as evidence for his interpretation.

The ooids in the Speechley sand in the cores from the Stewart well present an opportunity to appraise the two proposed depositional models. Our interpretation of the entire cored Speechley interval from the Stewart well is summarized in Figure 1. The basal 3 feet of core consists of graded and bioturbated, micaceous sandstone interbedded with mudrock. This sequence is overlain by 13 feet of mediumto very fine grained sandstone. This interval exhibits low-angle and trough cross-laminations and parallel laminations. The upper 7 feet of core, which contains the ooids, consists of very fine grained sandstones interbedded with mudrocks. The sandstones exhibit grading, low-angle and parallel laminations, wave-ripple cross-laminae, scour surfaces, and bioturbation. The mudrocks are also bioturbated.

We interpreted the core sequence according to the facies scheme of Johnson (1978) for shallow siliciclastic seas. This scheme is based on the recognition of "heterolithic" associations, which consist of interbedded sandstone and mudrock with proportions that vary from sand dominated (75 to 90 percent sandstone) to mixed (50 to 75 percent sandstone) to mud dominated (10 to 50 percent sandstone) (Johnson, 1978, p. 233). The assignment of these proportions to different parts of the Speechley core is shown in Figure 1.

We reject the classical turbidite model for the Speechley sand in the Stewart well because of the presence of well-developed oscillatory wave-ripple lamination and the evidence for extensive reworking of the sediments by organisms. Density currents did traverse the shallow seafloor during storms, as evidenced by the graded sequences and their associated scour features, but the fact that they were reworked by wave currents places them in shallow water, at least above storm wave base. The ooids are restricted to one small interval within the mixed sandstone and mudrock facies. If the Speechley were deposited as a turbidite channel fill and the ooids were transported over some distance from a more proximal shoal area, we would expect to find them dispersed throughout the Speechley interval. This is not the case. The ooids only occur within a wave-rippled and bioturbated zone, or, in other words, in a shallow-water environment that was agitated by wave action and that supported a benthic marine infauna.

A modern analogue for the environment in which we feel the Speechley sand formed is the Carolina continental shelf off the southeastern United States. Cleary and Thayer (1973) described the petrography of carbonate sands that are mixed with the dominant terrigenous sediments in this area. The percentage of carbonate grains on the shelf is a function of dilution by siliceous clastic sediments. The latter consist of quartz, feldspar, rock fragments, heavy minerals, and alauconite. Regional variations in Carolina shelf sand mineralogy are very similar to the variations in the mineralogy of the Bradford Group sandstones described by Glohi (1980). In Figure 3, we compare the mineralogy of the oolitic Speechley sand interval with some of the data from the modern Carolina shelf. On the Carolina shelf. ooids average 6 percent of the sand fraction and form a maximum of 15 percent. The ooids formed between 24,600 and 27,650 years ago in a shallow, hypersaline environment that existed behind calcareous shoals (Cleary and Thayer, 1973). The ooids have since mixed with the now predominant terrigenous clastics through normal shelf processes during Holocene sea-level rise. They are most concentrated





near the position of the original ooid shoals and become less common in the shelf sediments away from their site of origin.

Future petrographic work may document more occurrences of ooids in the sandstones of the Bradford Group in western Pennsylvania. Such findings could improve our understanding of the kinds of sedimentary processes that acted on the ancient floor of the Devonian sea.

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### NEW RELEASES

# Groundwater Resources of Delaware County

The Pennsylvania Geological Survey recently published Water Resource Report 66, Groundwater Resources of Delaware County, Pennsylvania. Authored by Wayne T. Balmer and Drew K. Davis of the U.S. Geological Survey, the report consists of a 67-page text accompanied by a full-color 1:50,000-scale geologic map showing the locations of selected wells.

The text contains a summary of the geologic and hydrologic



characteristics of the six major water-bearing formations in the county, including water quality; a brief discusion of the factors that influence groundwater flow; a summary of the nature of and service areas for the large public water suppliers in the county; construction, production, and ownership data for nearly 400 wells; laboratory results of organic and inorganic analyses of water samples; and discharge data from five stream basins in the county, which is useful for estimating available water resources.

Water Resource Report 66 may be purchased from the State Book Store, 1825 Stanley Drive, Harrisburg, PA 17105– 1365, for **\$11.50 plus \$0.69 state sales tax** for Pennsylvania residents. Orders must be prepaid; please make checks payable to *Commonwealth of Pennsylvania.*  Those who previously purchased only the plate for this report may now purchase the accompanying text for \$2.55. This price includes shipping, handling, and state sales tax. If ordering only the text, please send a check, payable to *Commonwealth of Pennsylvania*, to Pennsylvania Geological Survey, P. O. Box 8453, Harrisburg, PA 17105-8453.

# Coal Resources of Indiana County

The Pennsylvania Geological Survey has released Mineral **Resource Report 98. Coal Re**sources of Indiana County, Pennsylvania—Part 1, Coal Crop Lines, Mined-Out Areas, and Structure Contours. The report, by W. A. Bragonier of the Rochester and Pittsburgh Coal Company and Albert D. Glover of the Pennsylvania Geological Survey. contains a short introductory text and 122 two-color guadranglebased maps printed at a scale of approximately 1:62,500 in an 81/2by 11-inch loose-leaf format. For each of the twenty-six 7.5-minute topographic quadrangles that cover Indiana County, there is a separate map for each minable coal seam showing the coal outcrop lines and the extent of all known

strip and deep mining. An addition-

al composite map for each quadrangle contains the outcrop lines

of all principal coal seams, as well

as structure contours defining broad regional folds in the rocks.

The report provides valuable coal-resource information for future exploration and mining programs that support local employment and the local area economy. Additionally, the report provides framework information for environmental and land use planning. The structure contours drawn on several of the coal seams portray the fold structures in the county and thus provide reference information for geologic studies in other stratigraphic units.

Mineral Resource Report 98 may be purchased from the State Book Store, 1825 Stanley Drive, Harrisburg, PA 17105–1365, for **\$15.80 plus \$0.95 state sales tax for Pennsylvania residents**. Orders must be prepaid; please make checks payable to *Commonwealth of Pennsylvania*.

## Surficial Geology of the Easton, Riegelsville, and Frenchtown Quadrangles

The Pennsylvania Geological Survey has recently released three new open-file reports in the second installment of a series of 28 surficial geologic maps of 7.5minute quadrangles in the Allentown 30- by 60-minute map sheet. The reports are Open-File Report 96-38, Surficial Geology of the Pennsylvania Part of the Easton 7.5' Quadrangle, Northampton County, Pennsylvania; **Open-File Report 96–45, Surfi**cial Geology of the Pennsylvania Part of the Riegelsville 7.5' Quadrangle, Northampton and Bucks Counties, Pennsylvania; and Open-File Report 96-46, Surficial Geology of the Pennsvlvania Part of the Frenchtown 7.5' Quadrangle, Bucks County, Pennsylvania. All three reports are by Duane D. Braun of Bloomsburg University.



Each report consists of a one-color (black) photocopy of a 1:24,000-scale geologic map with a skeletal legend of from 12 to 32 surficial map units and a 5to 12-page text, which includes detailed descriptions of the map units, a short discussion of mapping methodology and glacial history, a table showing the relationship between mapping units and county soil series, and a sketch map of glacial borders in the Allentown 30- by 60-minute map sheet. The latter is not included in the Frenchtown report, because that quadrangle contains no glacial deposits.

The cost of each report is \$2.50 plus \$0.15 state sales tax for Pennsylvania residents. Please see the following announcement for instructions on ordering.

## Surficial Geology of Warren County



A new open-file report on the surficial geology of Warren County, northwestern Pennsylvania, has been released by the Pennsylvania Geological Survey. The report, by staff geologist W. D. Sevon, is a companion to previously released Open-File Report 95–02 (*Bed*rock Geologic Map of Warren *County, Pennsylvania*; see *Penn-sylvania Geology*, v. 26, no. 3/4, p. 8), and includes a one-color (black) 1:50,000-scale reconnaissance geologic map of the surficial deposits of the county showing the late Wisconsinan and pre-Illinoian glacial boundaries, and a 10-page text containing a discussion of

the texture, thickness, and origin of the mapped units.

Open-File Report 95–03, Surficial Geology and Geomorphology of Warren County, Pennsylvania, may be purchased from the Pennsylvania Geological Survey, P.O. Box 8453, Harrisburg, PA 17105--8453, for the prepaid copying and shipping costs of \$3.00 plus \$0.18 state sales tax for Pennsylvania residents. Prepayment is required; please make checks payable to *Commonwealth* of *Pennsylvania*. The report may be examined in the library of the Pennsylvania Geological Survey, Evangelical Press Building, Second Floor, 1500 North Third Street, Harrisburg, and in the Pittsburgh office of the Survey at 500 Waterfront Drive.

For further information on openfile reports, please contact Jon Inners, Chief, Geologic Mapping Division, telephone 717–787–6029.

## **Mineral Products Directory Completed**

A new directory of nonfuelmineral producers in Pennsylvania is available. The directory provides detailed information about the location and products of 695 nonfuel-mineral-producing sites in Pennsylvania. To be published as Information Circular 54. Directory of the Nonfuel-Mineral Producers in Pennsylvania, 5th ed., the new directory replaces the 1985 printed edition, which proved very useful but is now 10 years out of date. Information from this directory is now available by writing to the Bureau at P. O. Box 8453, Harrisburg, PA 17105-8453, or by e-mail to barnes.john@a1.dcnr. state.pa.us.

The directory format is similar to earlier editions. Mineral producers are assigned a number that identifies them on a large-scale state map that will accompany the printed report. To improve the new directory, latitudes and longitudes of mineral-producing sites and the name of the topographic quadrangle on which each operation is located are included.

The new directory was compiled following advice from a Bureau ad hoc advisory committee, the Geologic Resources Advisory Council. The committee advised the Bureau that a new edition would provide a useful and needed service to the state's mineral industry and its customers.

The information in the directory is available in the following formats: Microsoft Access for Windows 95; Microsoft Excel 3.0 for Windows; and comma-delimited text. Contact John Barnes to obtain digital or printed lists of companies, or for access to the directory via ftp.

The fifth edition of IC 54 is being prepared for printing as a book with accompanying commodity location maps and a large-scale state map. Anticipated publication is in late 1997.

### PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Donald M. Hoskins, Bureau Director

Access no. for the hearing impaired: 1-800-654-5984 (TDD) Pa. AT&T relay service Bureau staff may be reached by Internet using the following format: lastname.firstname@a1.dcnr.state.pa.us FAX: 717-783-7267

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