GRAPHITE PRODUCTS CORPORATION

Graphite Mining/Processing Operation

Wilton/Greenfield, New York

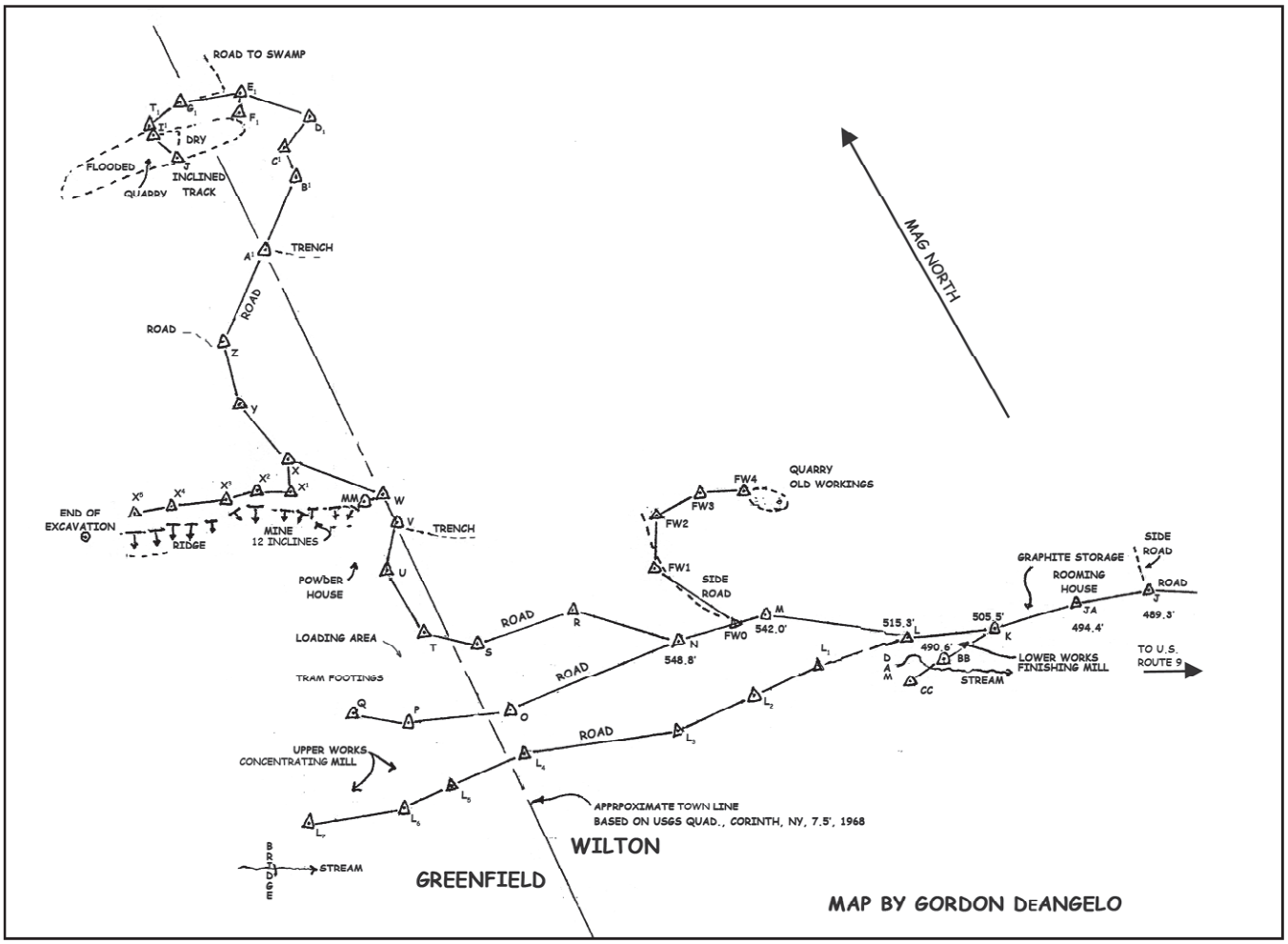
Of the four most productive graphite mines within the Adirondack Region, little documentation remains detailing the former operations at the Graphite Products Corporation in Wilton and Greenfield. A search of industry records, census data, and oral history reveals few clues about the workers who manned the year-round operation. However, the site itself remains virtually undisturbed except for natural processes of decline.

Graphite Mining in the Adirondack Region

The first commercial attempt to extract graphite from the Adirondacks occurred on Lead Hill near Ticonderoga in Essex County. In the 1850s the American Graphite Company operated the works there, and in the 1880s the Joseph Dixon Crucible Company took over the operation and became the first enterprise to import and manufacture graphite products in this country. Around 1902 the area began to attract attention, and in the following years many prospects were opened, companies formed and mills built for treating the ore (Alling 1917).

New York State soon became prominent in the production of high-grade graphite. Of these, the most productive were the American Graphite Company in Ticonderoga (later known as the Dixon and Faxon), the Hooper Mines in Dresden near Whitehall, Graphite Products Corporation north of Saratoga Springs, and Empire Graphite at Porters Corners (Alling 1917).

By the mid-19th century, many new uses came with the Industrial Revolution. The most important was the manufacture of crucibles used in the production of crucible steels, brass and other new alloys. Other uses included foundry facings that aided in the parting of cooled metal castings from their molds. Large amounts were used in stove polish, utilizing the small-sized or intermediate grades. As graphite



One of twelve drifts (mine openings). Photographed by Suzette Usher.

adheres to metal surfaces, it fills the pores and provides protective properties, reducing friction and acting as a lubricant. In a dry application, such as in textile mills where oil would soil the cloth, or for automobiles as lubricating oils and greases (Gwinn, 1943:13). Other uses included dry cell batteries, dynamo brushes, electrodes, steam and water packings, brake linings, and fertilizers. The paint industry made use of the lowest grade of ore, 30-35% purity; with manufacturers of crucibles, pencils and lubricants, 83-97% purity; and electrical component manufacturers consuming the material 97% or higher (Harrison 1955: 2-3).

Corporate History

In 1908 William A Pierson, attorney, William J. Delaney, attorney and Ralph H. Davison of Saratoga Springs with George F. Bryant and John H. Davis of Glens Falls, New York formed the Saratoga Graphite Company (SGC) with a capital stock of $175,000 (Papers of Incorporation Albany N.Y. 3/32/1908: 198-199). John H. Davis is listed as manager of the company from 1909 to 1910 (Glens Falls Directory 1909-1910). The mining and production of flake graphite was carried out in a minor way using open pit mining with all processing contained in one building until 1913 when John L. Henning from Saratoga Springs, Ralph H. Davison and William H. Namack of Ballston Spa, New York assumed ownership under the name Graphite Products Corporation (GPC). Graphite Products started quarrying ore in a new, much larger pit, abandoning the Saratoga Graphite Company's smaller open pit. A new multi-story concentrating mill was constructed and the former SGC building used as the refinishing mill. Davison and Namack also owned a nearby foundry.

Geology

The uplifting of the McGregor fault-line scarp, produced by differential erosion, forms the western boundary of the Lake George Depression and the Palmertown Range. GPC is located at the foothills of this range. The commercial deposits of graphite are found within the Grenville series; these are sedimentary rocks which are folded, metamorphosed and at times invaded by igneous rock. The metamorphosed rocks were subjected to heat and pressure resulting in the recrystallization or the rearrangement of the component minerals. In "The Adirondack Graphite Deposits" monograph, Alling provides detailed descriptions of the twenty-six deposits in the Eastern Adirondacks and divides these into the Northern (limestone and contact deposits) and Southern (bedded or blanket form of ore body) properties. These deposits were located from north at Lake Champlain south to Saratoga County, thus GPC is part of the southern area.

Graphite occurs in both crystalline and amorphous forms. The amorphous form is also crystalline but very fine grained. The crystalline variety is further categorized as flake, lump, chip, or dust. In New York State most of the graphite mined was of flake type and was classified by the size of the flakes, carbon content and impurities. Flakes more than 3 mm in diameter were rare.

The resulting graphite deposits were restricted to a stratum of quartzite or quartz schist ranging from 3 to 30 feet in thickness. These beds are traceable from Lake Champlain west to Johnsburg and from the Town of Hague, both in Warren County, south to Saratoga County. The graphitic rock does not exist as a continuous belt but in isolated patches that at one time probably did form a continuous bed. The rock has been folded and injected with various igneous rocks and faulted and dissected so that the deposits are irregular (Newland 1921).

At Graphite Products Corporation the graphite existed as a quartz–schist containing from 7.7 to 7.9% graphite, 73% quartz and trace amounts of biotite, mica, feldspar, serpentine, pyrite and apatite. There were two sets of workings, the quarry and the open pit. The deposits range in depth from 15 to 20 feet and are cut by several vertical faults.

Site Location

Graphite Products Corporation consists of the remains of the graphite mines and associated mill complex. The site is located about four miles north of Saratoga Springs, New York, in the Towns of Wilton and Greenfield, west of NYS Route 9. The property on which the GPC complex was built included 31 acres in the Town of Wilton and 118 acres in the Town of Greenfield. The construct of the site is essentially linear, connected by a dirt haul road formerly used for the mining and

Concentrating mill remains. Photographed by Suzette Usher.

industrial processes and existing today as a walking/logging trail connecting the contributing elements within the site. The elevation from the highway to the quarry rises from 343 to 649 feet above sea level.

Site Description/Process Flow

The following describes the extant physical features of the former GPC mining and industrial complex on the property. The order of the features mirror the mining and processing activities conducted on the site during operation. The locations of the activities reflect both the landscape and topography of the property: the mining areas are located at the highest elevations, transport by rail utilizes gravity, and the waterpower to the processing buildings exploits the down slope forces of the stream.

The main portion of the dirt haul road runs from U.S. Route 9 to the quarry. The road branches off above the dam and leads to the bottom of the concentrating, mill. To the southeast of the mine openings another branch leads to the top of the concentrating mill.

The Graphite Products mine and mill complex includes two bodies of water: one is an unnamed stream running east from the Town of Greenfield to U.S. Route 9 where it flows under the road continuing to Lake Elizabeth; and the other is the man-made quarry at the farthest northwest portion of the site which is now partially filled with water.

The quarry or open-pit mine is located in the northwestern portion of the site approximately 4300 feet from U.S. Route 9. The quarry runs east/west and measures 200 feet in length, 20 to 80 feet in width and 30 feet in depth. The western portion is now filled with water. The ore was hauled from the east side of the quarry by an inclined track using a small auxiliary or "donkey" engine and dumped into wagons for transport to the concentrating mill. At 200 feet to the southeast the road crosses a shallow trench. The first few feet are loosely lined with rock, and remains of what appears to be a later rail line are visible approximately 20 feet from the road crossing. Following the road 400 feet to the south are the openings to the mine. This area consists of an open pit 375 feet long with 12 inclines or non-vertical shafts (average height from 13-24 feet; average width 8 to 39 feet). These inclines were driven on a slope down to meet two horizontal drifts following the graphite body. These subsurface workings are now filled with water. Mill tracks were laid within.

To the north and parallel to the mine openings are the remains of the waste rock extracted from excavating the openings. From the eastern end of the mine the rail cars exited. Behind the mine openings on the southern side is located what may have been the powder house, comprised of a single layer of heavy stone 11 feet square with an opening (doorway) facing southwest. At approximately 200 feet to the south is a large level area measuring 40 by 60 feet supported on two sides by a heavy stone wall. This is the loading area. From this location there are two parallel rows of four each square stone/concrete footings, each measuring approximately 3 feet square by 2 feet in height. These appear to be the remains of the stone supports for the tram that delivered the ore from the mine to the concentrating mill. As in other mining complexes, the process made use of gravity by constructing the mill on the hillside.

The multi-level foundation made of stone and concrete measures 51 by 94 feet in diameter. Within the foundation are the remains of many concrete footings or supports for machinery and line shafting. To the east was a smaller addition measuring 32 by 39 feet possibly for stamp milling or the powerhouse. Attached to this was a smaller room 20 by 20 feet square made of rough laid stone. The mill water was supplied by a stream flowing past the mill to the south. The brook valley was dammed and received the tailings. The water was filtered through sand banks and reused (Alling 1917). The dam is located 1000 feet to the east of the mill and is constructed of earth, rock and wood. To the northwest

approximately 300 feet is the site of the former SGC quarry. This pit measures 75 feet east-west by 30 feet north-south, worked by Saratoga Graphite Company. To the east of the dam is the GPC finishing mill previously used by Saratoga Graphite Company as a concentrating mill.

This is a two-level foundation made of stone and concrete. A massive stone wall rises 10.5 feet from the stream bed and supports the lower level which measures 72.5 by 32.5 feet. The remains of several quartzite millstones are present. A concrete/stone wall showing wood impressions rises 7.5 feet to the upper level. A series of 12 threaded pins protrude from the wall evenly spaced near the top and below at floor level. To the east is another area measuring 35 by 14.5 feet and a still smaller foundation in the front measuring 7 by 6.5 feet. The walls here are in poor condition. The largest area on the upper level measures 54 by 14 feet. This area contains the partial concrete, stone and wood remains of what appears to be a steam engine mounting with a flywheel pit possibly used for line shaft belting overhead to operate processing equipment on the floor below. Adjacent to this are the remains of what appears to be a graphite storage bin. It is possible that a drying kiln, boiler room chimney or furnace may have been located on this same level, as the remains of refractory type brick are scattered about. An earth and riprap wall 5 feet high supports the road above.

Across from the finishing mill are the remains of the storage/loading area. In this area the graphite was sorted and stacked by grade, ready for shipment by horse and wagon and later by truck down to Route 9 and the trolley to Saratoga Springs (Petteys 1998). Different grades of graphite and the partial remains of wooden pallets and asphalt shingles were recovered here. Adjacent to this are the remains of the rooming house. The foundation consists of a small concrete boiler room and a larger cellar hole. Window glass, asphalt, brick, coal, ash, chimney tile, lamp glass, ceramics, broken bottles and cutlery were found to the rear of the foundation. The road continues east down to US Route 9.

Concentration Process of Flake Graphite

The greatest problem facing the graphite mine owners of the Adirondacks was the separation of the flake graphite from its associated gangue minerals without destroying the flakes or unduly reducing them in size. This is difficult as crushing forces small grains of gangue into the graphite. The process calls for long experience and mechanical ingenuity. Numerous failures were attributed to the separation process. In addition, the character of the ore could change as mining operations proceeded. This separation process is divided into two stages: "concentration" and "refining." Most commonly the concentration was performed at the mine site and the refining at another location. GPC was one of only three mines in the southern Adirondack area (the others being the American Graphite Company in Hague and the Flake Graphite Company in Porters Corners) that carried out both separation stages at the mining location (Alling 1917). The separation of ore from gangue was based on the distinctive physical and chemical characteristics of each. Some of these characteristics are differences in specific gravity, electrical conductivity, selective behavior of a mixture of water and oil upon the surface tension or upon the magnetic properties of the ore and gangue material. As a result of the separation process, the lighter graphite material was saved and the non-

Buddle components at concentrating mill. Photographed by Suzette Usher.

usable gangue was discarded.

The specific gravity method of ore concentration is subdivided into the wet and dry process. Both methods require that the ore, as it comes from the mine, be reduced to a pulverized condition. This was achieved by the use of crushers and stamps. The crushers reduced the ore to one and one half to three-inch pieces. From the crushers, the ore was sent to the stamps. A stamp is a heavy cam pestle that is raised in a huge iron mortar by steam or other power working; when dropped, the stamp or pestle creates a finely crushed ore. There were 3 banks of 5 stamps each in operation at GPC in 1918 (Clark 1918). GPC used the wet process, as did most of the other Adirondack mines. In this process the crushed rock is mixed with water and fed to a series of buddles. Buddles are circular tanks three and a half to four feet in depth and 16-18 feet in diameter. The buddle has a slightly convex bottom so the floor of the tank slopes in all directions from the center to the outside. A vertical shaft in the center carries a tub up to three feet in diameter with a perforated bottom.

The mixture of water and ore is fed into the tub by a stationary sluiceway or launder. The ore enters the buddle at the center and is carried to the sides by the water that escapes through specially arranged openings. This process was controlled either by manually operated valves or wooden stoppers. The actions of paddles or brushes that are attached to two horizontal arms secured to the center shift assure the even movement and distribution of the layers of slime. These revolving brushes or paddles lightly rub the surface of the material and gradually slide up the center shaft as the buddle is filled. The graphite flakes, due to their low specific gravity and flaky, scaly nature, are mainly floated to the sides, and the heavier minerals drop near the center of the tank. It could take several hours to fill a buddle so usually a series of them were used; while one was filling, another was emptied. After the tank was filled with the materials, it was allowed to partially dry and was shoveled up. An account written by Wilford C. Ross (1976: 19) about the graphite mine in Hague mentions "…. shoveling buddles was hard labor. Men received about five cents per hour. At times finishing in six hours...conditions in the mill were so dusty that it was hard to identify a fellow worker."

The outer portion nearest the wall of the tank was usually clean. The inner portion consisting of sand tailings was not used, and the middle portion containing both graphite and gangue material was passed to the next buddle for further concentration. Two to three buddles usually made up one set and the same number made up a second set. The buddle concentrate was further treated using revolving screen wheels. These were hexagonal and covered with screens of various mesh sizes. The reels were inclined slightly; the ore fed into one end, and the concentrates were thrown out the other end as the reels rotated. Jets of water directed against the outer part of the reel helped to separate the graphite and impurities that, because of their small size, passed through the screen and were discarded. The seconds are sometimes reground to remove the quartz and feldspar grains and sent through the screens again. The graphite was then dried by either direct or steam dryers.

In 1918 the Adirondack mines, including GPC, started substituting oil flotation for the buddle. The addition of oil to a combination of water and air separated the graphite from the gangue. This effected an increased saving of the graphite and reduced the amount of mica admixed with the product. The product was now ready for the refining mill (Newland 1919).

The Hooper pneumatic concentrator or air jig, manufactured at the Ticonderoga Machine Company, was the machine used in the final treatment of the graphite concentrates. This machine eliminated problems caused by the need for pumping large quantities of water and ore separation residues/waste in freezing weather; however, one disadvantage was its small capacity. Supposedly one man could tend six machines. Because the Hooper concentrator did not require the use of water, it enabled the company to work later in the season. The concentrator consisted of an inclined frame over which a broadcloth screen was stretched. A device below delivered a continuous series of air pulsations. Two sets of strips were placed over the cloth screen; the lower group inclined toward one side and the other inclined in the opposite direction "…and when (concentrates) composed of particles of different gravities are fed upon the (screen) the pulsations through the broadcloth…cause the heavier mineral particles to be thrown (settle) to the bottom…and are thus guided…toward the tailing side of the (concentrator)" (Alling 1917: 131). The clean graphite was guided by the upper set to the opposite, or concentrating side. This further separated the gangue and the ore. The presence of several quartzite broken mill or burr-stones suggests that these stones may have been used to reprocess the waste rock to free additional flakes of graphite.

Decline

During 1916 and early 1917 the amount of imported graphite from Ceylon, Madagascar and Korea was about eight times the domestic production. Of this, 90% was used in crucible manufacture. Open pit mining requiring only cobbing or washing for milling, lower labor costs, and high grade deposits found on Ceylon and Madagascar made the importation of foreign graphite very economical. The use of these imports was unrestricted until 1917 when the US entered World War I. During the winter of 1917-18 with freight conditions congested, an embargo against shipment of domestic graphite was ordered. This remained in force until early March 1918. This caused a stagnation of the domestic mining industry. Even so, 1919 production stood at 3,266,518 pounds of graphite, the highest amount in its history (Hartnagel 1927). The removal of freight restrictions was followed in April by a complete embargo on imports until July of 1918. On July 2 the embargo was extended until the end of 1918. At that time the War Industries Board made the request that 20% domestic graphite be used in crucible manufacture, and in 1919 this was increased to 25%. The board also required that applications made for import licenses by manufacturers not complying with the provisions of the request, not be approved by the board.

Before the declaration of war in 1914, all crucible makers in the US used clay imported from Bavaria. Little work had been done on domestic or English clay and with the supplies

being cut off during the war, the industry was forced to find alternative methods or supplies. This did not prove to be a serious obstacle; however, even in the course of experiments, no great success resulted in the use of more than 25% domestic flake graphite in crucible manufacture. It was hoped that the improvements in the brass and steel manufacturing production would be on a firmer basis than many small companies only producing crucible stock (Dubb 1920).

The mining of graphite in New York State, at one time one of the leading states in graphite production, came to a standstill in 1921. Although no production statistics are given for the last three years of mining, in 1919 the value of graphite produced in New York exceeded that of any other state. In 1920 New York's production was second only in the value of graphite sold, the other being Alabama, with only two mines in operation. In 1921 only one firm reported production. The suspension of graphite mining was simply due to the low price of the product. This seriously affected the industry throughout the United States. In 1918, 42 operations were reported and in 1923 only 7 (Hartnagel 1927: 42, 43). Low import prices made local milling costs prohibitive: 4 to 5 cents a pound, duty paid, compared with domestic prices from 14 to 18 cents per pound to produce. From 1937 to 1942 a deposit near Pope Mills, St. Lawrence County, N.Y., operated in a small way, but new explorations gave no indication of quantities needed to be profitable and by 1942 all operations ceased (Harrison 1955: XXII-5-6).

According to tax records, between 1915 and 1922 the GPC included 31 acres in the Town of Wilton and 118 acres in the Town of Greenfield. The owners paid taxes on the land, machinery and structures [buildings] to both towns (Saratoga Tax Records 1917-1922). Exactly when GPC stopped mining and processing graphite in Wilton is not known. The tax records include GPC until 1929, although the property values and listing of the mines, mill and machinery are no longer mentioned after 1920, the year of the highest taxes collected (Saratoga County Tax Records 1915-1924).

Final Thoughts

Research on this project started in the early 1990s when I made a wrong-turn while walking with a friend to see the frequented massive graphite mine openings. There on the side of the trail were two large, circular, metal objects. Behind these were the ruins of a large foundation. Little did I know that this was part of a large mining and milling complex, a part of the greater Adirondack graphite mining industry.

Ongoing research continues in hopes of promoting the history and preserving the site as part of our industrial archeological heritage.

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