

W. A. Jones

10055 Rossmore Sanitarium

A. J. Hughes

GUIDEBOOK

for

FIFTEENTH ANNUAL

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

May 27-29, 1949



HOSTS

Department of Geology
Franklin and Marshall College
Lancaster, Pennsylvania

The field excursions and the program of
the 1949 Field Conference have been prepared
by the following committee:

Ernst Cloos, The Johns Hopkins University
Randolph Chapman, The Johns Hopkins University
George K. Biemesderfer, Franklin and Marshall College
John Hall Moss, Franklin and Marshall College
Jacob Freedman, Franklin and Marshall College
Richard M. Foose, Chairman of the Conference
Franklin and Marshall College

Marchant N. Shaffner
Secretary of the Field Conference
Topographic and Geologic Survey
Harrisburg, Pennsylvania

FRANKLIN & MARSHALL COLLEGE
LANCASTER, PA.

OFFICE OF THE PRESIDENT

ROBERT B. NEUMAN
U. S. Geological Survey

May 26, 1949

TO THE MEMBERS OF THE FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS:

Welcome to Franklin and Marshall College. We are delighted to have you with us even if only for a short time. I realize that your program is such that it will not be possible for me to greet you in person, but I do want you to know that we are delighted to have you ~~with~~ us. I hope you will be able to see somewhat of our College. We want you to make this College your home for as long as you can remain on the campus. I sincerely hope that your stay will be a pleasant one and that you will be sure to let us know if there is anything that we can do to make you happy.

I very much hope that your field trips will be fruitful, as well as thoroughly enjoyable, and above all do come again. The latchstring will always be out.

Sincerely,

Theodore A. Distler

Theodore A. Distler

PROGRAM

Friday, May 27

- 9-12 A.M. REGISTRATION. Room 100 (Basement) Stahr Hall, F. & M.
Campus. Registration 1:00-3:00 P.M. for late arrivals.
Nominal registration Fee. Box lunch for Trip 2 - \$.80
Dinner - - - - - \$2.20
- 12:30 P.M. TRIP 1. OLD MINES and MINE RIDGE ANTICLINE. Prompt
Departure! Wood-Chrome Mine and discussion of chromite
in serpentine rocks. Gap Nickel Mine. Peach Bottom
slate belt. Geology of Mine Ridge anticline.
Leaders: Edward Sampson, Princeton University
Richard M. Foose, Franklin and Marshall College
Jacob Freedman, Franklin and Marshall College
George Biemesderfer, Franklin and Marshall College
- 8:00 P.M. SMOKER Arcadia Cafe. 27 W. Orange Street
Registration for late arrivals
HOSTS: SUN OIL COMPANY, Philadelphia, Pennsylvania
Entertainment: Moving Picture of Gult Coast Oil
operations
Geologic Highlights of Lancaster County
by John W. Price, Curator, F. and M.
Museum.
Refreshments in the solid, liquid, and "smokey" state
All are invited. LADIES TOO!

- * -

Saturday, May 28

- 8:00 A.M. TRIP 2. "MARTIC OVERTHRUST" AREA. Prompt Departure!
This is the first opportunity to examine the geology of
Southern Lancaster County and to discuss its problems in
the field. Contact metamorphism at the Safe Harbor Quarry.
Leaders: Ernst Cloos, The Johns Hopkins University
Randolph Chapman, The Johns Hopkins University
- 7:00 P.M. DINNER. Ballroom. Hotel Brunswick. N. Queen & Chestnut
Streets. Short business meeting after dinner.
Entertainment.

- * -

Sunday, May 29

- 8:45 A.M. TRIP 3. APPALACHIAN DRAINAGE and PLEISTOCENE TERRACES
Discussion of Appalachian drainage problems from top
of Chickies Rock on Susquehanna River. Structure of
Chickies Rock. Examination of field evidence for
Pleistocene origin of river terraces. Highspire gravel
pit.
Leaders: Howard Meyerhoff, A.A.A.S. and Smith College
John H. Moss, Franklin and Marshall College
Richard M. Foose, Franklin and Marshall College

GENERAL INFORMATION

1. All excursions will assemble and leave from in front of Stahr Hall on College Avenue headed South. All cars should be tagged with Field Conference placard and in line 15 minutes before departure time.
2. Please do not drive an empty car! Either fill it with other passengers or travel with another yourself. Keep the Caravan as small as possible. You may park your car on or off the Campus.
3. Departure times for the beginning of trips and throughout the trips will be prompt! When you hear a double whistle blast, please return to your car.
4. A complete first aid kit is located in the Franklin and Marshall Station Wagon at the head of the Caravan. Do not neglect small injuries.
5. Box lunches will be delivered to the party in the field on Saturday noon. Every person should purchase a Box Lunch ticket at the registration desk.
6. The Field Conference will disband in the field Sunday at about 1:00 P.M. in an area where lunch or dinner may easily be obtained.

LEGEND

TRIASSIC

- Rd DIABASE
- R RED SHALE & S.S.

ORDOVICIAN

- Oc COCALICO SHALE
- Ocl CONESTOGA L.S.
- Ob BEEKMANTOWN L.S.

CAMBRIAN

- Eco CONOCOCHEAQUE L.S.
- Ee ELBROOK L.S.
- El LEDGER DOLOMITE
- Ek KINZERS SHALE
- Ev VINTAGE DOLOMITE
- Ea ANTIETAM SCH. & QTZITE. (INC. HARPER'S)
- Ec CHICKIES QTZITE.
- eh HELLAM CGL.

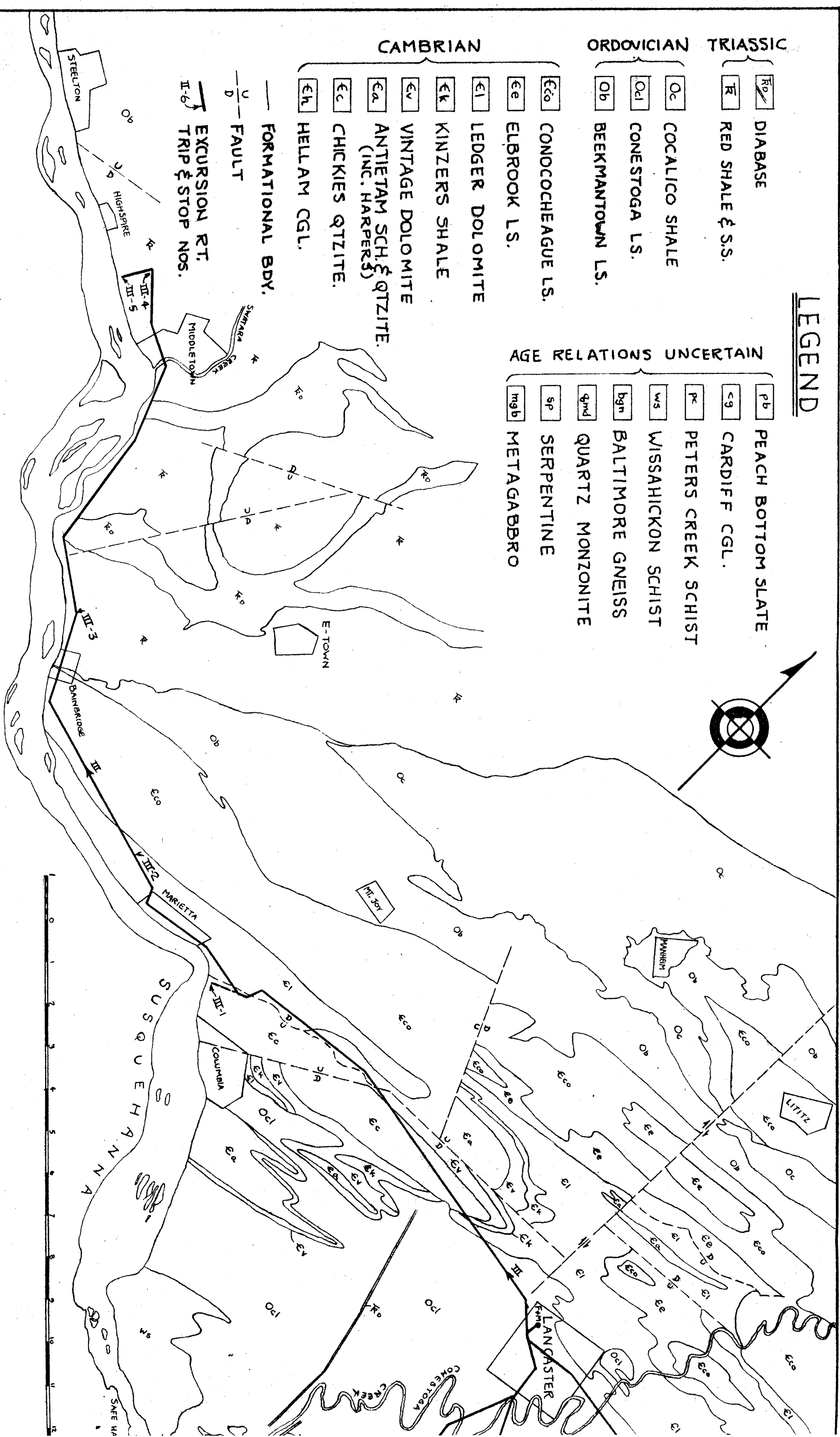
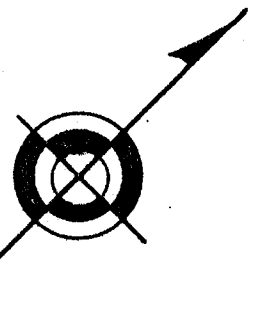
AGE RELATIONS UNCERTAIN

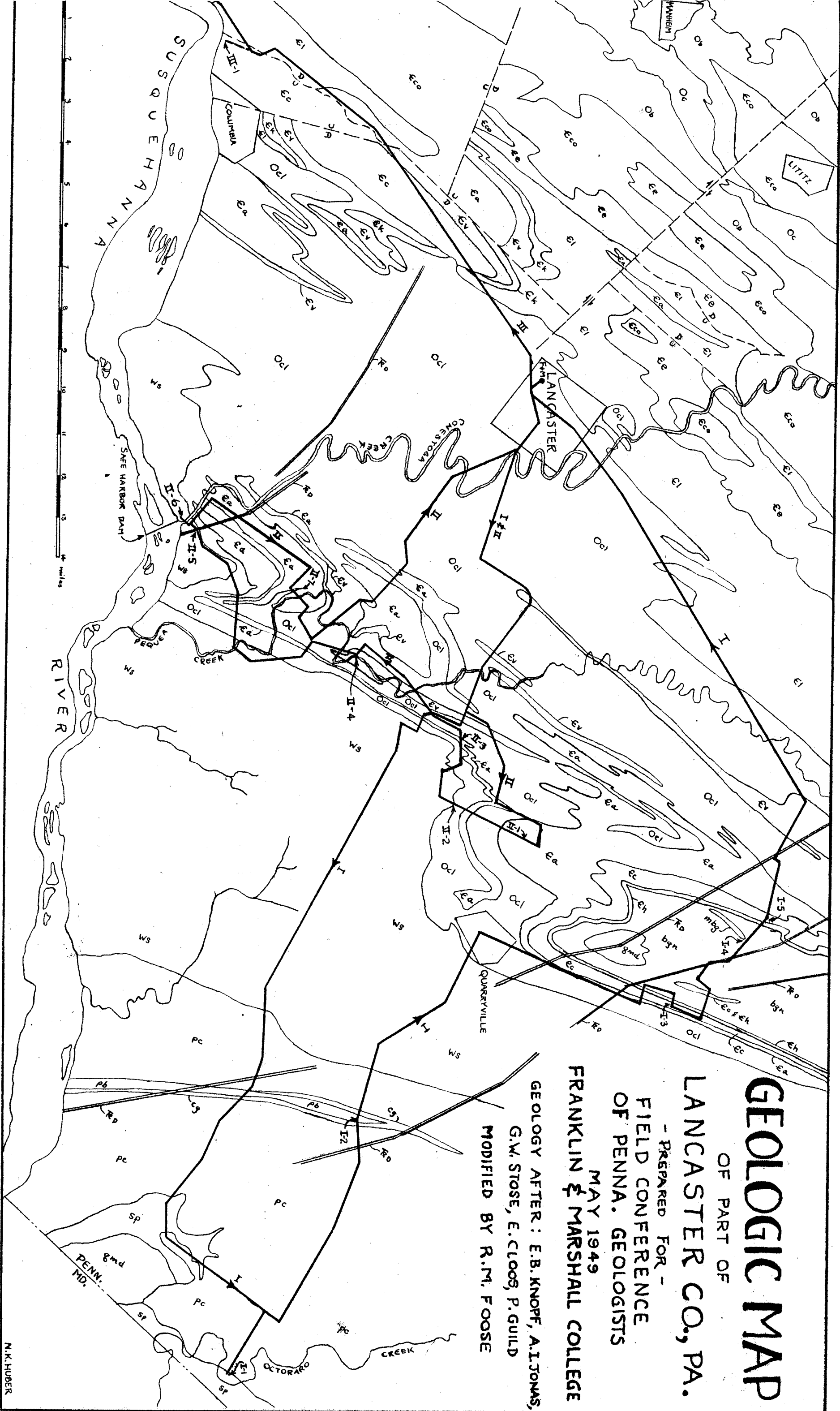
- Pb PEACH BOTTOM SLATE
- Cg CARDIFF CGL.
- Pc PETERS CREEK SCHIST
- ws WISSAHICKON SCHIST
- bgn BALTIMORE GNEISS
- qmd QUARTZ MONZONITE
- sp SERPENTINE
- mgb METAGABBRO

— FORMATIONAL BDY.

$\frac{D}{U}$ FAULT

$\nwarrow$ EXCURSION RT.
II-6 TRIP & STOP NOS.





GEOLOGIC MAP

OF PART OF
LANCASTER CO., PA.

- PREPARED FOR -
FIELD CONFERENCE
OF PENNA. GEOLOGISTS

MAY 1949
FRANKLIN & MARSHALL COLLEGE

GEOLOGY AFTER: E.B. KNOFF, A. JONAS,
G.W. STOSE, E. CLOOS, P. GUILD
MODIFIED BY R.M. FOOSE

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Franklin and Marshall College

Lancaster, Pennsylvania

FRIDAY, MAY 27

EXCURSION 1: Old Metal Mines and Mine Ridge Anticline

Departure: 12:30 P.M. Sharp

Leaders: Edward Sampson, Princeton University
Richard M. Foose, Franklin and Marshall College
Jacob Freedman, Franklin and Marshall College
George Biemesderfer, Franklin and Marshall College

Topographic Maps: Lancaster Quadrangle
McCalls Ferry Quadrangle
Quarryville Quadrangle
(Including Mine Ridge and Gap Nickel Mine)
Havre de Grace, Md.-Penna. Quadrangle
(Including Wood's Chrome Mine)
New Holland Quadrangle

References: Frazer, Persifor, Jr., Geology of Lancaster
County: Penna. Second Geol. Survey, Rept. CCC,
1880.
Jonas, A.I. and Stose, G.W., Lancaster Quadrangle:
Geologic Atlas 168, Pa. Geol. Survey, 1930.
Knopf, E.B. and Jonas, A.I., Geology of The
McCalls Ferry-Quarryville District, Pa.:
U.S.G.S. Bull. 799, 1929.
Bliss, E.F., Chrome ores of Southeastern Penna.
and Md.: U.S.G.S. Bull 725, pp. 85-98, 1921.
Kemp, J.F., The Nickel mine at Lancaster Gap, Pa.:
A.I.M.E. Trans. Vol. 24, pp. 620-633, 1895.

Parts of the descriptions of the Wood Mine and
Gap Nickel Mine have been taken from the
references listed above.

Detailed Itinerary

Miles

- 0.0 Heading South on College Avenue in front of Stahr Hall,
Franklin and Marshall College Campus.
- 0.2 Turn right on Buchanan Avenue
- 0.4 Turn left on N. West End Avenue
- 0.8 Cross Lincoln Highway. Stop sign. Caution
- 1.4 Turn left on Manor Street
- 1.7 Turn right on Fairview Avenue
- 2.4 Bear right at "Y" road
- 2.8 Turn right on S. Prince Street, Route 72
- 2.9 Bridge over Conestoga Creek
- 3.5 Media Heights Golf Club on left
- 4.7 Conestoga limestone, the bedrock for all of the Lancaster
Valley, crops out on left. Note drag folds and veins
of calcite and quartz. This is typical of the Conestoga.
- 6.0 Mylin's Corners. Turn left. View of Lancaster Valley
behind.
- 7.2 Big spring on right. This spring has a flow of 50 gallons
per minute, forming a pool 50 feet square.
- 10.0 Crossing Pequea Creek. Refton Cave is situated on the
bluff along the Creek a quarter mile from this point.
The cave is developed in Conestoga limestone with a
roof of Antietam schist.
- 11.1 At sign "Refton", crossing prominent ridge of Antietam
quartzose schist. Continue straight at crossroad.
- 11.4 Turn right
- 12.0 Covered bridge over Beaver Creek
- 12.4 Curve to left
- 12.8 Passing through another ridge of Antietam schist.
Conestoga limestone underlies the valley areas on both
sides of the ridge.
- 13.1 Crossing "Martic overthrust" and entering area underlain
by Wissahickon schist. Note higher, rolling topography.
- 13.3 Turn right

Miles

- 13.8 Smithville. Turn left. A quarry in the Wissahickon schist may be seen ahead and right. The new road cut exposes a large section of the schist.
- 14.0 Railroad underpass
- The several deep valleys crossed in the next four or five miles are not underlain by limestone. All the bedrock to the south is schist with minor exceptions that will be noted.
- 18.1 Good crop of Wissahickon schist
- 18.4 Crossroads at the Buck
- 20.0 Crossroads at Cochran's Corners
- 21.5 Bear left at "Y" road
- 22.1 Wissahickon - Peters Creek schist boundary is drawn here by Knopf and Jonas.
- 23.4 Crop of blue sericitic schist on left
- 24.6 Crossing area underlain by Cardiff Conglomerate and Peach Bottom slate. The conglomerate crops out back of the barn to the right.
- 26.2 Junction with Route 222. Bear right.
- 26.7 Wakefield crossroads
- 27.3 Curve to right
- 28.7 Entering belt of Serpentine rocks. The area underlain by serpentine is irregular and the route does not stay within it.
- 28.9 Turn left on to macadam road at New Texas (Lyles)
- 30.7 Turn left at "T" road
- 30.8 Turn right at "Y" road
- 31.8 Note typical vegetation of Serpentine "Barrens" to the right. Only pines, firs, and oaks thrive on the soils overlying serpentine.
- 32.0 Turn right toward Lees Bridge
- 32.5 Prominent crop of Peters Creek schist on left
- 32.9 Crop of schist

Miles

- 33.6 Straight ahead. Leave main road. Old road to Wood Mine
- 33.8 Crossing boundary from Peters Creek schist to Serpentine, here making an East-West contact.
- 34.2 WOOD CHROME MINE

STOP I Arrive: 1:40 P.M. Leave 2:40 P.M.

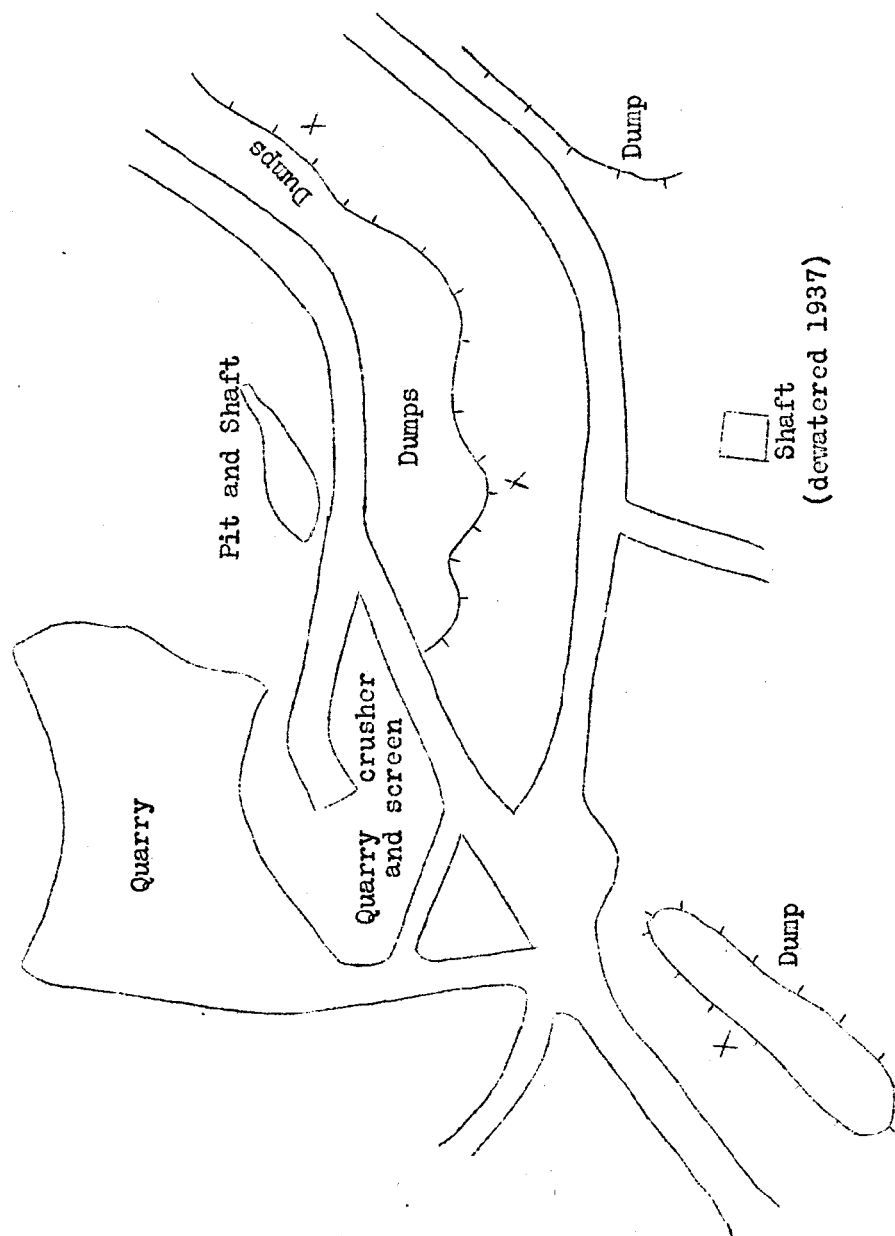
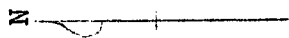
Chromite was produced in southern Lancaster County from 1828 to 1858, and from 1873 to 1882, at which time most of the mining ceased. The Wood mine, the largest and most famous, supplied nearly 100 percent of the world's chromite production prior to the Civil War. The ore was high grade, averaging 48 percent chromic oxide. Numerous smaller mines operated at the same time, and very small amounts of chromite have been produced from some of these smaller places since 1882.

The Wood mine was unwatered in 1937 and examined to its lowest level (about 720 feet); practically no ore remained. A drilling program by the Bureau of Mines and Geological Survey, U. S. Department of Interior, in 1941 failed to find an extension in one direction of the Wood ore body or to outline any other ore body.

The Wood Mine was opened in 1828. The country rock is serpentine. The ore body was almost 300 feet long as its greatest extension and had an average width of 20 feet. Pitch of the ore shoot was from 40 to 60 degrees. The strike is nearly east and west at the outcrop and nearly north and south on lower levels.

When the mine was closed in 1881 the total output was estimated at 100,000 tons. In its present state the mine consists of two openings. The larger opening is about 90 by 50 feet and trends northeast. It leads into a shaft that dips southward. About 150 feet south of this large pit is a smaller opening leading into a shaft that is connected by a northward drift with the larger opening. During the last few years of the mine's activity it was worked only through the larger opening down to a level of about 244 feet. The water level was kept constant by a pump operated through the deep shaft. Contrary to the usual condition in chromite deposits, the ore occurred in a vein along a well-defined footwall. The vein was about 300 feet long and had an average width of 20 feet. Large dumps containing thousands of tons of waste surround the mine, but the ore, which was massive, has been well sorted out. It was cobbled when labor was plentiful. Sometimes it was crushed and concentrated on jigs, and the residue was washed in a buddle.

SKETCH MAP OF WOOD MINE



X Best mineral collecting

Miles

One of the most amazing features of this mine was the method of dewatering. The power for pumping was taken from the Octoraro Creek, which is 1080 feet from the engine shaft. A wooden breast wheel 16 feet high by 18 feet long, was used under $10\frac{1}{2}$ feet of fall. The motion was transferred by a 6 x 8 inch wooden flat rod more than 1000 feet long, to the engine shaft. This rod traveled on a four foot stroke over wooden friction rollers. The power delivered to the pump was equivalent to a 60 horse power engine.

This mine is famous throughout the whole civilized world for specimens of minerals which it has furnished to many famous cabinets. It lies in a great sweeping oxbow of the Octoraro, in the extreme southern end of Little Britain Township, Lancaster County. Some of the more important and unusual minerals are:

Chromite, magnetite
Serpentine, Williamsite, Picrolite, Baltimorite
Kammererite, chlinochlore, chrysolite
Zaratite, Genthite, Deweylite
Brucite

WARNING: This part of Lancaster County has many ticks that carry Rocky Mountain Spotted Fever. Check yourself carefully now and when you return to Lancaster this evening.

- 34.8 Return to macadam road. Go straight ahead
- 36.4 At "T" road turn right toward Kirks Mill.
- 37.0 Kirks Mill. Turn left
- 37.2 Deep red soil covering a crop of the Peters Creek schist on right.
- 38.2 Excellent section of Peters Creek schist on right
- 39.1 STOP sign in Little Britain. Straight ahead
- 42.0 Fairmount crossroads
- 43.0 PEACH BOTTOM "SLATE"

STOP II Arrive: 3:00 P.M. Leave 3:15 P.M.

This ridge is underlain by the Peach Bottom formation in the center and the Cardiff conglomerate on the flanks. These rocks form a long canoe-shaped outcrop pattern which can be traced from here southwest to the Susquehanna River and beyond as far as Cardiff, Maryland.

Miles

These two formations are the top two members of the Glenarm Series which are thought to be of Algonkian age. At the base of the Glenarm Series is the Setters formation and Cockeysville marble which are not exposed in Lancaster County. Succeeding members are: the Wissahickon formation, Peters Creek schist, Cardiff conglomerate, and Peach Bottom slate.

At this stop, the Peach Bottom rocks are deeply weathered schists and are thin. Only the Cardiff rocks are prominent as quartzose schists showing stringers of sheared pebbles in a chloritic matrix.

Roofing slate was quarried along the Susquehanna River in Lancaster County during the 19th century but all operations were discontinued by 1930. Further west in York County the industry has continued to the present but on a much reduced scale. Today the Funkhauser Company is preparing the Peach Bottom slate in granular form for use in composition roofing and siding.

The structural geology of this area is complicated by the metamorphic character of the rocks and positive evidence for the age relationships is not clearly demonstrated.

- 43.2 Descending hill made by Cardiff conglomerate
- 44.0 Robert Fulton Tea House. Bear right on Route 222.
- 44.3 Unicorn crossroads. Boundary between Peters Creek schist (south) and Wissahickon schist (north) is drawn through here.
- 45.3 Bear right at Mechanics Grove
- 48.6 At Faith Orthodox Church - excellent view ahead of valley underlain by Conestoga limestone and Mine Ridge in the distance. Now descending hill and leaving the Wissahickon schist, crossing the "Martic overthrust".
- 49.2 Quarryville. Turn right at STOP sign on Route 372.
- 49.7 Crossing railroad bridge. Heading eastward along Conestoga limestone valley. Wissahickon schist forms the high "Front" of hills to the south. Mine Ridge anticline is to the north and the adjacent ridge is made by the tough Chickies quartzite located on the steeply dipping southern limb of the large structure.
- 51.8 Valley through the ridge to the north at this point "follows" a fault. The ridge is offset about 250 feet - east side moved south.

Miles

- 53.6 Turn left on dirt road. Immediately cross Harpers phyllite. Then climb ridge of Chickies quartzite.
Note white sand in road.
- 54.0 Crop of Hellam conglomerate both sides.
- View from here to the north shows the central part of Mine Ridge Anticline as a lowland. This is underlain by igneous and metamorphic crystalline rocks that are essentially undifferentiated. The ridge in the far distance compares with this ridge and is made by north-dipping Harpers phyllite and Chickies quartzite on the north flank of the anticline. The major and minor fold axes plunge toward the west.
- 54.2 Turn right at dirt crossroads
- Typical Amish farms along this road.
- 55.0 Turn right at "T" road. Note ridge ahead made by the Chickies quartzite.
- 55.4 GREENTREE QUARRY
- STOP III Arrive: 3:45 P.M. Leave: 4:15 P.M.
- The quarry is located in the Chickies quartzite. The Harpers phyllite crops out along the hillside to the south.
- Structural relations in the quarry are well displayed. Dips are to the south. A small unconformity is near the north wall. Lineation strikes East-West and plunges west. Drag folds well developed.
- Pegmatites cut the rock. Tourmaline is abundant and is oriented along the bedding planes. Garnets are abundant in the Harpers phyllite.
- 55.6 Turn left on macadam road, Route 372.
- The road is on Conestoga limestone.
- 56.3 Greentree Inn
- 56.4 Turn left at crossroads on Route 896. An excellent section is exposed along the right (east) side of the road. DRIVE SLOWLY to see:
- Garnetiferous
Harpers phyllite - Many drag folds
overturned to North

Miles

(56.5) Chickies quartzite - Scattered outcrops.
Massive quartz-schist
overturned to North.

(56.6) Hellam conglomerate - Stretched pebbles
overturned to North

(Excellent crop in field to west)

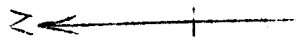
From observing this section, it is obvious that the south flank of the Mine Ridge anticline is locally overturned. At all places the dips are very steep. It is an asymmetric fold, having a rather gently dipping north flank. This structural pattern conforms generally with the structures of the rocks to the west and south of Mine Ridge that are involved in the "Martic overthrust" area.

- 57.4 Turn left on Route 896
- 57.8 Right turn at crossroads in Georgetown (Bart).
- 58.0 Bear right at "Y" road.
- 58.6 Diabase dike along road. Note residually weathered boulders.
- 58.8 Quartz vein in road cut to right
- 58.9 Diabase dike
- 59.4 Turn left on old road to Gap Nickel Mine.
- 59.6 GAP NICKEL MINE

STOP IV Arrive: 4:25 P.M. Leave: 5:15 P.M.

The Gap nickel mine is on Mine Ridge, about 12 miles south-east of Lancaster and three and one-half miles south of Kinzers on the Philadelphia division of the Pennsylvania Railroad. The nickel ore occurs in places along the border of a small gabbro mass that intrudes the early pre-Cambrian schists. Pyrrhotite and chalcopyrite with a small amount of pyrite make up the bulk of the metallic sulphides. The ore minerals are pentlandite, which is intergrown with pyrrhotite, and millerite. The millerite has been formed by downward enrichment of the primary sulphides.

The ore vein was vertical and from 4 to 30 feet wide. The mine is opened out on the vein in length by shafts and tunnels, about 2000 feet. The deepest point is 235 feet. There are 8 shafts ranging from 100 to 235 feet in depth and two or three others from 60 to 80 feet deep.



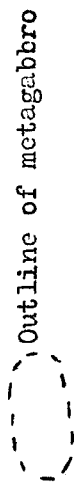
GEOLOGIC SKETCH MAP OF GAP NICKEL MINE AREA

(Mined-out and caved areas outline position of the old ore body fringing the metagabbro)

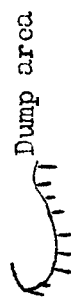
LEGEND



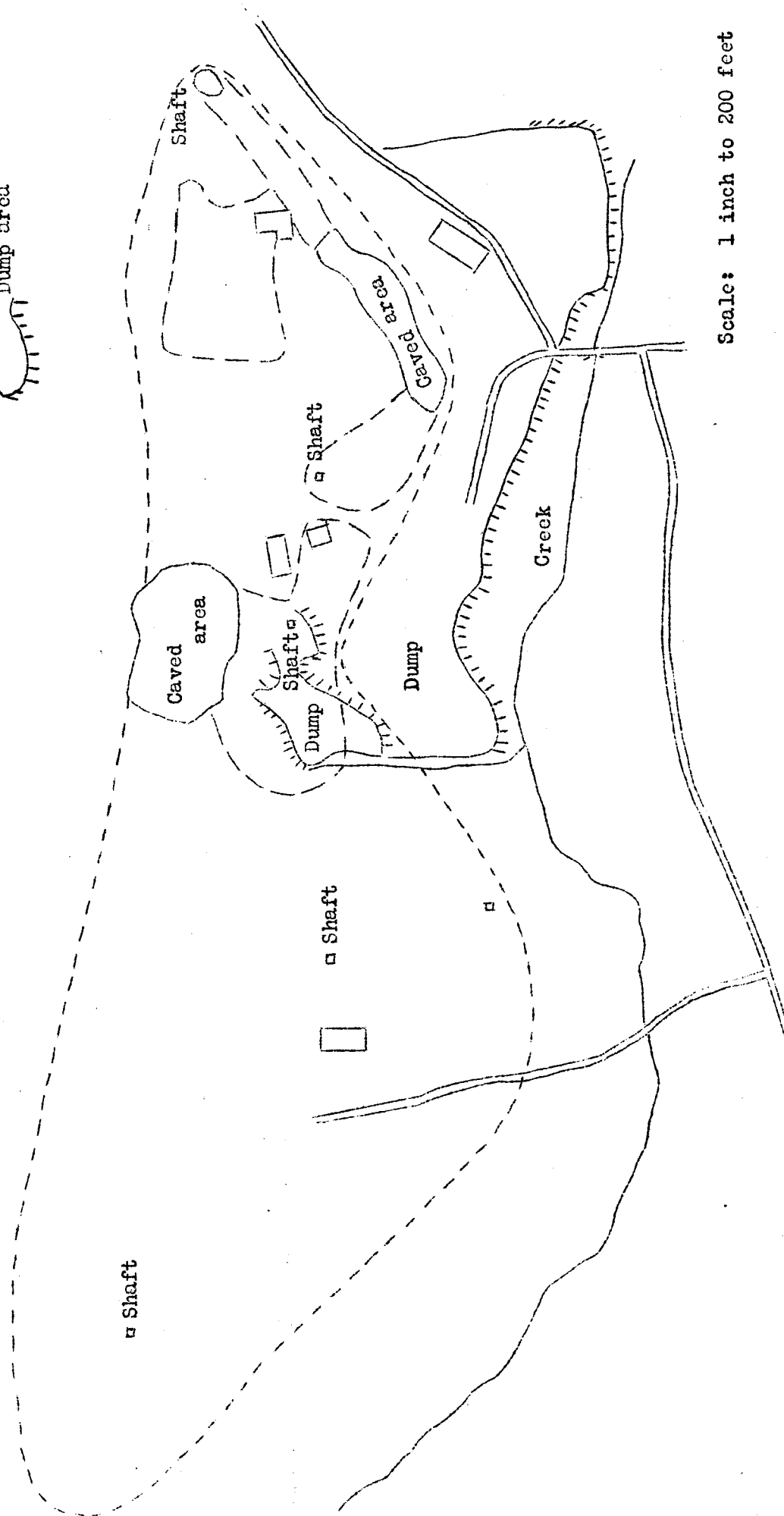
Mined-out area



Outline of metagabbro



Dump area



Scale: 1 inch to 200 feet

Miles

The presence of ore was noted apparently as early as 1718 in the copper-bearing waters of a mineral spring that issued from the ground at the place where the mine was afterward established. For 80 to 90 years the Gap mine was worked at intervals for copper, but the operations proved unsuccessful, and the mine had stood idle for about 30 years, when it was reopened in 1849, still as a copper-mining enterprise. At that time the nickel ore was being discarded on the dump as refuse, called by the miners "mundic", the Cornish word for pyrite. In 1852 a miner named Doble, who afterward became superintendent of the mine, suggested that some other mineral than mundic was present in the discarded material. An analysis by Genth finally showed the presence of nickel in the so-called mundic, and the Gap Mining Co. then devoted its attention to the mining of nickel ore. The ore was smelted in a preliminary way about a mile north of the mine. The operations were not financially successful until 1862, when the mine and smelter were purchased by a Philadelphian named Joseph A. Wharton, who established a nickel refinery, known as the American Nickel Works, in Camden, N. J., where the matte produced in the Gap smelter was refined and manufactured. The ore as it left the mines contained from 1 to 3 percent of nickel.

In 1877 the average annual production of the Gap mine was estimated at 7,200 short tons of ore, carrying from 1 to 3 percent of nickel. At that time the largest producer of nickel in the world was Norway, whose maximum annual output in 1876 was 42,500 tons of ore, or 360 tons of nickel. The Gap mine at this time produced about one-sixth of the total annual nickel output of the world. But in 1877, when New Caledonia exported 8,000 tons of ore averaging from 8 to 10 percent of nickel, the Pennsylvania nickel industry received a severe blow, and the advent of the Sudbury nickel ores in 1887 proved a death stroke to the Gap mine, which was closed in 1893.

Minerals that can still be collected include:

Chalcopyrite, Pentlandite, Pyrrhotite (nickeliforous)
Pyrite, Marcasite
Millerite
Violearite, Malachite

The best collecting is along the base of the dump at the western end of the dump area.

- 59.9 Return to macadam road. Turn left.
- 60.0 Nickel Mines crossroads. Straight ahead.

Miles

- 60.5 Straight ahead on old cinder road
- 60.6 Crop of Hellam conglomerate on right.
- 60.8 SLAG DUMPS

STOP V Arrive: 5:20 P.M. Leave 5:40 P.M.

When the ore was smelted here, the slag was poured into elongate kettles and transported to this place where the kettles were dumped. The slag has the shape of the old kettles. Note the flow structures on the slag. In all probability the slag at the bottoms of the piles has a high nickel content, for the ores were worked for copper alone for 80 to 90 years.

- 61.1 Return to macadam road. Turn left
- 62.2 Turn left. Diabase dike along road here.
- Route is along this dike for about one mile. Now descending hill that is held up by Chickies quartzite on the north flank of Mine Ridge anticline.

- 63.4 STOP sign. Straight ahead. Now in limestone.
- 64.5 Lincoln Highway at Kinzers. Turn left.
- 64.8 Slaymaker Quarry in Vintage dolomite on right.

From here to Lancaster the route is mainly along the floor of the Lancaster Valley, underlain by Ledger dolomite and Conestoga limestone. Hills to the right and left are underlain mainly by Kinzers shale.

- 74.6 Witmer Bridge over Conestoga Creek at east end of Lancaster.
- 75.7 Turn right and in one block turn left and follow Route 30 (Orange Street) through the center of Lancaster.
- 77.3 Bear right on Marietta Avenue, Route 340.
- 77.5 Turn right at traffic light on College Avenue.
- 77.9 FRANKLIN and MARSHALL COLLEGE

Arrive: 6:15 P.M.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Franklin and Marshall College

Lancaster, Pennsylvania

SATURDAY, MAY 28

EXCURSION 2: "Martic Overthrust" Area

Departure: 8:00 A.M. Sharp

Leaders: Ernst Cloos, The Johns Hopkins University
Randolph Chapman, The Johns Hopkins University

Topographic Maps: Lancaster Quadrangle
Quarryville Quadrangle
McCalls Ferry Quadrangle

References: Knopf, E.B. and Jonas, A.I., Geology of the
McCalls Ferry-Quarryville District, Pa.:
U.S.G.S. Bull. 799, 1929
Mackin, J.H., The problem of the Martic
overthrust and the age of the Glenarm Series
in southeastern Pennsylvania: Jour. Geol.,
vol. 43, no. 4, pp. 356-380, 1935.
Miller, B.L., Age of the schists of the South
Valley Hills, Penna.: Geol. Soc. Am. Bull.,
vol. 48, pp. 715-756, 1935.
Cloos, E. and Heitanen, A., Geology of the
"Martic overthrust" and the Glenarm Series
in Penna. and Md.: Geol. Soc. Am., Spec.
Paper no. 35, 207 pp., 1941.

INTRODUCTION

The Problem

In the Martic Hills, south of Lancaster, Pennsylvania, Wissahickon schist rests on Conestoga limestone, Vintago dolomite, and Antietam schist. Since the schist has been interpreted as pre-Cambrian, this superposition was thought of as a far-reaching thrust sheet--the Martic Overthrust--by Knopf and Jonas (1929).

B. L. Miller (1935) contested the idea and interpreted the schist as Martinsburg shale in normal position above the Conestoga limestone.

The lack of accurate information and the significance of the question for the age determination of the whole Glenarm Series to the south prompted the present author to remap the critical area at a larger scale. A new map and detailed analysis of the area has been published in 1941 (Cloos-Hietanen).

The results of the investigations are briefly summarized as follows:

The geologic map shows a five-fold repetition of the normal sequence with gently west-plunging or horizontal axes. The mica schist overlies the known Cambrian from Quarryville to Turkey Point at the Susquehanna River.

The repetition is thought to be due to thrusting from the South at an early stage since the thrusts parallel formational boundaries for long distances.

All secondary structures like cleavages and lineations transect or parallel the formational boundaries equally and are related to asymmetrical folding toward the south. Cleavage dips northward, folds are overturned southward (Pequea Creek, Safe Harbor quarry). Even the Mine Ridge anticline is a large asymmetrical fold with gentle north and vertical south limb.

It seems clear that several shorter thrusts accompany the proposed Martic Overthrust.

Age relations are not clear in the area. The Wissahickon schist is mostly identical with the Antietam or Harpers schists but for variable quantities of quartz veins or grain size. Metamorphism is not related to formations but to areas which seem to be determined by other factors. Metamorphic facies are superimposed over stratigraphic sequences.

The Wissahickon schist has recently been interpreted as Cambrian and not pre-Cambrian by Stose & Stose (1947) as had been suggested before. More precise age determinations are not possible without detailed work in the large terranes which are underlain by schist and its allied formations between the Lancaster area and the Potomac River.

Structural Details

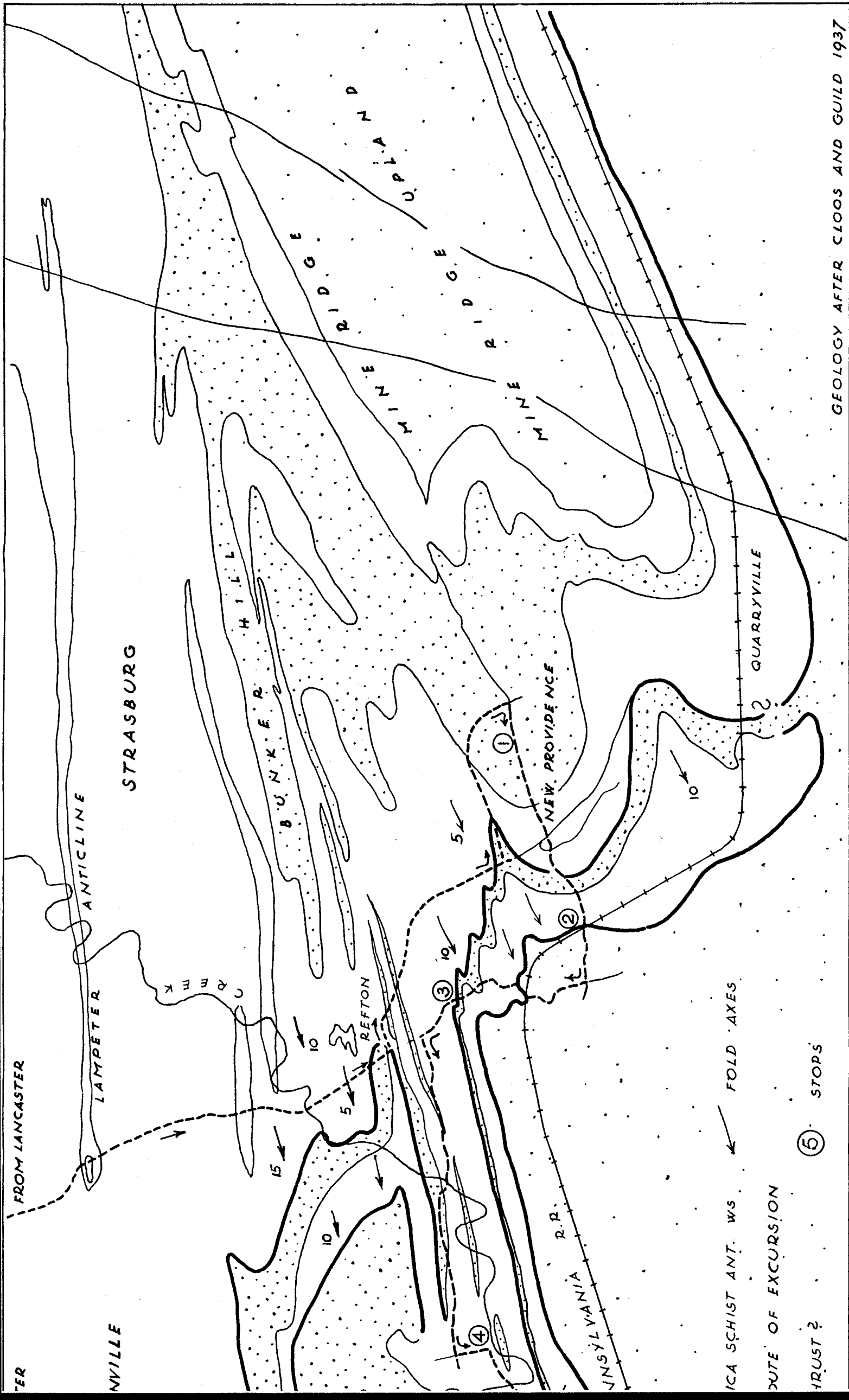
Detailed mapping of the area has shown that the normal sequence: Conestoga limestone, Vintage dolomite, Antietam schist (including Harpers) is repeated five times west of Mine Ridge anticline. Above the repeated sequence is Wissahickon schist to the west and south.

The structure pattern shows a series of westward plunging synclines intricately crinkled and modified. Axes plunge westward.

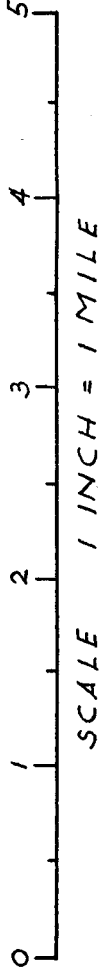
Antietam schist and Wissahickon schist are so similar that they can scarcely be separated on the basis of lithology alone. At Quarryville a layer of Antietam seems to join the Wissahickon complex.

Repetition of the sequence is thought to be due to thrusting prior to folding and formation of cleavage.

All folds are overturned or asymmetrical southward, cleavage dips to the north.

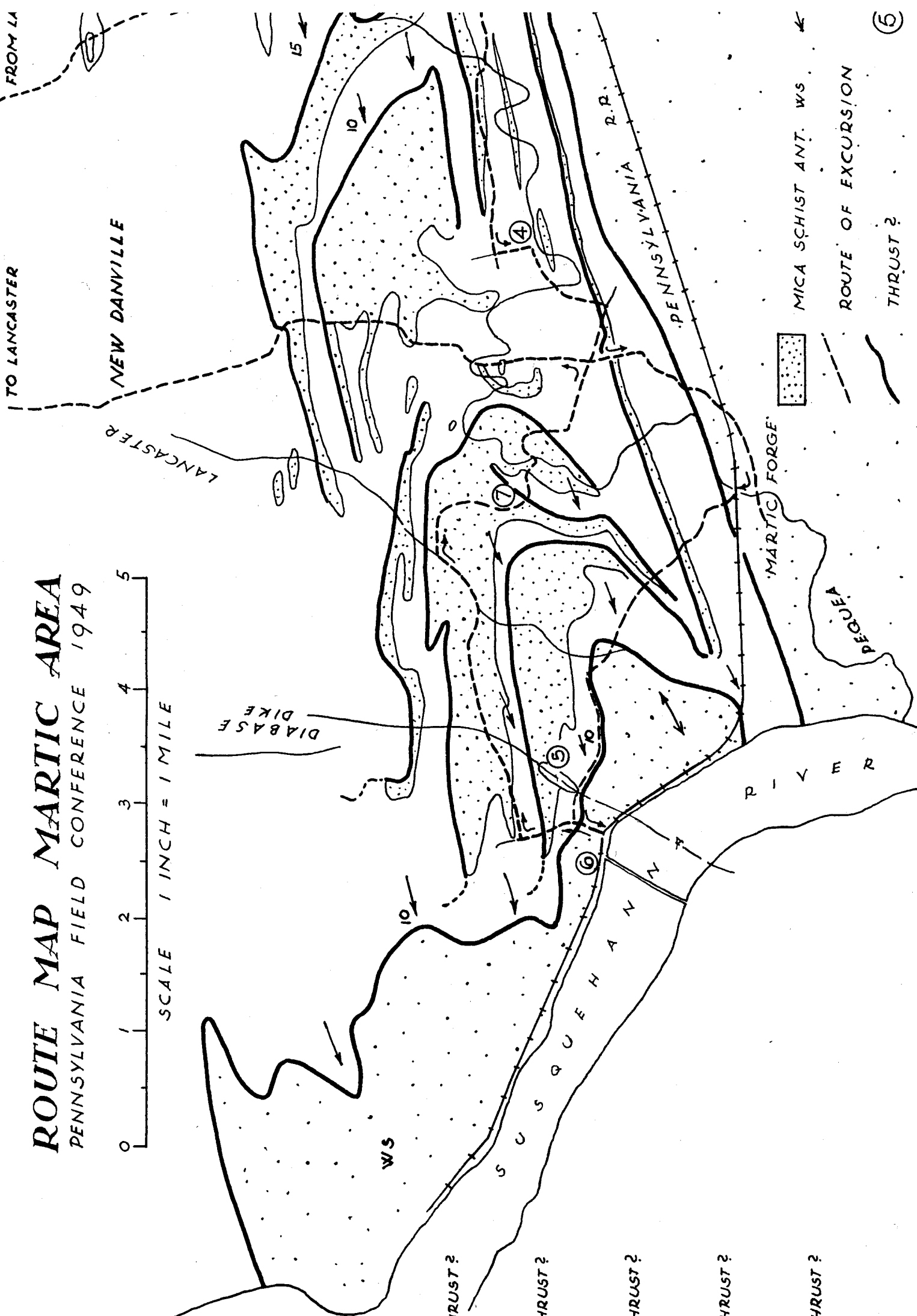


ROUTE MAP MARTIC AREA PENNSYLVANIA FIELD CONFERENCE 1949



SEQUENCE FROM
W TO E

- WISSAHICKON SC. — THRUST?
- CONESTOGA LS.
VINTAGE DOL.
ANTIETAM SC. — THRUST?
- CONESTOGA LS.
VINTAGE DOL.
ANTIETAM SC. — THRUST?
- CONESTOGA LS.
VINTAGE DOL.
ANTIETAM SC. — THRUST?
- CONESTOGA LS.
VINTAGE DOL.
ANTIETAM SC. — THRUST?



Detailed Itinerary

Miles

- 0.0 Heading South on College Avenue in front of Stahr Hall, Franklin and Marshall College Campus.
- 0.2 Turn right on Buchanan Avenue
- 0.4 Turn left on N. West End Avenue
- 0.8 Cross Lincoln Highway. STOP sign. Caution
- 1.4 Turn left on Manor Street
- 1.7 Turn right on Fairview Avenue
- 2.4 Bear right at "Y" road
- 2.8 Turn right on S. Prince Street, Route 72
- 2.9 Bridge over Conestoga Creek
- 3.5 Media Heights Golf Club on left
- 4.7 Conestoga limestone, the bedrock for all of the Lancaster Valley, crops out on left. Note drag folds and veins of calcite and quartz. This is typical of the Conestoga.
- 6.0 Mylin's Corners. Turn left. View of Lancaster Valley behind.
- 7.2 Big Spring on right. Flow 50 gallons per minute.
- 7.5 Crossing ridge of Antietam schist in center of Lampeter anticlinal axis, which plunges westward and extends from the Mine Ridge area.
- 8.6 Crossroads. View ahead of ridges made by Antietam schist "standing above" the valleys underlain by Conestoga limestone.
- 9.3 Road to right. Now crossing small band of Vintage dolomite in anticlinal axis.
- 10.0 Valley of Pequea Creek. Cluffed slopes along Pequea Creek to right are made by Antietam schist. Refton cave is situated on the bluff along the creek a quarter mile from this point. The cave is developed in Conestoga limestone with a roof of Antietam schist.
- 11.1 At sign "Refton", crossing prominent ridge of Antietam schist which is part of one of the large thrust sheets.
- 11.2 Turn hard left at Refton. This turn is in Conestoga limestone between two ridges of Antietam schist.

Miles

- 11.8 Crossing Antietam schist ridge split by Vintage dolomite in middle.
- 12.4 Crop of Conestoga schistose limestone.
- 12.6 Martinsville (Hessdale) in valley
- 13.2 Beaver Creek on right. Angle turn to left on to macadam road.
- 13.3 High hills on right of Beaver Creek are underlain by Antietam schist.
- 13.5 Zion Evangelical and Reformed Church. Turn left. Climbing ridge of Antietam schist.
- 13.8 Descending into small valley underlain by Conestoga limestone. Note large crop in field to right. Westward plunging nose of Mine Ridge straight ahead.
- 14.2 Quarry in schistose Conestoga limestone on right
- 14.5 Climbing Mine Ridge. Winter Hill School on right. Driving over Conestoga limestone. Antietam schist crops out on steep slopes to right.
- 14.7 Right turn. Immediately climb steep slope of Antietam schist toward axis of Mine Ridge anticline.
- 15.4 Right turn on to dirt road. Driving westward along the plunging axis.
- 15.5 STOP I Arrive: 8:30 A.M. Leave: 8:55 A.M.
- Top of hill one and one-half miles east of New Providence on road to Mine Ridge. General view of region. Hills in distance are Wissahickon schist, valley is underlain by limestone, we are standing on Antietam schist.
- The slope in foreground is approximately the axial plunge. Axes plunge westward under schist.
- To the northwest the broken up hilly area reflects the irregularity of structure.
- To the north is the Bunker Hill anticlinal axis; Antietam schist below Vintage dolomite.
- Proceed westward toward New Providence.
- 16.2 Excellent view westward from brink of Mine Ridge "Nose". Road leads through Antietam schist with many quartz veins.

Miles

- 16.6 Old lime kiln on right
- 16.8 Turn right on new concrete road. Turn left beyond Amoco station, cross bridge, turn left, and then right beyond Gulf station onto dirt road.
- 17.1 Underpass
- 17.2 Turn left near brick school on right
- 17.4 Pass through Antietam schist. Soil is sandy
- 17.5 Conestoga limestone on right dipping westward. The schistose limestone makes the highest hill here.
- 17.8 NEW PROVIDENCE RAILROAD CUT (Park cars on right.)

STOP II Arrive: 9:15 A.M. Leave: 10:15 A.M.

Take path at east end of bridge over R.R. and proceed into cut.

Profile in cut shows bluish, crinkled, highly micaceous Conestoga limestone in a few fresh areas, mostly weathered. Proceeding from south to north dip is north and mica schist rests on limestone. Axes plunge gently west and can be measured in many small drag folds in limestone and schist. To the north, dip of cleavage becomes gentle.

Between the 2nd and 3rd pole of power line a fault shows drag and brings up limestone (a bluish Conestoga shale) below schist.

At the 4th pole north of the bridge the limestone is below schist, dipping west.

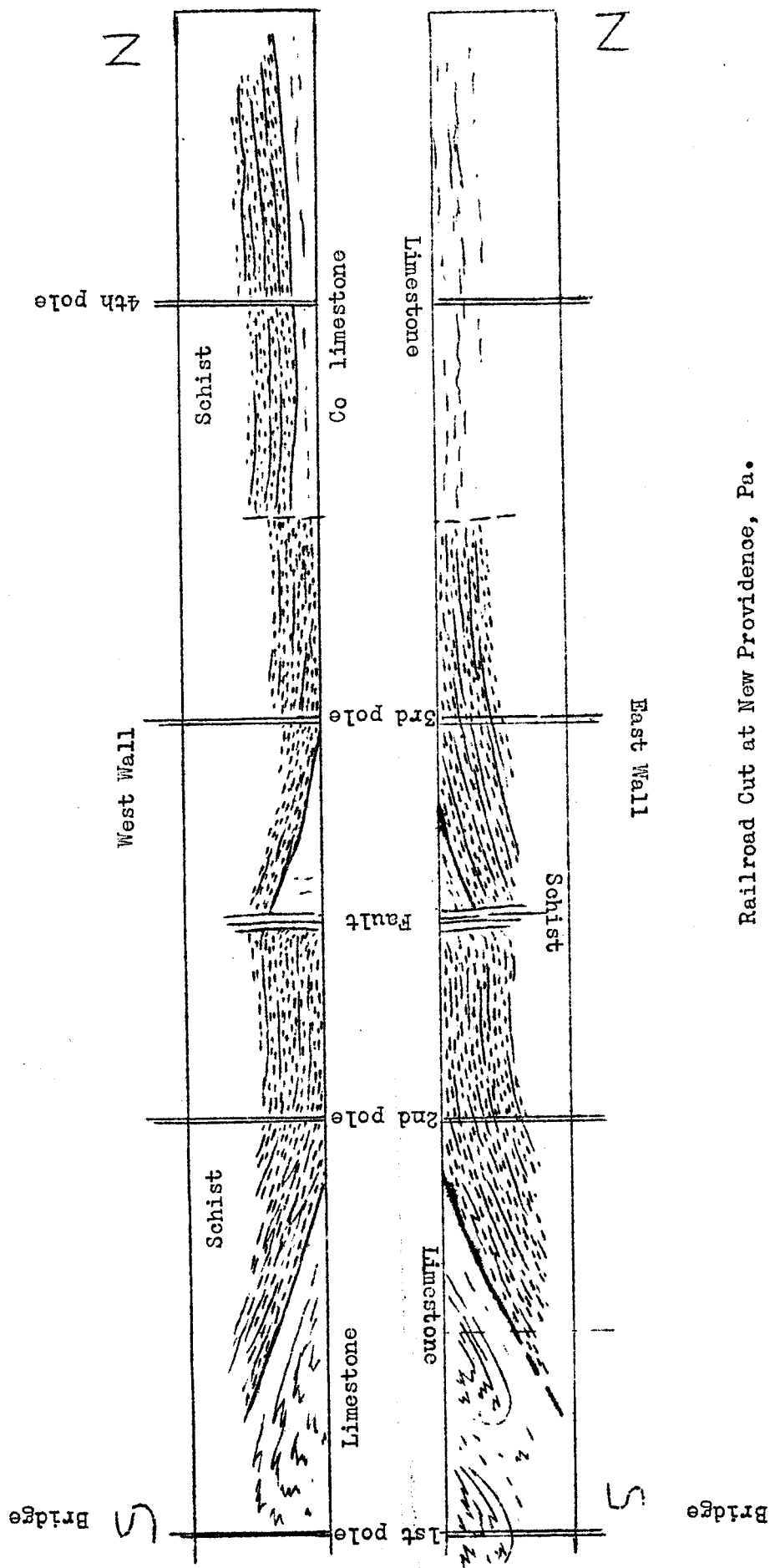
Limestone is highly micaceous and crumbly rich in calcite and quartz veins.

See special figure.

Proceed straight ahead on dirt road.

- 18.3 Wissahickon schist dipping west opposite farmhouse.
- 18.4 Turn right at cross roads.
- 18.9 Bear right at intersection. Gorge in schist on left.
- 19.0 Crop of schist on right with large quartz vein.
- 19.1 Underpass. Entering limestone valley.

Pennsylvania Field Conference



Railroad Cut at New Providence, Pa.

Milos

- 19.4 Bear right at intersection
- 19.6 Railroad crossing. To left (west) is limestone in valley and schist at top of hill. Fold axes plunge west under schist.
- 19.8 Railroad crossing. Topographic saddle to left front is limestone between Antietam schist to north and Wissahickon schist to south.
- 19.9 Cross Beaver Creek on iron bridge.
- 20.0 STOP III Arrive: 10:35 A.M. Leave: 11:00 A.M.
- Park on right just beyond farmhouse south of Refton on Beaver Creek.
- First layer of Antietam schist below Conestoga limestone, Vintage missing as everywhere toward the south.
- Mica schist with quartz veins.
- Fold axes, steep cleavage; resembles Wissahickon schist.
- From here a continuous ridge can be traced to Safe Harbor in the west and to Quarryville in the southeast.
- Proceed straight ahead on road.
- 20.3 Turn left (west) at crossroads.
- 20.8 Covered bridge.
- 20.9 Crossing ridge of Antietam schist.
- 21.2 Bear right onto dirt road near sharp curve.
- 21.3 In valley opposite farmhouse is Vintage dolomite in road.
- 21.6 New Smithville-Lancaster road cut. Turn right. Now road cut exposes Conestoga limestone to north, Vintage dolomite and Antietam schist to south.
- 21.8 Crossing Antietam ridge into valley of Conestoga limestone.
- 22.1 Turn left at crossroad. Large area of Vintage dolomite exposed here - curved around the high Antietam ridge to the west.
- 22.4 Crossing new Smithville road.
- 22.5 Entering fourth ridge of Antietam schist north of the Wissahickon schist. Note the valley of Conestoga limestone between this ridge and the third ridge (south).

Miles

- 22.6 Crop of Antietam schist on right.
- 22.7 Bear left at "Y" road. Entering limestone valley.
- 23.0 Turn left and climb third ridge of Antietam schist.
- 23.2 Crop of Antietam schist on right.
- 23.3 Turn right at crossroads. View to south of two more ridges of Antietam schist. Highest hills are Wissahickon schist.
- 24.1 Crossroads and church. Turn left (south)
- 24.4 Bridge across Pequea Creek. Turn right (west).
- 24.5 STOP IV Arrive: 11:25 A.M. Leave: 12:00
- Pequea quarry in Vintage dolomite and Conestoga limestone.
- Quarry north wall: light Vintage dolomite below Conestoga black shale. Bedding dips north.
- On west wall fold in Vintage with cleavage dipping north and overturned south. Note thickening of individual beds.
- Up the road to the west bedding almost obliterated transected by north-dipping cleavage shows asymmetry of fold toward the south. Valley south of road: Conestoga limestone, vertical or overturned.
- Hill to south, first ridge of Antietam, Wissahickon schist in distance.
- Proceed due west on road.
- 24.8 Covered bridge.
- 25.3 Crossroads in first ridge of Antietam schist. Turn right on paved road.
- 25.7 Village of Marticville. Turn sharply left (south) on Route 324.
- 26.1 Right angle turn followed by exposures of Conestoga limestone on right. Bedding vertical.
- 26.3 Old lime kiln and quarry on right.
- 26.6 Entering Wissahickon schist. Pond on right.
- 27.2 Proceed through underpass. Then keep straight ahead on Route 324.

Miles

- 28.0 Martie Forge. Cross bridge and turn right (north) on road to Safe Harbor. Wissahickon schist exposed on left.
- 28.2 Pennsylvania Railroad viaduct.
- 28.3 Vintage dolomite exposed in creek on right.
- 29.0 First ridge of Antietam schist. Follow road toward Safe Harbor.
- 29.3 Crossing ridge of Antietam schist.
- 30.1 Keep straight ahead toward Safe Harbor.
- 31.0 White church on right.
- 31.4 Hidden entrance to Safe Harbor quarry.
- 31.9 LUNCH STOP. SAFE HARBOR PICNIC GROUNDS
- 32.4 Entrance to Safe Harbor Quarry. Turn left into quarry.
- 32.8 SAFE HARBOR QUARRY

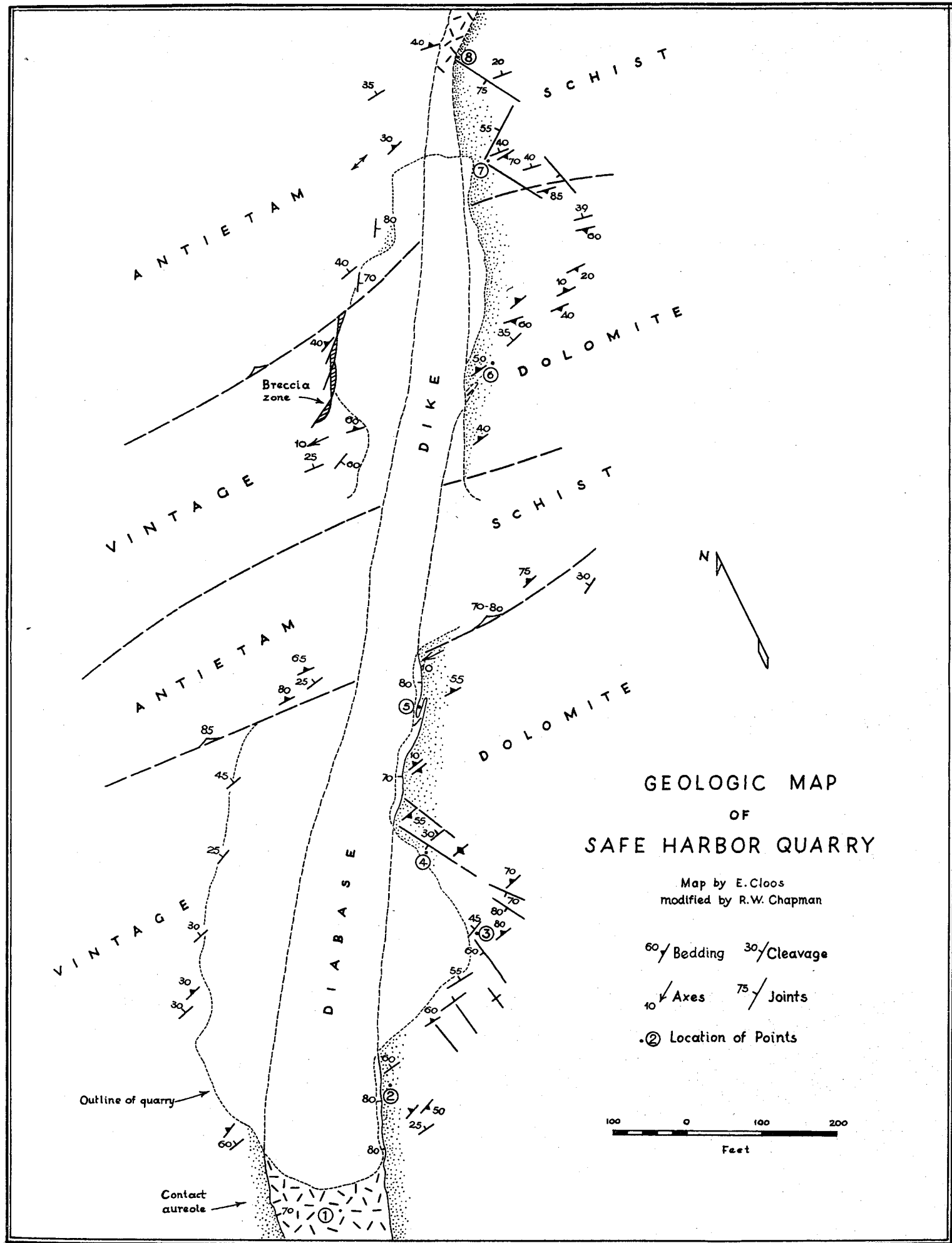
Arrive: 12:25 P.M. Leave: 1:10 P.M.

STOP V Arrive: 1:20 P.M. Leave: 3:15 P.M.

In this quarry a wide, nearly vertical, diabase dike trends northeast, cutting through highly folded Cambrian Antietam schist and Vintage dolomite. About 20 years ago the dike was quarried to supply rock for the building of the Safe Harbor dam, and the resulting steep-walled excavation affords a splendid opportunity to study both the structural features of the schist and dolomite and the contact metamorphic effects of the dike upon these rocks. Bedding, cleavage, folds, faults, and joints may be seen at many points. The contact metamorphic aureole, which is best exposed on the east side of the quarry, ranges from 15 to 65 feet wide and shows evidence of intense thermal metamorphism followed by hydrothermal alteration. These general relations are shown on the accompanying map.

Locality 1. Diabase dike. Note texture, mineral composition, jointing, and spheroidal weathering. The dike is about 160 feet wide here.

Locality 2. Contact-metamorphosed, Vintage dolomite with foliation dipping north. Intense thermal metamorphism converted the original dolomite to calcite and generated forsterite, tremolite, and diopside. Later hydrothermal alteration changed forsterite to antigorite and introduced magnetite and large quantities of talc. Compare this rock with the unaltered dolomite at Locality 3.



Milos

Locality 3. Unaltered Vintage dolomite with cleavage dipping north and bedding dipping south. A fold has been overturned to the south. Compare this rock, composed of dolomite, feldspar, quartz, and phlogopite, with the contact-metamorphosed Vintage dolomite at Locality 2.

Locality 4. Contact-metamorphosed Vintage dolomite. This rock is highly folded and sheared and the folds plunge southwest. This zone of shearing appears to have served as a channelway for hot solutions which have brought in a large amount of talc, some magnetite, and a little sphalerite.

Locality 5. Contact phase of diabase dike. Note fine grain, columnar jointing, and glassy selvages. Talc and serpentinite are present.

Locality 6. S-fold in Vintage dolomite overturned to the south. Cleavage dips north.

Locality 7. Unaltered Antietam schist showing good stratification (light and red bands) dipping south, and cleavage dipping north. This rock, containing quartz, plagioclase, muscovite, and biotite, should be compared with the contact-metamorphosed schist at Locality 6.

Locality 8. Contact-metamorphosed Antietam schist near the contact with the diabase dike. Intense thermal metamorphism recrystallized this schist near the contact to a hornfels consisting of orthoclase, plagioclase, cordierite, biotite and quartz. Later hydrothermal alteration has caused some rather significant effects. Compare this rock with the unaltered schist at Locality 7.

Return to highway.

33.2 Entrance to Safe Harbor quarry. Turn right toward Safe Harbor.

33.4 Turn left into power plant.

33.8 SAFE HARBOR RAILROAD CUT AND DAM. Park in parking area.

STOP VI Arrive: 3:25 P.M. Leave: 4:10 P.M.

Typical Wissahickon schist. Reddish bands are bedding with folds. Cleavage dips north. Fold axes horizontal or gently west plunging. Cleavage parallel bedding. A fracture cleavage transects in wrinkles and dips steeply. Quartz veins are abundant. Asymmetry is southward.

Proceed toward Safe Harbor.

Miles

- 34.4 Turn left (north) on main road.
- 34.6 Picnic Area
- 34.7 Turn right (east) on road to Conestoga, climbing up onto ridge of Antietam schist. Limestone valley to right.
- 36.9 Keep left at road intersection.
- 37.5 Turn right at road intersection.
- 38.3 EAST CONESTOGA. Final view of region.

STOP VII Arrive: 4:25 P.M. Leave: 4:55 P.M.

Valley in foreground is Conestoga limestone below Antietam which forms hill across valley. The valley trends east-west at its west end and swerves around to north-south and southwest to the left of Antietam Hill. Sequence is normal from observation point (Antietam) into the valley crossing Vintage and Conestoga limestone.

Axes plunge gently west and along the east side below the Antietam.

Observation point is on second Antietam Ridge. View south shows first ridge.

- 38.6 Turn left at "T" road.
- 38.9 Sickmans Mill on Pequea Creek. The Marticville Magnetite Mine is located a short distance downstream from the bridge. The Antietam schist is locally a magnetite-hornblende schist. The Safe Harbor Iron and Steel Co. attempted to mine the ore in 1912 and set up an elaborate mill. Quarries were opened in the ore, but little or none was ever milled and shipped. Large piles of the ore remain stacked near the openings.
- 39.2 Climbing steep hill that is the third ridge of Antietam schist.
- 40.2 Marticville. Turn left.
- 41.1 Crossing Pequea creek at Burnt Mills. Antietam schist in hills to left.

Pequea Silver Mine. One of the openings belonging to the old Pequea silver mines is visible just west of the bridge. These mines were worked as early as 1709. William Penn probably received royalties from some of the early mining. Sporadic mining finally ceased in

Miles

the early 1900's. Argentiferous galena bearing as much as 250 ounces of silver to the ton occurs in quartz veins that fill joints and follow bedding in the Vintage dolomite and Conestoga limestone.

- 41.2 Excellent exposure of Vintage dolomite on the right.
 The outcrop is a small anticline.
 - 41.7 Antietam schist lying on top of Conestoga limestone in
 road cut at curve.
 - 42.3 Bear left at "Y" road.
 - 42.5 Crossing the large fourth ridge of Antietam schist.
 - 42.7 Crossing limestone valley.
 - 42.8 Prominent crop of Antietam in the fifth and last ridge of
 schist.
 - 43.0 Entering the great Lancaster Valley underlain by Conestoga
 limestone.
 - 44.7 New Danville. Turn right.
 - 45.3 Large exposure of Conestoga limestone.
 - 45.5 Crossing Conestoga Creek.
 - 46.7 Old quarry in Conestoga limestone to left.
 - 47.3 Engleside underpass. Turn left on S. Prince Street.
 Continue on Prince Street through the center of town.
 - 49.0 Turn left on James Street. Straight ahead to Franklin
 and Marshall.
 - 49.5 FRANKLIN AND MARSHALL COLLEGE
- Arrive: 5:30 P.M.

FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

Franklin and Marshall College

Lancaster, Pennsylvania

SUNDAY, MAY 29

EXCURSION 3: Appalachian Drainage and Pleistocene Terraces

Departure: 8:45 A.M.

Leaders: Howard A. Meyerhoff, A.A.A.S. and Smith College
John H. Moss, Franklin and Marshall College
Richard M. Foose, Franklin and Marshall College

Topographic Maps: Lancaster Quadrangle
Middletown Quadrangle
New Cumberland Quadrangle

References: Meyerhoff, Howard A., and Olmsted, E.W., The
Origin of Appalachian drainage: Am. Jour.
Sci., vol. 32, pp. 21-42, 1936
Stose, G.W. and Jonas, A.I., Geology of The
Middletown Quadrangle, Pa.: U.S.G.S.
Bull. 840, 1933.
Stose, G.W., High gravels of Susquehanna River
above Columbia, Pa.: G.S.A. Bull. 39,
pp. 1073-1086, 1928.
Moss, J.H., Evidence for climatic origin of
lower Susquehanna river terraces at Highspire:
Proc. Penna. Acad. Sci., 1949.
Foose, R.M., Relationship of primary and
secondary structures on the anticline at
Chickies Rock, Pa.: Proc. Penna. Acad. Sci.,
pp. 122-126, 1948.

Detailed Itinerary

Miles

- 0.0 Heading South on College Avenue in front of Stahr Hall,
Franklin and Marshall College Campus.
- 0.4 Turn right on Marietta Avenue
- 1.9 Cross Little Conestoga Creek.
- 2.5 Typical topography developed on limestone bedrock.
- 3.0 Rohrerstown crossroads. Straight ahead.
- 3.3 Railroad bridge. Caution.
- 3.5 Hill to right underlain by Kinzers shale on flanks,
Antietam quartzite on crest.
- 4.1 Crossing ridge made by Kinzers and Antietam.
- 5.4 Hill of Chickies quartzite ahead to left.
- 5.8 Oyster Point quarry in weathered Chickies quartzite.
- 6.0 -
- 11.8 Road roughly parallels contact between Chickies quartzite
underlying hill on left and Conococheague limestone
underlying southwestern part of lowland on right.
Further northeast in lowland is Beekmantown limestone
and Martinsburg shale.
- 7.4 Village of Silver Spring
- 7.8 Entrance to Grubb Lake on left. This is a water-filled
open pit limonite mine, operated by the Chestnut Hill
Iron Mining Company till 1903.
- 10.4 Old limonite ore pit along road to left.
- 11.8 Turn left up Chickies Ridge.
- 12.4 Turn left at STOP sign. Caution. Excellent view over
Lancaster Valley to right.
- 12.6 Top of hill. Turn right.
- 12.9 CHICKIES RIDGE
- STOP I Arrive: 9:15 A.M. Leave: 10:35 A.M.
- Walk to Chickies Ridge (1/2 mile).
- Chickies rock is a single anticline in the Chickies
quartzite with minor folds on the major fold. The

Miles

axial plane strikes N.72°E., dips 70°SE. The fold plunges northeast at an angle of 15 to 25 degrees. Fracture cleavage is well developed.

Structure of Chickies Rock

Discussion of Appalachian Drainage. (Meyerhoff)

Terraces: Between Chickies Rock and Highspire the Susquehanna valley is lined by a series of river terraces marking higher levels at which the river once flowed. The lower terraces, and maybe the higher, are believed to have been produced by the climatic changes associated with Pleistocene glaciation.

13.1 Return to macadam road. Turn left and descend Chickies Hill on Route 441.

13.9 Crossing Chickies Creek. Faulted boundary between Chickies quartzite and Conococheague limestone.

14.2 Quarry in limestone on right.

14.8 Marietta. STOP sign. Caution.

15.4 -

15.9 Notice that road is located along terrace top with lower terrace to left and higher to right.

16.0 Turn right

16.4 Bear left on Route 441. Marietta Depot on left. High ridge across river is underlain by Chickies quartzite.

16.5 -

17.2 Several terraces are visible. Road climbs from 20-foot terrace to 60-foot terrace.

17.9 MARIETTA DEPOT

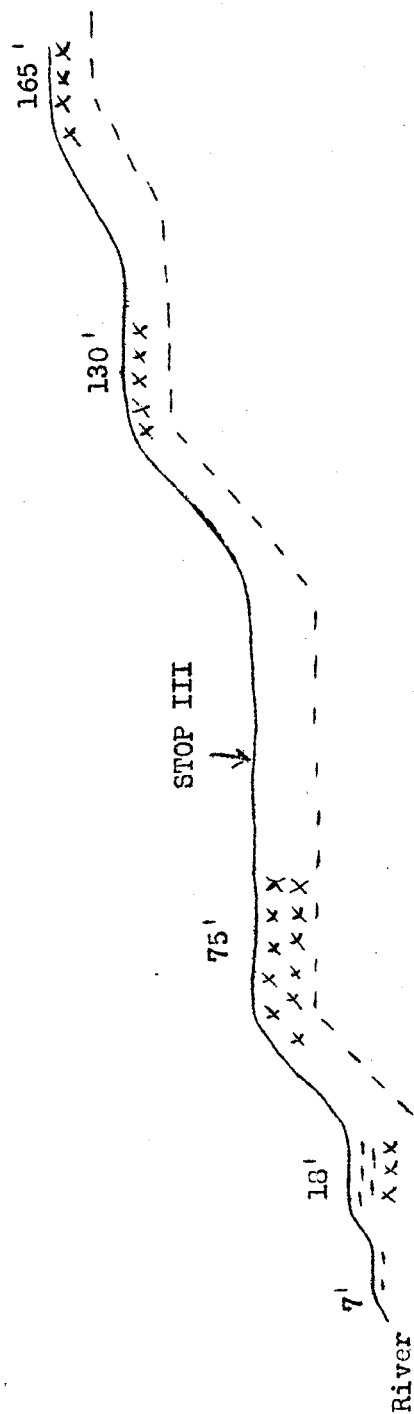
STOP II Arrive: 10:55 A.M. Leave: 11:15 A.M.

Three terraces are visible: a lower one about 20 feet above stream grade on which the ordinance plant is situated, a second about 60 feet above stream grade on which the road is situated, and a dissected higher terrace to right.

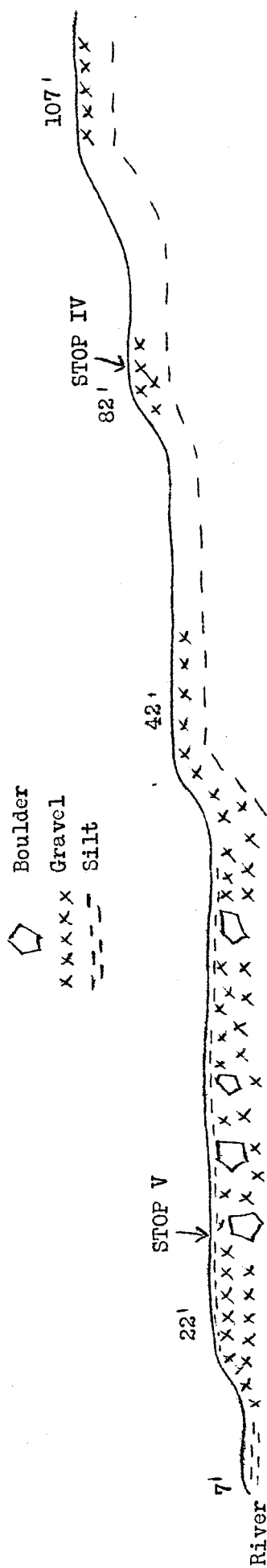
Proof that the river once flowed at these higher elevations is contained in the rounded gravels on the terrace.

Miles

- 18.0 -
20.6 Dissected remnants of the three terraces noted at Stop II, and an additional terrace 70 feet above stream grade can be noted in this section of the excursion.
- 21.2 Crossing small ridge made by Diabase dike.
- 21.5 Entrance to large dolomite quarry of J. E. Baker Co.
- 23.0 Bainbridge crossroads. Entering Triassic rocks.
- 24.4 SHOOPS FARM (Stay in cars!)
- STOP III Arrive: 11:30 A.M. Leave: 11:40 A.M.
- The road has been following the broad top of a terrace approximately 60 feet above stream grade. This terrace can be seen extending far up and down the river. The hill to the right is a higher terrace approximately 140 feet above present river level. It is a rock-cut terrace consisting of a gravel veneer on a bedrock step.
- 26.5 -
27.2 Continue along Route 441 to Middletown
- Large Triassic diabase sill or dike cuts Triassic red shales and sandstone of the New Oxford and Gettysburg members. Large potholes cut in the diabase in the Susquehanna River to the left.
- 30.5 -
31.0 The northern "sheet" of diabase crops out along here, making the high ridge to the right and the high, flat-topped island in the river to the left.
- 31.3 Cross Railroad tracks. Caution.
- 32.0 Cross Swatara Creek. Note coal dredging operations. Turn right and follow Route 441.
- 32.4 Turn left on Ann Street
- 32.8 Turn right at STOP sign.
- 32.9 Turn left on Route 230. Route 230 is located on terrace 20 feet above stream grade.
- 33.6 Turn right off Route 230 at Esso Gas Station.
- 34.7 JEDNOTA SCHOOL
- STOP IV Arrive: 12:05 P.M. Leave: 12:25 P.M.
- At this stop a flight of four terraces is visible.



Sketch of Terrace Profile at Shoops Farm



Sketch of Terrace Profile at Highspire

Scale
Horizontal 1" = 500'
Vertical 1" = 100'

Miles

The party will walk to the outer edge of a terrace standing about 80 feet above the river.

The gravel comprising the terrace is clearly visible. The top of the 40 foot terrace can be seen below in the foreground. The trees in the distance stand on the 20 foot terrace. A higher terrace 110 feet above the river level can be seen in the distance.

Proceed straight ahead

- 35.0 Turn left on dirt road.
- 35.5 Pit in the Highspire terrace on left.
- 35.6 Turn left on Route 230
- 35.9 HIGHSPIRE GRAVEL PIT

STOP V Arrive: 12:30 P.M. Leave: 1:30 P.M.

At this stop it will be possible to study the gravel and boulders comprising one of the lower terraces. The heterogeneous composition, including igneous materials, is striking. Results of studies on the size and shapes of the gravels will be presented. The large boulders are believed to have been ice rafted, which argues that the gravel fill was deposited during a glacial period and trenched during a succeeding interglacial or interstadial period.