Economic Geology of the Hudson River Valley

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INTRODUCTION

The purpose of this field trip is to examine some of the economic uses of the rock and mineral deposits of the Hudson River Valley, and to discuss the importance of economic geology in helping to bring these commodities to the market. The area we will study has a wide variety of economic deposits and mining operations, all of which are related to the construction industry. This is in part due to the location near major metropolitan markets and the presence of a major transportation route, the Hudson River, but is basically controlled by the nature and location of the geologic deposits.

During this trip four sites will be examined, each producing a different product, and each with a different geologic setting that must be considered in the mining process. The sites to be visited are Norlite Corporation, Cohoes, New York, producing lightweight aggregate; Atlantic Cement Co., Ravena, New York, producing portland cement; Callanan Industries, Port Even, New York, producing construction aggregate; and another portion of the Callanan property producing sand for bituminous concrete.

There is a long history of geologic work in the Hudson River Valley, going as far back as Amos Eaton in the first quarter of the 1800's, which has led to a large volume of geologic studies and innumerable field trips. This guidebook draws principally from three previous trips, the 33rd New York Geological Association trip in 1961 (Dunn & Rickard, 1961), the 61st New England Intercollegiate Geologic Conference in 1969 (Brown & Cutcliffe, 1969), and the 14th Annual Forum on the Geology of Industrial Minerals in 1978 (Banino & Brown, 1978).

GEOLOGIC SETTING

The geologic units to be studied on this trip include the Ordovician Snake Hill shale, the Silurian and Lower Devonian units which form the Helderberg Group, and Pleistocene glacial deposits. The Snake Hill and associated basinal shales such as the Normanskill shale form the bedrock floor of the Hudson River Valley and are exposed over wide areas where they are not covered by glacial deposits or recent alluvium. Along the west side of the valley are a prominent series of hills known as the Helderbergs which form a major escarpment from Schenectady south to about Catskill, New York. From this point south, the Helderberg formations form a less prominent scarp which is overwhelmed by the Devonian sandstone and shale of the Catskill Mountains which rise majestically behind them. Overlying the rock units are a wide variety of glacial deposits including till, varved clay, sand and gravel, and aeolian sands.

The rock units to be observed during the trip range from the Ordovician Snake Hill shale through the Devonian Esopus shale. These units, with some minor changes, persist from Albany to Kingston at which point they become separated from the Hudson River by the abrupt rise of the Silurian Shawangunk quartzite which forms the sharp ridge known as the Shawangunk Mountains. The structures are dominated by thrust features indicating compression from the east. The deformation becomes more intense southward, so that at Atlantic Cement the structural features consist of low-angle thrust faults and broad, open folds, while at the Callanan quarry the structures consist of both low and high-angle thrusts and tight complex folds. The regional strike is north-south to northeast-southwest with an overall dip to the west, under the Catskills.

BEDROCK STRATIGRAPHY

The stratigraphy covered in this trip has been studied by many workers, but is based largely on work by Cutcliffe, Dunn, Bird and others during the early 1960's in a number of quarries in the Hudson River Valley. Other sections were studied and measured to gain a more complete understanding of the stratigraphy. A synopsis of the stratigraphy is presented in Figure 1. Additional more detailed work by LaPorte, Rickard and others has been carried out since that time to interpret the depositional environments and stratigraphic relationships.

SNAKE HILL SHALE

The Snake Hill shale is a dark gray to black, somewhat silty shale with occasional beds of laminated siltstone. It is a thick sequence, estimated to be 3000 to 4000 feet thick, of basinal sediments that is well exposed during low water in the Cohoes gorge of the Mohawk River. The Snake Hill, of late Middle Ordovician age, is slightly older than the Normanskill formation which underlies the Helderberg sequence near Ravena and Kingston, New York.

Because of its more uniform nature, the Snake Hill is suitable for production of lightweight aggregate, whereas the Normanskill with chert and graywacke beds would not provide a consistent product for the manufacturing process.

RONDOUT FORMATION

The Upper Silurian Rondout formation has varying units of dolomite, magnesian limestone and limestone that formerly were extensively mined to produce natural cement. The formation is characterized by buff-weathering greenish-gray, magnesian limestones which in the field trip area lie with sharp unconformity over the Ordovician Normanskill shales. Thickness decreases to the north. In the vicinity of Rosendale, the thickness of the unit is almost 50 feet and at the quarry about 40 feet. To the north at the Atlantic Cement quarry, the unit averages three to five feet.

FIGURE 1

STRATIGRAPHY AND USE OF FORMATIONS IN THE CENTRAL HUDSON VALLEY

Age	Formation	Lithology	Uses
Lower Devonian	Esopus	Shale to sandstone	Lightweight aggregate, portland cement*
	Glenerie	Quartzose limestone to sandstone	Coarse aggregate
	Connelly	Sandstone	Coarse aggregate
	Port Ewen	Calcareous siltstone to shale	Coarse aggregate
	Alsen	Limestone	Coarse aggregate, portland cement**
	Becraft	Limestone	Coarse aggregate, portland cement
	New Scotland	Calcareous shale to limestone	Coarse aggregate, portland cement**
	Kalkberg	Limestone	Coarse aggregate, portland cement**
	Coeymans	Limestone	Coarse aggregate, portland cement
	Manlius	Limestone	Coarse aggregate, portland cement
Late Silurian	Rondout	Dolomite to magnesium limestone	Coarse aggregate
Ordovician	Snake Hill Normanskill	Graywacke and shale	Lightweight aggregate

* Used as an additive for alumina

** When blended with the more pure Manlius, Coeymans and Becraft limestones

In the Kingston-Rosendale area, the Rondout is divided into four members. From bottom to top they are the dark gray Wilbur limestone (3-15 feet), the greenish-gray Rosendale magnesian limestone (17-27 feet), the dark gray Glasco limestone (10-15 feet), and the greenish-gray Whiteport magnesian limestone (9-14 feet). The Rosendale and Whiteport members are the classical "water-limes" that were extensively mined underground in the Rosendale area.

MANLIUS FORMATION

The Manlius formation is divided into the Thacher, Olney, Elmwood, and Clark Reservation members in the Mohawk River Valley. However, only the lowest member, the Thacher, is present in the Hudson River Valley, and the following discussion refers only to the section to be observed on this trip.

The Manlius consists of interbedded dolomitic "ribbon" limestones, and dark gray, pure, massive to biostromal limestones. Primarily for mining control in the cement quarries, this formation has been subdivided into units designated from bottom to top as M-1 through M-6. At the Atlantic Cement quarry, where the entire formation is mined for cement limestone, the Manlius is 52 to 55 feet thick. At another cement quarry in East Kingston, the Manlius is 52 feet thick but only the M-3 through M-6 units are used for cement limestone.

The M-2 and M-5 units reflect Rondout-type lithologies, being light-gray, "ribbon" bedded, magnesian limestones. The two to four-foot thick M-5 unit is a distinctive marker horizon in most outcrops and quarries where it is present.

COEYMANS FORMATION

The Coeymans is a pure, bluish-gray, medium to coarsely crystalline limestone that forms prominent ledges along the Helderberg escarpment. It lies between the dark gray, finer grained M-6 unit of the Manlius and the chert beds of the overlying Kalkberg formation. The unit is generally massive-bedded, with individual beds recognized only with difficulty. White calcitic crinoid stems, locally silicified, are common.

The upper contact with the Kalkberg is gradational, but determination of the contact is important for cement chemistry control. The contact is placed at the base of the first horizon at which black chert beds are spaced about a foot aprt. This closely approximates a sharp change in silica content, from about 10 percent below to about 25 percent above. At Atlantic Cement, the Coeymans is 28 feet thick, and occasional black chert nodules and discontinuous chert beds are included at the top of the formation. At Callanan, the Coeymans is 20 feet thick and little if any chert is located below the lowest, nearly continuous chert bed.

KALKBERG FORMATION

The Kalkberg ranges from a bluish-gray, chert-rich limestone to gray, fine grained, argillacesous limestone. Primarily on the basis of lithology, the formation has been divided into four members in the field trip area; the Lower and Upper Hannacroix, and the Lower and Upper Broncks Lake.

The Lower Hannacroix is the dominant bluff-maker of the Helderberg Escarpment and is readily recognized by the prominent black chert layers spaced about one foot aprt. The rock is massive-bedded and is finer grained and darker than the underlying Coeymans. It ranges in thickness from 11 feet at Atlantic Cement to 18 feet at the Callanan quarry.

The Upper Hannacroix is a fine-grained, fairly massive, gray limestone with anastomosing argillaceous partings which give a "tennis net" appearance on weathered surfaces. This unit does not contain layers of chert, but has numerous small nodules of black and dark gray chert nodules. With the absence of chert, this unit is similar in appearance to the Coeymans, though it is generally finer-grained. The top of this unit is marked by the first appearance of a dark gray, euxinic shale bed, about two feet thick, containing pyrite nodules and small brachiopods. Thicknesses range from 10 feet at Atlantic Cement to 18 feet at Callanan.

The Lower Broncks Lake has fine-grained, bluish-gray limestone beds one to three inches thick interbedded with one to two-inch beds of calcareous shale. Fossils are abundant in this unit and encrusting bryozoans are common. Thicknesses range from 15 feet at Atlantic Cement to 14 feet at Callanan.

The Upper Broncks Lake is a fine grained, bluish-gray limestone with beds from three to over twelve inches thick and fewer shale layers than the underlying unit. One to three thin, black to dark gray chert layers occur near the base. Thicknesses range from 30 feet at Atlantic Cement to 27 feet at Callanan.

Although the lithology of the Kalkberg varies, the chemistry of the formation is fairly consistent. A silica content of from 25 to 30 percent is found regardless of whether it is in the form of bedded limestone and chert, shale and limestone layers or argillaceous limestone. The top of the Kalkberg marks a distinct change in chemistry, with silica jumping from less than 30 percent in the Kalkberg to nearly 50 percent in the New Scotland.

NEW SCOTLAND FORMATION

The New Scotland can generally be described as an alternating, medium gray, very fine grained, impure limestone and dark gray calcareious mudstone with varying amounts of chert and pyrite. There is a significant facies change in this formation along the Hudson River Valley. To the north, near Atlantic Cement, it is generally a calcareous mudstone while to the south, near Callanan, it is generally a more or less argillaceous limestone. In both cases, the lowest beds are chemically a calcareous mudstone or siltstone having less than 45 percent total carbonate. The uppermost beds become more calcareous and coarser grained as they grade into the Becraft formation. The contact with the Becraft is placed at the first appearance of a green shale layer. Thicknesses vary from about 98 feet to the north and about 100 feet to the south. In the Kingston area, the formation is divided into ten subunits, each about ten feet thick.

BECRAFT FORMATION

The Becraft is an easily recognizable formation consisting of very coarse grained, light gray to nearly white, pure limestone with more or less pink calcite. It is very massive, forming prominent ledges, and bedding is often difficult to distinguish. Locally, gray chert occurs near the base and top of the formation. While it frequently forms ledges, it also often underlies extensive wetlands, lying between high hills formed by overlying sandstone and shale formations.

Thicknesses range from 45 feet at Atlantic Cement to about 37 feet at Callanan. It is the formation with the highest carbonate content in the central Hudson River Valley, with over 90 percent total carbonate. Magnesium oxide comprises from less than one or two percent of the rock. This high purity led to the excavation of many pits by early miners who used the Becraft for agricultural limestone and cement.

ALSEN FORMATION

The Alsen forms the top of the Helderberg sequence and is present from near the Town of Catskill on the south. It is a medium to dark gray, cherty limestone with interbedded, thin, shaly partings. It is somewhat similar in appearnce to the Lower Hannacroix of the Kalkberg. At Atlantic Cement, the Alsen is absent, and the Becraft is directly overlain by the brownish-dark gray Glerie sandstone. At Callanan, the Alsen is 20 feet thick. In the cement quarry in East Kingston, it is mined along with the Becraft for cement limestone.

PORT EWEN FORMATION

The Port Ewen forms the base of a group known as the Tristates Group which lies below the Onondaga Formation. It is a medium to dark gray cherty argillaceous limestone to limy siltstone. Locally, it becomes very siliceous, and black chert occurs as bands and nodules. It is similar to the New Scotland formation but is almost barren of fossils. From a thickness of about 150 feet at its type section near Kingston, it thins rapidly northward. At Callanan, the unit is about 100 feet, and only a few feet remain at Atlantic Cement.

CONNELLY FORMATION

The Connelly is a coarse grained, white to light gray quartz sandstone. It is locally conglomeratic and has an argillaceous matrix. Iron, as pyrite, is common and occasionally serves to cement the grains. The formation, over 15 feet thick at Kingston, thins rapidly to the north. At Atlantic Cement, it is represented by a few feet of sandy limestone.

GLENERIE FORMATION

The Glenerie is a thin, cherty, siliceous limestone containing Oriskany fossils in the lower central Hudson Valley. It ranges from 5 to 110 feet thick, thinning rapidly to the north. The unit is only a few feet at Atlantic Cement.

While the formations from the Rondout through the Becraft change only slightly from East Kingston to Ravena, the overlying formations, the Alsen, Port Ewen, Connelly and Glenerie change dramatically. From a full, well developed sequence at the Callanan quarry, they thin rapidly to the north so that the approximately 250 foot Hudson section is represented by only about 5 feet of rock at Atlantic Cement. Here, there are about 2½ feet of cherty, quartzose limestone immediately above the Becraft which have elements of the Alsen and Port Ewen. The next 2½ feet are sandy, fossiliferous, calcareous siltstone having elements of the Connelly and Glenerie. The Glenerie-Connelly formation equivalent in the Ravena area is mined as a decorative building stone. It is locally known as "fossil rock" and is used as a facing stone on many local structures.

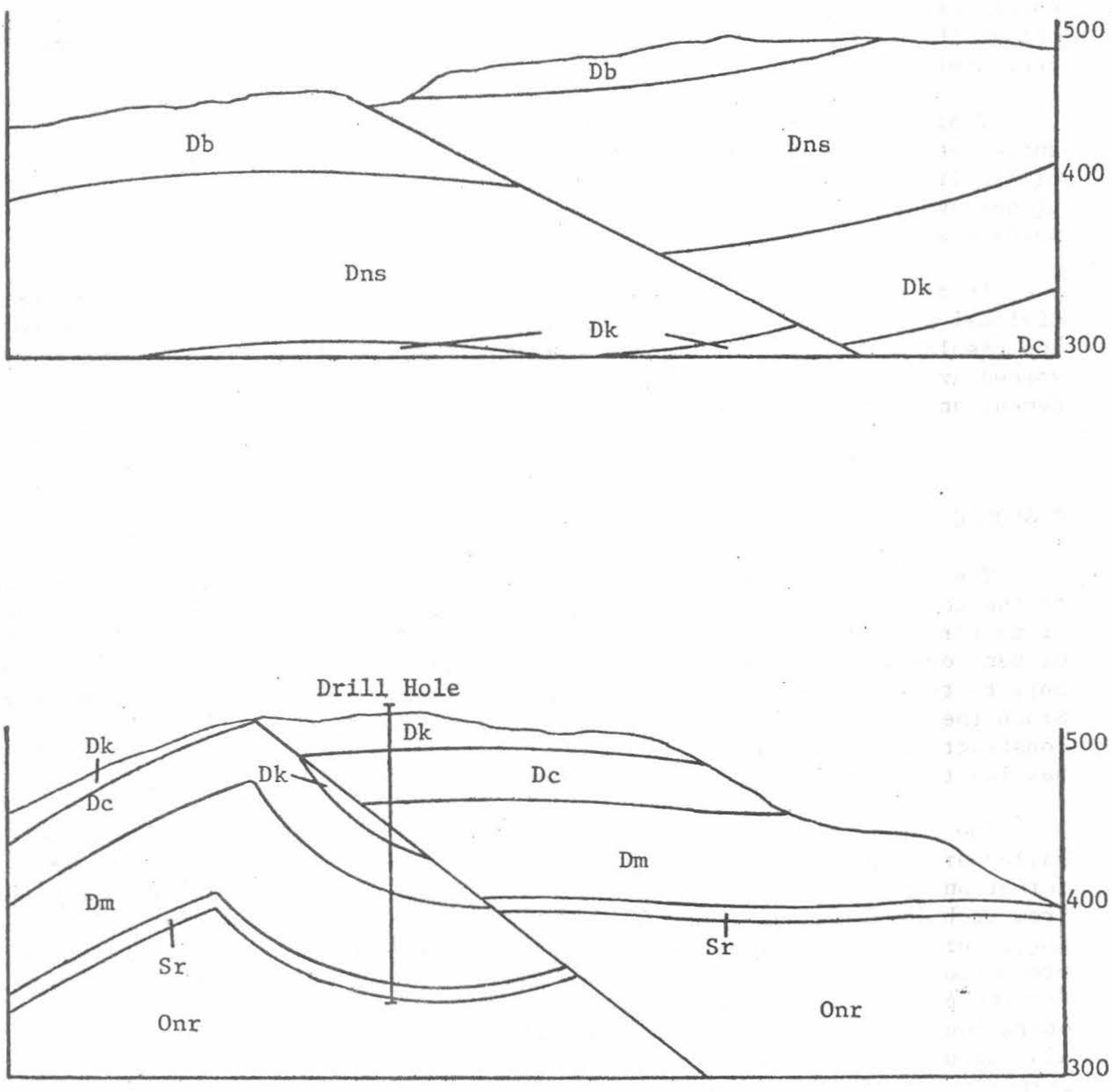
ESOPUS FORMATION

The Esopus is a dark gray, silty shale to shaly siltstone that forms gentle to steep slopes above the Glenerie limestone. The lower portion of the unit contains occasional beds of silty limestone and in general is somewhat more calcareous than the remainder of the unit. Commonly, it is a monotonous sequence of shale that ranges in thickness from 120 feet near Callanan to 150 feet at Atlantic Cement.

STRUCTURES OF THE CENTRAL HUDSON RIVER VALLEY

Underlying the Helderbergian formations is the thick sequence of shale and sandstone known as the Normanskill Shale that is highly folded and faulted. Separating the carbonates from the Normanskill is a sharp unconformity that can be considered a decollement. Deformation increases in intensity at the contact, and the lowest Rondout is locally fractured and thickened by thrust faulting. The Helderbergian units were under compression from the east, giving a general north-south strike to the structures. Intensity decreases to the north.

FIGURE 2



Scale 1" = 100'

TYPICAL HUDSON VALLEY-TYPE
FOLD-THRUST FAULT STRUCTURES

These sections show typical fault-fold relationship in the field trip area. Note in the lower section that the size and even the presence of the syncline under the thrust fault is not indicated in surface outcrops. The stratigraphic relationships at the surface actually suggest normal faulting.

Normal faulting is seldom encountered, although the outcrop pattern and topography created by high-angle reverse faults locally may resemble normal fault geometry. Similar structures persist from south to north, though the intensity of folding and displacement along the faults generally decrease.

Typical fold-fault structures in the Helderbergian rocks consist of an anticline thrust over its adjacent syncline so that in plan view two anticlines lie next to each other, separated by the fault. In some cases, the hidden syncline may be very large, but the size may not be determined from surface evidence alone.

In areas of particularly intense deformation, local thickening of individual beds can occasionally be found. This increase in thickness is not the result of "plastic" flow, but rather of slight offsets along closely spaced axial cleavage planes. An example of this is exposed at Atlantic Cement and such structures have also been observed at Callanan.

ECONOMIC GEOLOGY

The use of rock materials in the central Hudson River Valley is related to the construction industry: limestone for cement, limestone and some sandstone for coarse aggregate, and shale for lightweight aggregate. The location of many operations along the Hudson River enables low-cost transportation not only to the New York metropolitan area but to the southeastern U.S. and beyond. Since the early 1960's, when many facilities such as Atlantic Cement were constructed, the decreasing demand for construction materials in the Northeast has led to the closing or sale of several cement plants.

The principal economic uses of the formations in the central Hudson Valley are shown in Figure 1. The high-lime Manlius, Coeymans and Becraft formations are used for the manufacture of cement with some additional blending from such low-lime units as the Kalkberg, New Scotland and Alsen. All of these formations, as well as the Port Ewen and Glenerie, are used for the production of aggregate. The Esopus shale has been used by three producers for the production of lightweight aggregate, however, only one remains in operation today. The more uniformly shaly portion of the Snake Hill also used by one producer for the manufacture of lightweight aggregate. Formerly extensive operations in the Rondout formation utilized the dolomitic limestone members for natural cement, chiefly from underground mines that extended from East Kingston to Rosendale. The last operation closed in the 1960's. These beds occur in strongly overthrusted structures and sometimes very steep folds. Interestingly, the New York Thruway passes over the Rondout across one of the few stretches in many miles where there had been no mining.

STOP 1 -- Norlite Corporation

The Norlite Corporation, a subsidiary of P. J. Keating Co., Lunenburg, Massachusetts, produces expanded shale aggregate, or lightweight aggregate, by a rotary kiln process. The property consists of the deep quarry and manufacturing facility. The Snake Hill shale which is quarried is overlain by glacially derived overburden consisting of clay, silt, and cobbles, which are stripped off prior to drilling and blasting.

Geology

The Snake Hill is a thick sequence of shale with occasional mudstone and sandstone beds. As revealed in the quarry and drill core, the rock is a monotonous sequence of medium dark gray to dark gray, very fine grained shale with occasional thin beds of convoluted mudstone or very fine sandstone. Overall, bedding dips about 50 degrees to the southeast and cleavage dips about 60 degrees to the southeast.

Close inspection of the quarry reveals more detailed structural features. Where bedding is sufficiently apparent, the noses of isoclinal folds can be observed, particularly where the rock is more of a siltstone than a shale. Along the west wall of the quarry, one of several faults can be observed. This fault cuts the rock at a lower angle than either the bedding or the cleavage. The age of the faulting is not known.

Manufacturing

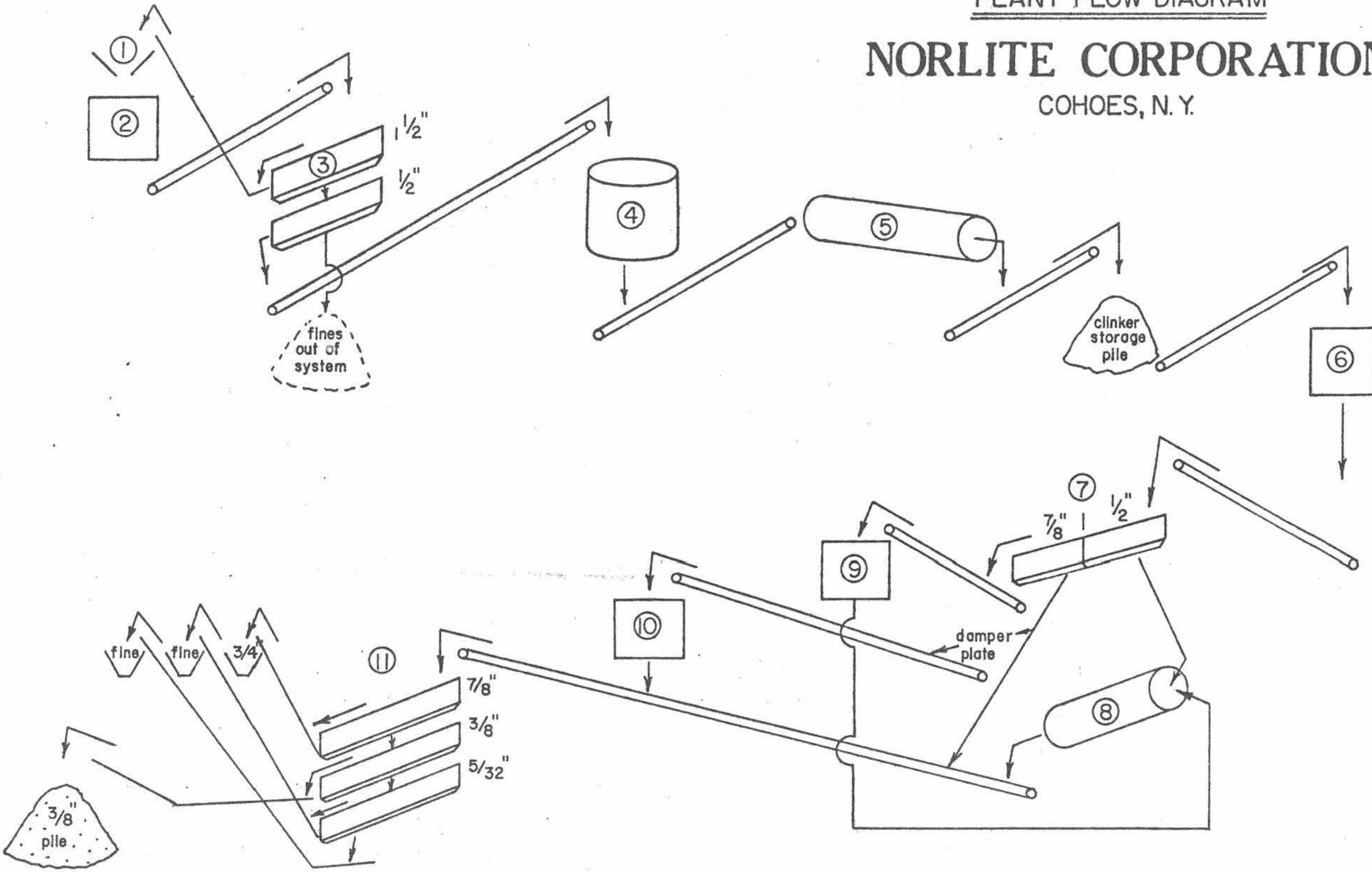
Norlite lightweight aggregate is a manufactured product in which crushed shale is expanded to produce an aggregate used, normally, for Portland cement concrete. The advantage of this product is its reduction in weight as compared to normal weight aggregate. This allows the production of lightweight concrete, either for small structures to be moved by hand, such as concrete blocks or curbing, or for structural concrete, particularly in tall buildings where there is a considerable savings in reducing the total weight of the building. Typically a cubic foot of Norlite coarse aggregate weighs 45 pounds compared to about 100 pounds for regular weight concrete.

Expanded shale aggregate also has several other properties that make it attractive for specific uses. Because lightweight aggregate contains very small separated air cells, it has enhanced insulatory value. The air cells greatly enhance the thermal resistance (R value) of concrete, so that lightweight aggregate concrete has the capability of providing over twice the thermal insulation of normal weight concrete. Also, because all combustible material has been burned out in the manufacturing process, the fire resistance of lightweight aggregate concrete is greater than that for natural aggregate concrete.

PLANT FLOW DIAGRAM

NORLITE CORPORATION

COHOES, N.Y.



(1) Kennedy Van Saun Pan Feeder

(2) Kennedy Van Saun 150 hp., 36" x 48" Impact Crusher, 2" Setting

(3) Kennedy Van Saun Two-deck Screen

(4) 35' High, 35' Wide Silo

(5) # 2 Kiln, 11' x 175'

(6) Kennedy Van Saun 20 hp., 20" Single Roll Crusher, 3/4" Setting

(7) Single Deck, Multisize Screen

(8) 150 hp., 5 x 12 Ball Mill, 3/8" Setting

(9) Kennedy Van Saun 40 hp., Impact Crusher, 3/4" Setting

(10) Frontier Crusher 18" Double Roll Crusher, 3/8" Setting

(11) 2-3 Screen Decks With Same Screens
- a) Simplex 6 x 12 Deck
- b) Kennedy Van Saun 5 x 14 Deck

The basic process in expanding shale is the introduction of crushed shale into an oil fired rotary kiln where temperatures in the burning zone are maintained between 2000 and 2100 degrees Fahrenheit. At this temperature the shale reaches what is known as the point of incipient fusion where the shale is in a semiplastic state and gasses are generated by the breakdown of carbonates and oxides. The gasses are generated but contained within the semiplastic mass, expanding the shale and creating individual non-connecting air cells. As the material is passed out of the kiln, it is air quenched to form a vitreous clinker that is then recrushed and sized to make the final product. Figure 3 is a plant flow diagram of the Norlite process.

STOP 2 -- Atlantic Cement Company

Atlantic Cement went into production in 1960 following detailed geological analysis which preceded the investment of $44,000,000. There are three major quarries on the property: the Becraft quarry, the North Coeymans-Manlius quarry, and the South Coeymans-Manlius quarry. Adjacent to these are several other mining faces, including the high face of the Esopus shale and lower benches in the Kalkberg. The Becraft and Coeymans-Manlius quarries provide the high-calcium limestone for cement while the Esopus face provides an alumina additive and the Kalkberg is stripped to gain access to the Coeymans-Manlius.

The Kalkberg is a New York State Department of Transportation-approved coarse aggregate source. However, an aggregate processing plant has never been established here. Because the Kalkberg that is being removed is a future resource, it is placed separately in stockpiles for possible future use. The top of one of these stockpiles is undergoing reclamation, though it is realized that it may be disturbed later.

The Coeymans-Manlius face is excavated from a few feet above the Rondout-Manlius contact, to avoid incorporating the dolomitic Rondout in the shot, to about ten feet above the Coeymans-Kalkberg contact. Silica from the Kalkberg requires some adjustment of the design mix, but this increases reserves and decreases the amount of Kalkberg that must be removed.

Stop 1a

The walls of the access ramp of the North Coeymans-Manlius quarry expose a complete section from the Rondout to the Lower Hannacroix member of the Kalkberg formation. The contact of the Rondout with the underlying Normanskill shale is at the water level of the sump at the bottom of the ramp. The Rondout can be seen to be about four feet thick, increased over its normal two foot thickness by faulting. The Manlius units and Coeymans are well exposed along the ramp. Note the gradational contact of the Coeymans and Lower Hannacroix near the top of the ramp where chert can be seen on both sides of the contact.

Stop 1b

The full section of Becraft is exposed in the Becraft quarry. The lower contact is gradational but can be placed about two feet below a discontinuous blue-gray chert horizon that can be found on the face. The high shale face above the Becraft is in the Esopus formation which is used as an alumina and silica source. Below the Esopus, the upper two feet of the Becraft face in places reveal the remnants of the Alsen, Port Ewen, Connelly and Glenerie formations that are fully developed at the Callanan quarry.

A high-angle thrust fault, with relatively minor displacement, is located at the north end of the quarry. The area around this quarry has well developed synclinal ridges, with the youngest unit, the Esopus, forming the ridges and the high-carbonate Becraft forming the valleys which occasionally contain wetlands.

Stop 1c

The access into the South Coeymans-Manlius quarry displays a complex local structure. This exposure is at the northern end of a major thrust fault, at the point where the displacement is small enough that the rock has failed by folding rather than by faulting. The black chert bands of the Lower Hannacroix mark the asymmetrical anticlinal fold. However, the bedding is largely obscured by very well developed fracture cleavage. There is marked thickening of the beds along the fold crest as a result of slippage along the cleavage surfaces.

POINTS OF INTEREST -- New York State Thruway

Thruway
Markers

123.7 The slope of the road climbs the Helderberg Escarpment passing from the Normanskill to the Helderberg group.

122.0 East Side. Lower Hannacroix member of Kalkberg formation; note black chert bands. West Side. Long cut contains all units from Manlius through New Scotland in a very complex structure.

120.6 Kalkberg formation.

120.3 New Scotland formation.

120.1 Becraft formation.

119.2 Esopus formation. Note the difference in weathering response between the clean Becraft limestone road cuts and the highly fragmented Esopus shale cuts. The latter indicates a high sensitivity to wet-dry or freeze-thaw alternations. A breakdown of the fine material at the base of a cut is an almost certain indication that the rock is unsuitable for use as crushed stone.

118.9 Becraft formation, steeply dipping.

118.4 New Scotland through Becraft.

117.7 Esopus formation.

117.0 Onondaga formation. Note chert layers.

116.4 Highly fractured Becraft. These calcite-healed fractures suggest nearness to a thrust fault.

116.0 Note long, north-south lake on right. Structure and stratigraphy suggest the lake marks the position of a thrust fault, a common occurrence in this area.

113.8 East Side. Note New Scotland faulted onto New Scotland.

113.7 Becraft above New Scotland. The bridge crosses Austin Glen, the type locality of the Austin Glen member of the Normanskill formation.

112.9 Esopus below Schoharie.

111.9 Schoharie. The cut in the median strip is synclinal.

111.5 Esopus-Schoharie-Onondaga.

110.1 Schoharie-Onondaga.

109.8 Cut east of Thruway. Esopus with lowest portion high in bedded chert.

109.1 Esopus below, Schoharie above with broad transition zone.

108.0 To east of Thruway lie three cement plants clustered in the beds of the Helderberg group. South to north they are: The Alpha Portland Cement Company; The Lehigh Portland Cement Company; and the Marquette Cement Manufacturing Company.

103.8 Port Ewen formation above Becraft. Note the large blocks that break loose from the face of the road cut. These are known to engineering geologists as wedge failures. These bedding plane and joint intersection problems have largely been eliminated by pre-split blasting of the final face.

STOP 3 -- Callanan Industries, Inc. - Port Ewen Crushed Stone Quarry

The Port Ewen quarry is owned and operated by Callanan Industries, a subsidiary of Penn Dixie Corporation. The principal product is New York State Department of Transportation approved coarse aggregate (crushed rock). Within the past five years a small fine aggregate (sand) operation was initiated to produce asphatic sand for the company's asphalt plant located on the property.

Two crushed stone products are produced; high friction bituminous concrete aggregate, and portland cement concrete aggregate. The reserves are within the Lower Devonian Helderbergian rock units.

High friction aggregate is specified by the New York State Department of Transportation for use in top coarse asphaltic concrete pavements to obtain an aggregate that does not polish when exposed to heavy traffic. High friction aggregate specification requirements are divided into non-carbonate and carbonate rock types. Most noncarbonate high quality rocks such as granites, diabases, and quartz feldspar gneiss, can be used as high friction aggregate and also as a 20% blend to upgrade high quality aggregate that does not otherwise meet the high friction aggregate specifications.

The second classification, carbonate rocks, which the entire Port Ewen quarry sequence falls within, to meet high friction aggregate requirements either must contain 10 percent material pluss 100 mesh insoluble residue in concentrated hydrochloric acid (presumably quartz) or contain 20 percent noncarbonate material (chert).

Ten formations are mined at the Port Ewen operation. They are the upper two units of the Rondent, Manlius, Coeymans, Kalkberg, New Scotland, Becraft, Alsen, Port Ewen, Connally, and Glen Erie formations. With the exception of the Connally formation which is a calcareous sandstone, all of the other formations are either dolomitic limestones (Rondent and Manlius), high calcium pure limestones (Coeymans and Becraft), cherty limestones (Kalkberg, Alsen and Glen Erie) or argillaceous limestones (New Scotland and Port Ewen formations).

Listed below are the formations and their uses:

Formations	Approximate Thickness	Use	
Glen Erie	100	Regular aggregate - high friction	Upper High Friction Sequence
Connally	15	Regular aggregate - high friction	
Port Ewen	100	Regular aggregate - high friction	
Alsen	20	Regular aggregate	
Becraft	40	Regular aggregate	
New Scotland	115	Regular aggregate - high friction	Lower High Friction Sequence
Kalkberg	65	Regular aggregate - high friction	
Coeymans	20	Regular aggregate -	
Manlius	50	Regular aggregate -	
Rondout (2 units)	40	Regular aggregate -	

The two products must be mined, processed, stockpiled and delivered separately. Plant production demands necessitate maintenance of separate operating faces and loading units for each product. For example, high friction aggregate will be mined from two separate faces for two or more 8-hour shifts followed by regular aggregate production from two additional faces for several shifts or days.

Structure

The Helderbergian limestone formations are intensely folded and faulted. The initial stop at this site will be in the northeastern portion of the quarry where the lower Rondout, Manlius, Coeymans, Kalkberg, and New Scotland vertical beds are forming the east limb of north-south trending syncline which plunges to the north. The Becraft, Alsen and Port Ewen formations are complexly faulted in the northeastern portion of the quarry and challange certain geological interpretations without additional subsurface drill hole information.

The northern face exhibits several moderate angle thrust faults in the Glen Erie, Connally, and Port Ewen formations. The distinctive Connally calcareous sandstone unit makes an excellent marker bed to discern the structural relationships.

In the western portion of the quarry a major thrust fault has been mapped and mined during the past twenty years. The eastward dipping thrust sheet has caused numerous mining stability problems.

Quality of Products

New York State Department of Transportation requirements for high friction aggregate demand that only the approved formations be included in that product. This demands good quality control beginning with well defined geology, ongoing mine planning and regular production control.

Dunn Geoscience Corporation personnel are retained to complete biannual geologic source reports which represent in both map and cross section form the areas of proposed operation for the next two years of both products by formation boundaries. In addition, the boundaries of each product are marked with spray paint on the faces and targets are set on the upper levels to indicate the orientation of the third dimension extension of the contact.

A mine plan has been completed by Dunn Geoscience Corporation to allow annual and monthly planning to be fitted into a long term mining and reclamation plan. Triennial reclamation plans are required and submitted to the New York State Department of Conservation

Market

The large majority of the finished products are barged to New York City via the Rondout Creek and Hudson River. The crushed rock and fine aggregate that is supplied to the Callanan asphalt plant is used within the local region.

Sand

The sand deposit appears to be an upland erosional remnant of a formerly larger deposit. Similar material can be found on the east side of the railroad tracks and to the north along the north valley wall of Rondout Creek at Wilbur, New York.

The source is glacio-lacustrine in origin, displaying a single mode of deposition. The several local deposits exhibit similar structure suggesting that the depositional environment was fairly extensive in the Rondout-Hudson Valley region. Damming by glacial ice in the Hudson River valley is believed to have created a lake both in the Rondout and Wallkill River valleys that extended to the south to within 2½ miles of New Paltz, New York.

Material composition and bedding configurations suggest that the Port Ewen deposit was laid down in a pro-delta glacio-lacustrine environment. The slight coarsening upward and distinct bedding indicated either a slight shallowing of water or an advance of the sediment source into the lacustrine environment. The aeolian sand probably represents final deposition in the pro-glacial zone as lake waters receded.

The soil layer and the aeolian fine sand is stripped from the proposed area of operation. The sand deposit is removed by front-end-loader, into trucks, and hauled to the asphalt plant site where it is stockpiled and blended as needed. The gradation and quality of the deposit is such that no additional processing of aggregate is required.

Material from the source primarily is used to make bituminous concrete aggregate as required.

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