Gems of the Wissahickon

by
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The location of the Wissahickon gorge in a major urban-suburban region makes it an ideal site for Philadelphia area schools to explore and a prime resource for environmental education. The possibilities are extensive for the study of geology, ecology, conservation, and early American industrial history. In the Wissahickon one can learn to identify common rocks and minerals and read the story contained in metamorphic rocks. Geological features in turn determine types of flora and fauna- and ultimately shape human activities in a given location. The site is also valuable for learning common plants and animals, especially the stream organisms as well as for conducting water quality or transect studies. For 200 years in colonial times through the Civil War era there were 2 dozen mills located within the Wissahickon gorge along both the main creek and its tributaries. It is hard to imagine this idyllic stream once ran through a bustling and polluted industrial valley. The physical remains of many of the old mills can still be found near the Blue stone bridge, along Cresheim Creek and near the Livesey homestead.

WISSAHICKON GEOLOGY

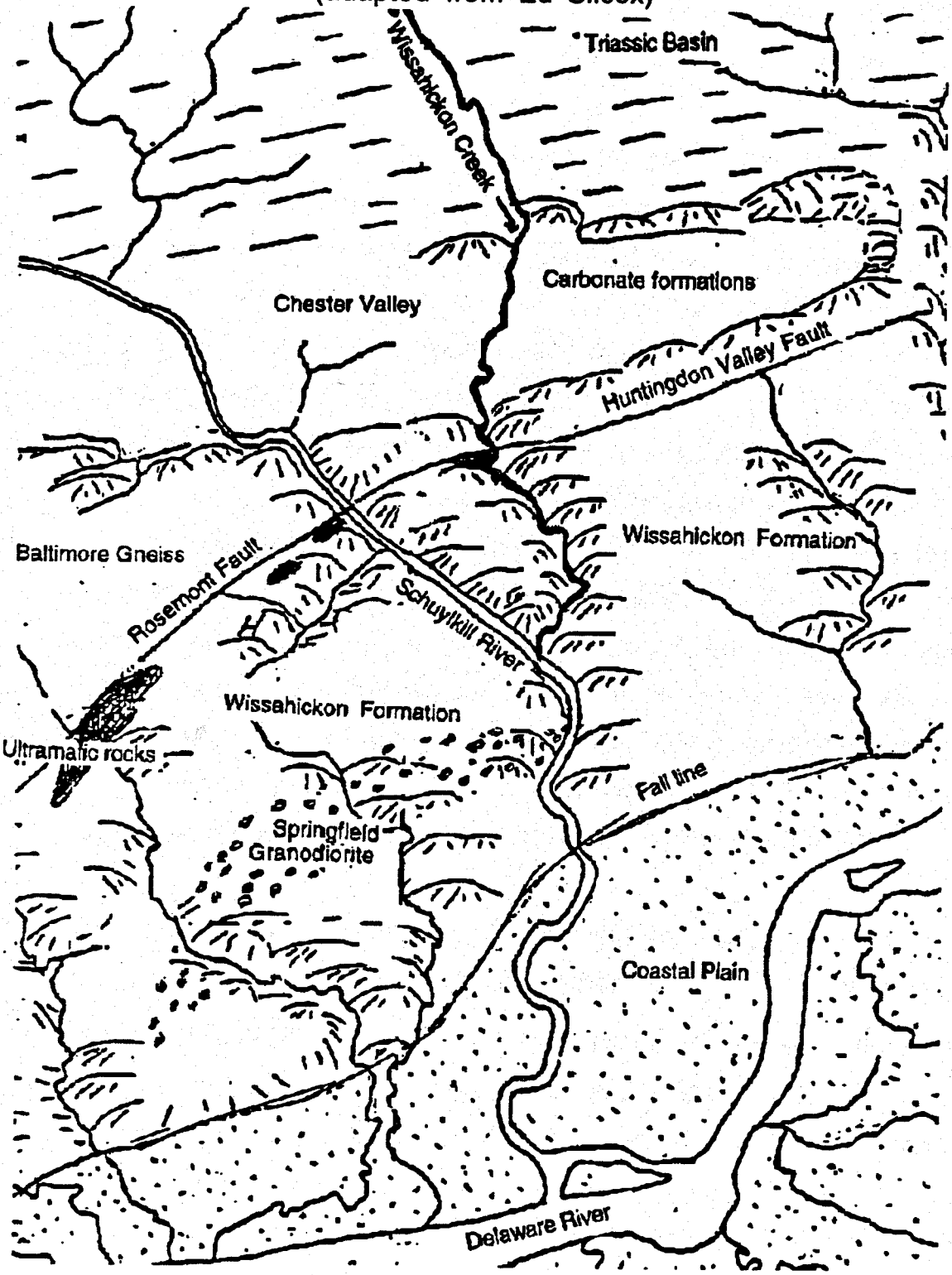
The Wissahickon Creek and its tributaries pass through several geological provinces including the Newark Basin of triassic sandstones and shales, the limestones and dolomites of the Chester Valley, across the Huntingdon Valley shear zone, into the Piedmont Province where its waters merge with the Schuylkill river and Delaware to flow across the Atlantic plain into Delaware Bay and the sea. Philadelphia's Wissahickon Gorge belongs to the Piedmont Province of Pennsylvania, a strip of

sloping land rising from the Atlantic coastal plain between New York and Alabama on the eastern side of the Appalachian Mountains. The Piedmont zone consists of Precambrian and lower Paleozoic rocks, the oldest rocks in Pennsylvania. In its last 7 miles the Wissahickon stream drops over 100 ft in altitude.

Once buried 25 kilometers below the surface, Wissahickon rocks provide evidence of the powerful tectonic forces that can close oceans and build mountain ranges. At one time geologists hypothesized that Wissahickon rocks were part of ancestral North America , but a major fault, the Huntingdon Valley shear zone, abruptly separates Wissahickon schist from very different rock types to the north. Structural features within the Huntingdon Valley fault suggest that the metamorphic bedrock underlying Philadelphia came from a location to the northeast. As with all sciences, new discoveries require the revision and expansion of explanations.

The concept of terranes, developed in the study of west coast geology, offers a plausible explanation of the origins of Wissahickon rocks. They may have been part of a mountain range far older than the Appalachians that rifted from another continental mass and traveled with the oceanic crust eventually adhering to our continent. During 250 million years of activity along a converging plate boundary numerous small microcontinents, including the ancestral Wissahickon, torn from their earlier locations became firmly welded to the North American coastline.

Geological Provinces of the Wissahickon Water Shed
(adapted from Ed Silcox)



THE STORY IN WISSAHICKON ROCKS

The history of the Wissahickon's aluminum rich shist began with the weathering and erosion of an ancient continent more than half a million years ago in a location yet undetermined. Aluminum is concentrated in clays by surface hydrolysis of feldspar, the major component of granite. These ancient clays were carried by flowing water and eventually collected at the margins of continents, in deltas , on floodplains, or in shallow inland seas where they were compressed by the weight of overlying layers and consolidated into the shale that eventually was transformed into schist. It is possible that this shale contained fossils, but subsequent metamorphism destroyed them.

In numerous places in the Wissahickon we find interlayering of schist and quartzite suggesting that the original shale and sandstone sediments were sorted by particle size during a long period of deposition. Fine clay particles settle out in still, almost motionless water, but heavier sand particles can be deposited in moving water. If the motion of water in a given location differed over time the structure of the resulting sedimentary rocks could show alternating layers of sandstone and shales.

Sometime after their formation the proto-Wissahickon shales and sandstones began to undergo metamorphism, slow solid state chemical reactions which require temperatures in the range of 200-800^{o} Celsius. Although no melting occurs atoms can regroup by diffusion into new crystal configurations producing chlorite, muscovite and biotite mica, garnet, staurolite, kyanite, tourmaline, and sillimanite, the aluminum rich silicate minerals embedded in different types of Wissahickon

schist. These embedded minerals are called index minerals because they reveal the conditions of metamorphism.

The specific minerals found in rocks depend on a combination of temperature and pressure during metamorphism . Different minerals are favored to grow under different conditions. For example biotite begins to form at about 400^{o} C; garnets at around 500^{o}, and kyanite around 600^{o} while sillimanite requires temperatures over 600^{o}. To read the story in metamorphic rocks geologists use the Barrovian sequence of index minerals. The sequence of these index minerals in Wissahickon schist (biotite, garnet, staurolite, kyanite, sillimanite) indicates that pressure increased along with temperatures during metamorphism. The presence of both kyanite and sillimanite gives us clues to the depth at which the process of metamorphism occurred. The conditions which produce sillimanite from kyanite are found at depths of about 20-25 kilometers. For these Wissahickon rocks to be exposed at the surface 20 kilometers or more of crust must have eroded away. The thickness of the remaining crust in this location is 30 Kilometers indicating that metamorphism must have occurred in an ancient mountain range where the crust was at least 50 kilometers thick. During an ancient period of mountain building shales and sandstones were buried deep in the crust. Heat and compression converted the shales first into slate and then into schist. Deformation produced the folds and minute crinkles, crenulations, seen within layers of schist. Simultaneously the sandstone was converted into quartzite.

Coarse, light pegmatite layers are also found many Wissahickon exposures. Pegmatite intrusions probably formed as the overlying schists and quartzites cooled. Hot igneous magmas moved into spaces or

cracks within the schist. The large feldspar crystal size found in Wissahickon pegmatite indicates a high water content in the magma.

Gneiss is the fourth type of metamorphic rock common in the Wissahickon. Generally harder than schist, it appears as finely banded with thin parallel layers of different colors, dark and light. Like schist the precursor of some gneiss is silt or mud sediment but with insufficient aluminum to allow the formation of micas during metamorphism. Other types of gneiss may form from the metamorphism of igneous rocks.

THREE SELF-GUIDED GEOLOGY WALKS

(Adapted from Bruce Goodwin, Guidebook to the Geology of the Philadelphia Area.)

The Wissahickon Gorge has been used for many years by area schools and colleges for the study of geology and ecology. Its rock formations supply visual evidence of the amazing processes that take place within the Earth's crust. First hand examination of a well chosen rock exposure gives a better understanding of geological sequences than one can achieve from reading or classroom lecture alone. The equipment you need to carry is simple and inexpensive. A steel nail will allow you to observe the relative hardness of rock layers and a hand lens or magnifying glass will allow you to examine small mineral crystals within the rocks. Look for a freshly broken, unweathered surface. The Wissahickon's large exposures must be preserved as a public educational resource. They should not be broken by ordinary observers. However university geologists with Park Commission permission often leave a freshly broken surface allowing others to study the mineral structures

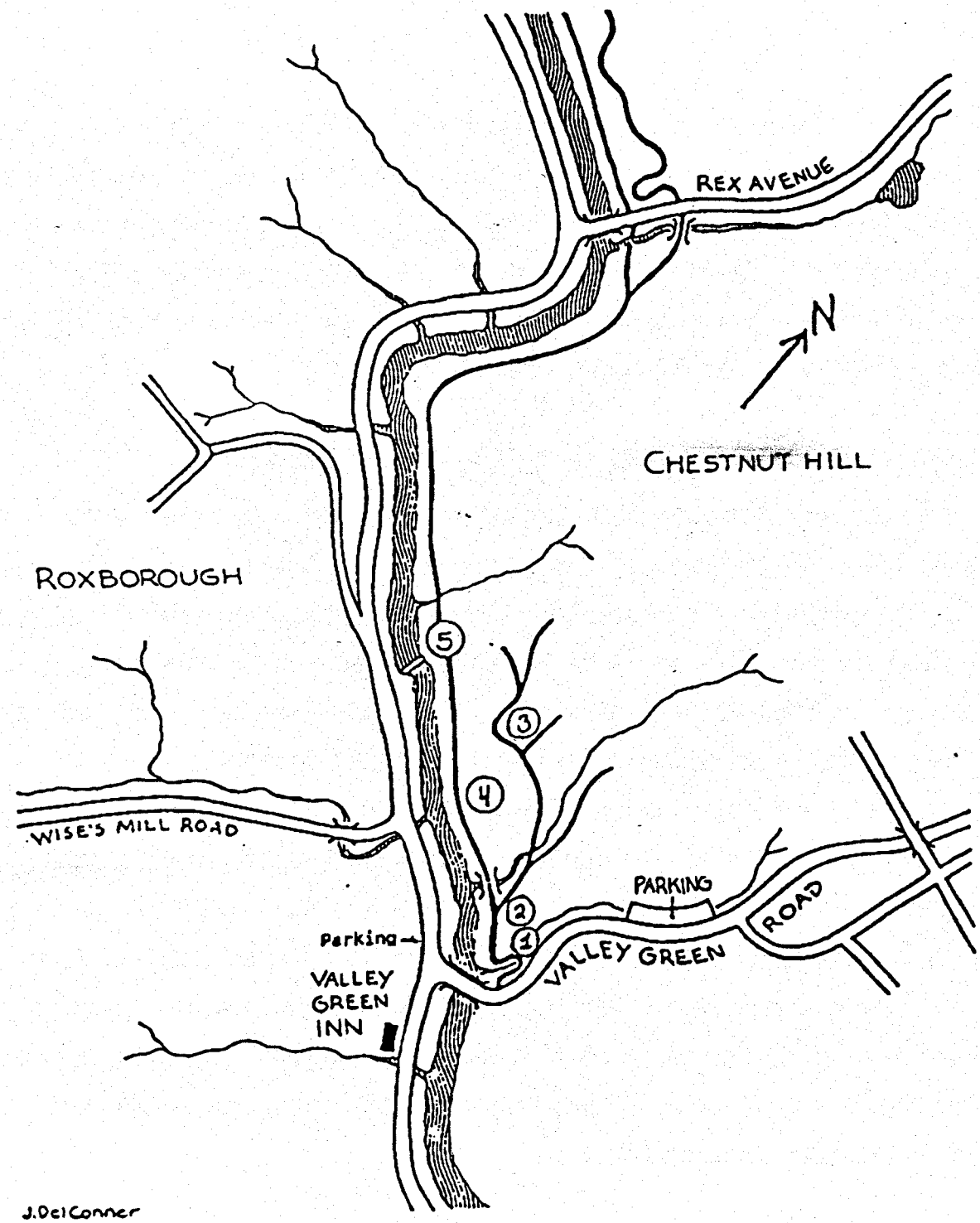
within the rock .

GEOLOGY WALK I: These five sites are found within a half mile along the east side of the creek just north of Valley Green. Together they make an interesting 1-2 hour field trip. Park in the upper parking lot off Valley Green Avenue on the east side of the creek in Chestnut Hill. Follow the footpath toward Valley Green but take the pathway that turns north before you reach the bridge across the creek.

SITE 1. ALTERNATING LAYERS OF SCHIST AND QUARTZITE

As you approach the top of the incline leading north from Valley Green Road, look for a prominent exposure just opposite a small shelter where the pathway turns sharply. This rock contains alternating layers of schist and quartzite which have become tilted almost vertically. You can easily distinguish the two rock types by the presence or absence of layering and the hardness or tendency to crumble. Hardness can be assessed by using an ordinary steel nail to see how easily the rock can be scratched. The schist is the layered rock that scratches very easily while the quartzite forms step-like blocks of uniform consistency and is more difficult to scratch. The schist contains numerous small garnets and mica . Furthermore layers within the schist have tiny waves or ridges called crenulations which make the rock look crinkled while the quartzite surface looks more even. A close examination of the schist will tell you much about the rock's history.

GEOLOGY WALK 1



The layering in schist and mica is perpendicular to the direction of compression during deformation long ago. The types of minerals present can indicate the temperature-pressure conditions during metamorphism. For example this rock contains garnet but not staurolite so that we can hypothesize that its temperature did not rise as high as that in rock containing staurolite or kyanite crystals. The "rusted" appearance of freshly broken rock at this site indicates the presence of iron compounds.

This site may contain some freshly broken sections which show how weathering can alter the appearance of a rock. For fully accurate identification look at an unweathered surface. Geologists carry hammers for breaking off fresh pieces. However, the rocks in the Wissahickon should not be broken intentionally. Crystals should not be removed from rocks, but you can find many garnets lying in the soil along the path at the base of this rock.

The blue-green or gray-green crusty covering over much of this formation is a lichen composed of a symbiotically growing fungus and green alga. The alga may also colonize rock on its own forming a thin, green layer. The bright green spongy clusters are moss. The moss and lichens colonizing this rock serve as pioneer plants critical in the long process of soil formation. Carbon dioxide from their rhizoids forms carbonic acid in the wet rocks dissolving the minerals and starting the conversion of rock into soil. After they die their organic remains mix with grains of rock to form the complex, vital substance we call soil. In many places this rock seems to have crumbled to the consistency of soil. The specific mineral content of a rock as well as its hardness and permeability to water influence the types and quantities of covering vegetation. Acid rain also contributes to the process of rock weathering and erosion.

In some places an inch of soil can form in a decade, while in other areas, such as on steep slopes subjected to constant water runoff, it may take 100 years for an inch of soil to accumulate. In the Wissahickon soil loss has become a major conservation problem. Although all rooted plants help hold topsoil in place, people walking on the hillside off the established pathways contribute to the loss of soil that is so apparent in the muddiness of the creek after rainfalls.

In early spring before the leaf canopy obscures the light the covering of pioneer plants can become quite thick supporting a microhabitat within the forest. It has its own food chain with plant producers, herbivore insects and possibly several levels of predators. . You may observe a bustling colony of insects feeding and raising their young. There may be some spider webs or other evidence of carnivores. Nearby rotting logs allow you to follow other steps in the creation of soil and the recycling of resources through decay.

Through out time geological processes have helped determine the evolution of life on this planet. Since continental bedrocks are the primary source of essential mineral nutrients for both plants and animals the specific minerals available along with the topography of the land determine which organisms will be found in the Wissahickon.

SITE 2: THE ROCK WITH THE MISSING WEDGE

Look for a large rock formation rising high above you on the right side of the descending path which leads north from site I. Near the top it looks as though a large triangular piece of rock has fallen out. This formation is particularly interesting for its fractures. Near the middle

you will see two fracture lines that cross to form an 'X', a conjugate joint set. When rocks are deeply buried and very hot they are pliable and fold as they undergo compression, but when they cool they become brittle and crack when compresses. If there has been no movement of pieces on opposite sides of the crack, the fracture is called a joint. If movement has occurred, the crack is called a fault. You can see that along almost all the fractures the bedding planes of schist and quartzite have not moved relative to each other.

Notice that the schist beds are inclined at an angle of about 45 degrees toward the path giving us evidence of the deformation and uplift of sedimentary rock that had been laid down vast ages ago. The direction from which pressure was applied to this rock is revealed by the alignment of the schist and mica layers perpendicular to the direction of the stress. Closest to the path you will find a large block of quartzite which has been folded over.

At the base of this rock where it comes close to the path you can take a close look at the schist. Much of it looks black from weathering. With close inspection you'll find more embedded garnets . The crystal size varies greatly. Notice the fine crenulations or tiny folds in the schist. If you look at a crenulated schist layer from the top you will see parallel rows of small fold hinges.

The schist in this formation contains many thin veins of quartzite. Quartzite veins may form within schist if superheated steam carrying dissolved silicates flows through a crack within the schist while it is still deep below the surface. With slow cooling the minerals gradually precipitate within the crack to fill the space. Under different circumstances the same kind of slow mineral deposition can lead to fossil formation. Once exposed at the surface the schist formation is

subjected to physical and chemical weathering. In time the quartzite veins stand out on the cliff face because they are much harder than the surrounding schist which has eroded away.

SITE 3: THE STRIPED ROCK, UPPER EXPOSURE

To get to site 3 cross the wooden bridge just north of site 2 and follow the path up a hill for about 550 feet. This exposure is a beautiful example of folding, uplifting, and metamorphosis. Notice the igneous intrusions of pegmatite that form white wavy bands through the rock. As the original schist layers were compressed by continental plate movement pegmatite flowed between them. Then as the pressure continued both rock types folded together. You can get a surface view of folding on the top of this rock which has very obvious synclines (troughs) and anticlines (crests), the geological terms for different parts of a rock fold.

SITE 4: THE STRIPED ROCK, LOWER EXPOSURE

Retrace the path southward back to the main trail along the creek where you make a very sharp right and walk north. Soon you will come upon a large low exposure of rock which extends across the path out into the creek. The up hill end contains two intersecting fractures where a large wedge of rock is missing. On the fracture face you can see prominent lineations from crenulations.

Before you cross this rock climb down to the creek. There you will see a free standing block made of dark gray rock with vertical wavy white bands which you will recognize as layered schist and coarse grained pegmatite. Since both rock types are folded together we have evidence that the pegmatite flowed between the schist layers before the

major folding occurred. Notice how the pegmatite bands extend across the freestanding rock and up into the main formation. The lineations from schist crenulations are prominent on its north side. .

MAGARGEE DAM SITES:

These two sites are on the East side of the creek near the old Magargee lower mill dam. To reach them cross over the rock at site 4 and follow the path northward. Site 5 is a towering cliff at the Magargee Dam. Site 6 is about 750 feet further north.

SITE 5: THE CLIFF HANGER

Site 5 is a towering exposure of pegmatite, schist, and quartzite that extends across the path. In addition to the usual embedded "gems" this formation has a number of interesting features. Look first at the south end. Notice the alternating bands. These beds are inclined slightly downward toward the north. The pegmatite layers composed of feldspar, quartz and mica are very thick. They have very rough textures and are light in color. Notice the large size of the white feldspar crystals. Large crystal size suggests a high water content in the magma. The high proportion of water enhances diffusion and allows crystals to grow larger than they would with lower proportions of water. The darker schist will show characteristic layering (schistosity) while the quartzite will appear uniform and may be broken into blocks. Because the igneous pegmatite formed in bands parallel to the bedding of the quartz and schist it is called a sill. If the pegmatite had cut across the bedding planes of the other rocks it would be a dike. Near the creek are found numerous lose pieces of schist. Needle like crystals of tourmaline may be found in some of these fragments.

Look at the big fractures that run through this rock. You can tell that these fractures occurred after the igneous intrusion and folding because they cut across continuous features. There are several ways fractures can form. If a rock is brittle or relatively cool when compressed, it may show intersecting conjugate joint sets as seen in site 2. Unloading fractures may develop when erosion of heavy overlying rocks allows the whole formation to rise. These horizontal separations are most likely to occur between different type of rocks as the top layers lift off the bottom. You will notice in many places along this trail still another way fractures develop. Very small cracks may be enlarged by the accumulation of water that repeatedly freezes and thaws. If the crack becomes large enough to hold a plant, the growth of roots further widens the fracture.

Look up at the horizontal overhangs at the top of this formation. These overhangs are produced by fractures between schist layer or between two different types of beds. Rock beneath these fractures has fallen out allowing us a three dimensional view of bedding planes and schistosity. You can see here that rock layers are like sheets that may spread over a very large area. The free standing rock near the creek will give you the same three dimensional view of schist foliation and the alternating pegmatite-schist layers.

Follow the path about halfway up the slope that crosses in front of the formation. Look closely at the cliff vertical face. Find the large quartzite fold underneath narrow bands of schist and quartzite that show two small folds. To the left of this region you can see a three inch pegmatite band cutting across the top of a quartzite fold. Because it cuts across the other layers it is classified as a dike. We can conclude that it appeared after the quartzite had folded.

GEOLOGY WALK II: FOUR SITES ALONG FORBIDDEN DRIVE.

The following four sites are found within about half a mile north of Wise's Mill Rd. Together they may an interesting 1-2 hour geology hike . They can be reached from Wise's Mill Rd. off Henry Avenue. Park at in the designated area along the stream and walk north.

SITE 1: MAGARGEE DAM WEST

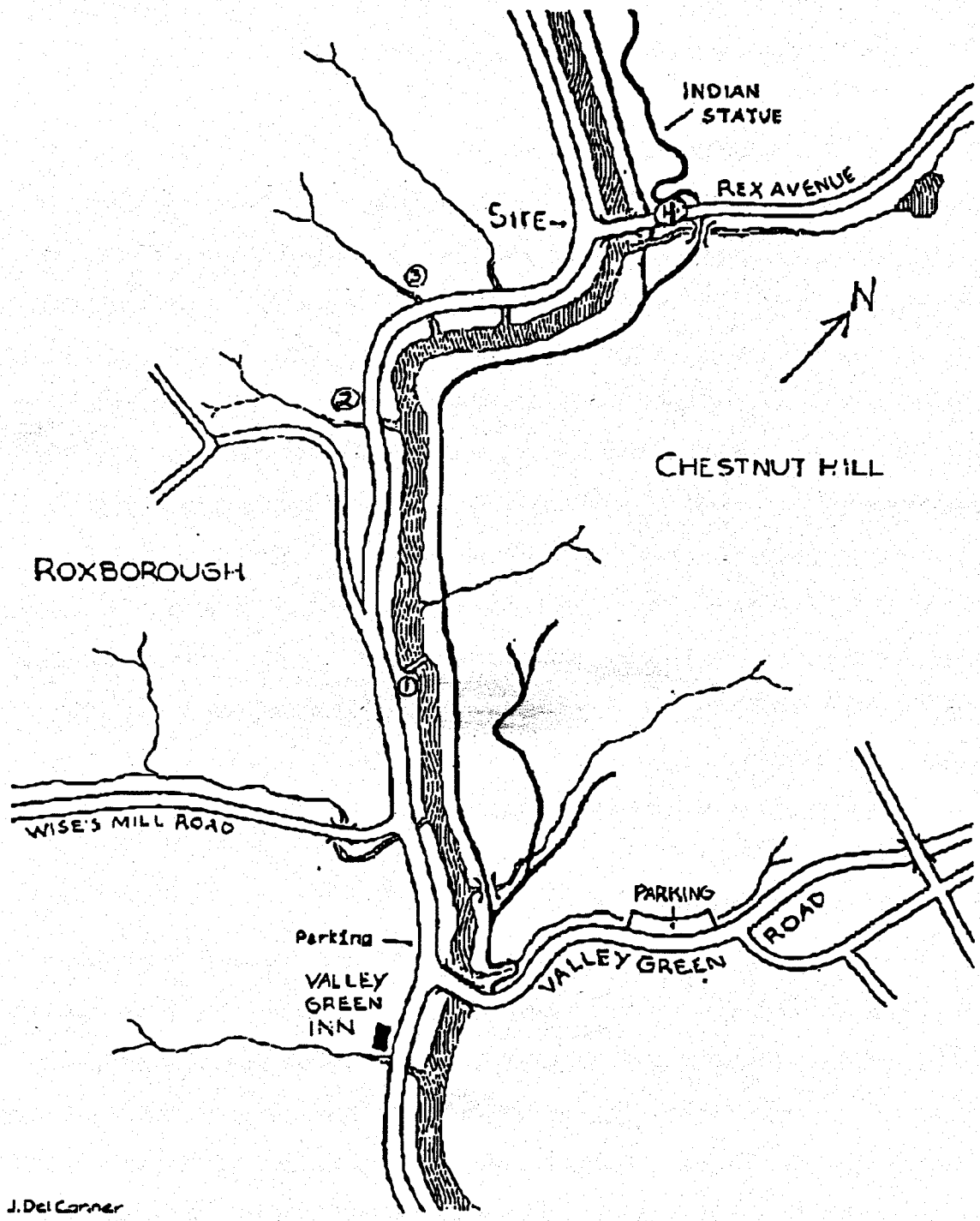
To reach this site walk north from Valley Green along the west side of the creek past the intersection of Forbidden Drive and Wise's Mill road. On your right at the base of the next hill you will see a broad low area between the road and the creek. Walk through this area until you reach the creek near the waterfall. Go out on the large, low igneous rock that extends across the creek in front of the old Magargee Mill dam. This exposure is made of pink and white feldspar along with quartz and mica. At numerous places the pegmatite encloses chunks of gray quartzite called xenoliths. Some of the xenoliths are crossed by small white veins of almost pure quartz. The xenoliths most likely pieces of metamorphic rock that were caught up and carried along in this massive igneous pegmatite intrusion.

Return to Forbidden drive and continue to walk north.

SITE 2: THE HIDDEN SPRING ROCK

This formation is a massive ledge along the roadway at the closed spring with the inscription "PRO BONO PUBLICO". This structure was once a public watering fountain constructed in 1854 along the Wissahickon Turnpike. It was the gift of Charles Magargee, the owner of the land, and John Cook, its builder. At one time Wissahickon water was famous sold widely as potable spring water. However, ground water from the Wissahickon is no longer safe to drink. The fountain was sealed in 1968.

GEOLOGY WALK 2



The vertical face at the south end of this exposure is kept very wet by water from springs. In summer the mossy covering is thick. Take a close look at the plant and animal life on the surface. The springs behind this rock have promoted the growth of dense vegetation. In the winter magnificent icicles hang from these rocks. The color of the icicles reveals the minerals contained in the ground water. Rusty colored icicles are produced from water high in iron, while water with a high copper content will make icicles with a faint blue-green tinge.

Just to the left of the sealed fountain you can see a long oblique widened crack filled with soil. This crack is a fault because the rock layers on each side are displaced. The part of this formation with the most interesting quartzite and schist folds lies to the right of the fountain, Look about half way up the ledge where you can see several very large recumbent, tight folds of quartzite and schist which show evidence of tortuous metamorphic compression during ancient mountain building. Notice the tiny garnets and crenulations in the schist. This ledge once came close to the creek forming a barrier to road construction. Further north you can see drill marks where part of this exposure was once blasted away.

SITE 3: A NATURAL WATER FALL

As you continue to walk north from the fountain, the next almost dry stream bed you pass on your left contains a ridge of hard vein quartz which makes a natural waterfall. In the last century when the water table in this valley was much higher than it is today, water must have cascaded over this ledge in significant amounts, but today only a tiny stream passes flows in the wet season. Close inspection shows this rust stained rock is almost pure quartz with a little mica. However, it shows

lineations along its long axis. This natural quartzite dam formed inside a mold of schist. Long ages ago hot flowing water with dissolved quartz flowed through a large crack in a slowly cooling mass of schist. The minerals slowly settled out filling the space. The resulting quartz vein carries an imprint of schist lineations from its mold. Fine mica in the quartz vein suggests that it later underwent additional metamorphism. Long after the mountain building came to an end water flowing down the slope wore away the softer schist leaving the harder quartz vein intact. The valuable mineral deposits found in many mountain ranges form by a similar process. Hot water flowing through fractures within the crust carries different dissolved minerals that precipitate in veins when subjected to cooling and decreased pressures.

SITE 4: THE PEGMATITE SILL AT THE REX AVENUE BRIDGE

This site lies on the east side of the Rex Avenue bridge next to steep stone stairs that lead upward toward the Indian Statue. The most prominent feature of the formation is the light colored pegmatite sill visible between layers of much darker rock. Note the deep, horizontal fracture between the lower side of the pegmatite and the underlying schist, a region of weakness between the beds. This may have been produced by the unloading or wearing away of heavy overlying layers. At the base of this formation you can see a layer of quartzite. Notice the vertical joints that divide the quartzite into blocks. If you climb up the stairs and look at the pegmatite sill closely you will see that it slopes gently down toward the north. When you cross the Rex Avenue bridge look back toward the opposite shore. If low vegetation growth permits, you can see the pegmatite sill run northward for about 100 feet with the

same gentle incline giving an indication of how large a sill can be. Some sills have dimensions of many miles.

From the bridge observe the color of the stream. It always carries a load of sediment showing that erosion is a continuous process. For a day or so after a heavy rain the creek will look especially muddy as extra quantities of soil are washed away. At a number of places along the stream you may observe an accumulation of the rocky remnants of old dams from the 18th and 19th centuries when there were 24 mills along the Wissahickon in the area between the Schuylkill River and Germantown Avenue near Chestnut Hill College.

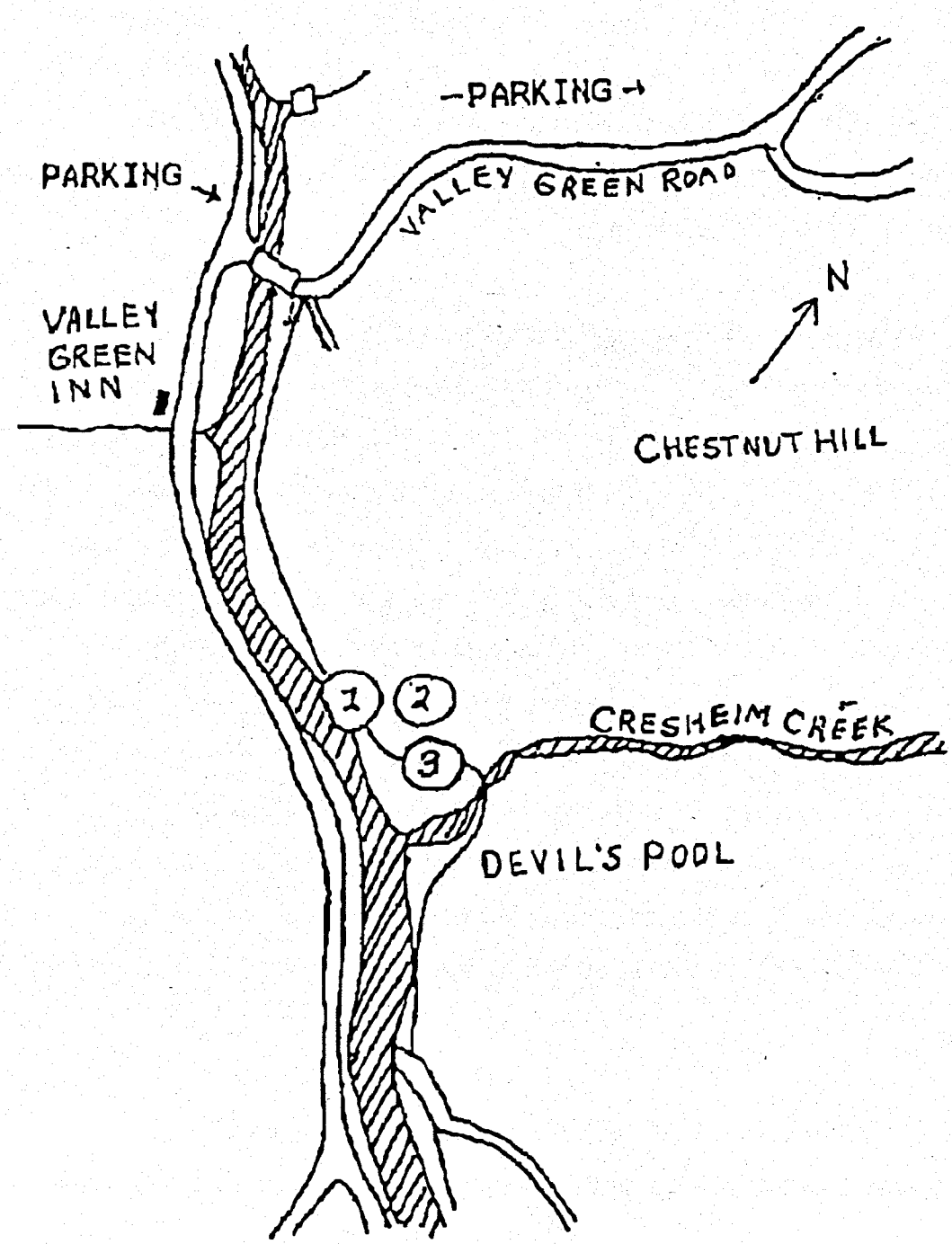
GEOLOGY WALK III: SOFT ROCK AND HARD ROCK:

These three sites are located within 30 feet of each other and would make an interesting 30-45 minute field trip. The closest parking is in the up hill lot off Valley Green Road on the east side of the creek. Parking is also available near the intersection of Wise's Mill Rd and Forbidden Drive. To reach the three sites take the pathway leading south from the east end of the bridge at Valley Green Road. This path immediately branches. Follow the branch closest to the creek. Walk southward for about a third of a mile (10 minutes at a leisurely pace) until you come to several small exposures (waist to shoulder high) adjacent to the right side of the path and several massive exposures extending up the hill to your left. You will need a steel nail and a magnifying lens to complete the observations suggested for this geology walk.

GEOLOGY WALK III: SITE 1: GARNET-MICA- KYANITE SCHIST

The exposures closest to the path on the creek side of this site are

GEOLOGY WALK 3



garnet-mica schist with occasional kyanite crystals. The densely packed garnets range from 1/8 to 1/4 inch in diameter. The sparkle or shine of this rock is due to muscovite mica. Two kinds of mica are present in the Wissahickon, silvery muscovite mica and black, shiny biotite mica. Both kinds of mica form thinly layered sheets that can easily be separated. In the Wissahickon, muscovite mica is far more common than biotite mica. Notice the layers in the schist incline toward the north. Test the hardness of this rock with a steel nail. Notice how hard you must scratch to leave an imprint. Examine the garnet and mica with your magnifying lens. Kyanite is less prevalent and more difficult to find. The most prominent kyanite crystals are about 5 mm long and 2mm wide. Kyanite forms slender knife-blade shaped crystals that can be scratched more easily lengthwise than crosswise.

SITE 2: THE ANTHOPHYLLITE SILL

Looking up the hill away from the creek you will notice several massive dark greenish-brown rocks that form prominent silhouette against the sky. These exposures look very different from schist These massive 10 foot blocks lack layering or schistosity. The surface may look pock marked or pitted. Find a region of this exposure where the weathering is minimal to examine the surface closely with your hand lens. The anthophyllite forms long slender crystals radiating out from a central point in aggregates about half an inch in diameter. This sill is also rich in talc, a mineral so soft that you can scratch it with your fingernail. The talc makes this rock break in sheets and feel slippery when rubbed.

This anthophyllite formation is a metamorphic ultramafic rock rich in iron and magnesium, possibly derived from a piece of Earth's

mantle which was caught up in tectonic shearing, moved up into the oceanic crust, further changed by heat and pressure, and later uplifted Notice its softness in comparison to the other nearby rocks ; you can even scratch it with your fingernail. Another mineral in this rock, whitish-gray Talc, is identified by its softness and its slippery feel. Both talc and anthophyllite are formed when certain igneous minerals are subjected to later metamorphism. Two hundred million years of mountain erosion and isostatic upliftling has revealed this 20 foot band of unusually soft rock. Notice that one of the anthophyllite blocks is thrust high into the air forming an almost vertical sill. We know these rocks are uplifted sills not dikes because they are parallel to adjacent layers which have also been tilted up. A dike cuts across the bedding planes of adjacent rock.

According to Magee in his work Wissahickon Valley Industrial Mills Colonial and Revolutionary (p 29), this anthophyllite sill provided the mineral material used by at least one mill on Cresheim creek to make imitation "asses skin" paper from what the colonists called rotten stone. Paper with a mineral content is especially useful for printing money because it cannot be easily counterfeited.

Near the pathway immediately north of the anthophyllite sill is a bright green, sparkly chlorite vein embedded in a mass of highly metamorphic gneiss which also contains garnet, mica, and quartzite veins. The wavy chlorite vein is vertical 2-2.5 cm wide (1 ") and is visible from the base of the exposure to near the top. Chlorite is one of the clay derived minerals formed initially in low grade metamorphism, but it also forms from high temperature hydration of other basic silicates during continued metamorphosis.

SITE 3: METAMORPHIC GNEISS

About 30 feet south of the anthophyllite sill another massive exposure extends outward across the path to the creek. Most of this rock is derived from schist which has been mixed and folded together with pegmatite, quartz and quartzite to give a marble-cake appearance. The fine interlayering of these four types of rock during intense metamorphism has produced an extremely hard, finely banded gneiss. Because of the contortions and folds it is difficult to trace any one layer over a distance. Masses of pegmatite and rusty colored quartzite form pods within the swirled rock. Test this rock for its hardness compared to the other two exposures observed on this walk. Over a very short distance along the creek we have seen two extremes in rock hardness.

For those who explore the Wissahickon geology, one of its most fascinating aspects is the wide variety in rock form and substance that can be seen within a short distance. Some rocks have been folded as though they were made of putty while other rocks have been cracked into huge blocks during long periods of compression. Other rocks, such as the serpentine and anthophyllite outcroppings with high concentrations of talc, are so soft that one can scratch them with a fingernail. A few feet away one may find rocky ledges that are so hard they can barely be marked with a steel nail. Adjacent exposures of shist may reveal very different mineral crystals. On your next hike in the park investigate this geologic diversity for yourself and wonder about the tumultuous forces at work within the earth's crust producing this great variety.