STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

REPORT OF INVESTIGATIONS NO. 54

BEDROCK GEOLOGY OF THE GARRETTSVILLE QUADRANGLE

by

J. Osborn Fuller

COLUMBUS

1965

Bedrock Geology of the Garrettsville Quadrangle, Ohio

Ohio Division of Geological Survey Report of Investigations No. 54

ERRATA

Plate 1, Map (in pocket)

About 0.5 mile north of Welshfield, abandoned quarry symbol should be located east of the traction line instead of west of it, as shown.

Near location 8, 0.8 mile east of Nelson, abandoned quarry symbol should be located at the northeast corner of the intersection of the Nelson and Nelson Ledges roads, instead of south of the intersection, as shown.

Under Explanation - "Glacial pit" should read "Gravel pit."

Page 17, 5th paragraph, 13th line - "demands" should read "demand."

Page 18, 2nd line - "make" should read "makes."

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

REPORT OF INVESTIGATIONS NO. 54

BEDROCK GEOLOGY OF THE GARRETTSVILLE QUADRANGLE

by

J. Osborn Fuller

COLUMBUS
1965

Price $1.50 plus tax

Columbus Blank Book Company
Columbus 7, Ohio
1965
Bound by the State of Ohio

CONTENTS

ILLUSTRATIONS

Plates

CONTENTS

Figures

INTRODUCTION AND ACKNOWLEDGMENTS

This report on the bedrock geology of the Garrettsville quadrangle has a two-fold purpose. First, the text is written with a minimum of technical language so that the layman, with the aid of the illustrations, can learn about his region and especially about the economic potentialities of a specific property. The second purpose is to present new discoveries in the text and a detailed geologic map which make possible sophisticated interpretations by the geologist.

Work on the Garrettsville quadrangle started in 1941 but solutions to many problems did not result until after 13 summers of field work throughout northeastern Ohio. During this period Dr. Myron T. Sturgeon worked some of the Garrettsville quadrangle and the following field assistants also worked on the project: Dr. William M. Merrill, Dr. Charles N. Bowen and Mr. John J. Pedry. Numerous other geologists spent several days with the writer. Of these, Drs. George W. White and John D. Winslow made contributions to the present study. The detailed mapping, however, is the sole responsibility of the writer.

GENERAL SETTING

The Garrettsville quadrangle (pl. 1) lies in northeastern Ohio and Garrettsville, the principal town (pop. 1,662, 1960 census), is 33 miles southeast of Cleveland and 12 miles west-northwest of Warren. The population of the area is scattered in small towns less than five miles apart and on farms along the closely spaced network of roads. People gain their livelihood by farming, working in small businesses and industries in the region, and working outside the region in larger cities such as Cleveland, Ravenna and Warren.

The highest point in the area is a hill called Sugarloaf which is near the center of the quadrangle and which rises to just over 1,380 feet in elevation. The lowest point is found where the Grand River leaves the quadrangle at an elevation of about 852 feet. Maximum relief, is, therefore, about 530 feet.

The area covered by the quadrangle is part of the upland or Appalachian Plateau which constitutes eastern Ohio, western Pennsylvania, and western New York. The generally flat-lying beds of the plateau have been cut by stream erosion to form a rolling country whose relief has been reduced north of the glacial boundary principally by the filling of the valleys with glacial material. Deposition of glacial materials in the old valleys has disturbed the original drainage and made many lakes and swamps which are most abundant in Newbury township, in the northwestern part of the quadrangle. The uplands are covered with glacial deposits 10 to 20 feet thick which weather to make the relatively good soils of the region.

One of the prominent valleys of northeastern Ohio is the north-south trending Grand River valley. In the quadrangle, the western boundary of this valley is formed by an escarpment 100 to 170 feet high. This escarpment and the valley to the east are best seen from a point half a mile east of the town of Nelson (pl. 1, location 9) where, on a clear day, it is possible to look east across the broad Grand River valley and see, on the other side of the valley, an escarpment four miles away. At Nelson Ledges the escarpment rises 170 feet in less than half a mile. It is formed of two benches, the lower representing the Sharon Conglomerate and the upper the Massillon Sandstone, with a thin shale separating them. To the south, where the shale becomes thicker, the Massillon bench has been eroded back much further than the Sharon bench and the escarpment is not as prominent. To the north of Nelson Ledges, where the Sharon Conglomerate is thinner or absent, the escarpment is less distinct because it is formed in the less resistant Meadville and Massillon strata. The upland west of this escarpment is underlain by Pennsylvanian shales and sandstones. Rising from the lowland to the east of the escarpment are a few hills composed of the same kinds of rocks as found in the upland. Geologically these are called outliers. The most conspicuous one is Kennedy Ledge in Nelson Township.

The area covered by the Garrettsville quadrangle is topographically the highest land in the northeastern part of the state. This high land serves as a divide for three different drainage basins which are shown in figure 1. Rain falling near the crossroads elevation 1275 one mile south of the Sugarloaf (pl. 1) may go in three different directions. Rain falling west of the crossroads joins the main stream of the area, the Cuyahoga River, and flows southwestward to Akron and then northward to enter Lake Erie at Cleveland. Rain falling east of the crossroads flows east and then north and enters Lake Erie near Painesville via the Grand River. Rain falling south of the crossroads eventually flows into the Gulf of Mexico via Silver and Eagle Creeks and the Mahoning, Ohio and Mississippi Rivers. A small area in northwestern Newbury Township drains into the Chagrin River and thence into Lake Erie.

The valley shape and course of the Cuyahoga River are unusual enough to cause special mention. The headwaters of the Cuyahoga River are immediately to the north in the Chardon quadrangle. In its upper reaches the Cuyahoga River flows in a broad glacially filled valley with abundant swampy land along the main stream and its tributaries, many of which drain small glacial lakes. From Hiram Rapids until it leaves the map at the southwest corner it flows on or close to rock and has formed a narrow V-shaped valley, much in contrast to the broad valley of the upper reaches. Normally a river has a V-shaped valley near its headwaters and its valley widens downstream. The reversal of valley shape along the Cuyahoga River is the result of glacial action. The upper valley flows on a filled preglacial valley and a poorly drained glacial plain. Ice forced displacement of the stream in the southwestern part of the quadrangle onto the rock upland where it cut a V-shaped valley.

The unusual pattern of the Cuyahoga River and its tributaries (fig. 1) is the result of disruption of an older pattern by ice movement and ice deposits. Direction of most of the tributaries indicates that the former drainage was to the south. Effects of the ice produced the many barbed tributaries and the U-shaped pattern of the course of the main stream which originates 12 miles south of Lake Erie, flows south and then southwest for 40 miles to Akron where it turns northwest and flows 33 miles to Cleveland where it enters the lake just 30 miles west of its origin.

The streams of the Grand River basin in the quadrangle flow only a few miles on the upland before they tumble over the east-facing escarpment into the broad Grand River valley. Where these streams descend the escarpment, falls, rapids and gorges are found, and there are many scenic areas, the best known being the northern part of Nelson Ledges (fig. 2) and the Parkman Gorge (pl. 1, location 3). A similar pattern of short headwaters in the upland, gorges at the edge of the upland (fig. 3), a series of falls and rapids over the escarpment, and broad valleys below, is found along the streams of the Eagle Creek basin. South of Nelson Ledges, the escarpment swings southwest in a long reentrant up Eagle Creek. Eagle Creek crosses the lower bench of the escarpment in a falls at Garrettsville and its tributaries cross the upper bench of the escarpment in a series of falls or rapids (pl. 1, location 12).

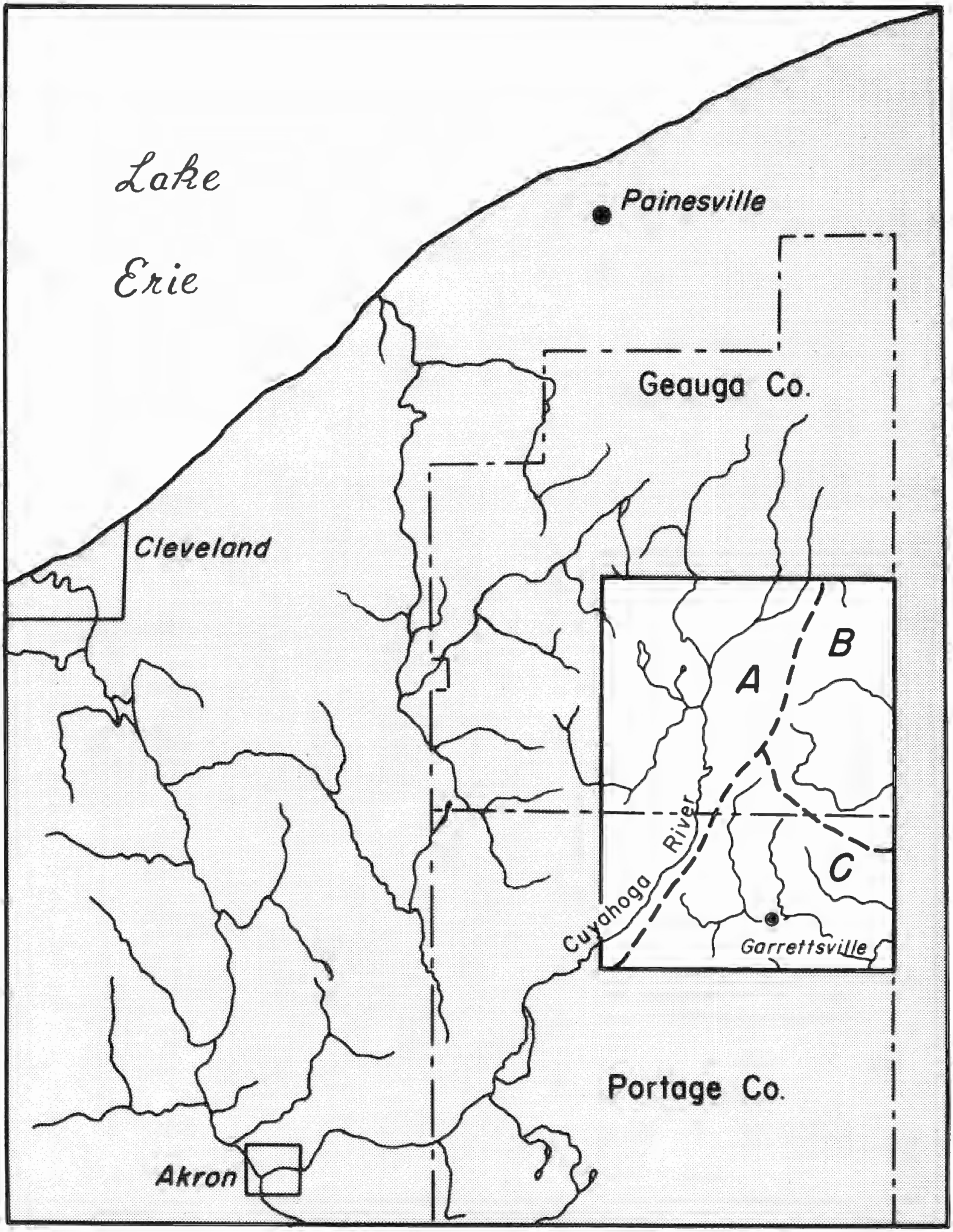


Figure 1. - Drainage basins of the Garrettsville quadrangle. A - Cuyahoga River drainage basin, B - Grand River drainage basin, C - Silver-Eagle Creek drainage basin.

Figure 2. - Cascade Falls over Sharon Conglomerate at Nelson Ledges State Park. Large blocks of conglomerate have separated along joint planes in this scenic area. Cave at base of falls is in Mississippian shale (Orangeville).

Figure 3. - Gorge in Sharon Conglomerate. Rock is sandstone phase of Sharon Conglomerate with a few pebble layers exposed along tributary to Eagle Creek at Camp Dussel near Garrettsville (pl. 1, locality 12).

AREAL GEOLOGY (STRATIGRAPHY)

Detailed descriptions of the ten mapped and six unmapped formations or members found on the Garrettsville quadrangle are given in the legend on the geologic map (pl. 1). The base of the escarpment and the country at the east in the Grand River valley are underlain by Mississippian rocks. Outcrops are rare except close to the escarpment because of thick glacial cover in the valley. The rocks above the base in both benches of the escarpment and the exposed rocks to the west are Pottsville units of Pennsylvanian age. Other than the good exposures along the escarpment most Pottsville outcrops are found along streams. The geologic map shows each observed outcrop and its extent. Future reference thereby is facilitated and the amount of visible control used in drawing the lines in any region is apparent. In addition to outcrops, data from over 400 water and oil well records on file in the Ohio Division of Geological Survey, the Ohio Division of Water, and the U. S. Geological Survey in Columbus were used to draw the geologic boundaries. In Newbury Township, where only three rock outcrops were found, the number of good water well records was large and therefore the contacts could be drawn with some certainty.

MISSISSIPPIAN SYSTEM

The lowest Mississippian bed exposed in this region, the Berea Sandstone, forms a uniform platform sloping gently to the south on which the overlying regularly bedded Mississippian shales and siltstones were deposited. In the northern one-third of the map area the Berea dips uniformly to the south 10 feet per mile. At the eastern side of the region, about one mile south of Bundysburg, well records indicate a reversal of this dip and a gentle arch persists to Kennedy Ledge where the southerly dip is resumed. Well records, admittedly poor, suggest that the dip from Kennedy Ledge south is not as regular as it is in the northern half of the area. In the southwestern part of the area wells are not drilled deep enough to give a clear picture of the structure of the Berea. More detailed descriptions of the Berea and its origin can be found in a paper by Pepper and others (1954).

The other four Mississippian units form a regularly bedded sequence of shales and siltstones (fig. 4) (pl. 1, location 4) overlying the Berea platform. Contacts between the various Mississippian rock units are gradational and, along with post-Mississippian erosion, account for rapid variation of thickness from section to section. If other Mississippian beds were deposited on top of the Meadville Shale in this region they have been completely eroded. In most of the area the Meadville Shale was eroded before deposition of Pennsylvanian beds and in the southern part of the area the Sharpsville Sandstone was also largely eroded.

EROSION SURFACE ON MISSISSIPPIAN BEDS

Outcrops in places show the contact rising sharply between the flat-lying Mississippian beds and the overlying Pennsylvanian beds (fig. 5) (pl. 1, location 5). This type of contact is called an unconformable contact by geologists. An example of how the unconformity shows up on a map is found just north of Nelson Ledges (pl. 1) north of where the picture (fig. 5) was taken. Northward from the quarry (pl. 1, location 5) the elevation of the contact (970 feet) is about the same as that seen in figure 5 for a distance of 0.2 mile. From this point the contact runs northwestward for 0.6 mile, cutting across the contours. On the road between elevations 967 and 1228 the Mississippian beds are in contact with the Massillon Sandstone and both the Sharon Conglomerate and Sharon Shale are absent. This represents the edge of a Mississippian upland and the difference in elevation on the surface is about 140 feet in less than a mile.

Figure 4. - Even-bedded Mississippian Shale (Orangeville) in Parkman Gorge (Plate 1, location 4).

Figure 5. - Contact (unconformity) between even-bedded Mississippian shale (Orangeville) and massive Sharon Conglomerate. Kaiser Aluminum and Chemical Co. quarry north of Nelson Ledges (plate 1, location 5).

Figure 6 is a contour map of the old erosion surface on the Mississippian beds. In the construction of the map existing elevations were corrected for dip. Corrections were related to the uniform dip (10 feet per mile to the south) of the underlying Berea Sandstone. The correction was achieved by arbitrarily picking an east-west line (shown on the map) to serve as an axis of rotation. All elevations to the north of this line were decreased in elevation proportional to the distance from this axis of rotation and all to the south increased similarly. Thus an elevation 2 miles north of the line would be corrected by the subtraction of 20 feet and an elevation 1. 5 miles south would be corrected by addition of 15 feet. Contours then were drawn using the corrected figures. The resulting elevations have no significance as to the height of land during any period at the end of erosion of the Mississippian beds or the beginning of the deposition of the Pennsylvanian beds, but the relief is believed to be approximately correct.

Completely eliminating the dip shown in the underlying Berea implies that when the Berea was tilted the Pennsylvanian beds were already deposited and they were tilted a like amount. There appears to be some justification for this assumption. As will be discussed shortly, the Sharon Conglomerate, the first Pennsylvanian deposit, is believed to be a delta deposit with a northerly source. For streams of the delta to flow to the south a southerly slope for the region had to exist. After correcting the elevations for a dip of ten feet per mile to the south, comparison of elevations of valley bottoms and ridge tops in the quadrangle indicate that they are higher in the northwest by approximately forty feet.

Elimination of the dip of the beds to the amount of 10 feet per mile implies that the Berea was horizontal when it was deposited. The work of Pepper and others (1954) shows that in this region the Berea was also a delta deposit with a northern source. Therefore, the surface on which it was deposited must also have had a southerly slope. How much of the present dip of 10 feet per mile is original slope and how much is later tilt it is impossible to determine with present knowledge. Considering the fact that the Sharon Conglomerate is coarser than the Berea Sandstone, the original slope of the surface on which the Berea was deposited was probably less than that on which the Sharon was deposited. Correction for the total dip of 10 feet per mile is not justified, yet any other figure selected would be arbitrary and therefore correction for the total amount has been made.

Two other sources of error suggest caution in accepting figure 6. One of these is the assumption that the top surface of the Berea was relatively flat after deposition. It appears certain that there was some relief on this surface but the relief is not believed to have been sufficient to have destroyed the gross aspects of the surface shape represented by the contours in figure 6. It is also assumed that the later tilting was uniform throughout the quadrangle and that no other folding affected the beds. The gentle arch south of Bundysburg to Kennedy Ledge and the less regular dip south of Kennedy Ledge have already been mentioned, but well records are so poor that the accuracy of the data is not certain.

In summary it is believed that in spite of these errors figure 6 gives a good approximation of the post-Mississippian--pre-Pennsylvanian erosion surface.

In addition to the general southerly slope of the erosion surface, examination of figure 6 shows that Mississippian highland runs northwest across the eastern part of the map. Only the slope at the western edge of this highland is shown because later erosion in the northeastern part of the quadrangle has removed the contact and eroded the formations well below the projected position of the contact. Along the slope the dropoff into the basin is steep. In the southeastern corner of the map it amounts to over 120 feet in about 1. 5 miles. The basin lying southwest of the upland shows two well-defined stream valleys flowing southwest from the highland and two others are suggested at the extreme corners of the map. These valleys create a southwestern flowing drainage pattern with V-shaped valleys. The streams apparently had falls or rapids where they came off the slope of the highland.

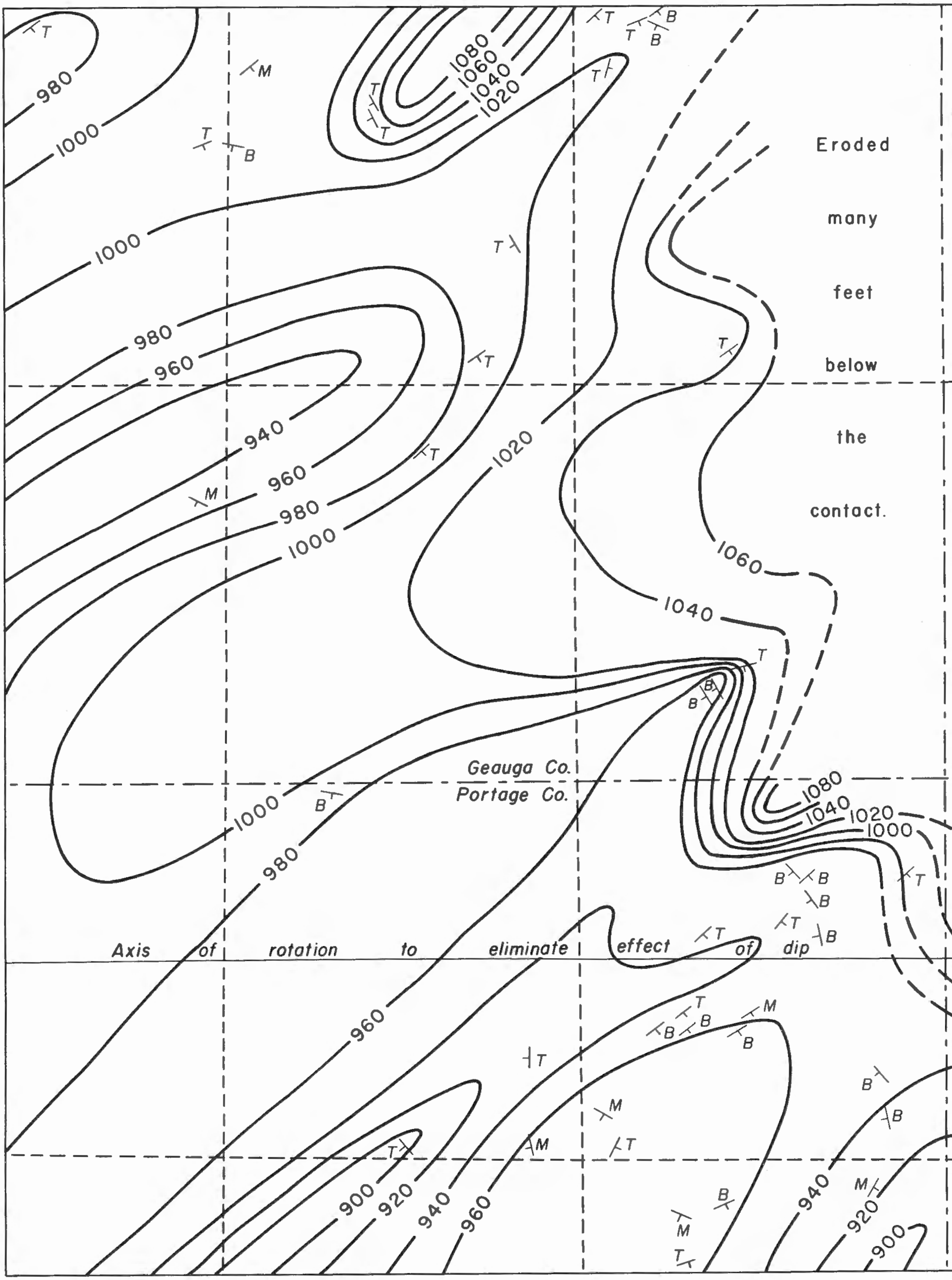


Figure 6. - Contour map of Mississippian-Pennsylvanian contact. Crossbedding strike and dip directions indicated were measured near top (T) middle (M) and bottom (B) of Sharon Conglomerate.

PENNSYLVANIAN SYSTEM

The Pennsylvanian Pottsville beds were deposited on the rolling erosion surface cut on Mississippian rocks. Pennsylvanian rocks differ markedly from the underlying Mississippian units. Detailed descriptions of the Pennsylvanian units are given in the legend on the geologic map. In general the differences are those found between marine beds and continental beds. The marine Mississippian beds are regularly bedded with ripple marks and marine fossils. Most of the formations are composed of silt- and mud-sized particles and the coarsest grained sediments are the few pebbles up to $\frac{1}{8}$ inch in size found in the Berea Sandstone. In contrast the Pennsylvanian beds are made of coarser grained sediments, dominantly sandstones and some conglomerates with pebbles up to four inches in size. Shales are less abundant and always silty. Plant remains are found commonly and some coal beds are present. Characteristically the beds are irregularly bedded and lenticular. A hill slope 1.5 miles south of Hiram displays an example of the lenticular character of the beds (pl. 1). Here the lenticules in the Sharon Shale are large enough to map.

HARRISON ORE

The variable nature of the Pennsylvanian beds warrants a more detailed discussion of the individual units. The lowest bed has been called the Harrison Ore. It is actually a contact phenomenon found at the base of whatever Pennsylvanian sandstone is in contact with the underlying Mississippian beds. The Harrison Ore results from downward percolating ground water which is stopped by the less pervious Mississippian beds and deposits its mineral matter as cementing material for the sand and pebble or produces concretions. Normally the iron is in the form of limonite or siderite but in some localities marcasite is found. The Harrison Ore has been mined but at present it is of no economic importance.

SHARON CONGLOMERATE

Overlying the Mississippian beds throughout most of the area is the Sharon Conglomerate with its basal iron-rich zone, the Harrison Ore. The Sharon Conglomerate is dominantly a pure friable sandstone (fig. 7), but in places it is a sandstone with scattered pebbles (fig. 8), and pebble layers (fig. 9). Thick conglomerate zones (fig. 10) which gave the formation its name are rare. Fuller (1955) described the Sharon Conglomerate as a deltaic sheet, spread in a post-Mississippian lowland. The characteristic deposit is a sand with scattered pebbles. At certain periods shifting rapid currents caused the winnowing out of the sand and left extensive layers of these pebbles called lag gravels (fig. 9). In certain localities channels eroded in the sand sheet and the rapid currents not only sorted out the sand but also brought in pebbles, many of which are coarser than those in the adjacent sand. This formed a conglomerate channel (fig. 11). Tracing of these channels, plotting of the dips of the crossbeds (Fuller, 1955), and study of the north-south variation in grain size, and chemical composition (Bowen, 1953) all indicate that the sediments of the Sharon Conglomerate had a northern source. This source was a sedimentary or metamorphosed sedimentary sequence, at least in part, as indicated by the high purity of sand (96 percent SiO_2), pebbles of sandstones, conglomerate, weathered limestones, and other features of the formation (Fuller, 1955). A clue to the age of source material was discovered when Devonian fossils were found as pebbles in the conglomerate (Fuller, 1950 a, 1950 b).

Figure 7. - Sharon Conglomerate (sandstone phase with scattered pebbles). Sandstone crossbedded. Hammer on shale lens in sandstone; another shale lens lies 6 inches higher. West end of Industrial Silica Corp. quarry (pl. 1, location 10).

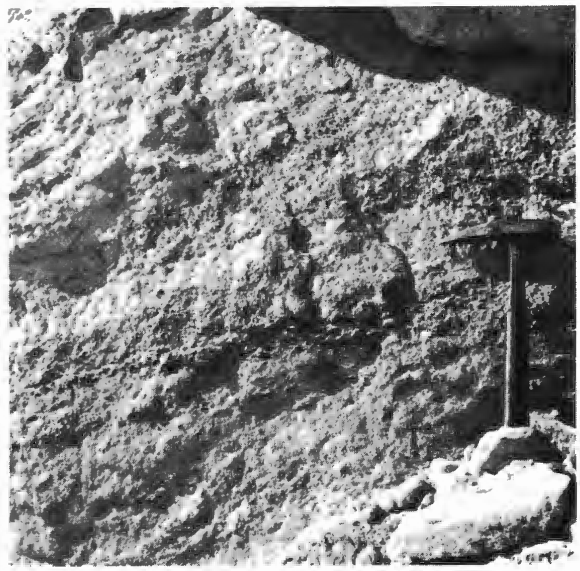


Figure 8. - Sharon Conglomerate (mixed phase). Central area of Industrial Silica Corp. quarry. In this part of the quarry the formation is a mixture of sandstone with abundant pebbles and conglomerate with sand matrix (see pl. 1, location 10).

Figure 9. - Sharon Conglomerate (sandstone phase with well defined lag gravel). Layer shows below top of the rule. Industrial Silica Corp. quarry (see pl. 1, location 10).

Figure 10. - Sharon Conglomerate (conglomerate phase). General Refractories Co. quarry (see pl. 1, location 8).

Figure 11. - Edge of conglomerate channel in Sharon Sandstone phase with scattered pebbles. Hammer head at basal contact of channel. Conglomerate phase becomes thicker to right of picture. General Refractories Co. quarry 0.8 mile east of Nelson (pl. 1, location 8).

Crossbedding. - The dip direction of the crossbedding is dominantly to the southeast. The range is from east-southeast to southwest. These readings indicate a northwestern source for the Sharon Conglomerate in the area. Considering the fact that the Sharon was deposited on a rolling surface which had well developed stream channels flowing southwest off the highland lying to the northeast, it is remarkable that the dip direction of the crossbedding is as consistent as the readings indicate. Furthermore, plotting of the readings on figure 6 indicates that generally the southwesterly dipping crossbedding occurs in the Sharon where stream valleys on the Mississippian-Pennsylvanian surface were well developed or where a steep hill was present. In areas which were relatively flat or near the top of the formation when the valley had been filled, the dip is to the southeast.

Thickness. - Figure 12 is an isopach map showing the thickness of the Sharon Conglomerate. As might be expected, there is a relationship between the thickness of the Sharon (fig. 12) and the topography of the Mississippian surface (fig. 6). The isopach map of the Sharon, because of less data, is not as detailed as figure 6 and contours are drawn on a 25-foot interval instead of a 20-foot interval. The thickness map of the Sharon reflects and confirms the map of the Mississippian-Pennsylvanian surface in three features. The first of these is the highland in the two northeastern townships.

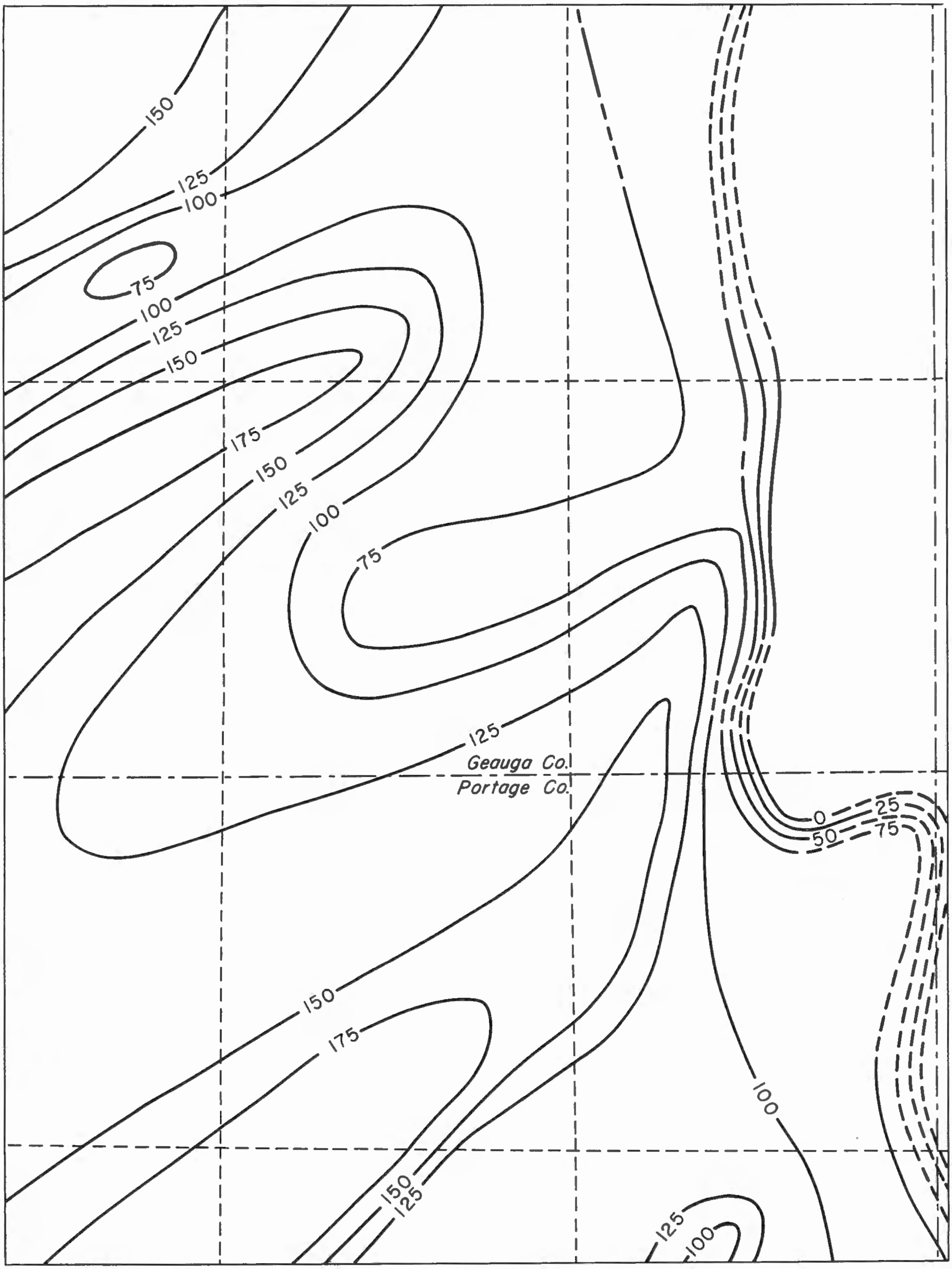


Figure 12. - Isopach map to show thickness of Sharon Conglomerate.

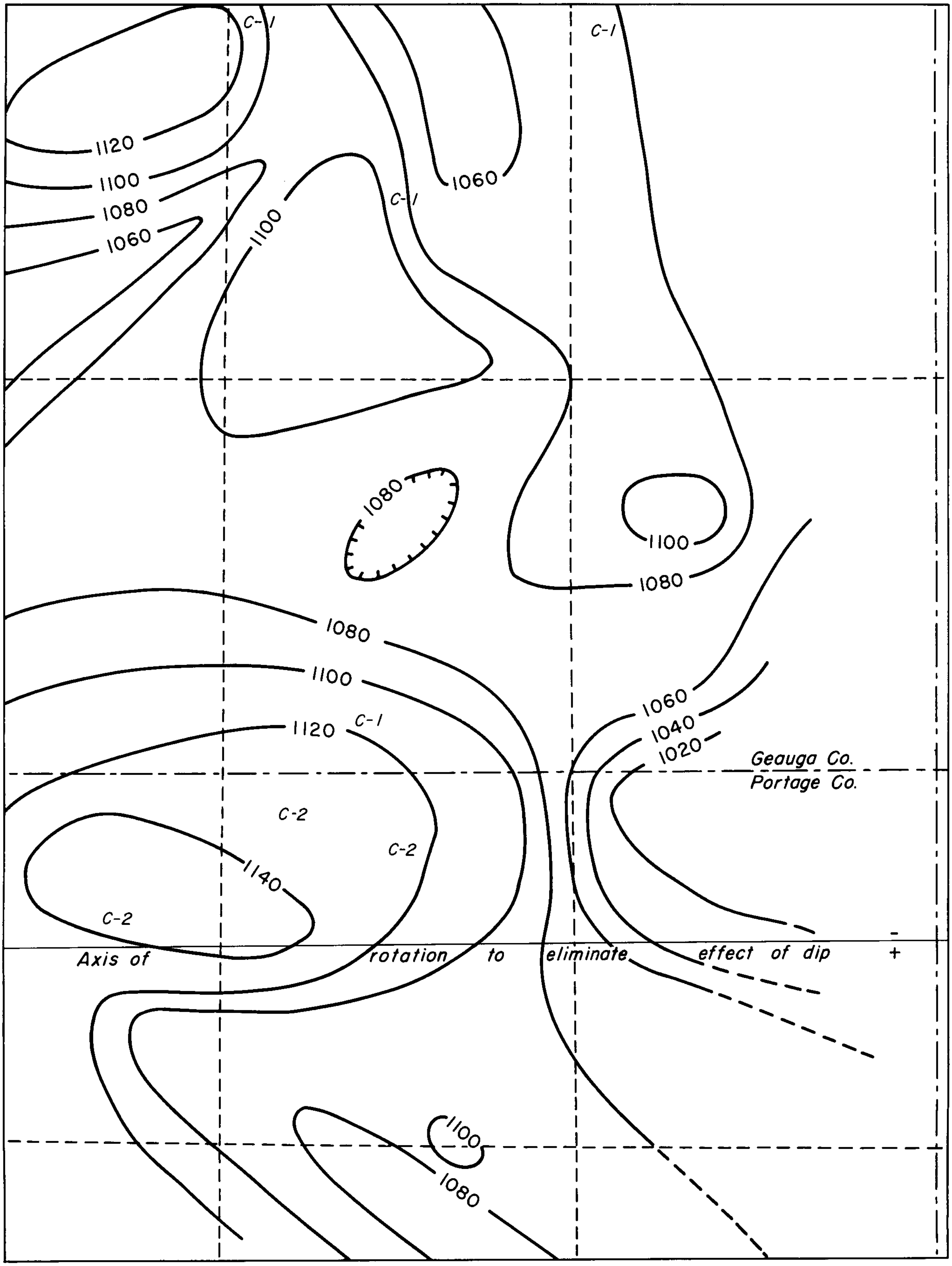


Figure 13. - Contour map on top of Sharon Conglomerate.

Sharon never was deposited on this highland, and Massillon Sandstone lies directly on the Mississippian in places in the eastern part of Parkman Township (pl. 1). Second, the thinner Sharon lying west of the highland in the center of the map reflects the higher land on the Mississippian-Pennsylvanian surface as shown on the contact map. Third, the thickest Sharon reflects the two deep valleys trending southwestward from the highland. In the basin, away from the edge of the highland, the Sharon ranges in thickness from about 60 to about 180 feet.

Top Surface of Sharon Conglomerate. - Figure 13 is a contour map on the top of the Sharon Conglomerate. Elevations were corrected as described for figure 6, before the contours were drawn. The map indicates that the top is not a flat plain but a rolling irregular surface with a maximum relief of about 50 feet. No pattern for the hills and lowlands is discernible. The southwest-trending valleys of the Mississippian-Pennsylvanian erosion surface have been completely masked. The Mississippian highland apparently still rose above this deltaic plain.

SHARON (NO. 1) COAL

The Sharon Coal, where present, lies just above the Sharon Conglomerate with a thin underclay separating coal and conglomerate. It is found in a few outcrops and wells. The locations of the principal occurrences are shown on figure 13 by a "C-1" symbol. Comparing the location of these symbols with the outcrops (pl. 1) it is apparent that a small coal basin was formed in the north-central part of the area and that later erosion removed all coal except on the edge of this basin.

SHARON SHALE

Above the Sharon Coal is the Sharon Shale. In some places the coal is absent and the Sharon Shale rests on the Sharon Conglomerate. This non-fossiliferous shale is regularly bedded and contains siltstone interbeds. In some localities the Sharon Shale grades laterally into a fine-grained pure sandstone which has the general appearance of a fine-grained Sharon-type sandstone. Also present in the shale are lenses of medium-grained sandstone which are much less pure and resemble the Massillon Sandstone. These lenses are referred to as Massillon-type sandstone and where large enough are shown on the map as Massillon lenses in the Sharon Shale (geologic map, pl. 1, 1.5 miles south of Hiram).

In some localities thin coal or carbonaceous streaks are found in the shale. These may represent the feather edges of mappable coals found further to the south but are more likely patches of thin local beds.

QUAKERTOWN (NO. 2) COAL

Near the top of the Sharon Shale, in thicker sections, is a thin unmappable coal which is considered to be the Quakertown or No. 2 Coal. Outcrops or well records in which this coal is found are plotted on figure 13 as "C-2". These locations are concentrated in the southwest area of the map. Because the Sharon Shale has been eroded throughout the area it is impossible to determine whether the Quakertown Coal extended beyond this southwest area or not.

MASSILLON SANDSTONE

Above the Sharon Shale is a massive sandstone in most of the area. Where the Sharon Shale has been eroded, the sandstone rests on the Sharon Conglomerate. The writer has called this sandstone the Massillon Sandstone because of its relative location in the stratigraphic column, but its direct correlation with the type Massillon at Massillon, Ohio is not implied. Winslow (1957) and others have called this sandstone the Connoquenessing, but correlation with the type Connoquenessing of Pennsylvania is equally or more uncertain. In the quadrangle, this sandstone has long been confused with the sandstone phase of the Sharon Conglomerate. Work by Fuller (1947, 1955) pointed out that the Massillon and the sandstone phase of the Sharon could be separated on the basis of crossbedding, degree of sorting, abundance of feldspar particles, and purity. These differences usually can be observed in the field where there is a sizeable outcrop and hand specimens can usually be identified.

In addition to the problem of separation of Sharon and Massillon there is a further problem of where to draw the base of the Massillon Sandstone when there are Massillon-type sandstone lenses in the Sharon Shale. This problem is best understood by reference to the geologic map (pl. 1) where the area 1. 5 miles south of Hiram is shown. If the basal contact were drawn at the base of the lowest Massillon-type sandstone the contact would be drawn at an elevation below 1100 feet, or approximately 100 feet lower than shown here. If, however, the lower lenses were not exposed, the contact would be drawn higher in the section depending on which lens was exposed. The thicker massive bed is more consistently exposed and therefore it is more practical to define the Massillon as the massive sandstone. Furthermore, the character of the contact suggests that this is a more logical base than the base of the lowest Massillon-type sandstone in the Sharon Shale. Characteristically the base of the thick massive bed cuts across the beds of the underlying shale to produce an unconformable contact similar to that between the Mississippian and Pennsylvanian beds.

Erosion of the Sharon Shale after deposition apparently cut channels in the shale and in places removed it completely. On the resulting surface the Massillon sand was spread as a delta deposit. The low areas filled first and then the shale hills were covered. Thicknesses of the Massillon are therefore variable, ranging from 15 feet over the shale hills to 100 feet in the old valleys. The Massillon Sandstone spreads further to the east than the Sharon with the result that for 3. 5 miles along the Mississippian-Pennsylvanian contact in Parkman Township the Massillon Sandstone lies directly on the Mississippian beds. In areas where erosion has removed all, or almost all, of the Sharon Shale, and the Massillon and Sharon are in direct contact, or a thin shale bed is present, the two units have been called Sharon in the literature. Separation is possible, however, and if a contact is visible the lowest Massillon usually is slightly coarser, carries coal fragments and is iron stained.

In contrast with streams of the Sharon delta which had a northwestern source the streams of the Massillon delta had a northeastern source (Fuller, 1955).

MERCER SHALE AND LOWER MERCER LIMESTONE

Above the Massillon Sandstone is a blue-gray shale which locally has interbedded fine-grained sandstones, siltstones, and coal beds. These beds may correlate with units found to the south which lie between the Massillon Sandstone and the Homewood Sandstone, but they are so poorly developed that identification is not possible in the area of the Garrettsville quadrangle. Apparently the quadrangle lies on the feather edge of deposition for this sequence and formations which are mappable to the south are very patchy and not identifiable here. One exception to this is a limestone found at two localities in the quadrangle. In an outcrop 1.3 miles southwest of Hiram Rapids a weathered cherty 9-inch-thick fossiliferous limestone is found with a thin coal and underclay beneath it. The limestone is apparently the Lower Mercer Limestone. Dr. George White (personal communication) reports another occurrence of the Lower Mercer Limestone in a section he measured in Hiram when the excavation was being made for a new field house in 1958. The Lower Mercer Limestone was present in the bottom of the excavation at an elevation of about 1217 feet. In the next quadrangle to the south, at Lime Ridge School, about 6.7 miles south of the Hiram Rapids outcrop, the Lower Mercer has been previously identified. Discovery of the Hiram Rapids outcrop (pl. 1, location 14) extends the northern limit of the Lower Mercer Limestone into the Garrettsville quadrangle, but the limestone is not mappable.

The Mercer Shale is mappable as a shale unit 60 to 70 feet thick lying above the Massillon Sandstone and below the Homewood Sandstone. In one area near the center of the quadrangle, where the Massillon Sandstone is missing, Mercer Shale lies on Sharon Shale and the base of the Mercer is drawn at the base of the Lower Mercer Limestone.

HOMEWOOD SANDSTONE

Capping the highest hills of the area is a sandstone identified for the first time by the writer as the Homewood Sandstone on the basis of its relation to the Lower Mercer Limestone. In the literature this sandstone has been considered part of the Sharon or Massillon units. In an unpublished paper by G. H. Colton (n. d.) this sandstone is recognized as a separate unit but is considered to be a local lens and no attempt is made to place it in the general geologic column.

Exposures of the Homewood Sandstone are very limited because of its location on hill tops and because it is very friable and breaks down rapidly into a sandy soil. Where exposed it is a white, crossbedded, channel-type sandstone. It is finer grained and more poorly sorted than the Massillon but in this area seems to have a greater purity than the Massillon.

Half a mile south of the quadrangle and one mile east of Shalersville, in the Ravenna quadrangle, outcrops exposed in building the Ohio Turnpike show that the Homewood Sandstone has an unconformable contact with the underlying Mercer Shale. The Homewood Sandstone is apparently a typical channel sandstone and it is believed that there is a similar contact with the Mercer Shale in the Garrettsville quadrangle, but the outcrops are too poor to observe the unconformable relationship.

If other beds were deposited on top of the Homewood Sandstone they are not now apparent. Evidence from other areas suggests the probability of some deposition and later erosion. A long interval of geologic time elapsed before the next deposits were laid down in Pleistocene (glacial) time.

The Pennsylvanian Pottsville beds have been described in sequence and the legend on the geologic map shows the complete section but it is important to reiterate that, as the descriptions of the individual units indicate, these beds show great variability. Variability in thickness is caused by several factors, including (1) relief of the original surface on which the first deposits were laid down and (2) erosion within in the Pottsville which cut out some of the shale deposits prior to deposition of the channel sands of the Massillon and Homewood Sandstones. Lateral change in the sediments from medium-grained sandstones to fine-grained sandstones and to shales is common. Thus erosion and lateral gradation produced the lenticular irregular beds so typical of the deltaic and nearshore deposits of lower Pennsylvanian time in which correlation with beds some distance away is hazardous but still attempted. As long as this lenticular character is understood the tentative correlations are serviceable. Examples of these variations are shown on the geologic map and in the cross-sections, but many more exist which are too limited in areal extent to be mapped.

QUATERNARY SYSTEM

This paper deals only with bedrock geology of the quadrangle. Because of their significance to the bedrock story and to the economic geology of the area, the approximate position of the deep valleys cut in glacial time is shown on the geologic map. They are now filled with sediments several hundreds of feet thick. On the uplands the till averages 10 to 15 feet thick and reaches a maximum of 50 feet in thickness. For more detail on the glacial deposits, the reader is referred to the reports by Baker (1957) and by Winslow (1957).

In recent time, the swamps are gradually being filled by sediment and organic debris, and along the streams alluvial deposits are being formed, but neither of these deposits is extensive enough nor valuable enough to warrant mapping.

ECONOMIC GEOLOGY

SHARON CONGLOMERATE

In the Garrettsville quadrangle the Sharon Conglomerate is and has been the most important formation from an economic standpoint. Formerly it was quarried for building stone for foundations and bridges. Many small long-abandoned quarries are found which were exploited for this purpose.

As the country became more highly industrialized the high silica content of the formation became important in the iron and steel industry. This area, lying midway between the iron and steel centers of Cleveland and Youngstown and served by a well integrated transportation network, became a good source of raw materials for silica brick, ferrosilicon, and molding sand. It still maintains an important position in these products and the Sharon, because of its high silica content, will continue to play an important part in an industrial society. The sandstone phase of the Sharon averages 97 percent SiO_2 and the conglomerate phase 98 percent SiO_2. Furthermore, the conglomerate and sandstone each has uses for which it is particularly suited and a well-situated operation can shift its product depending on the nature of the demand. This is possible because a quarry located on the conglomerate phase can continue along the trend of the channel if pebble is the desired product. If, however, the market demands shifts and sand becomes the desired product, the quarry operation can be extended across the channel axis through a mixture of sand and pebble and then into relatively pure sand. Obviously combinations of sand and pebble can be produced simultaneously. One such channel in the Garrettsville quadrangle extends from Nelson Ledges in Nelson Township south-southeast through Newels Ledge and into Windham Township. This channel belt is the location of all of the active or recently active quarries in the Sharon Conglomerate. The five largest quarries are located along this belt.

Beside the high silica content the Sharon has another very desirable property which makes it practical to work. It is very friable, that is, it breaks apart easily.

Some blocks can be reduced to a pile of sand or pebble by kicking and grinding with the heel of a field boot. The friable nature of the freshly quarried material make crushing easy and practically any kind of primary crusher can be used. However, because the fragments produced are quartz grains, often with secondary crystal faces which produce sharp cutting edges, the product is highly abrasive and this must be taken into account when selecting the crushing and grinding equipment. The sand grains and pebbles are slightly cemented by small amounts of clay, secondary silica, and iron oxide. Cementation is just enough to make a rock which requires blasting, but proper spacing of the holes will bring about good fragmentation. On the other hand, prolonged exposure causes the rock to harden (caseharden) and produces resistant ledges and stone suitable for building blocks. Locally circulating water will increase cementation, usually by iron oxide, and these reddish or brown resistant blocks normally are discarded in a quarry operation.

Preliminary crushing and grinding reduces the product mainly to the original grain size, that is, to pebble if the rock is a conglomerate and to sand if it is a sandstone. Further treatment depends on the end product desired. For almost all products washing and screening are normal next steps. Washing removes contaminants (surface material introduced during quarrying) and also some of the cementing material. Screening produces the size sand or pebble desired and gives a wider range of product. Dirt, silt, and clay are all easily removed. Iron oxide, which cements or stains the sand grains or pebbles, is more difficult to remove but scrubbing will remove some. Pebbles generally can be cleaned to bring the silica content up to 99 percent SiO_2. Sand treatment is more difficult and the results are more variable because of the greater amount of original cementing material present and the difficulty of obtaining complete separation with crushing.

Both the sand and pebble have the desired characteristics to make them industrial silica products of various types. Treatment which was originally quite simple is becoming more complex and is almost certain to increase in complexity as the consuming industries prescribe more rigid specifications. Fortunately the Sharon has the desired physical, mechanical and chemical properties to respond readily to more complex treatment and to yield products that will meet more rigid specifications. As a result it seems almost certain that utilization of the formation for industrial silica products will increase.

At present the operating quarries are producing foundry sand, pebble for ferrosilicon, pebble for refractory brick, and abrasive sand in minor quantities.

The five largest quarries located on or near the conglomerate belt trending southward from Nelson Ledges will be discussed briefly. They are active or have been active recently and potentially are the most logical locations for further activity. They will be discussed in order from north to south.

KAISER ALUMINUM AND CHEMICAL COMPANY QUARRY

At a location numbered 5 on the geologic map (pl. 1) is a quarry which has changed ownership several times. Its long history is not worth tracing for the purposes of this report. Relatively recently it was operated by the Niles Fire Brick Company which sold it to Mexico Refractories which in turn sold it to the Kaiser Aluminum and Chemical Company.

The operation is just south of the area where the old erosion surface rises sharply and the rolling surface of the unconformity between the Mississippian and Pennsylvanian beds shows clearly (fig. 5) (pl. 1, location 5). The contact and therefore the quarry floor is above the level of the Grand River valley to the east, and drainage from the quarry has exposed a good section of the Mississippian (Orangeville) beds below the quarry floor. These beds are blue-gray shales with interbedded siltstones. The siltstones are $\frac{1}{2}$ inch to 1 inch thick and are 6 inches to 1 foot apart. Because they are more resistant than the shale, they stand in relief in the outcrop. The whole sequence is stained with iron, mainly on the surface, because of a large flow of water from the Sharon Conglomerate at the contact. The pit floor is very irregular because of the irregular nature of the contact at this locality. The deepest part of the pit is in the southwest corner where the contact is 10 feet below that in the north part of the pit. The quarry face shows about 40 feet of conglomerate with a few more sandy beds.

Inspection of the geologic map (pl. 1) and figures 6 and 12 shows that extension of the quarry to the north would mean a rapid rise in the quarry floor and thinning of the conglomerate. Extension to the south, west, and especially to the southwest would mean a dropping of the quarry floor and an increase in thickness of the conglomerate. Because of the location of this quarry on the edge of the conglomerate channel, more problems related to the rolling Mississippian-Pennsylvanian contact are to be anticipated than in those quarries to the south. The most favorable directions of development of this quarry appear to be to the south and southwest. Problems with overburden and water flowage will always be greater than in the operations further south. The quarry has been operated for pebble.

HARBISON-WALKER REFRACTORIES COMPANY QUARRY

Just west of Nelson Ledges State Park the Harbison-Walker Refractories Company opened a pit in 1942 (pl. 1, location 7). Between 4 and 12 feet of glacial till was stripped off the conglomerate and a pit about 15 feet deep was opened. Drilling demonstrated a maximum thickness of 74 feet before the Mississippian (Orangeville) Shale was reached. After the first pit had been enlarged a second lower bench was developed about 25 feet deeper.

Pebbles generally range between $\frac{1}{8}$ and 1 inch in size with a fair number larger. The sand of the matrix is coarse. Along a few prominent joints ground water has circulated and deposited limonite, which locally decreases the high purity of the white conglomerate. If the rock is strongly discolored and solidly cemented these blocks are discarded.

In places the bottom beds are heavily iron stained. This suggests that in parts of the quarry the present floor is closer to the Mississippian shales than the drilled thickness of 74 feet would suggest. It is also notable that the lower ledge is more sandy than that in the first part of the original quarry. Carbon streaks are fairly abundant, some lenses of which are up to 3 feet long. A few shale lenses 6 feet in length and 2 to 4 feet in thickness are also found.

The writer believes that the present operations are not far from the Mississippian-Pennsylvanian contact and that the Sharon Conglomerate thickens going to the west. He thinks that the 74-foot maximum thickness found by drilling was west of the present operations, and that it is very likely that the lower part of the section of Sharon will be more sandy. He suspects that the conglomerate channel was caused by a stream flowing between the Mississippian highland to the east and the edge of the Sharon delta which had partly filled the basin to the west with a mixture of sand and pebbles.

The quarried product, after crushing, screening and washing, is used for the manufacture of silica brick.

GENERAL REFRACTORIES COMPANY QUARRY

In 1955 the General Refractories Company started a quarry at the northwest corner of the intersection of the Nelson and Nelson Ledges roads, 0.8 mile east of Nelson (pl. 1, location 8). The new pit is not very deep and the various quarry faces show different sections through the Sharon conglomerate. On the east and south face about 15 feet of conglomerate with a few sandstone lenses is exposed. The amount of sandstone increases toward the west. On the west face, 8 feet of sandstone is overlain by a channel of conglomerate (fig. 11) about 7 feet thick in which good crossbedding is developed. Above this is 5 feet of platy sandstone and then 5 feet of glacial cover. Along this face to the northeast the conglomerate channel cuts deeper into the underlying sandstone with a resultant increase in pebble content of the quarry face. The northeast face is all good conglomerate with pebbles up to $2\frac{1}{2}$ inches in size. In the north face about 20 feet of conglomerate is exposed and over it is a platy sandstone 3 to 5 feet thick. This sandstone has scattered pebbles in it and in some areas the pebbles are very abundant. The conglomerate of this face has pebbles averaging $\frac{1}{2}$ inch in size, with a grit matrix. There is evidence of Mississippian shale being dug out of the bottom of the pit and the contact to the east along the escarpment is at 950 feet elevation. The drill holes reportedly went down to shale in the quarry bottom, which suggests a rise in contact of 10 or more feet.

The exposure suggests that the southwestern part of this quarry is in the western edge of the conglomerate channel that runs south-southeast through Nelson Ledges. Therefore the relative proportion of sand to pebble would be expected to increase to the west beyond the edge of the channel. The center of the channel would appear to be in the eastern part of the quarry, extending eastward under the road. This is confirmed by the presence of a small abandoned quarry on the east side of the road in which the quarry face shows 10 to 12 feet of conglomerate with pebbles ranging from $\frac{1}{8}$ inch to 3 inches in size. The conglomerate in the abandoned quarry is overlain by a 2-foot bed of sandstone with scattered pebbles. Some areas of the rock in the General Refractories Company Quarry are highly iron stained and a pile of waste composed of these blocks is developing in the quarry.

The material quarried is used for making silica brick after washing and crushing. Originally only the coarser material was used but now a process is being developed which will permit usage of finer material.

INDUSTRIAL SILICA CORPORATION QUARRIES

Phalanx Quarry. - One mile south-southeast of Newels Ledge, in Nelson Township, the Industrial Silica Corporation has operated a quarry in the Sharon Conglomerate for many years (pl. 1, location 10). This is now a large pit. The principal product originally was pebble, but lesser amounts of sand were also sold. The quarry extended north-northwest following the conglomerate channel. When there was a greater demand for sand the western side of the quarry was used because of the higher sand content. After World War II an extensive shift in market took place. The pebble produced in this quarry is of smaller size than the pebble to the north; the demand for it fell off and the demand for sand increased. Drilling proved that the rock to the west was mostly sandstone and the quarry was extended to the west. Sand became the dominant product instead of pebble. Now the quarry is being extended to the west. As this proceeds the amount of pebble decreases.

As a result of this shift in quarrying objectives it is now possible to see a good cross section of a part of the ancient Sharon delta which contained one of the conglomerate channels. A more detailed description of the parts of the quarry and their relationship to the conglomerate channel follows. In the northeastern part of the quarry the conglomerate phase which formed in the central part of the channel is well exposed. A ditch cut to drain the quarry shows the relationship of the conglomerate to the underlying beds. The contact rises out of the quarry and the writer believes this rise represents the edge of the basin in which the Sharon delta was deposited. Below the contact are sandy shales which are not typical of the Mississippian Orangeville Shales which normally are found below the Sharon in this region. These shales are not as regularly bedded and are more silty than the Orangeville Shales. They contain abundant plant fragments and are believed by the writer to be Pennsylvanian but pre-Sharon in age. These shales may represent some of the fines washed out of the delta as it built forward into the sea or some of the material washed off the Mississippian highland to the east. The 10 to 12 feet of shales are so poorly exposed that an accurate determination of their origin is not readily possible.

On top of this material, and in unconformable relation to it, the conglomerate phase of the Sharon is found. The basal few inches of conglomerate is cemented with marcasite; this is the Harrison ore. Above this basal bed is a friable, coarse pebbly conglomerate with pebbles up to 2 inches in size but averaging less than $\frac{1}{4}$ inch in size. The pebbles lie against one another and only a small amount of finer material partly fills the interstices. The conglomerate is 20 feet thick near the eastern edge of this part of the quarry but increases to 40 feet in a horizontal extent of 50 feet. This thickness difference can be accounted for by later erosion. Crossbedding, which dips to the southwest, is present in the conglomerate. The beds of the conglomerate near the shale hill slope 2° to 4° to the east and abut against the hill.

The writer believes that this conglomerate is not the original deposit against this shale hill. He thinks that the basin to the west was filling with sand containing a few scattered pebbles and these sediments were being deposited from streams flowing southwest forming a delta in the pre-Sharon basin. As this basin filled, the shifting streams on the delta washed out the sand from this mixture of sand and pebble and concentrated the pebbles into channels. It is likely that one of the streams flowed along the edge of the delta between the delta and the Mississippian highland to the east to form the conglomerate belt that extends from Nelson Ledges south-southeastward through Newels Ledge. The 2° to 4° slope on the beds to the east is believed to be original slope of deposition for these beds.

Westward from the thick pebble concentration the amount of sand increases. No single large channel boundary is apparent; rather the change is gradational, with some small channel fillings in successive beds. Four hundred feet west of the shale hill pebbles still dominate the rock but they are larger and are found in a coarse sand matrix. Some pebble lenses are very coarse and some lenses are coarse sand.

Westward still further, near the east-west center of the quarry, the sand and pebble are equally mixed and a few sandstone beds appear. Crossbedding is very well developed. Sweeps of the crossbeds reach 10 feet in length. The sand of this part of the quarry averages 0.5 mm in size. Pebbles are generally smaller than to the east.

Westward from the central part of the quarry, pebble decreases and sand increases in amount and becomes slightly finer. Pebbles are found in a few layers with a coarse sand matrix, and a few lag gravels are present. Further to the west, in the newest part of the quarry, pebbles are rare and conglomerate layers have disappeared. At one place in the west end of the quarry, in the sandstone with scattered pebbles, a channel has developed, and in the channel is a steeply crossbedded fine-grained platy sandstone. At the extreme west end 8 shale lenses were observed 1 inch to 6 inches thick. The shale was blue gray and very silty. The change from conglomerate to sandstone takes place in a distance of 2000 feet.

At the eastern edge of the quarry the Sharon cropped out but as quarrying proceeds westward a thin glacial-till cover has to be removed which is 3 to 5 feet thick. When it is removed a glacially scratched and grooved surface is exposed.

At present the principal product of this quarry is molding sand. Five types are produced. Sand for sand blast and some dry molding sand also are produced.

South Phalanx Quarry. - With the shift in demand from pebble to sand the Industrial Silica Corporation, in addition to extending their old quarry to the west into the sandstone phase of the Sharon Conglomerate, in 1941 opened a new quarry in the sandstone phase 1 mile to the south-southwest (pl. 1, location 11). Sand grains average 0.25 to 0.5 mm in size and pebbles are rare and small, the largest observed being $\frac{1}{4}$ inch long. At this location about 20 feet of the sandstone has been exposed with a two- to six-foot glacial-till cover. The sandstone is very friable. Crossbedding with a strike of N 31° E and a dip of 27° SE was measured and the beds themselves had a strike of N 22° E and a 4° SE slope which is believed to be the slope of the original delta surface.

MASSILLON SANDSTONE

Three abandoned quarries produced sandstone for bridge abutments and building foundations. One of these actually is not in the Massillon Formation but in a lens of the Massillon-type sandstone in the Sharon Shale.

HOMEWOOD SANDSTONE

Two quarries have operated in the Homewood Sandstone to produce building stone. One is on top of Sugarloaf and the other is in Hiram where stone was quarried for several of the Hiram College buildings.

GLACIAL DEPOSITS

The kames and kame terraces which are widespread throughout most of the western part of the map and in the belt between Parkman and Grove are a source for sand and gravel. All of the 15 pits are shown as inactive, but this only means that there is no continuous quarrying going on in them. Many are still used when road work is going on in the immediate area or when people want a few loads of sand and gravel. The largest pit, 1 mile west of Mantua, was opened by the Portage Gravel Company. The kames and kame terraces are the potential source of considerably more material.

SHARON COAL

Coal has been mined from both the Sharon and Quakertown Coals to a limited extent at several localities throughout the quadrangle. The only mines, however, are found in the northwest corner of Burton Township. Here are found one shaft, one slope and several air shafts. A native who helped dig the shaft reported that 36 feet of shale was penetrated in reaching the coal. Above the coal was a black "slate" and the coal was $2\frac{1}{2}$ to 3 feet thick. In some places an underclay was found, in others it was absent. The native said that it was a "light coal full of tar and a good coking coal." Water problems in the shaft caused its abandonment about 1890, after which the slope was opened. The mine was operated most of the time by two men. A more recent attempt to obtain coal by stripping did not appear to be very successful. Well records indicate that the coal in this basin represents the thickest coal in the quadrangle and therefore no coal mining of any magnitude is possible.

OIL AND GAS

Wells have been drilled to test the Berea Sandstone in most parts of the quadrangle and some have tested the Clinton sands. No production has resulted. One Clinton well in the southeastern part of the quadrangle reported a show of gas in the Berea Sandstone.

WATER

Because the quadrangle lies in the highest area in northeastern Ohio, and has part of the headwaters of three drainage basins, the surface water supply is limited. The underground water supply is much more favorable than would be expected. The best source of water is found in the buried valleys shown on the geologic map (pl. 1). Though most of the fill of these buried valleys is fine sand and silt, sand and gravel are locally abundant and, where a surface stream follows or crosses these deposits to give recharge, they yield large quantities of water. Unfortunately it is not possible to predict absolutely where water-bearing gravels will be found in the buried valleys or how much water will be found. A well in the gravels south of Mantua yields 800 gallons per minute. The public water supply for the town of Mantua is from 3 wells a quarter of a mile east of town, in sands and gravels, and the supply seems adequate to take care of considerable expansion. In some localities the sands and gravels are in lenses which are surrounded by less permeable clays which inhibit recharge. Wells in such lenses will furnish a limited supply, roughly 10 to 70 gallons per minute.

The four sandstones of the region are all water aquifers of more consistent extent but of lower yield than the buried valleys. The best aquifer is the Sharon Conglomerate. Yield may reach as high as 200 gallons per minute but yields of 10 to 50 gallons per minute are more expectable. The village of Hiram gets most of its water from wells located 1 mile west of the village where the Sharon Conglomerate yields about 100 gallons per minute.

The Massillon sandstone is more lenticular and not as permeable as the Sharon Conglomerate, so generally the yield is less than that of the Sharon. The Homewood Sandstone is confined to the hill tops in the quadrangle. Although it is permeable the collecting area is limited and not much water is drawn from it. Reported yields are 5 to 10 gallons per minute. According to Winslow (1957) the Berea Sandstone should contain potable water in the Garrettsville quadrangle, although the water is salty further to the south. Because of its depth and the availability of other sources it has not been used very much. The public water supply of Garrettsville comes from the Berea Sandstone. The well yields about 50 gallons per minute. A few other wells in the

Garrettsville region draw water from the Berea. For a much more detailed discussion of the water potentialities of the southern part of the quadrangle the reader is referred to Winslow (1957).

SUMMARY

This report on the bedrock geology of the Garrettsville quadrangle is written with a minimum of technical language for the layman and yet because of the detail presented on the maps and the new material reported it is of importance to the geologist.

The Berea Sandstone of Mississippian age is the oldest formation exposed in the area. It crops out along Grand River and Swine Creek in the Grand River valley. It forms a gently south-sloping platform on which the other four even-bedded Mississippian units have been deposited - the Sunbury Shale, Orangeville Shale, Sharpsville Sandstone and Meadville Shale. Other Mississippian beds if deposited have been eroded and erosion has also removed the Meadville and Sharpsville in some areas. In the area of the quadrangle the land surface resulting from this erosion was a highland in the region of the present Grand River lowland from which streams flowed southwest to produce valleys about 100 feet deep in a lowland to the west.

The Pennsylvanian Pottsville beds first filled these valleys and then built up a sequence of delta deposits in this lowland. The lowest delta deposit is called the Sharon Conglomerate. The material was derived from the north, as indicated by direction of dip of crossbedding, trend of conglomerate channels, north-south variation in grain size, and chemical composition. Characteristically the delta deposit was a mixture of sand and scattered pebbles. Streams flowing across this deposit cut channels, and as these channels filled the sand was washed away and the pebbles concentrated to produce the conglomerate belts. Sheet wash on the delta also removed the sands at times and concentrated the pebbles in horizontal beds called lag gravels.

The Sharon Conglomerate is overlain by the Sharon Shale which was deposited on a lowland. Two patchy coals, the Sharon near the base and the Quakertown near the top of the Sharon Shale represent former peat swamps. Erosion removed part, or in places, all of the Sharon Shale and on this surface the second Pottsville delta was deposited to produce the Massillon Sandstone. This channel sandstone is less pure than the Sharon Conglomerate and has fewer pebbles. Otherwise it is very similar to the Sharon, being poorly bedded, crossbedded and of variable thickness. Dip of the crossbedding, however, indicates that the Massillon delta had a northeastern source instead of a northern source.

Overlying the Massillon Sandstone is the Mercer shale, similar in character to the Sharon shale, but in two localities containing a fossiliferous limestone identified as the Lower Mercer Limestone. After deposition of the Mercer Shale erosion again took place and a third delta was deposited called the Homewood Sandstone. This sandstone is pure, friable and crossbedded. It is finer grained and more poorly sorted than the Massillon Sandstone.

The next deposits in the area are the Pleistocene glacial deposits. For the purposes of this report only the buried valleys are shown on the map. The glacial deposits subdued the former landscape and disrupted the old drainage.

From an economic standpoint the Sharon Conglomerate is and always has been the most important deposit in the quadrangle. Its earliest uses were for foundations and bridge abutments. Later it was used for road material. More recently the high silica content has given it importance in the iron and steel industry for silica brick, ferrosilicon, and molding sand. It also has minor uses as abrasive sand and traction sand. Five quarries in the Sharon Conglomerate are or have been active recently along a belt from Nelson Ledges south through Newels Ledge and down into Windham Township. The Sharon Conglomerate is also an important source of water for the region.

The glacial kames and kame terraces which are widespread in the central and western part of the quadrangle are a good source of sand and gravel and are quarried whenever the need arises. Sand and gravels of the buried valleys are a good source of water.

The Massillon and Homewood Sandstones have been quarried for building stone in the past and Sharon and Quakertown Coals have been mined sparsely.

In conclusion, the Garrettsville quadrangle has been dominated by the Sharon Conglomerate. It makes the most spectacular scenery, it is the richest economic product, and it is the source of much water. It will continue to play a dominant role in the development of the quadrangle as the northeastern part of the state becomes more industrialized.

REFERENCES CITED

Baker, J., 1957, Glacial geology of Geauga County, Ohio: Univ. of Illinois, Ph. D. dissert. (unpub.)

Bowen, C. H., 1953, Petrology and economic geology of the Sharon Conglomerate in Geauga and Portage Counties, Ohio: Ohio State Univ. Eng. Exp. Sta. Bull. 153, 58 p.

Colton, G. H., n. d., The Geology of Hiram Township: unpublished short manuscript loaned by Ray Garver of Hiram, Ohio.

Fuller, J. O., 1947, Sharon conglomerate, a source of high-silica raw material: Ohio State Univ. Eng. Exp. St. News, v. 19, No. 2, p. 48-55.

______________ 1950a, Northern Middle Devonian sedimentary source for the Sharon conglomerate of northeastern Ohio (abs.): Geol. Soc. America Bull., v. 61, p. 1463-1464.

______________ 1950b, New discoveries concerning the Sharon conglomerate in northeastern Ohio (abs.): Geol. Soc. America Bull., v. 61, p. 1567.

______________ 1955, Source of Sharon conglomerate of northeastern Ohio: Geol. Soc. America Bull., v. 66, p. 159-176.

Pepper, J. F., D. F. Demarest and Wallace de Witt, Jr., 1954: Geology of the Bedford shale and Berea sandstone in the Appalachian basin: U. S. Geol. Survey Prof. Paper 259.

Winslow, J. D., 1957, The stratigraphy and bedrock topography of Portage County, Ohio, and their relation to ground-water resources. Univ. of Illinois, Ph. D. dissert. (unpub.)

STATE OF OHIO
JAMES A. RHODES, GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
FRED E. MORR, DIRECTOR
DIVISION OF GEOLOGICAL SURVEY
RALPH J. BERNHAGEN, CHIEF

BEDROCK GEOLOGY OF THE GARRETTSVILLE QUADRANGLE, OHIO

By
J. Osborn Fuller

1965

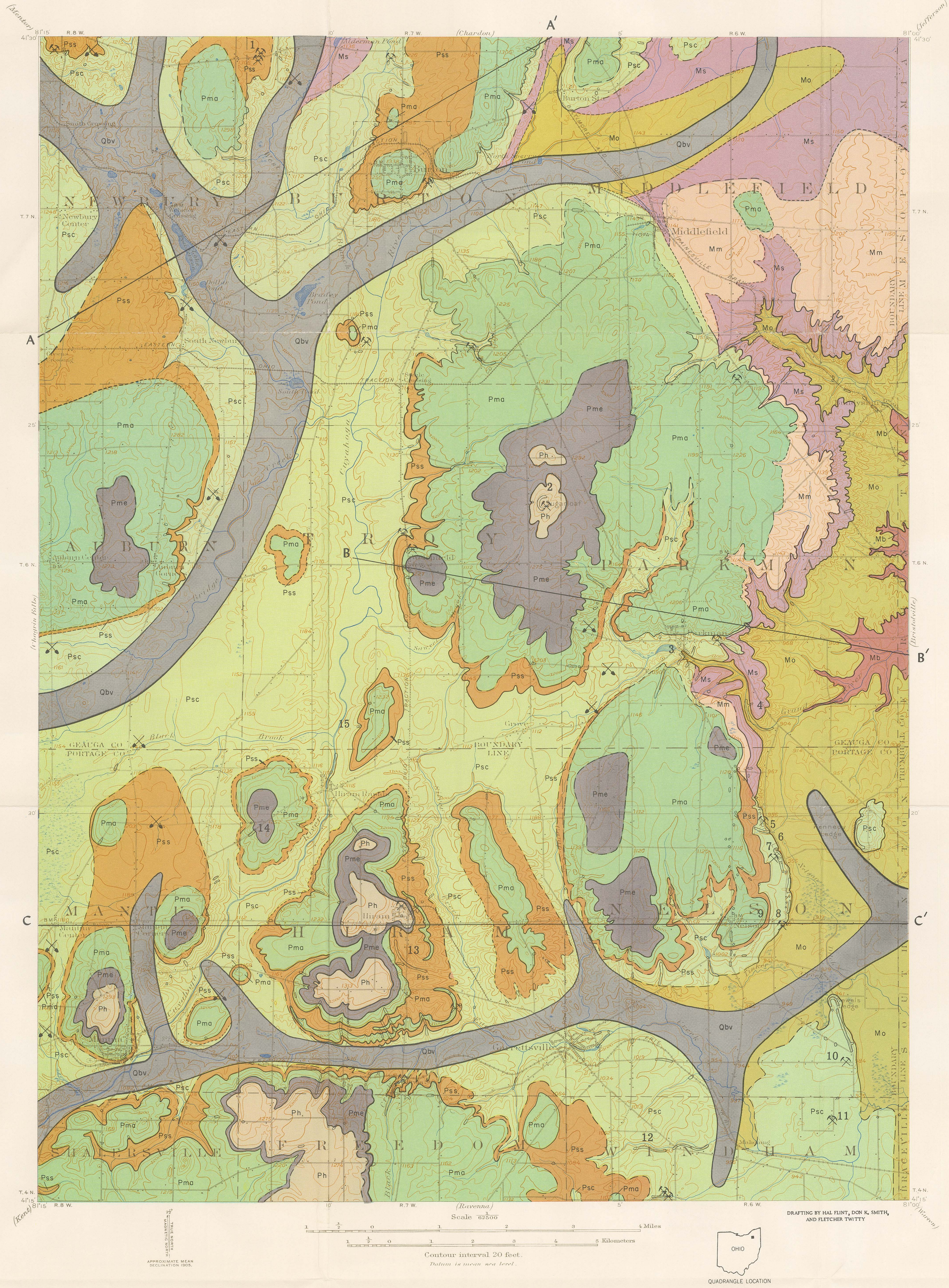
PLATE 1
REPORT OF INVESTIGATION NO. 54
BEDROCK GEOLOGY OF GARRETTSVILLE QUADRANGLE
GEAUGA AND PORTAGE COUNTIES, OHIO

SYSTEM	GROUP	FORMATION, MEMBER, OR BED	LITHOLOGY	THICKNESS IN FEET	DESCRIPTION
QUATERNARY				0-50	*Glacial till, unsorted mixture of clay, sand, and gravel.
				75-250	Glacial valley fill, sand and silt, with some till and local lenses of coarser sand and gravel; deposited in steep-walled valleys; is a good source of water in gravel; "sandy lime" description in well records in numerous wells at different elevations below gravel believed to be secondary cementing caused by water circulation.
PENNSYLVANIAN	POTTSVILLE GROUP	Homewood Sandstone		65-75	Sandstone, white to tan, weathering buff, fairly massive, irregularly bedded, coarse- to medium-grained (2 mm - 0.1 mm), well-sorted to poorly sorted, some small pebbles 3.2 mm (1/8 in.), friable where fines scarce; contains muscovite, feldspar in small quantity, limonite concretions and fossils of coal plants; differs mainly from Sharon and Massillon Sandstones in marked variability of grain size and greater quantity of feldspar than Sharon.
		Mercer Shale *Lower Mercer Limestone		60-70	Shale, dominantly blue-gray, weathering brown, some red, some black; one black shale resting on 2 in. of fire clay probably represents a coal horizon; shale irregularly bedded and sandy, with abundant muscovite in lower part, more regularly bedded and less sandy in upper part; a few interbedded fine-grained sandstones and laminated siltstones several feet thick, with coal streaks; shales with siderite concretions and locally contorted. A tilted outcrop section 1.3 miles southwest of Hiram Rapids shows in ascending order--underclay, coal, fossiliferous limestone (lower 6 in. cherty, upper 3 in. silty to silty shale); this limestone is believed to be the northernmost outcrop of Lower Mercer Limestone in Ohio.
		Massillon Sandstone		15-100	Sandstone, white to tan, weathering brown, irregular- to platy-bedded and crossbedded, upper part more regularly bedded than lower part, platy beds with ripple marks; shale interbeds up to 2 ft thick abundant locally; quartz grains 0.1 mm - 0.75 mm, poorly sorted with fines present and scattered pebbles averaging under 6.4 mm (1/4 in.) and some up to 50.8 mm (2 in.) rare pebble lenses, muscovite, feldspar and clayey matrix; crossbedding well developed, NNE source, siderite and limonite concretions, plant fragments, Calamites sp.
		*Quakertown Coal		0-1	Coal, local, not mapped--scattered outcrops and well reports, a few farm mines now abandoned.
		Sharon Shale		0-140	Shale, siltstone, and fine-grained sandstone with shale dominant; shale mostly blue-gray, weathering brown, sandy, some concretions of siderite or limonite, lenses of coal in some localitites, some shales black with plant fragments, Lepidodendron sp.; other beds of two types: (1) sandstone or siltstone, light-gray weathering brown, regular-bedded, micaceous, well-cemented, with ripple marks, (2) sandstone, white, weathering buff, irregularly bedded, crossbedded; some well-sorted and pure like Sharon but finer grained; some less pure and like Massillon; both with rare pebbles; both grade laterally into type 1 and shale.
		*Sharon Coal		0-3	Coal, local, not mapped--mined about 68 years ago in northwestern Burton Township in shafts and drifts.
		Sharon Conglomerate *Harrison Ore		0-195	Sandstone, pure (96-99% SiO_2--orthoquartzite) with quartz pebbles and locally pebble lenses and layers, white, weathering buff, friable, irregularly bedded, finer grained and more regularly bedded near top, shale interbeds rare but several feet thick locally; quartz grains 0.1 mm - 1.5 mm, average 0.5 mm, subrounded to rounded, well-sorted, fine grains rare; small quantity of muscovite, feldspar, and heavy dark minerals; crossbedding well developed indicating NW source, average angle of repose 23° SE, plant remains rare, differential weathering. Conglomerate with rounded quartz pebbles or varieties of quartz 3.2 mm - 95.0 mm (1/8 in.-3 3/4 in.), locally well-sorted in layers, lenses, and thick beds which are in linear southerly trending zones; rare pebbles with Devonian fossils. Harrison ore locally at base, sandstone stained or cemented by limonite; siderite and limonite concretions.
MISSISSIPPIAN	CUYAHOGA GROUP	Meadville Shale		0-80	Shale and siltstone interbedded in approximately equal amounts; shale, blue-gray, weathers brown, micaceous, silty; siltstone, blue-gray, weathers brown, laminated, in beds 1/2 in. to 3 3/4 in. thick; one limy bed about 10 ft. above base with a few fossils: Lingula melie Hall, other brachiopods.
		Sharpsville Sandstone		70±	Siltstone (0.05 mm avg. grain size), blue-gray, weathers buff, micaceous, even-bedded platy beds 2 in. thick on average and irregular beds up to 1 1/2 in. thick in groups with maximum thickness of 15 ft., some siderite and limonite concretions, rare ripple marks and fucoid markings; interbedded blue-gray shale rarely in greater quantity than siltstone; both siltstone and shale sparsely fossiliferous; a siltstone 1 ft to 2 ft thick 8 ft to 12 ft above base, weathering with rounded surfaces, locally nodular; a coquina and another less persistent limy siltstone at the top are distinctive; fossils present: Lingula melie Hall, Orbiculoidea newberryi Hall, Camerotoechia sp., Chonetes sp., Rhipodomella? sp.
		Orangeville Shale *Sunbury Shale		110-140	Shale, blue-gray, flaky, silty, weathers brown; some layers with limonite and siderite concretions; interbedded blue-gray siltstones weathering buff, 1/4 in. to 2 in. thick, widely spaced near base, more abundant near top but less than shale in quantity; fossils persist through lower 60 ft but not as abundant as near base; some coquinal layers; basal beds black shale with fossils (Lingula melie Hall and Orbiculoidea sp.) called Sunbury Shale but gradational upper contact and lack of exposures make mapping as separate unit impractical.
		Berea Sandstone		40-65	Sandstone, blue-gray, weathering brown, friable, fine- to medium-grained (0.08 mm - 0.5 mm), even-grained with some angular grains, finer grained in upper part, ripple-marked in upper part and crossbedded in lower part with crossbedding indicating source from NW, dip angle of crossbeds 12°-15° (less than in Sharon or Massillon), clay particles, feldspar, and many limonite-speckled beds; in fineness and angularity resembling Massillon rather than Sharon Sandstone.

*Not shown on map.

LOCATIONS OF BETTER OUTCROPS

Glacial till	Almost any fresh road-cut.
Glacial valley fill	Abundant well records in Newbury Township define course and character of valleys.
Homewood Sandstone	Quarry on Sugarloaf. Water tower hill 0.9 mi. west of Hiram.
Mercer Shale	Valley 1.2 mi. due west of Hiram Station.
Lower Mercer Limestone	1.3 mi. SW Hiram Rapids.
Massillon Sandstone	Stream S of Hiram Station; 0.7 mi. W of Burton Station; N of Parkman; 0.5 mi. E of Nelson; 1.7 mi. NE of Welshfield.
Quakertown Coal	0.8 mi. NE of Burton Station.
Sharon Shale	0.7 mi. SW of Hiram Rapids; 1.1 mi. SE of Hiram Rapids; 0.7 mi. S of Hiram; Hiram Station on stream. Streams flowing S in Eagle Creek S of Hiram.
Sharon Coal	Coal Spring (see pl. 1- No. 15).
Sharon Conglomerate	Sandstone phase- Swine Creek, Parkman Falls, Tinker Creek, Garrettsville Falls, Hiram Rapids. Conglomerate phase- Nelson, Kennedy, and Newels Ledges.
Harrison Ore	Nelson Ledges, Parkman Gorge.
Meadville Shale	Only exposed in Middlefield, Parkman, and Nelson Townships, in a few small outcrops. Best exposures Swine Creek and first main tributary to SE.
Sharpsville Sandstone	Swine Creek and steeper tributaries.
Orangeville Shale	Only good exposure along steep banks of Grand River Valley SE of Parkman, west of US Route 422.
Sunbury Shale	Only two good outcrops are on Grand River and Swine Creek.
Berea Sandstone	Only two good outcrops are on Grand River and Swine Creek.



EXPLANATION

QUATERNARY

Qbv — Area underlain by buried valley

PENNSYLVANIAN

Ph — Homewood Sandstone

Pme — Mercer Shale

Pma — Massillon Sandstone

Pss — Sharon Shale

Psc — Sharon Conglomerate

MISSISSIPPIAN

Mm — Meadville Shale

Ms — Sharpsville Sandstone

Mo — Orangeville Shale

Mb — Berea Sandstone

Operating quarry

Abandoned quarry

Glacial pit

Position of outcrop

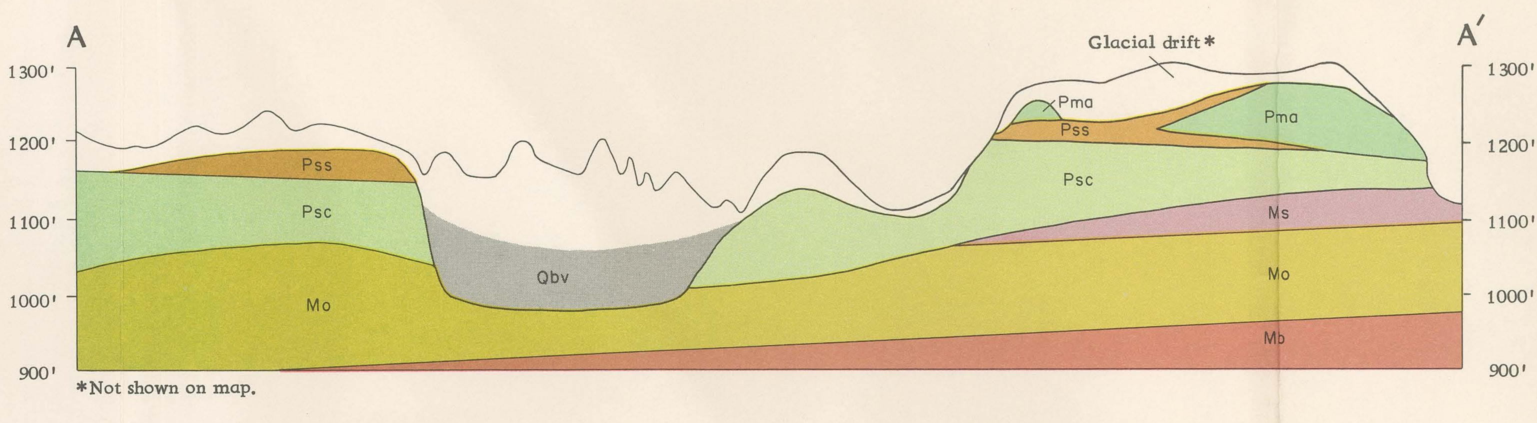
5 — Location mentioned in text

Contact

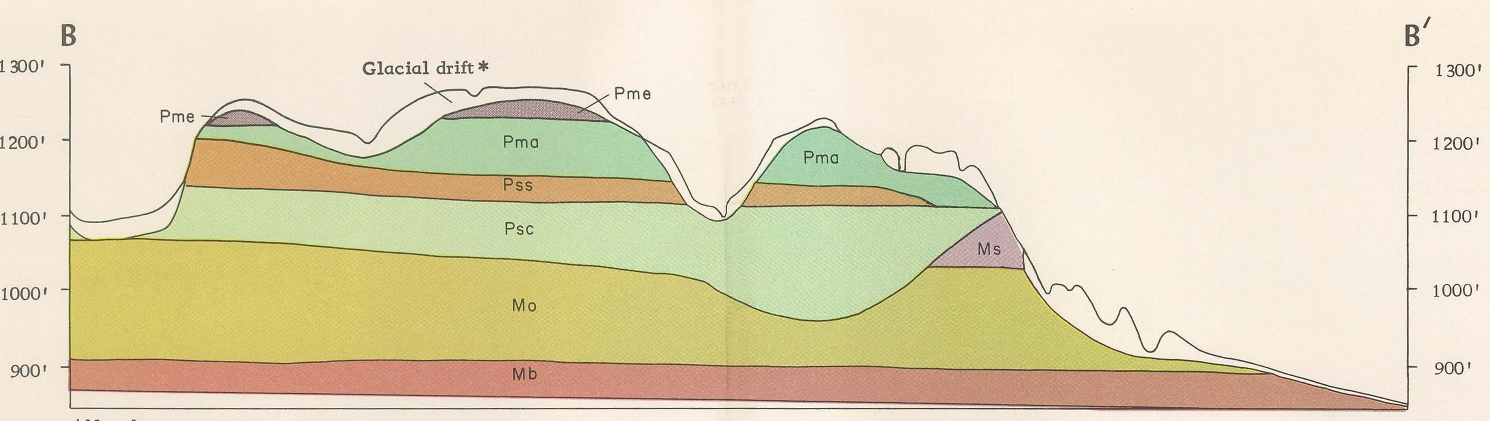
Probable contact

Uncertain contact

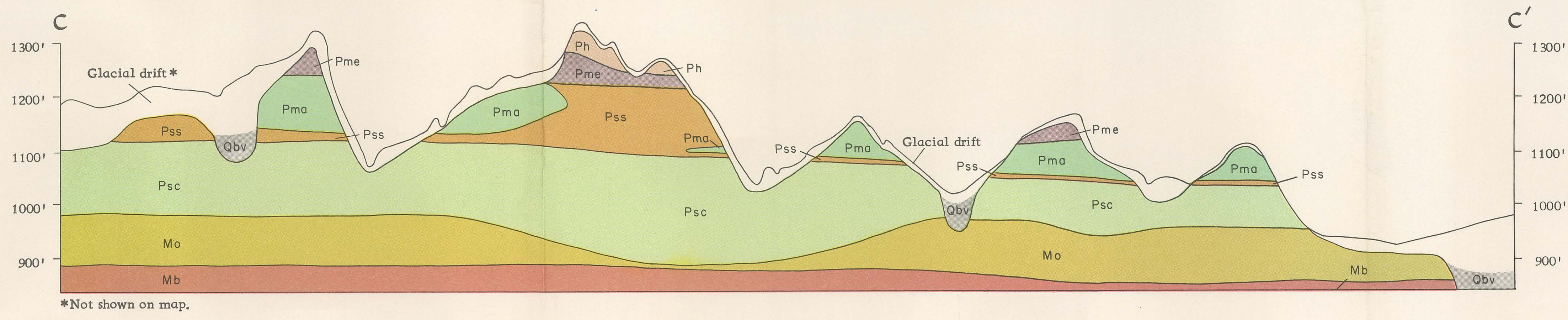
Approximate boundary of buried valley



*Not shown on map.



*Not shown on map.



*Not shown on map.