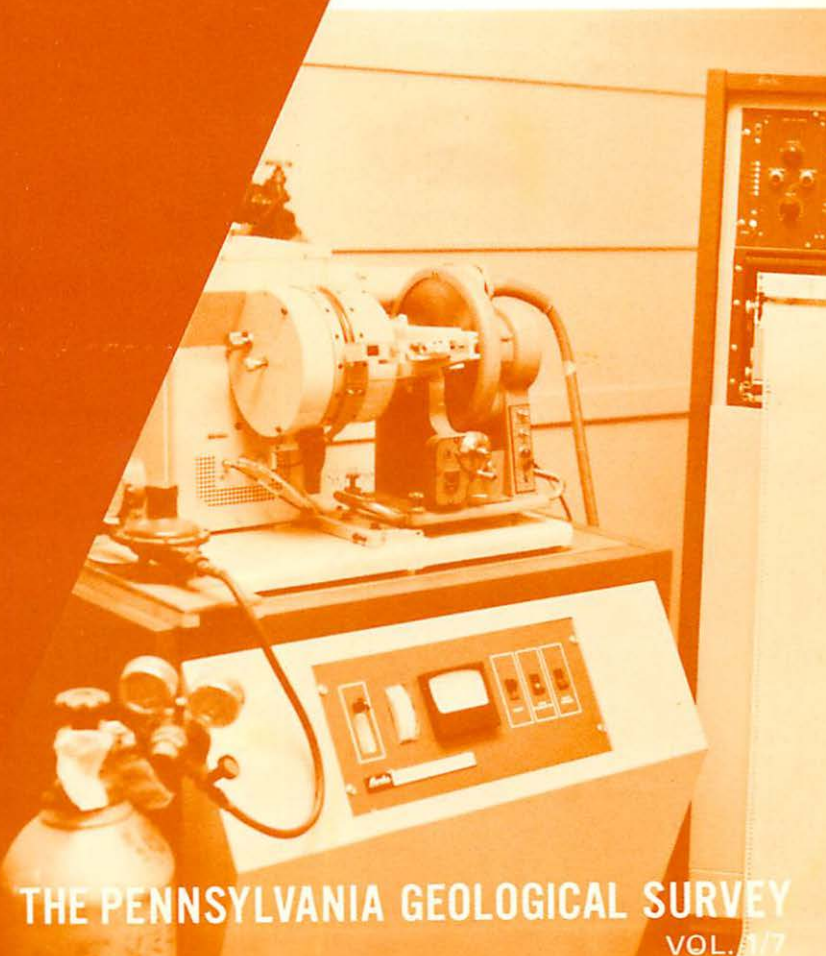


Mr. North

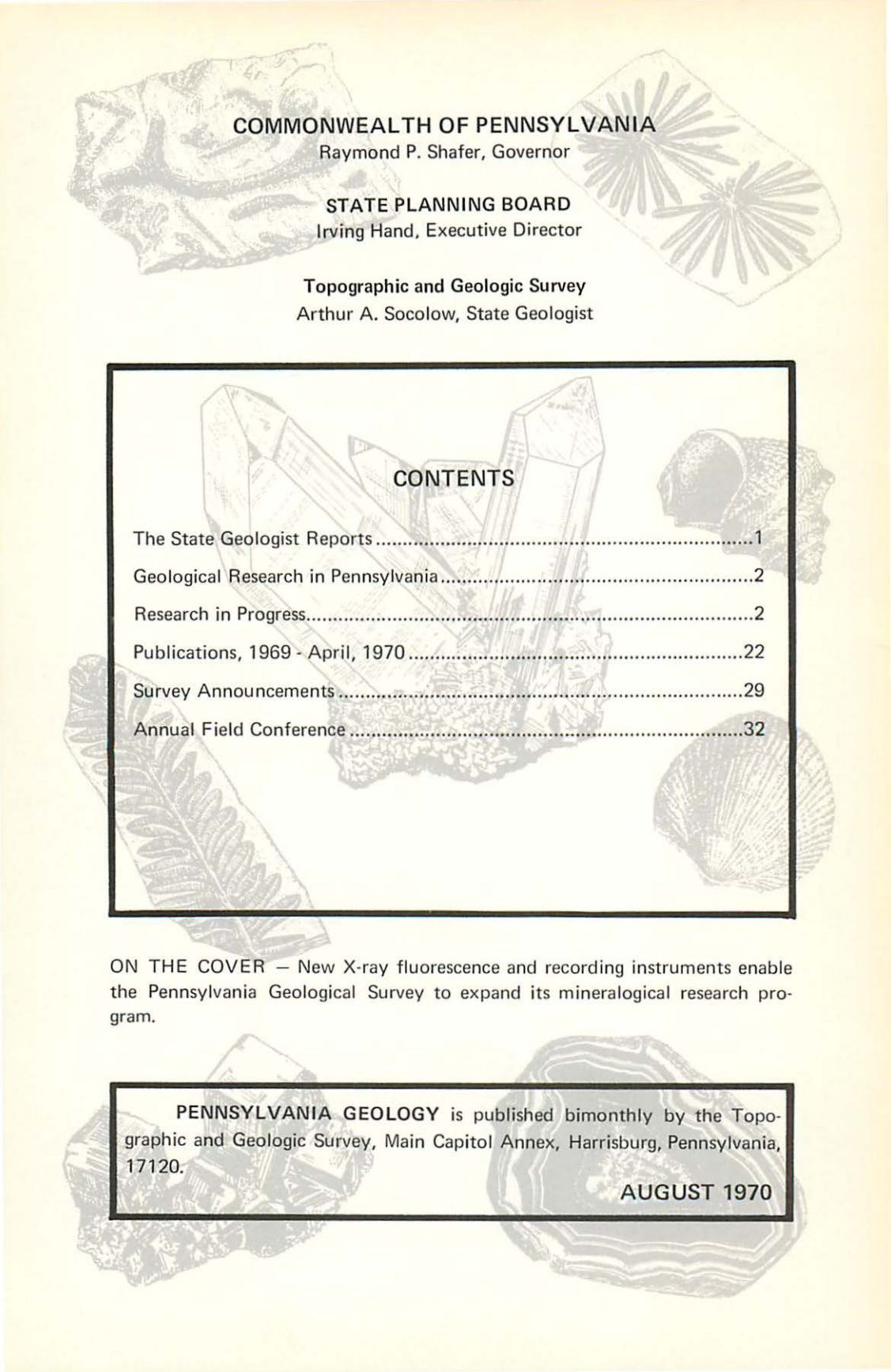
SEP 11 1970

Aug. 70

P N S Y L V A N I A GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 1/7



COMMONWEALTH OF PENNSYLVANIA

Raymond P. Shafer, Governor

STATE PLANNING BOARD

Irving Hand, Executive Director

Topographic and Geologic Survey

Arthur A. Socolow, State Geologist

CONTENTS

The State Geologist Reports	1
Geological Research in Pennsylvania	2
Research in Progress	2
Publications, 1969 - April, 1970	22
Survey Announcements	29
Annual Field Conference	32

ON THE COVER — New X-ray fluorescence and recording instruments enable the Pennsylvania Geological Survey to expand its mineralogical research program.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Main Capitol Annex, Harrisburg, Pennsylvania, 17120.

AUGUST 1970

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

GEOLOGIC RESEARCH
A NEED FOR RELEVANCE



Recognizing that most readers of Pennsylvania Geology have an interest in keeping up with geologic research in Pennsylvania, this issue of the bulletin is devoted to a comprehensive enumeration of all such research brought to our attention. It is pleasing to note that Pennsylvania's varied and complex geology continues to attract new research efforts not only by researchers from in-state institutions, but also by researchers far beyond our borders. We are also happy to see that so many of the current research efforts are field projects directed toward resolving field and regional geologic problems. In an era when the pendulum has swung so far to the side of laboratory research, it is good to see that so many recognize that there are still challenging and inspiring problems to work on in the field.

The time is now ripe for our geologic researchers to carry their efforts that one giant step farther which will relate their sophisticated research efforts and findings to man and his environment. Research geology and environmental geology need not be separate and incompatible, as some of our traditionalist colleagues contend. Environmental geology need not be non-scientific, even as research need not be limited to enumeration of principles and processes.

As members of society with unique capabilities, geologists have a responsibility to aid man to manage and protect his physical environment. It will not do for geologists to be aloof and disdainful of man's needs, for in that case men of lesser abilities will fill the void. Each geologist should now assess the relevance of his contributions. The Pennsylvania Geological Survey is acutely aware of geology's impact upon man in Pennsylvania. Thus, we encourage and support geologic research that has a relevance to the needs of man.

Arthur G. Socolow

GEOLOGICAL RESEARCH IN PENNSYLVANIA 1970

INTRODUCTION

The fourteenth annual report of Geological Research in Pennsylvania has been compiled by the Pennsylvania Geological Survey as a service to all individuals interested in geological research on Pennsylvania.

The listings are grouped into major categories of research to facilitate your search for information on a particular subject. Project descriptions are printed where authors supplied us with such descriptions. Publications printed during 1969 and the first part of 1970 are listed alphabetically.

As with all compilations, there may have been omissions. If you know of anyone who would be interested in receiving this annual report, send us their name so that it can be included on our mailing list. Additional copies can be obtained by writing to the Bureau of Topographic and Geologic Survey, Main Capitol Annex, Harrisburg, Pa. 17120.

RESEARCH IN PROGRESS

AREAL GEOLOGY

HAROLD H. ARNDT, U. S. Geological Survey. Western Middle Anthracite Field, Pennsylvania.

KENT BUSHNELL, Slippery Rock State College. Geology of Ohiopyle State Park.

KENT BUSHNELL, Slippery Rock State College. Geology of McConnells Mill State Park.

AVERY A. DRAKE, JR., U. S. Geological Survey. Geology of Allentown Quadrangle. Objectives: To decipher the tectonic history of the area with special emphasis on the emplacement of gravity slides, Alpine nappes, and thrust sheets.



JACK B. EPSTEIN, U. S. Geological Survey. Geology and Mineral Resources of the Wind Gap and Adjacent Quadrangles.

RODGER T. FAILL and RICHARD B. WELLS, Pennsylvania Geological Survey. Geology and Mineral Resources of the Millerstown 15-Minute Quadrangle. Areal mapping, stratigraphic description, and structural analysis of the geology in the Millerstown 15-minute quadrangle with discussion of economic resources, engineering properties of the rocks, and ground water potential.

DONALD W. FISHER, New York Geological Survey. Geologic Map of New York - 1970. Five sheets (scale 1:250,000); also generalized tectonic-metamorphic map (approx. 1:1,500,000) with master legend and references on 6th sheet.

GARY B. GLASS, Pennsylvania Geological Survey. Geology and Mineral Resources of the Houtzdale and Ramey 7½-Minute Quadrangles.

ALBERT D. GLOVER and THOMAS M. BERG, Pennsylvania Geological Survey. Geology and Mineral Resources of the Northern Half of the Penfield 15-Minute Quadrangle.

DONALD M. HOSKINS, Pennsylvania Geological Survey. Geology and Mineral Resources of the Millersburg Quadrangle.

DAVIS M. LAPHAM, Pennsylvania Geological Survey. The Serpentinities and Associated Rocks of Lancaster County, Pennsylvania. Structure, lithology, petrology, mineralogy, geochemistry, and economic geology of the serpentinites and associated metasediments of Southern Lancaster County.

RICHARD NICKELSEN, Bucknell University. Cleavage in Bloomsburg Formation in Buffalo Valley.

JOHN O. OSGOOD, Lehigh University. A Paleoenvironmental Study of the Allentown Formation. A stratigraphic and petrographic examination of the Allentown Formation in the area of its outcrop between the Delaware and Schuylkill Rivers is to be conducted in order to determine the environment of deposition, nature of the Allentown paleoslope and its relationship to the Reading Prong.

JOHN B. ROEN, U. S. Geological Survey. Geology of the Midway Quadrangle, Southwest Pennsylvania.

JOHN B. ROEN, U. S. Geological Survey. Geology of the Waynesburg-Oak Forest Area, Southwest Pennsylvania.

S. P. SCHWEINFURTH, U. S. Geological Survey. Geology and Mineral Resources of the Claysville-Avella Area. This project is to geologically map two 7½-minute quadrangles and parts of two others that join them on the west to complete geologic mapping to the Pennsylvania State Line in Washington County; to evaluate coal and other mineral resources and to gather and evaluate data that will aid in understanding the depositional framework of the Upper Pennsylvanian-Lower Permian of the northern part of the Dunkard Basin, its structural history, and the paleogeographic controls of coal accumulation and quality.

WILLIAM D. SEVON, Pennsylvania Geological Survey. Geology and Mineral Resources of the Northern Half of the Lehighon 15-Minute Quadrangle, Pennsylvania. Mapping and detailed interpretation of the geology of the area.

WALLACE de WITT, JR., U. S. Geological Survey. Hyndman 15-Minute Quadrangle. Field work this year will be concentrated mainly in the southwest part of the area in the valley of Wills Creek, south of the town of Hyndman and along the Allegheny Front to west of Wills Creek.

GORDON H. WOOD, JR., U. S. Geological Survey. Drainage of Anthracite Mines Southern Anthracite Field. A comprehensive study of the geology of the southern and eastern parts of the Pennsylvania Anthracite region. Project aims for an understanding of Silurian through Pennsylvanian rocks, the tectonics of the Appalachian Plateau and Valley and Ridge Provinces in eastern Pennsylvania, and the causes, whether sedimentary or structural, that resulted in the formation of anthracite.

ECONOMIC GEOLOGY

JACOB FREEDMAN, Franklin and Marshall College. Geochemical Exploration for Mineral Deposits in Lancaster County.

GARY B. GLASS, Pennsylvania Geological Survey. Computer Programs in Coal Geology. Two computer programs have been completed. The first upgrades an "as received" proximate coal analysis to a moisture-free and a moisture and ash-free basis; this program also upgrades sulfur contents and B.T.U. values. The second program performs a weighted average for an unlimited number of separate proximate analyses; this second program was designed to recombine proximate analyses of separate portions (benches) of a coal seam into a theoretical composite analysis of the entire seam.

KARL V. HOOVER, Pennsylvania Geological Survey. Clay-Shale Resources of the Pittsburgh Trade Area. Field and laboratory evaluation of the clay and shale deposits in southwestern Pennsylvania.

KARL V. HOOVER, Pennsylvania Geological Survey. Atlas of Pennsylvania Mineral Resources: Part 2 - Clays and Shales. Compilation of all geologic information of Pennsylvania's clays and shales. The publication will be a collection of geologic maps, physical property and ceramic list data, chemical analyses, and summary tables of established and potential uses.

JOHN W. HOSTERMAN, U. S. Geological Survey. Northern Appalachian Clay Studies. Field work on this project is complete. A final publication will describe the underclays of Somerset and Fayette Counties, Pennsylvania.

DANA R. KELLEY and DAVID DEBOR, Pennsylvania Geological Survey. Subsurface Reservoir Core Analyses. Compilation of core analysis data into tabulations and graphs illustrating porosity, permeability, saturation, density, salinity, and other core data relationships by unit.

WILLIAM S. LYTLE, Pennsylvania Geological Survey. Crude Oil Reserves of Pennsylvania. To bring Survey publication M-32 "Crude Oil Reserves of Pennsylvania" up-to-date using chemical logs and core reports that were not available when M-32 was written. Considerable additional information is now available which will give more meaning to the reserve estimate.

WILLIAM S. LYTLE, DANA R. KELLEY, WALTER R. WAGNER, LOUIS HEYMAN, Pennsylvania Geological Survey. Oil and Gas Developments in Pennsylvania in 1970. A description of the developments during 1970 in search of oil and gas, including highlights, statistics, and general oil and gas data.

WILLIAM S. LYTLE, DANA R. KELLEY, WALTER R. WAGNER, LOUIS HEYMAN, Pennsylvania Geological Survey. The Petroleum Industry and the Future Petroleum Province in Pennsylvania, 1970. A review and forecast of the petroleum industry in Pennsylvania for stimulating and promoting the industry in the state by demonstrating the demand and need for new hydrocarbon reserves and the exceptional potential for discovery of such reserves with improved technology, and new ideas and operating methods.

JAMES P. MINARD, U. S. Geological Survey. Southeast Appalachian Sediments. Investigations of potential mineral deposits, especially heavy metals, in the Atlantic Coastal Plain and eastern Triassic basins.

JOHN SLAUGHTER and H. LAWRENCE McKAGUE, Rutgers University. Genesis of the Stratiform Copper Deposits of the Catskill Formation in Northeastern Pennsylvania.

WALTER R. WAGNER and DANA R. KELLEY, Pennsylvania Geological Survey. Surface Middle Devonian (Onondaga) Economic Stratigraphy of Western Pennsylvania. To erect a stratigraphic framework for Upper Devonian, Mississippian and Pottsville (Pennsylvanian) rocks of western Pennsylvania. The work is to be completed in three phases. Phase I, showing major subdivisions of Upper Devonian Rocks, is published (Pa. Geol. Survey PR 178). Phase II, in process, consists of a network of cross sections tying subsurface data (geophysical well logs) into surface sections. The sections will show hydrocarbon reservoirs, gross stratigraphic changes, and position of fresh water, coal, limestone, clay and other major resources. Phase III - regional interpretation of Phase II employing isopach and lithofacies maps.

ENGINEERING GEOLOGY



A. J. DEPMAN and D. G. PARILLO, U. S. Army Engineer District, Philadelphia. Engineering Geology of the Tocks Island Reservoir Complex. Engineering geology of the entire project including foundation and rock mechanics studies for design recommendations and maximum use of required excavation and local materials for construction purposes; effect of structures on ground water. Pleistocene geology highlighted and studied in detail; Silurian Bloomsburg Formation through Devonian Catskill studied.

NORMAN K. FLINT and JAMES V. HAMEL, University of Pittsburgh. Analysis and Design of Highway Cuts in Rock: A Slope Stability Study on Interstate Routes 279 and 79 near Pittsburgh, Pa.

JOHN R. HARRIS and MARSHALL A. NELSON, U. S. Army Engineer District, Philadelphia. Engineering Geology of Blue Marsh Reservoir. Engineering geology of the entire project including foundation studies for design recommendations and maximum use of local materials for construction purposes; environmental studies for recreation purposes and for quality of water. Ordovician geology highlighted.

KARL V. HOOVER, Pennsylvania Geological Survey, RICHARD HOWE and DAVID REIDENOUR, Pennsylvania Department of Highways. Engineering Properties of Shales for Highway Granular Material Use. Investigations of engineering properties of shales for use as a granular material for highway construction. A major endeavor of the project is to establish testing standards for selecting suitable shales.

R. G. LAZOR and A. J. DEPMAN, U. S. Army Engineer District, Philadelphia. Final Foundation Report - Beltzville Dam, Lehigh, Pennsylvania. Final foundation report highlighting structural geology encountered during construction of Beltzville Dam; details foundation treatment including pressure grouting, dental treatment, and high velocity concrete treatment of abutment area. Foundation rock is fossiliferous Devonian Mahantango Formation; axis of dam and pertinent structures located normal to axis of Lehigh anticline.

ENVIRONMENTAL GEOLOGY



WILLIAM B. FERGUSSON, Villanova University. Geological Approach to Man's Environment. Environmental problems related to the geology of the area illustrated with case studies from the author's experiences.

ALAN R. GEYER and WILLIAM G. McGLADE, Pennsylvania Geological Survey. Environmental Geology for Land-Use Planning. Guide to the value of geology in all phases of land-use planning, design, and construction.

MARY E. HORNE, Pennsylvania Geological Survey. Environmental Geology of the Greater York Area. This study involves the incorporation of basic geologic mapping with soils mapping, ground water data, mineral resource data, and engineering characteristics of rock formations with the application of these data to present land use in the area and to projected growth needs.

DANA R. KELLEY, Pennsylvania Geological Survey. Clay-shale Related Landslides in the Pittsburgh, Pennsylvania Area. As a means of informing industry, government, and the public of the serious landslide hazards existing in and about Pittsburgh, a short compilation of existing knowledge and causes of these slides is being prepared, including a map of slides of record, general cross sections illustrating stratigraphic variation in hazardous zones and selected illustrations, diagrams, and graphs.

WILLIAM G. McGLADE, Pennsylvania Geological Survey. Environmental Geology of the Harrisburg Metropolitan Area. Compile, reinterpret and add basic geology, ground water, mineral resource and engineering data for the Harrisburg Metropolitan area. The purpose of this study is to apply geological principles, interpretation of data toward an understanding of the subject area that will be immediately useful to planners, engineers, government officials, and the general public.

WILLIAM G. McGLADE, J. P. WILSHUSEN and A. R. GEYER, Pennsylvania Geological Survey. Engineering Characteristics - Rocks of Pennsylvania. Project covers geologic, engineering, and ground water characteristics of each rock formation described on the 1960 State Geologic Map. Material will be presented in chart form and is intended as a supplement to the State Geologic Map.

NEILSON RUDD, Geo-Engineering Laboratories, Inc. The Feasibility of Sub-surface Liquid Waste Disposal in Pennsylvania. The project consists of three phases: 1) a comprehensive review of the principles of deep well disposal, 2) a discussion of techniques and guidelines for site selection, evaluation, and operational monitoring, and 3) a regional survey of potential disposal reservoirs within the Commonwealth of Pennsylvania.

S. F. THOUMSIN and J. R. NIEHEISEL, U. S. Army Engineer District Philadelphia. Delaware River Estuary - Nature, Source and Cause of Shoaling. Part III of a seven part study on Long Range Disposal Areas for Delaware River Shoals. Purpose of study is to provide basic data on the physio-chemical properties of principal shoal areas, the sources, and mechanisms causing their formation. In due course extensive petrologic studies are to be made. In addition the potential agricultural value of the sediments was studied.

GENERAL GEOLOGY

ERNST CLOOS, Johns Hopkins University. Geology of the Thomasville Area, York County. This will complete a study which began in 1935 and continued since then. It includes Kinzers and Vintage stratigraphy at Thomasville, structural geology, some economics, and historical development. Dolomite and dolomitization and a few fossils will be included.

ALAN R. GEYER, Pennsylvania Geological Survey. A Geologic Guide to Rickett's Glen State Park. A geologic description of Rickett's Glen State Park with special emphasis on the origin of the waterfalls.

DONALD HOFF, Pennsylvania Historical and Museum Commission. Planning of Permanent Earth Science Exhibits for the William Penn Memorial Exhibits.

BION H. KENT, U. S. Geological Survey. Geology of the Mather-Garards Fort Area, Southwestern Pennsylvania. Project objectives include (a) geologic quadrangle mapping at 1:24,000 scale; (b) sedimentological studies, primarily of lithofacies trends and their effects upon associated coal beds; and (c) evaluation of coal resources, primarily in the Pittsburgh, Sewickley, and Waynesburg coal beds.

DAVIS M. LAPHAM and ALAN R. GEYER, Pennsylvania Geological Survey. Common Rocks and Minerals of Pennsylvania. A complete rewrite of the Survey's Education Series No. 1 booklet.

WILLIAM S. LYTLE and LILLIAN HEEREN, Pennsylvania Geological Survey. Principal Crude Oil, Product and Natural Gas Pipelines. Brings the pipelines map up-to-date showing changes, refineries and gas storage fields.

WILLIAM G. McGLADE, Pennsylvania Geological Survey. Pennsylvania Trail of Geology - The Grand Canyon of Pennsylvania. A geological description of the Pennsylvania Grand Canyon for the lay reader.

GEOCHEMISTRY

DONALD LANGMUIR and DONALD O. WHITEMORE, The Pennsylvania State University. The Nature of Yellow-boy Precipitates from Acid-mine Waters. Examination of the physical and chemical properties of ferric oxyhydroxides precipitated by oxidation and/or hydrolysis of acid-mine waters.

DAVIS M. LAPHAM, Pennsylvania Geological Survey. Isotopic Dating of Precambrian Schists, Erie County. Correlation and significance of K-Ar and Rb-Sr age dates on Precambrian metasediments from drill cores beneath the Plateau.

DAVIS M. LAPHAM, S. ROOT, and D. MACLACHLAN, Pennsylvania Geological Survey. Isotopic Dating in the Reading Prong of Pennsylvania. Correlation and Significance of K-Ar dates in the Pennsylvania Reading Prong.

DAVIS M. LAPHAM and S. ROOT, Pennsylvania Geological Survey. Isotopic Dating in the Blue Ridge of Pennsylvania. Correlation and significance of U-Pb, K-Ar, and Rb-Sr dates in the Pennsylvania Blue Ridge.

DAVIS M. LAPHAM and S. ROOT, Pennsylvania Geological Survey. Isotopic Dating of Faulting in the Great Valley of Pennsylvania. Significance of K-Ar dates on fault gouge and enclosing sediments in the Pennsylvania Great Valley.

H. LAWRENCE MCKAGUE, Rutgers University. Trace Element Distribution in State Line Serpentine.

ARTHUR W. ROSE and DAVID C. HERRICK, The Pennsylvania State University. Geochemistry of the Cornwall Iron Ore Deposit. The main emphasis of the project is on oxygen isotope abundance, supplemented by considerable chemical and mineralogical work, in order to interpret temperature and other conditions of ore formation, and processes of ore formation.

ARTHUR W. ROSE and ROBERT C. SMITH II, The Pennsylvania State University. Geochemistry of Triassic Diabase. The abundance of trace and major elements has been determined in about 100 chilled border samples and in several suites of samples through sheets. The results are being used to better understand the origin of the diabase magma and the associated ore deposits.

ARTHUR W. ROSE, JAMES McNEAL, and M. L. KEITH, The Pennsylvania State University. Geochemistry of Pennsylvania Stream Sediments. Present work is concentrated on the abundance of mercury in stream sediments, and on the partition of Cu, Zn, Ni, Co, and Pb between exchange sites, organic matter, iron oxides, sand, silt and clay fractions. Statistical techniques are being used to improve resolution of anomalies in a large group of samples covering the southeastern part of the state.

F. K. SZUCS, Slippery Rock State College. Correlation and Absolute Age Determination of the Slippery Rock Till. Exposures of the Slippery Rock Till were correlated by using neutron activation techniques.

PETER W. WEIGAND, University of North Carolina. Geochemistry of Pennsylvania Triassic (?) Dolerite Dikes. This project is part of a larger study concerned with the geochemistry of the eastern North American Triassic (?) dolerite dikes.

GEOMORPHOLOGY

DONALD R. COATES, State University of New York at Binghamton. Terrain Comparison of the Glaciated and Non-Glaciated Appalachian Plateau. This is largely a quantitative and computergraphic morphometry study of the 1:62,500 scale topographic maps in a 20,000 square mile region.

RICHARD A. MARTIN, Millersville State College. Devil's Race Course Boulder Field, Dauphin County.

WILLIAM B. WHITE, The Pennsylvania State University. Caves of Pennsylvania. Progress has been made in compiling a new comprehensive catalog of the caves of Pennsylvania. Work on the western portion of the state is complete and data for the Piedmont and Great Valley are nearing final form.

GEOPHYSICS

RONALD R. HARTMAN, Aero Service Corporation. Development of a digital recording-computer contouring package for radioactivity survey data. Aero Service Corporation has recently completed the installation of a new airborne geophysical survey package in an Aero Commander aircraft. The package includes a magnetometer with a sensitivity of 1/10 gamma, a scintillation counter with spectral channels to detect radiation in the uranium, potassium and thorium emission ranges, and a digital recording system which records barometric and terrain clearance altitudes as well as the geophysical data. At the heart of the system is a doppler navigation installation which provides a ground distance base for the recording of all data. The system is designed for mineral exploration work.

PETER M. LAVIN, The Pennsylvania State University. Iron Ore Geophysics. The purpose of the study is to search for characteristic geophysical responses which can be used in distinguishing between aeromagnetic anomalies in the Triassic Basin of southeastern Pennsylvania due to massive magnetite deposits (of possible economic importance) and anomalies due to diabase intrusives (disseminated magnetite).

GLACIAL GEOLOGY

DONALD R. COATES, State University of New York at Binghamton. Mastodon Bone Age and Geomorphic Relations in the Susquehanna Valley. A massive 20-inch bone has been identified as a pelvic fragment of a mastodon, *Mammot americanus*, and has yielded a Carbon-14 date of 13,320 - 200 yrs. B.P. The bone was discovered in a gravel pit, 11 feet below the ground in a terrace along the valley of the Chemung River.

GEORGE W. CROWL, Ohio Wesleyan University. Pleistocene Geology of the Delaware Valley, Matamoras to Shawnee on Delaware.

DENIS E. MARCHAND, Bucknell University. Pre-Wisconsin Pleistocene Stratigraphy and Chronology of the Central Susquehanna Region.

WILLIAM D. SEVON, Pennsylvania Geological Survey. Investigation of characteristics of a small boulder field which is adjacent to the Wisconsin 'terminal' moraine and overlies Wisconsin outwash sediments.

STANLEY M. TOTTON, Hanover College. Fossil Beetles from Wisconsin Peat, Titusville, Pennsylvania. A 40,000 year old peat deposit at Titusville, Pa., has yielded the remains of 750 individual beetles, many of which have been identified to genus and species. The species identified have a northern distribution and are found typically in the Hudsonian Zone of Canada.

HYDROLOGY



ALBERT E. BECHER and WALTER S. WETTERHALL, U. S. Geological Survey. Urban and Rural Ground Water Hydrology in the Northern Part of the Cumberland Valley, Pennsylvania.

JAMES DIAZ and RICHARD R. PARIZEK, Geo-Technical Services and The

Pennsylvania State University. Effects of Spray Irrigation of Sewage Effluent on Ground Water. Soil tests and ground water data from exploration holes in deep residual soils (Wissahickon) at the site indicate suitable conditions for spray irrigation of effluent from aerated sewage lagoons (now under construction). Irrigation rates, nutrient content, growth rate of crops and nursery stock, effects on surface and ground water will be monitored and recorded for several years.

JAMES DIAZ and RICHARD R. PARIZEK, Geo-Technical Services and The Pennsylvania State University. Investigation of Safe-yield of Aquifer. An investigation using electrical analog modeling techniques and digital computer will be made this summer to predict the sustained safe-yield of an aquifer of Cockeysville Marble surrounded on three sides by Wissahickon schist.

MARILYN GINSBERG, State University of New York at Binghamton. Relationship between the Geology and the Geohydrology of the Triassic Basin in Pennsylvania.

JERRALD R. HOLLOWELL and HARRY E. KOESTER, U. S. Geological Survey. Ground Water Resources of Lackawanna County. Project is to evaluate and appraise the ground water resources in the county.

DONALD LANGMUIR and WILLIAM S. SANNER, JR., The Pennsylvania State University. Nitrogen and Phosphorus Variations in Ground Water beneath Farm Land, Mahantango Watershed, Pennsylvania. Investigations of controls on and variations in amounts of nitrogen and phosphorus in ground water in a part of the Mahantango Watershed, Pennsylvania.

DONALD LANGMUIR and ROGER L. JACOBSON, The Pennsylvania State University. Hydrogeochemistry of Ground Water in Carbonate Rocks. Study of how ground water in a carbonate rock terrane is related to gas-solution-mineral reactions, pollution, and hydrogeology.

DONALD LANGMUIR, RICHARD R. PARIZEK, and MICHAEL A. APGAR, The Pennsylvania State University. The Chemical Interaction of Sanitary Landfill Leachate with Unsaturated Soil in a Carbonate Rock Terrane. Investigation of the detailed physical-chemical processes which account for renovation of landfill-leachate in a soil, and the establishment of site-selection criteria for landfills in carbonate-rock terranes in Pennsylvania. An improvement in leachate quality occurs within unsaturated soil beneath landfills. Serious ground water pollution by leachates will occur if landfill materials come in contact with ground water.

ORVILLE B. LLOYD, JR. and DOUGLAS J. GROWITZ, U. S. Geological Survey. Ground Water Resources of Central and Southern York County. The investigation will evaluate the water-bearing and water-quality characteristics of the major bedrock units in the area of study.

THOMAS G. NEWPORT and JOHN GALLAHER, U. S. Geological Survey. Summary reports of the ground-water resources of each county in Pennsylvania.

WILLIAM B. WHITE and HENRY W. RAUCH, The Pennsylvania State University. Solution Kinetics of Carbonate Rocks. Empirical rates of solutions for various carbonate rocks in water at one atm CO_2 pressure have been determined in the laboratory. The variation in solution rate between rock lithologies correlates with the amount of solution cavity development observed in these rocks in the field.

WILLIAM B. WHITE and EVAN T. SHUSTER, The Pennsylvania State University. Chemistry of Limestone Spring Waters. The seasonal fluctuations in the chemistry of limestone spring waters reflect the type of aquifer system feeding the spring. Large fluctuations imply conduit systems with fast flow-through times. Small fluctuations imply diffuse flow systems. Most spring waters are found to be under-saturated with respect to CaCO_3 .

CHARLES R. WOOD, U. S. Geological Survey. Ground-water Resources of the Clarion River and Redbank Creek Basins. Ground-water quality and availability will be studied with special emphasis on quality problems related to mining and active and abandoned oil and gas wells.

IGNEOUS AND METAMORPHIC GEOLOGY

W. A. CRAWFORD and P. G. ROBELEN, Bryn Mawr College. Petrological and Chemical Variations of the Honeybrook Anorthosite.

MINERALOGY

DAVIS M. LAPHAM and ALAN R. GEYER, Pennsylvania Geological Survey. Mineral Collecting in Pennsylvania. A continuing project to describe minerals and mineral localities in Pennsylvania.

WILLIAM B. WHITE, The Pennsylvania State University. Infrared Spectra of Hydrous Carbonate Minerals. Infrared spectra have been measured on the hydrous carbonate minerals artinite, nesquehonite, and hydromagnesite. The spectra were used to determine the positions and hydrogen bonding of hydroxyl ions and water molecules. Artinite and nesquehonite have similar structures and spectra results are consistent with the published structure of artinite. Hydromagnesite has a quite different structure based on hydroxide layers.

PALEONTOLOGY



DONALD BAIRD, Princeton University. Additions to the Vertebrate Fauna of the Upper Kittanning Coal (mid-Pennsylvanian) of Cannelton, Beaver County, Pennsylvania. A search of the old Survey collections at the William Penn Memorial Museum has yielded a specimen of the coelacanth fish *Rhabdoderma elegans* which seems to be the first record of a Carboniferous coelacanth in Pennsylvania. A search of the Princeton paleobotanical collection produced a specimen of the ubiquitous fresh-water shark *Xenacanthus compressus*. Both were collected by mine-owner I. F. Mansfield at Cannelton about 1877.

ROGER L. BATTEN and R. H. ROLLINS, American Museum of Natural History. Conemaugh-Allegheny Gastropods and Paleo-Ecology.

STIG M. BERGSTROM, The Ohio State University. Conodont Biostratigraphy of the Middle Ordovician of Pennsylvania.

ALBERT A. BERTI, University of Western Ontario. Pollen and Seed Analysis of the Titusville Section (Mid-Wisconsin), Titusville, Pa.

PETER W. BRETSKY, K. W. FLESSA, and S. S. BRETSKY, Northwestern University. Ecology of Late Ordovician Benthic Communities. The investigation was a study of the paleoecology of the fossiliferous beds at the top of the Reedsville and Martinsburg Formations. The area covered extended from central Pennsylvania to northern Tennessee.

JOHN A. CLENDENING, Pan American Petroleum Corp. Sporological Evidence on the Geological Age of the Dunkard Strata in the Appalachian Basin. Study of fossil spores and pollen from throughout the Dunkard strata substantiates an Upper Pennsylvanian rather than a Permian Age for the entire sequence of strata.

CHRISTOPHER J. DURDEN, Texas Memorial Museum. Systematics and Biostratigraphy of the Insects, Arachnids, and other Terrestrial Arthropods of the Pennsylvanian. European sub-epochs (Autunian A. Stephanian C & A-B, Westphalian D, C-D, C, B, A, and Namurian C) recognized in both bituminous & Anthracite fields on the basis of distribution of blattoid genera. "Cassville" fauna located in the Southern Anthracite Field in roof Black Mine Vein. "Cassville" genera occur in European Aut. A., not in Stephanian.

NILES ELDREDGE, American Museum of Natural History. Middle Devonian Trilobites.

HENRY FAUL, CAROL FAUL, and others, University of Pennsylvania. Beltville Reservoir Paleontological Salvage. We are making a reference collection of fossils from the well known Mahantango Formation locality along Pohopoco Creek which will be flooded by the Beltville Dam Reservoir.

WILLIAM H. GILLESPIE, West Virginia University and JOHN A. CLENDENING, Pan American Petroleum Corp. Age of Dunkard Group, Appalachian Basin.

ALBERT L. GUBER, The Pennsylvania State University. Paleoecology of Columbiana.

ALBERT L. GUBER and LYNN BRANT, The Pennsylvania State University. Paleoecology of Brush Creek.

JON D. INNERS, Pennsylvania Department of Highways. Stratigraphy and Paleontology of the Onesque Thaw Stage in Pennsylvania.

RICHARD LUND, University of Pittsburgh. Fossil Fishes from Southwestern Pennsylvania. Detailed paleontologic work with very close stratigraphic control, upon vertebrate-bearing beds from the Allegheny to the Dunkard, is in progress. A new genus of Lungfish, with a species is being described, as well as new species of fresh-water shark. Some understanding of stratigraphic succession of faunas is emerging.

WILLIAM H. PARSONS and DOUGLAS SCHAMEL, Allegheny College. Palynology of Peat and Lake Deposits of Crawford County, Pennsylvania. We are comparing pollen stratigraphy of lake bed sediments with stratigraphy of selected interstadial and postglacial peat deposits of eastern Crawford County.

HAROLD B. ROLLINS, RICHARD LUND, JACK DONAHUE, and ROGER BATTEN, University of Pittsburgh. Community Structure and Evolution in the Conemaugh of the Appalachian Basin.

CRAIG D. SHAAK, University of Pittsburgh. Brush Creek Limestone (Pennsylvanian) within the Appalachian Basin. This Ph.D. thesis is designed to establish lateral and vertical species diversification in the Brush Creek Limestone (Pennsylvanian) within the Appalachian Basin. The goal of the investigation is to reconstruct the fossil communities and their variations with respect to paleoenvironments.

KEITH S. THOMSON, Yale Peabody Museum. A new genus and species of lobe-fin fish from the Upper Devonian (Oswayo Formation) of Clinton and McKean Counties, *Hyneria lindae*, throws new light on the origin of the amphibians because it "shows a closer general resemblance to the Amphibia than any other known rhipidistian."

SEDIMENTARY PETROLOGY



ROBERT W. ADAMS, S.U.N.Y. College at Brockport. Compaction in Carbonates - Mechanisms and Significance.

WILLIAM R. KAISER, Johns Hopkins University. Sedimentology of the Mahantango Formation. Determine the geometry of the Montebello Sandstone Member and to unravel the coarsening-upward cycles. Investigate regional lithologic changes within Mahantango. Detailed petrology of the coarsening-upward cycles.

JOHN B. ROEN, U. S. Geological Survey. Petrology of the Pittsburgh Sandstone in the Northern Half of the Dunkard Basin.

ALLAN M. THOMPSON, University of Delaware. Upper Ordovician Clastic Wedge Deposits. Active parts of the project include two areas: (1) delineation of depositional environments and tectonic styles associated with the transition from flysch to molasse sedimentation in the Upper Ordovician Taconic clastic wedge deposits of the Reedsville Formation; and (2) color boundaries of the Juniata Formation. This area relates to redefinition of the major stratigraphic units present in the Upper Ordovician.

ROGER G. WALKER and JOHN C. HARMS, McMaster University. Catskill Delta in Central Pennsylvania. Sedimentological study of Catskill Delta establishment in Central Pennsylvania.



STRATIGRAPHY

ROBERT W. ADAMS and RICHARD M. LIEBE, S.U.N.Y. College at Brockport. Stratigraphic Analysis of Dolomitic Greenbrier Limestone. We are examining the dolomite-limestone facies of the Greenbrier-Loyalhanna Limestone stratigraphic interval in the tri-state area of Pennsylvania, Maryland, and West Virginia. Micro-paleontological work with conodonts will be combined with petrographic and areal facies mapping to resolve time-stratigraphic problems in the area.

THOMAS M. BERG, W. E. EDMUNDS, A. D. GLOVER, and G. B. GLASS, Pennsylvania Geological Survey. Project TASIC. This project (Temporarily Available Stratigraphic Information Collection) is a continuing program involved with the recovery of stratigraphic data from active coal and clay strip mines and construction sites, while exposures are available. This long-term project is designed to provide data for future mapping and regional mineral resource evaluation. This information will also be useful in establishing the stratigraphic framework of coal-bearing rocks in western Pennsylvania, in making reserve calculations, in coal and coal land evaluation, in ground-water aquifer potential, in excavation and foundation information and in clay, shale, and other resource exploration.

JOHN M. DENNISON and DONALD M. HOSKINS, University of North Carolina and Pennsylvania Geological Survey. Purcell Limestone in Appalachian Basin.

JOHN M. DENNISON, University of North Carolina. Aspects of Silurian and Devonian Stratigraphy in Appalachian Basin.

JOHN M. DENNISON and DANIEL A. TEXTORIS, University of North Carolina. Stratigraphy and Petrology of Devonian Tioga Bentonite. Regional distribution of stratigraphic relations and thickness of tuffaceous beds of the Tioga Bentonite horizon, along with petrologic analysis of mineralogy and size distribution as related to probable source area.

A. C. DONALDSON, J. KIRR, R. HUGHART, R. NORECK, and L. HEFFNER, West Virginia University. Sedimentation patterns and tectonic elements of the Blacksville, West Virginia-Pennsylvania 15-Minute Quadrangle.

A. C. DONALDSON, West Virginia University. Upper Pennsylvanian System in West Virginia, Pennsylvania, and Ohio.

A. C. DONALDSON and J. KIRR, West Virginia University. Stratigraphy of the Blacksville, West Virginia-Pennsylvania 7½-Minute Quadrangle.

A. C. DONALDSON, West Virginia University. Use of Stromatolites for Recognition of Lithofacies of Cambrian and Ordovician Carbonates of West Virginia and Pennsylvania.

R. W. FAAS, P. BEGLUND and S. KAPLAN, Lafayette College. Analysis of some Triassic Border Fault Lithofacies. Great lithofacies variation exists adjacent to the north border of the Newark-Gettysburg Basin in Pennsylvania. Three phases of research are being considered, the first of which is presently underway; 1) The mapping, description, and analysis of the border fault lithologies and their depositional mechanism(s); 2) reconstruction of rock provenance for each separate fan-like deposit; and 3) analysis of primary rock features related to the lacustrine environment.

HELMUT GELDSETZER, Queens University. Stratigraphic and Tectonic Patterns of the Devonian in Northeastern North America. The objectives of the study are to trace pronounced faunal and lithic breaks throughout the above area, to establish sedimentologically sound facies relationships for each depositional episode, and to determine the amount of erosional removal prior to a new depositional episode.

J. DOUGLAS GLAESER, Pennsylvania Geological Survey. Triassic Sediment Properties as Climatic Indicators. Rock composition, sedimentary cycles, calcretes, cross bed and pebble orientations, limestone debris-flow fans, algal structures, and alluvial fan deposits suggest arid climate sedimentation.

J. DOUGLAS GLAESER, Pennsylvania Geological Survey. Internal Geometry of Triassic Alluvial Fan, Basal New Oxford Formation. Multi-directional exposures in abandoned strip pits of basal New Oxford conglomerates show details of sedimentary properties and primary structures of alluvial gravel fan developed on the pre-Triassic surface.

J. DOUGLAS GLAESER, Pennsylvania Geological Survey. Correlation and Environmental Interpretation of Upper Devonian Rocks in Northeastern Pennsylvania. Regional study of surface and subsurface Upper Devonian sections in terms of depositional origin of correlatable stratigraphic units. Hydrocarbon, flagstone, and artesian water distributions are controlled by sedimentological character of the associated stratigraphic units.

KENNETH HASSON and JOHN DENNISON, East Tennessee State University. Stratigraphy of Harrell Shale and Millboro. Harrell Shale of Pennsylvania is a tongue of the Millboro Shale black shaly facies of Virginia. The Tully Limestone forms a marker horizon associated with the Harrell and Millboro.

JAMES W. HEAD, Lunar Exploration Department, Bellcomm, Inc. Late Cayugan (Upper Silurian) and Helderbergian (Lower Devonian) Paleoenvironmental Stratigraphy and Basin Evolution.

LOUIS HEYMAN, Pennsylvania Geological Survey. Subsurface Correlation Sections, Tully (M. Devon.) - Queenston (U. Ordov.). Establish stratigraphic framework for subsurface sedimentary petrology studies of various producing and potential oil and gas reservoirs in this part of the geologic section. These reservoir rocks are also potential waste disposal zones. Other zones of potential value (brine production, evaporites) will be indicated.

WAYNE C. MARTIN and B. R. HENNINGER, Miami University (Ohio) and West Virginia University. The Mather and Hockingport sandstone lentils (Pennsylvanian and Permian) of the Dunkard Basin, Pennsylvania, West Virginia, and Ohio.

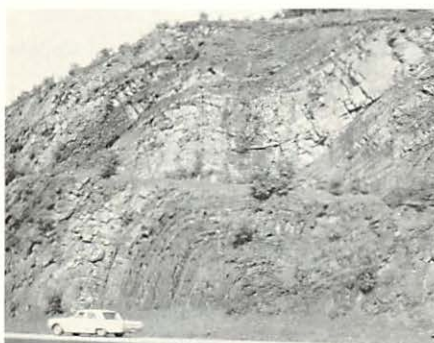
W. C. MARTIN and D. M. LOREN, Miami University (Ohio). Integrated Facies Analysis of the Dunkard Group.

C. E. PROUTY, Michigan State University. Revision of the Chazy of Pennsylvania. The stratigraphy of the Chazy rocks is being studied in regard to their lateral relationship between eastern and central Pennsylvania; between eastern Pennsylvania and the Maryland and Virginia outcrop; and to their subsurface extensions into western Pennsylvania and West Virginia. Measured sections and most fossil collections have been made from the Pennsylvania outcrop.

JOHN B. ROEN, U. S. Geological Survey. Stratigraphy of the Coal-bearing Rocks of the Monongahela and Dunkard Groups in the Northern Part of the Dunkard Basin. Fifteen regional stratigraphic cross sections have been constructed showing the correlation and facies trends of the coal-bearing rocks of the Monongahela and Dunkard Groups in Ohio, Pennsylvania, and West Virginia.

HAROLD B. ROLLINS, JACK DONAHUE, NORMAN FLINT, and RICHARD LUND, University of Pittsburgh. Depositional Environment of the Conemaugh in the Appalachian Basin.

PETER G. WALDO, University of Massachusetts. Taconic Unconformity. The study is a problem for a Ph.D. thesis. It is a combined stratigraphic and structural study of the taconic unconformity in Pennsylvania, New York, and New Jersey. Emphasis is being placed on stratigraphic nature of the unconformity, geometry of pre-unconformity folds, and deformation of the unconformity during the Appalachian Orogeny.



STRUCTURE

INA B. ALTERMAN, Columbia University. Structural and Tectonic History of the Taconic Allochthon and Autochthon, East-Central Pennsylvania. Detailed geologic mapping of the eastern end of the so-called "Hamburg Klippe". Investigation includes mechanisms into the formation and deformation of the slaty cleavage and the relationship of these to the tectonic events, mechanisms of emplacement of allochthonous sequences, and relations of these events to a larger regional tectonism.

HAROLD C. FRY, JR., University of Pittsburgh at Johnstown. Limestone Border Conglomerate in the Vicinity of Bowmansdale.

RAYMOND R. KNOWLES, City College of New York. Study of Deformation Lamellae in Quartz in the Tuscarora-Juniata-Bald Eagle Formations near Milroy and the Tuscarora Formation at the Delaware Water Gap.

R. POWELL, P. J. CONEY, and L. MEADE, White Pigment Corp. Structure and Stratigraphy of Kinzers Formation. Structural Interpretation of West York Quarry (Kinzer Formation) and Definition of Recognizable Stratigraphic Units.

PUBLICATIONS

1969 - APRIL, 1970

- Adams, R. W., 1970, Loyalhanna limestone - cross-bedding and provenance, *in* Fisher, G. W. and others, ed., Studies of Appalachian geology: Central and Southern: New York, John Wiley and Sons.
- Bretsky, Peter W., and others, 1969, Brachiopod ecology in the Ordovician of Eastern Pennsylvania. Jour. of Paleontology, v. 43, no. 2.
- Bretsky, Peter, W., 1969, Central Appalachian late Ordovician communities. Geol. Soc. America Bull.
- Bretsky, Peter, W., 1969, Brachiopod ecology in the Ordovician of eastern Pennsylvania, Jour. Paleontology.
- Carter, W. D., 1969, The W. L. Newman Phosphate Mine, Juniata County, Pennsylvania. Penna. Geol. Sur. 4th ser., Inf. Cir. 64.
- Chafetz, H., 1969, Petrography and stratigraphy of carbonate rocks of the Lower and Middle Ordovician. Penna. Geol. Survey, 4th ser., Gen. Geol. Rept. 58.
- Cramer, Fritz H., 1969, Possible implications for Silurian Paleogeography from Phytoplankton assemblages of the Rose Hill and Tuscarora of Pennsylvania. Jour. of Paleontology, v. 43, no. 2.
- Dahlbert, Eric C., 1969, Use of model for relating geochemical prospecting data to geological attributes of a region, South Mountain, Pennsylvania *in* International Geochemical Exploration Symposium: Col. School Mines Quarterly, v. 64, no. 1.
- Deasy, George F. and Phyllis R. Griess, 1969, Economics of Pennsylvania's clay and shale production, Part 2-B. Penna. Geol. Survey, 4th ser., Min. Res. Rept. 50.
- Deike, R. G., 1969, Relations of pointing to orientation of solution cavities in limestones of central Pennsylvania. Am. Jour. Sci.
- Edgerton, C. D., 1969, Peat bog investigations in northeastern Pennsylvania. Penna. Geol. Survey, 4th ser., Inf. Cir. 65.

- Edmunds, W. D., 1969, Revised lithostratigraphic nomenclature of the Pottsville and Allegheny Groups (Pennsylvanian) for use initially in Clearfield County, Pennsylvania. Penna. Geol. Survey, 4th ser. Inf. Cir. 61.
- Emrich, Grover H. and Merritt, Gary L., 1969, Effects of mine drainage on ground water. Ground Water v. 7, no. 3.
- Epstein, J. B., 1969, Surficial geology of the Stroudsburg quadrangle, Pennsylvania. Penna. Geol. Survey, 4th ser., Gen. Geol. Rept. 57.
- Epstein, J. B., and Hosterman, J. W., 1969, Residual clay deposits in rocks of early and middle Devonian age near Kunkletown, Pennsylvania: U. S. Geol. Survey Prof. Paper 650-D.
- Faill, R. T., 1969, Kink band structures in the Valley and Ridge Province, Central Pennsylvania. Geol. Soc. Am., Bull. v. 80.
- Faill, R. T., 1969, Tectonic development of the Triassic basin in Pennsylvania: Geol. Soc. Am. Abstracts for 1969, part 7.
- Flint, Norman K., 1970, Application of geology in highway planning and design. Abstract, (Geol. Soc. Am., NE Section Meeting).
- Flueckinger, L. A., 1969, Geology of a portion of the northern half of the Allensville 15-minute quadrangle. Penna. Geol. Survey, 4th ser., Prog. Rept. 176.
- Freedman, Jacob, 1968, Geochemical prospecting for zinc, lead, copper and silver, Lancaster Valley, southeastern Pennsylvania. U. S. Geol. Survey press release.
- Gait, G. B., 1970, Microfilming maps of abandoned anthracite mines in the Lackawanna Basin, Northern Anthracite field. U. S. Bur. Mines, Inf. Circ. 8453.
- Geyer, A. R., 1969, Hickory Run State Park. Penna. Geol. Survey, 4th ser., Park Guide 2.
- Glaeser, J. D., 1969, Geology of flagstone in the Endless Mountains Region, northern Pennsylvania. Penna. Geol. Survey, 4th ser., Inf. Circ. 66.
- Glaeser, J. D., 1969, Absence of Pocono Formation at Elk Mt., Susquehanna County, Pennsylvania. Pa. Acad. of Sci., v. 42.

- Glaeser, J. D. 1970, Correlation of Catskill sedimentary environments and its economic significance. Abstract, Geol. Soc. Am. NE Section Meeting.
- Gordon, Robert B., 1969, A note on the weathering of serpentinite found in southeastern Pennsylvania. Pa. Acad. Sci. Newsletter, v. 27, no. 1.
- Gross, D. L. and Moran, S. R., 1969, Textural and mineralogical gradations in tills of the Allegheny Plateau: Geol. Soc. Am., Abstract, part 6, NE Section Meeting.
- Guber, Albert L., 1969, Sedimentary phosphate method for determining paleosalinities: a paleontological assumption. Science, v. 166.
- Henderson, John R., 1969, Tectonic significance of minor structures in Conococheague Formation near Lancaster, Pennsylvania. Am. Jour. Sci., v. 267, no. 2.
- Heyman, Louis, 1969, Geology of the Elk Run Gas Pool, Jefferson County, Pennsylvania. Penna. Geol. Survey, 4th ser., Min. Res. Rept. 59.
- Hoover, K. V. (ed.), 1970, Proceedings: Fifth forum on geology of industrial minerals. Penna. Geol. Survey, 4th ser., Min. Res. Rept. 64.
- Hosterman, J. W., 1969, White clay deposits near Mount Holly Springs, Cumberland County, Pennsylvania: U. S. Geol. Survey Prof. Paper 650-B.
- Kelley, Dana R., 1969, A resume' of some major geophysical logging methods for Pennsylvania Operators. Penna. Geol. Survey, 4th ser. Min. Res. Rept. 61.
- Kelley, Dana R. and William G. McGlade, 1969, Medina and Oriskany production along the shore of Lake Erie, Pierce Field, Erie County. Penna. Geol. Survey, 4th ser., Min. Res. Rept. 60.
- Kelley, Dana R. and others, 1969, Oil and gas developments in Pennsylvania in 1968. Penna. Geol. Survey, 4th ser., Prog. Rept. 177.
- Kent, B. H., 1969, Methods of storing and retrieving core-log data on coal-bearing roads in southwestern Penna., U. S. Geol. Survey Prof. Paper 650-C.
- Kent, B. H., 1969, The geologic setting of a Pittsburgh coal mine in southwestern Pennsylvania as related to roof rock conditions. Abstract, Geol. Soc. Am., NE Section Meeting.

- Kent, B. H., 1970, Geologic map of the Mather quadrangle southwestern Pennsylvania. U. S. Geol. Survey Map GQ-826.
- Kent, B. H., 1969, Geologic map of part of the Carmichaels quadrangle, southwestern Pennsylvania. U. S. Geol. Map I-588.
- Kent, B. H., Schweinfurth, S. P. and Roen, J. B., 1969, Geology and land use in eastern Washington County, Pennsylvania. Penna. Geol. Survey, 4th ser. Gen. Geol. Rept. 56.
- Lane, B. E., and Parizek, R. R., 1968, Leachate movement in the sub-soil beneath a sanitary landfill trench traced by means of suction lysimeters; 2nd Mid-Atlantic Indust. Waste Conference, Drexel Inst. of Tech. Philadelphia.
- Langmuir, Donald, 1969, Saturation with calcite and dolomite of some ground waters in folded and faulted carbonate rocks. Geol. Soc. Am., Abstract, Annual Meetings, Atlantic City, N. J.
- Langmuir, Donald, 1969, The chemistry of ground and surface waters in Nittany Valley. Earth and Mineral Sciences, v. 38, no. 9.
- Langmuir, Donald and Jacobson, R. L., 1969, The hydrochemistry of sinking and resurgent streams in carbonate rocks of central Pennsylvania. Abstract, Water Well Jour. v. 23, no. 9.
- Langmuir, D. and Whittemore, D. O., 1970, Variations in the stability and behavior of ferric oxyhydroxides precipitated from natural waters and acid-mine drainage. Abstract, W A T R 025, 159th National Meeting, Houston, Texas.
- Lapham, D. M. and Geyer, A. Mineral collecting in Pennsylvania. Penna. Geol. Survey, 4th ser., Gen. Geol. Rept. 33, third edition.
- Lytle, W. S. Moraine State Park. Penna. Geol. Survey, 4th ser., Park Guide 4.
- MacCartney, John C. and Whaite, Ralph H., 1969, Pennsylvania anthracite refuse, a survey of solid waste from mining and preparation. U. S. Bureau Mines Inf. Circ. 8409.
- Martin, Wayne D. and Henniger, Bernard, 1969, Mather and Hockingport Sandstone Lenticles (Pennsylvanian and Permian) of Dunkard Basin Pennsylvania, West Virginia and Ohio. Am. Asso. Petroleum Geol. Bull., v. 53, no. 2.

- McCarren, E. F. and W. B. Keighton, 1969, Water quality and discharge of streams in the Lehigh River basin, Pennsylvania. U. S. Geol. Survey Water Supply Paper 1879-H.
- McGlade, W. G., 1969, Limestone and dolomite distribution in Pennsylvania. Penna. Geol. Survey, 4th ser., Map 15.
- McGlade, W. G., 1969, Archbald Pothole State Park. Penna. Geol. Survey, 4th ser., Park Guide 3.
- McKague, H. Lawrence, 1970, The effects of serpentinization upon the trace element distribution in the State Line serpentinite. Abstract, Geol. Soc. Am., NE Section Meeting.
- McNay, Lewis, 1970, Surface mine reclamation, Moraine State Park, Pennsylvania. U. S. Bur. Mines Inf. Circ. 8456.
- Monmonier, M. S., 1969, Trends in upland accordance in Pennsylvania's Ridge and Valley section. Pa. Acad. Sci. Proceedings, v. 42.
- Oliver, W. A., Jr., deWitt, W., Jr., Dennison, J. M., Hoskins, D. M., and Huddle, J. W. Correlation of Devonian rock units in the Appalachian Basin. U. S. Geol. Survey Chart OC 64.
- Prouty, C. E., 1969, Guidebook for field excursion of central Appalachians of Ohio, Pennsylvania, and Maryland (with A. T. Cross), Mich. State Univ., Dept. of Geol. Publication.
- Rankin, William E. and Peter, M. Lavin, 1970, Gravity survey for drift-filled valleys in the Mercer Quadrangle, Pennsylvania. Jour. Hydrology, v. 10.
- Ray, Clayton E. and others, 1970, A peccary, *Platygonus Compressus* LeConte, from drift of Wisconsinan Age in northern Pennsylvania. Am. Jour. Sci. v. 268, no. 1.
- Roen, J. and Hosterman, J., 1969, Analysis and potential uses of selected shales and clays of Greene County, Pennsylvania. Penna. Geol. Survey, 4th ser., Inf. Cir. 67.
- Rones, M., 1969, A lithostratigraphic, petrographic and chemical investigation of the Lower Middle Ordovician rocks in central Pennsylvania. Penna. Geol. Survey, 4th ser., Gen. Geol. Rept. 53.

- Root, S. I., 1970, Structure of the northern terminus of the Blue Ridge in Pennsylvania, *Geol. Soc. Am., Bull.*, v. 81, no. 3.
- Sevon, W. D., 1969, The Pocono Formation in northeastern Pennsylvania. 34th Annual Field Conference of Pennsylvania Geologists, Guidebook, Penna. Geol. Survey.
- Sevon, W. D., 1970, Mississippian unconformity in northeastern Pennsylvania. Abstract, *Geol. Soc. Am., NE Section Meeting*.
- Sevon, W. D., 1970, Palmerton Sandstone as a source of sand in Carbon and northeastern Schuylkill Counties, Pennsylvania. *in* Proc. Fifth Forum on Geology of Ind. Min. (K. V. Hoover, ed.) Penna. Geol. Survey, 4th ser. Min. Res. Rept. 64.
- Shields, Ronald R., 1969, An application of surface geophysical techniques to the study of watershed hydrology. *Water Resource Bull.* v. 5, no. 3.
- Simpson, Dale R., 1969, Prelinite veins in Triassic diabase, Coopersburg, Pennsylvania. *Geol. Soc. Am. Bull.* v. 80, no. 7.
- Smith, Richard E., 1969, Petrography-porosity relations in carbonate-quartz system, Galesburg Formation (Late Cambrian) Pennsylvania. *Am. Asso. Petroleum Geol. Bull.*, v. 53, no. 2.
- Sterner, T. E. and Campbell, G. G., 1968, A case history of two stream-injection pilot tests in Pennsylvania. *Producers Monthly*, v. 32, no. 10.
- Subitzky S., 1969, Geology of selected areas in New Jersey and eastern Pennsylvania. *Geol. Soc. Am. Guidebook*, 1969 Annual Meeting.
- Szucs, F. K., 1970, Pre-Pleistocene drainages of Slippery Rock and Muddy Creeks determined by subsurface exploration. *Geol. Soc. Am., Abstract*, vol. 2, no. 1.
- Thompson, A. M., 1970, Sedimentology and origin of Upper Ordovician clastic rocks, central Pennsylvania. *Guidebook, Eastern Section SEPM*, April 25-26, 1970.
- Thompson, A. M., 1970, Lithofacies and formation nomenclature in Upper Ordovician stratigraphy, central Appalachians, *Geol. Soc. Am., Bull.*, vol. 81, no. 4.

- Thompson, A. M., 1970, Geochemistry of color genesis in red-bed sequence, Juniata and Bald Eagle Formations, Pennsylvania. *Jour. Sed. Pet.*, v. 40, no. 2.
- U. S. Department of Interior, 1968, Natural resources of Pennsylvania.
- Vasilescu, Mircea S., 1969, Performance of Muddy Run embankment—discussion. *Am. Soc. Civil Engin. Proceedings* vol. 95, *Jour. Soil Mechanics and Found. Div.* no. SM3.
- Wagner, Walter R., 1969, Representative gamma-ray logs from shallow and deep wells, western Pennsylvania. *Penna. Geol. Survey, 4th ser., Prog. Rept.* 178.
- Warner, Jeffrey, and Al-Mishurt, Ali, 1969, Variations of the basal spacing of muscovite with metamorphic grade in southeastern Pennsylvania. *Pa. Acad. Sci. Proc.* v. 42.
- White, G. and others, 1969, Glacial geology of northwestern Pennsylvania. *Penna. Geol. Survey, 4th ser., Gen. Geol. Rept.* 55.
- Wilshusen, J. P., 1969, Trough Creek State Park. *Penna. Geol. Survey, 4th ser., Park Guide* 1.
- deWitt, Wallace, Jr., 1970, Age of the Bedford Shale, Berea Sandstone and Sunbury Shale in the Appalachian and Michigan basins, Pennsylvania, Ohio, and Michigan. *U. S. Geol. Survey Bull.* 1294-G.
- Wood, G. H., Jr. and H. H. Arndt, 1969, Geologic map of the Shenandoah quadrangle, Schuylkill County, Pennsylvania. *U. S. Geol. Survey Map* GQ-781.
- Wood, G. H., Jr., Arndt, H. H., and Carter, M. D., 1969, Systematic jointing in the western part of the Anthracite region of eastern Pennsylvania. *U. S. Geol. Survey Prof. Paper* 1271-D.
- Wood, G. H., Jr., Trexler, J. P. and Kehn, T. M. 1969, Geology of the west-central part of the southern Anthracite field and adjoining area, Pennsylvania. *U. S. Geol. Survey Prof. Paper* 602.
- Yeloushan, Charles C., 1969, The mineral industry of Pennsylvania in 1967. *Penna. Geol. Survey, 4th ser., Inf. Cir.* 63.
- Zeilinger, J. E., 1969, Preparation characteristics of coal from Beaver and Lawrence Counties, Pennsylvania. *U. S. Bur. Mines Rept. Inv.* 7324.
- Zeilinger, J. E. and Deurbrock, A. W., 1970, Preparation characteristics of Pennsylvania Anthracite from the Kidney Seam, northern field. *U. S. Bur. Mines Rept. Inv.* 7364.

SURVEY ANNOUNCEMENTS

THE SURVEY UP-DATES ITS X-RAY EQUIPMENT

In 1957, the Pennsylvania Geological Survey bought its first x-ray equipment. By 1969, this equipment was not only outmoded by new advances in technology, but, as a result of almost constant usage, was beginning to have as much "down-time" for repairs as available running time. Consequently, the two new units pictured on the cover have been installed to replace two similar, earlier units. The new equipment comprises a vacuum x-ray spectrograph (left-center) and a solid state, modular power and control unit (right).

The x-ray spectrograph will allow semi-quantitative and quantitative chemical analysis for elements heavier than sodium. For many elements, the limit of detection will be less than 0.01 percent. The power and control unit contains the strip-chart recorder upon which the spectrographic curves are traced. It also serves as the control and recorder for the x-ray diffraction (mineral analysis) unit to the left of this picture.

This new equipment in the Mineral Resources Division will allow the Survey to perform a wider range of rock and mineral analyses with greater accuracy than was previously available with the old equipment. Some of the studies that will utilize this equipment are: 1) analyses of clay and shale resources in Pennsylvania; 2) the potential uses of glacial materials (clays, aggregate, ground water, availability); 3) the character and uses of Cumberland Valley carbonate rocks; 4) engineering problems involving rock slides; 5) the rocks and economic geology of the Pennsylvania serpentinite belt (crushed stone, chromite, nickel, magnesite, talc); and 6) the iron-ore deposits of Pennsylvania. Besides these projects, this equipment can be used for more routine service work for the Survey staff, for other governmental agencies, and for the public when the problem is of sufficient importance to justify the use of such complex, sophisticated instrumentation.

SECONDARY OIL RECOVERY OPERATIONS IN PENNA.

As of December 31, 1969, there were 75 waterflood projects in Pennsylvania, encompassing 30,850 acres. About 10,000 water injection wells were injecting 350,000 barrels of water per day into the producing horizons at pressures of 600 to 2,000 psi and about 9,000 wells were producing the flood oil from within the projects.

As of the same date, 16 gas injection projects encompassing 13,000 acres were operating with 500 gas injection wells and 2,000 producing oil wells. A total of 4,800 Mcf of gas was being injected per day at pressures of 50 to 250 psi.

The amount of secondary recovery oil produced in 1969, was 2,931,000 barrels or about 67 percent of the total production for the year. In 1961, there were 4,550,000 barrels of secondary recovery oil produced, which was about 80 percent of the total crude oil produced during that year. The peak year for secondary recovery in the Commonwealth was 1937, when 83 percent of the yearly production of 19,189,000 barrels was recovered by secondary methods.

About 340,000,000 barrels (revised figure) of secondary crude oil has been produced in Pennsylvania since 1907, when the effects of flooding became noticeable in the annual crude oil production. This is about 27 percent of the total cumulative oil production of 1,265,332,000 barrels to the end of 1969. About 93 percent of the secondary recovery oil was produced by waterflooding, mostly from the Bradford field.

The total cumulative oil production from the Bradford field, 85 percent of which lies in Pennsylvania and 15 percent in New York, was about 636,297,000 barrels to December 31, 1969. About 370,569,000 barrels or 58 percent was produced by secondary methods.

The proven crude oil reserves for Pennsylvania as of December 31, 1969, were 54,740,000 barrels, most of which will be produced by secondary methods.

The tertiary recovery projects of steam flooding and miscible displacement have temporarily been abandoned but a Maraflood pilot project in McKean County is being expanded into a large-scale project. Other companies are interested in the Maraflood process and one is actively coring several areas to evaluate them with respect to Maraflooding.

OLD MOON ROCK

A Moon rock brought back by the Apollo 12 crew apparently **dates back to the formation of the Solar System**. G.J. Wasserburg of Cal Tech has firmly dated it as 4.6 billion years old — the oldest rock known. (The fine materials brought back by Apollo 11 and 12 are about that age, but the rocks run a billion years younger.) The specimen, known as rock 13, is granite-like, and is the most radioactive rock—by a factor of 10—yet found in the lunar specimens. Although

it was picked up in the Ocean of Storms it is probably from the lunar highlands. Its age and composition seem to add to the evidence for an originally hot Moon, for it can hardly have crystallized from any relatively transitory event such as meteoritic impact or cooling of a lava on the surface.

ASH UTILIZATION SYMPOSIUM

Earlier this year the Second Ash Utilization Symposium was held in Pittsburgh. The symposium, which was jointly sponsored by the U.S. Bureau of Mines, the National Coal Association, the American Public Power Association, the Edison Electric Institute and the National Ash Association, Inc., featured 21 papers dealing with problems and uses of ash from power generating plants. This ash, which is fine, solid particles of noncombustible material, is derived from the burning of solid fuels such as coal and is deposited in quiet portions of furnaces and flues, in boilers, or is carried out of chimneys with the waste gases. Pollution caused by this material is a major problem as is the economical disposal of the ash when it is collected and removed from the furnaces and air.

Collectively, the symposium papers listed the following present and future uses for this ash: control of abandoned mine fires; prevention of subsidence in abandoned mines; remote sealing of portions of active mines; extinguishment of mine refuse dump fires; prevention of methane drainage in active mines; prevention of acid mine drainage from abandoned mine entries; raw material for the manufacture of cement, concrete products, bricks and fertilizers; material for road base, lightweight aggregate, and fill; aid to soil stabilization; source for mineral fillers, absorbents, flucculants, and coagulants; aid to metal and mineral recovery techniques; neutralizer of acid mine drainage; treatment for polluted lake water to remove inorganic phosphorous, suspended matter, and organic concentrations; and as an anti-skid agent for surface pavement mixes.

Since coal's major customers are the electric power generating installations, research in ash utilization is of great importance to the coal industry. Currently, only 20 percent of the 30 million tons of ash generated per year is put to constructive use. C.E. Brackett of Birmingham, Alabama's Southern Electric Generating Company predicted that the electric utility industry in the United States will be producing 42.5 million tons of ash by 1975. Unless more and better uses for this ash are developed, the cost of ash removal and disposal could seriously affect coal's position in the highly competitive power world, which is continually facing stricter pollution regulations.

The search for new and better methods of utilizing coal ash will continue to be a big item in research. Only by developing ash into an economical by-product, can it be made to pay for its own removal.

THE MINERAL INDUSTRY OF PENNSYLVANIA IN 1968

The Pennsylvania Geological Survey has published "The Mineral Industry of Pennsylvania in 1968" as Information Circular 69, by Charles Yeloushan of the United States Bureau of Mines. This publication is a concise summary of the quantity and dollar value of the reported production by commodity and by county of Pennsylvania's important mineral industries. Also included are uses, users, and a list of principal producers. The publication also is a storehouse of miscellaneous factual information ranging from the number of scraper loaders used in anthracite mining (131) to the winner of the "Sentinels of Safety" award for the most injury-free man-hours of work in quarrying operations (given to the Millard Quarry, Bethlehem Steel Corp., Annville, Lebanon County).

In 1968, Pennsylvania's mineral industries attained a total value of \$904 million, a \$5.6 million increase over 1967. Bituminous coal production was the leading producer (\$408.9 million with Washington County being the largest producer; stone was the second largest commodity (\$108.1 million); anthracite (\$97.2 million), sand and gravel (\$31 million), and natural gas (\$24.4 million). The cement industry, including Portland and masonry, totaled \$123.1 million, representing nearly a 10 percent increase over 1967 production. Other increased production was shown by copper, stone, gold, silver, clays, sand and gravel, cobalt, iron ore, mica, and pyrite.

This publication may be obtained at no cost from the Topographic and Geologic Survey, Main Capitol Annex, Harrisburg, Pa. 17120.

ANNUAL FIELD CONFERENCE of PENNSYLVANIA GEOLOGISTS

October 2-3, 1970 Field trip through eastern Piedmont of Maryland. Hosts: Maryland Geological Survey. Pre-registration by Pennsylvania Geological Survey, Harrisburg.



PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Arthur A. Socolow, *State Geologist*

Donald M. Hoskins, *Assistant State Geologist*

ADMINISTRATIVE DIVISION

John P. Wilshusen, *Editor*

Elsie Adams, *Administrative Assistant*

Sandra Blust, *Librarian*

Constance Grier, *Typist*

Sharon Gunning, *Typist*

John G. Kuchinski, *Draftsman*


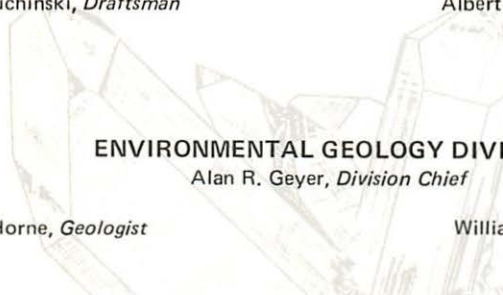
Deborah Lehmer, *Typist*

Virginia Milewski, *Draftsman*

Donna M. Snyder, *Stenographer*

Linda M. Ulsh, *Stenographer*

Albert VanOlden, *Draftsman*



ENVIRONMENTAL GEOLOGY DIVISION

Alan R. Geyer, *Division Chief*

Mary E. Horne, *Geologist*

William G. McGlade, *Geologist*

FIELD GEOLOGY DIVISION

Samuel I. Root, *Division Chief*

Thomas M. Berg, *Geologist*

William Bragonier, *Geologist*

William E. Edmunds, *Geologist*

Rodger T. Faill, *Geologist*

J. Douglas Glaeser, *Geologist*

Gary B. Glass, *Geologist*

Albert D. Glover, *Geologist*

David B. MacLachlan, *Geologist*

William D. Sevon, *Geologist*

Richard B. Wells, *Geologist*



MINERAL RESOURCES DIVISION

Davis M. Lapham, *Division Chief*

John H. Barnes, *Geologist*

Leslie T. Chubb, *Laboratory*

Technician

Karl V. Hoover, *Geologist*

OIL AND GAS DIVISION

(Pittsburgh State Office Bldg.)

Dana R. Kelley, *Division Chief*

Lajos Balogh, *Draftsman*

David Debor, *Laboratory Technician*

Lillian Heeren, *Draftsman*



Louis Heyman, *Geologist*

Cheryl Lewis, *Stenographer*

William S. Lytle, *Geologist*

Kathleen McConnel, *Typist*

Walter R. Wagner, *Geologist*



HOW ROBERT A. BOWEN
SECRETARY OF COMMERCE
414 SOUTH OFFICE BLDG
HARRISBURG PA 17120

GROUND-WATER LEVELS

