Warm Lake Estate Vineyard and Winery
3868 Lower Mountain Road, Lockport, NY 14094
office 716.731.5900 fax 716.731.2926
www.WarmLakeEstate.com

May 17th, 2004
Michael J. VonHeckler

William Foster, Chief RPD
Alcohol and Tobacco Tax and Trade Bureau
PO Box 14412
Washington, DC 20044-4412

Subject: AVA Petition for the Niagara Escarpment

Dear Mr. Foster,

Please accept this Petition for the Niagara Escarpment American Viticultural Area. Enclosed please find the following:

- 2 copies of the Petition - 10 pages
- 2 copies of the Reference Material Tables A-G
- One set of 5 USGS quadrangle maps of the proposed area including: Lewiston; Ransomville; Cambria; Lockport; and Gasport.
- One AAA map of New York State with the Proposed AVA high lighted
- One AAA map of western New York with the Proposed AVA high lighted
- One USGS map of Lockport with the Proposed AVA high lighted

Nancy Sutton of the Bureau has reviewed an advanced copy of the proposal text and we have attempted to incorporate all of her comments.

If you have any questions, please do not hesitate to call me at (716) 731-5900

Sincerely,

The Niagara Escarpment
A New Proposed American Viticultural Area

Summary:

This petition is being proposed by Warm Lake Estate, Vineyard and Winery, for the creation of a new American Viticultural Area to be known as "The Niagara Escarpment". The proposed AVA is located in Niagara County, New York just across the border from the Canadian viticultural area known as the Niagara Peninsula. The proposed new AVA is a physical extension of the established Ontario viticultural area of Canada, separated by the Niagara River as the international border. The area within the proposed AVA boundary has the potential to grow wine grapes of exceptional quality. This ability is attributed to the geographical features, soil types and climate of the proposed AVA. Once approved the "Niagara Escarpment" AVA will be used as a powerful marketing tool for the established and emerging wineries within the proposed AVA.

Background:

Within this proposal you will find historical and current evidence that the area within the proposed "Niagara Escarpment AVA" boundary is locally, nationally and internationally known as the "Niagara Escarpment", historical and current evidence that the proposed AVA boundaries are correct and evidence that the geographical features of the area produce growing conditions which distinguish the proposed "Niagara Escarpment" AVA from surrounding areas. A narrative description of the boundaries based on features which can be found on USGS maps is included as well as copies of each of these maps.

Petition:

Warm Lake Estate hereby proposes to designate an American Viticultural Area in Niagara County, New York to be known as "The Niagara Escarpment". This proposed viticultural area bisects the center of Niagara County in an east-west orientation. The entire area contains approximately 18,000 acres and approximately 400 acres of established vineyard. Supporting information includes:

1. The proposed "Niagara Escarpment' AVA is known locally, regionally, nationally, and internationally as the "Niagara Escarpment". Evidence that the proposed AVA is known as the "Niagara Escarpment" includes (Table A):

a. Locally, on a website (www.regional-institute.buffalo.edu/regi/natu) created by the Institute for Local Governance and Regional Growth and titled "2002 Equity in Buffalo Niagara: Regional Overview" a passage describes the Niagara River as flowing over the "Niagara Escarpment" creating Niagara Falls.

b. Regionally, according to Vintage New Yorks' website (www.vintagenewyork.com/regions/erie) the prime vineyard sites in New York State are bordered by the Niagara River on the west, Lake Ontario to the north and the "Niagara Escarpment" to the south.

c. Internationally, Ontario's Niagara Escarpment website (www.escarpment.org/geology/about_geology) states that the "Niagara Escarpment" extends from Rochester New York, south of Lake Ontario to Hamilton, Ontario.

d. Nationally, the Niagara Tourism and Convention Corporations website (www.niagara-usa.com/attractions/niagaralanding) describes Niagara Landing Wine Cellars as being located at the base of the "Niagara Escarpment".

e. Locally, Western New York Regional Information Network's Town of Cambria website (www.wnyrin.com/c_niag/welc/juri/juri_cambt) describes the Town of Cambria as being divided in the middle by the "Niagara Escarpment".

f. Locally, according to Thingstodo.com website (www.thingstodo.com/states/NY/greater_niagara) the Lockport Locks and Erie Canal Cruise takes place on and over the "Niagara Escarpment".

g. Nationally, according to a press release titled "Governor: 1.8$ Million For Western NY Parks, Recreation" issued by the New York State Governor April 24, 2001 (www.state.ny.us/governor/press/year01/april24_01) the City of Lockport will receive state funding to restore a stairway that descends the "Niagara Escarpment" for public appreciation.

2. Warm Lake Estate has chosen elevations and geological features to provide the boundaries for the proposed Niagara Escarpment AVA as listed below in sub paragraphs a through d. These elevations and other natural formations have a direct correlation to viticulturally distinguish the AVA from the surrounding grape-growing area.

   According to the USDA "Soil Survey of Niagara County, New York"; (October 1972, page 191) (Table B), Niagara County occupies part of the Huron and Ontario Plains. The Ontario Plain extends from the south shore of Lake Ontario south to the foot of the Niagara Escarpment, and the Huron Plain from the crest of the escarpment southward beyond the county line.

   The Niagara Escarpment consists of an age old limestone bluff. The crest has an elevation of slightly more than 600 feet and the base is at the 400 foot contour line. Both the Ontario and Huron Plains are relatively flat with grades or slopes of less than 20 feet pr mile. The Niagara Escarpment has a steep slope of 106 to 317 feet per mile. Therefore the 600 and 400 foot elevations established the boundaries respectively of the proposed AVA.

   The Niagara River bisected the Niagara Escarpment forming Niagara Falls and the international boundary which separates Niagara County, USA from Canadian. The Niagara River was thus the obvious choice for western boundary of the Niagara Escarpment AVA. Johnson Creek was chosen as the eastern boundary of the AVA because it is a significant geological feature that distinguishes the end of the Niagara Escarpment in Niagara County, New York.

   The viticultural distinguishing elements for grape growing and the resultant wine quality has been the topic of debate for some time. However, according to "The Oxford Companion to Wine"; Oxford University Press, published in 1994, page 884 (Table C), scientific opinion now almost universally agrees with Dr. Gerard Seguin, researcher at the University of

Bordeaux that climate and soil physical characteristics predominate as the main influence over grape and wine qualities.

With regard to soil physical characteristics the Companion goes on to state "...that the best wines come from soils that are well drained, furnish a steady but moderate water supply to the vines and have restrictive mineral vine nutrition thus ensuring that growth is restrained." In summary restrained growth in the vine results in superior pigment and flavor compounds in the resultant wine. The counter point is that poor drainage and high nutrition in the vineyard results in less pigmentation, diluted flavors and a lower quality wine. A detailed discussion of these assertions is contained in the Companion.

The steep slope of the Niagara Escarpment is distinguished from both the Ontario and Huron Plains by the nature of its soils and drainage. The two Plains are relatively flat with deep soils which can harbor excessive water and nutrition. In contrast the Niagara Escarpment has rather shallow soils with sufficient slope or grade to make drainage amendments feasible where the soils are naturally somewhat poorly drained and the nutrition is restrained by the nature of the eroded soils.

a. The proposed AVA northern boundary has been chosen to be 400 feet in elevation. According to the "Soil Survey of Niagara County, New York"; (October 1972) (Table B), the 400 foot contour line represents the boundary between the Niagara Escarpment and the near flat Ontario Plain. The Ontario Plain is described as having a slope of 20 feet per mile which is in direct contrast to the sloping land (106 – 317 feet per mile slope) within the proposed AVA.

b. The proposed AVA southern boundary has been chosen to be 600 feet in elevation. This is the maximum height of the Niagara Escarpment and according to the "Soil Survey of Niagara County, New York"; (October 1972) (Table B), marks the beginning of the Huron plain. The Huron Plain described by the "Soil Survey of Niagara County, New York"; (October 1972) (Table B), is very flat and unprotected which is significantly different from the gentle 2-6% slope on average that the proposed AVA contains.

c. The proposed AVA western boundary has been chosen to be the Niagara River. The Niagara River provides a natural geographical boundary between the USA and Canada. The Niagara Escarpment extends west of the Niagara River into Canada and it is included in the Niagara Peninsula viticultural area as designated by the Government of Canada.

d. The AVA eastern boundary is proposed to be at Johnson Creek east of Gasport, New York. According to the "Soil Survey of Niagara County, New York"; (October 1972) (Table B), the base of the Niagara Escarpment changes from 400 feet in elevation to 500 foot in elevation as well as becoming much narrower and steeper as one travels east. These changes in land features at the eastern end of the county make the farmable land less desirable for wine grape production; therefore the area east of Johnson Creek was not included in the proposed AVA boundary.

3. **Exceptional Quality Wine Grapes:** In this section we provide evidence that the geographical features of the proposed "Niagara Escarpment" AVA produces growing conditions which distinguish the proposed area from surrounding areas:

a. **Geographic Features:** The area within the proposed AVA's boundary enjoys an average slope of 2 – 6% according to the "Soil Survey of Niagara County, New York"; (October 1972) (Table B). The Ontario Plain to the north and the Huron Plain to the south are both nearly flat, which is significantly different from the 2-6% slope that exists within the proposed AVA boundary. According to the "Soil Survey of Niagara County, New York"; (October 1972) (Table B), east of the proposed AVA boundary the base of Niagara Escarpment rises in elevation to 500 feet and becomes much narrower and steeper compared to the area within the proposed AVA. The proposed "Niagara Escarpment" AVA is on average 7 miles South of Lake Ontario.

As discussed in paragraph 2 above, scientific opinion now universally agrees that the viticultural distinguishing elements for grape growing and the resultant wine quality are climate and soil physical characteristics.

With regard to soil physical characteristics the best wines come from soils that are well drained, furnish a steady but moderate water supply to the vines and have restrictive mineral vine nutrition thus ensuring that growth is restrained. That is restrained growth in the vine results in superior pigment and flavor compounds in the resultant wine. The counter point is that poor drainage and high nutrition in the vineyard results in less pigmentation, diluted flavors and a lower quality wine.

The steep slope of the Niagara Escarpment is distinguished from both the Ontario and Huron Plains by the nature of its soils and drainage. The two Plains are relatively flat with deep soils which can harbor excessive water and nutrition. In contrast the Niagara Escarpment has rather shallow soils with sufficient slope or grade to make drainage amendments feasible where the soils are naturally somewhat poorly drained and the nutrition is restrained by the nature of the eroded soils.

b. **Climate:** One of the challenges in consistently producing quality grapes for wine production, in cool climate viticultural areas such as the Niagara Escarpment, is achieving sufficient heat accumulation during the growing season. The maritime influence of Lake Ontario upon the Niagara Escarpment significantly impacts the accumulation of heat there and a true symbiosis between lake and escarpment exists. Supportive documentation includes the "Soil Survey of Niagara County, New York"; (October 1972, page, 192) (Table B) and the "Site Selection for Grapes in the Niagara Peninsula" (Map enclosed). The Soil Survey states that "... the climate is greatly influenced by Lake Ontario... in fall the lake waters are a source of heat that reduces cooling at night and increases the length of freeze-free growing season." Site Selection states that "Lake Ontario has a major influence on the climate... The lake absorbs and stores vast amounts of heat which it releases whenever the surrounding air and land is cooler than the lake.... The pattern of airflow is altered by the slope of the land. With steep slopes, cold air drainage is rapid." The Air Flow Pattern is shown in the sketch on the Site Selection Map.

Research has been performed by the Canadian government in order to aid in vineyard site selection in the Niagara Peninsula. From this research, direct inferences have been made on the areas between the Niagara Escarpment and Lake Ontario in Niagara County. According to the publication titled "Site Selection for Grapes in the Niagara Peninsula" (Map enclosed), J.Wiebe & E.T. Anderson Horticultural Research Institute of Ontario Vineland Station, Ontario, a unique airflow pattern exists that benefits areas between Lake Ontario and the Niagara Escarpment. Under frost conditions in the fall, an airflow pattern develops due to the warm waters of the lake. Air rises as it is warmed by the lake drawing cooler air in from the lake shore creating offshore breezes. "The air now above the lake is warmed, rises and flows back over the land, creating a circular heat-pump effect." This unique airflow pattern benefits the vineyards by minimizing frosty conditions in the fall and increasing heat accumulation, thereby extending the growing season. Areas along the south shore, 0.5 – 2 miles from Lake Ontario, can have up to a two-week delay in bud break do to the cold waters of Lake Ontario. The proposed "Niagara Escarpment" AVA is between 6 – 8 miles south of Lake Ontario. Due to this distance, grapes grown within the proposed AVA boundary have experienced little to no delay in bud break from lake influence. Therefore, grapes grown within the proposed "Niagara Escarpment" AVA will have an extended ripening season when compared to grapes grown outside the boundary, either south and above the Niagara Escarpment or North and closer to Lake Ontario. The publication titled "Site Selection for Grapes in the Niagara Peninsula - Zone A, the Lakeshore Effect Zone," supports this contention and states that: a) the cool lake breeze in spring and until midsummer retards growth somewhat and b) most grape cultivars require a long warm season and fruit quality is sometimes poor close to the lake because of the lower temperatures. Also due to its distance from Lake Ontario, the proposed AVA does not experience as much of a cooling effect in the summer increasing heat accumulation as well. Temperature data has been taken from Warm Lake Estate Vineyard and Winery located within the proposed AVA, as well as temperature data obtained from the National Climatic Data Center for the Niagara Escarpment. This data was reviewed utilizing algorithms obtained from John Gladstones' Book "Viticulture and the Environment", (Table D). The data indicates that the Niagara Escarpment in Niagara County has, over a 25 year

period from 1970 to 1994, an average growing temperature degree day (growing season) suitable for growing exceptional wine grapes.

c. **Soil:** According to the "Soil Survey of Niagara County, New York"; (October 1972) (Table E), Niagara County contains an association of soils known as Hilton-Ovid-Ontario (HOO) and Rhineback-Ovid-Madalin (ROM). The HOO includes a prominent limestone escarpment. Hilton soils are underlain by calcareous loamy glacial till. Ovid and Rhinbeck soils have silty clay subsoil and Rhinebeck is from the illitic family of soils. Exceptional quality wines are produced from clay, calcareous and illitic soils.

Substantiation of this statement is available in much of the current wine literature. Cited here specifically are the "Oxford Companion to Wine", 1994, page 175, (Table C), and "Viticulture and the Environment" 1992, pages 36 to 38, (Table D), wherein a discussion is made of the attributes of calcareous and clay soils. Clay and calcareous soils are especially celebrated in many wine growing regions. Clay has the ability to supply a steady stream of nutrition to the vine and calcareous soils have the structure necessary to meter water to vine as well. As mentioned earlier, vines with good drainage, balanced water and nutrition produce grapes with superior pigmentation and flavor components.

According to the Oxford Companion, page 427, a significant proportion of the world's famous wines are from vineyards whose underlying rock contains illite. Included in the reference are the wine growing regions of: the Medoc, Hermitage, Cote d'Or, and the Napa Valley amongst others. Illite results from weathered feldspars and micas in the soil. James Wilson in his book, "Terroir", (1998), page 28, (Table F), states that illite is one of the minerals that may be found in clay that plays an integral role in the balanced feeding of mineral nutrients to the vine plant and neutralization of toxins. In Mr. Wilsons' words, "those soils with better balanced nutrition are most likely to grow the finer wines."

The Niagara Escarpment
A New Proposed American Viticultural Area

Boundaries:

1. Beginning at the Western boundary the Niagara River (Niagara Gorge) (Table G) as shown on Lewiston NY Quadrangle.
2. The boundary runs east along the 400 foot contour line that runs parallel to Ridge Road (Route 104).
3. The boundary leaves the Lewiston Quadrangle and enters the Ransomville Quadrangle continuing in an easterly direction until the 400 foot contour line reaches Dickersonville Rd.
4. At the intersection of Dickersonville Road and Ridge Road the boundary continues east bisecting the area between Ridge Road and Lower Mountain Rd. until it leaves the Ransomville Quadrangle map.
5. The boundary then enters the Cambria Quadrangle map continuing east bisecting the area between Ridge Rd (Route 104) and Lower Mountain Road until it reaches Stone Road on the Lockport Quadrangle map.
6. The boundary continues SE parallel to Stone Rd. until it reaches the West Branch of Eighteen Mile Creek Ravine.
7. The boundary follows the Eighteen Mile Creek Ravine south until it reaches Jackson Street. Here the Boundary follows Jackson Street easterly, until Jackson Street intersects with Purdy Road. The 400 ft contour line continues on the eastside of Eighteen Mile Creek in a northeasterly direction.
8. The 400 ft contour line continues through Ridgelea Heights and north of Slayton Settlement Road. Then enters the Gasport Quadrangle.
9. Continuing in a northeast direction the 400 ft contour line runs between Ridge Road (Route 104) and Slayton Settlement Road.
10. At the intersection of Route 104 and Quaker Road the 400 ft contour line crosses Route 104 and runs parallel to it on the north side until it reaches Johnson Creek.
11. Johnson Creek is the eastern most boundary of the proposed AVA. Following Johnson Creek south until just south of Route 31 and begin heading west on the 600 ft contour line.
12. Continue in a westerly direction just south of the East Branch of Eighteen Mile Creek.
13. Crossing the East Branch of Eighteen Mile Creek northeast of Terrys Corners. Then heading north for a short distance before continuing to run parallel with Route 31 west.

14. The Boundary then enters back into the Lockport Quadrangle map.
15. Continuing to move west between Route 31and the Erie Canal. The 600 ft contour line skirts the northern edge of the City of Lockport. Crossing the Erie Canal at the Locks.
16. Continuing on the northern edge of Lockport in a westerly direction.
17. Entering the Cambria Quadrangle, the 600 ft contour line now takes a southwesterly direction between Upper Mountain Road and Lower Mountain Road.
18. On the Ransomville Quadrangle map, 600 ft contour line continues between Upper Mountain Road and Lower Mountain Road until Lower Mountain ends at Route 104. The 600 ft contour line then runs westerly between Upper Mountain Road and Route 104.
19. The Boundary now enters the Lewiston Quadrangle map and runs west until it reaches the western and beginning boundary of the AVA at the Niagara River.

If you have any further comments questions regarding this petition please contact

Michael J. VonHeckler
716.731.5900 office
716.471.5108 cell

Mailing address:
Warm Lake Estate
3868 Lower Mountain Rd.
Lockport NY, 14094

Exhibits for Niagara Escarpment AVA petition –

- A. Web site hard copies.
- B. Soil survey of Niagara County, New York – geography, physiography and drainage.
- C. Excerpts from The Oxford Companion to Wine, edited by Jancis Robinson.
- D. Climate information.
- E. Soil survey of Niagara County, New York – soil information.
- F. Excerpt from Terroir, by James E. Wilson.
- G. Soil survey of Niagara County, New York – county description
- Letters of Support
- Article "Roll out the barrel," Toronto Star, July 21, 2004.
- Map A - AAA map, New York
- Map B - AAA map, New York State, Western Region
- Map C – AAA, Lockport, New York.
- Site Selection for Grapes in the Niagara Peninsula.

TTB Note: Due to their size, Maps A-C and the Site Selection for Grapes in the Niagara Peninsula map were not scanned. Contact TTB for more information.

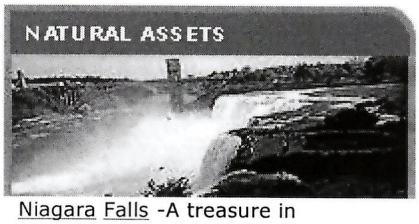
TABLE A

WEB SITE HARD COPIES

The Niagara Escarpment
A New Proposed American Viticultural Area

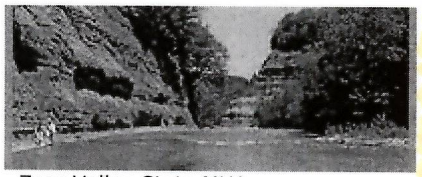
ABOUT THE REGION

Buffalo Niagara - NATURAL ASSETS

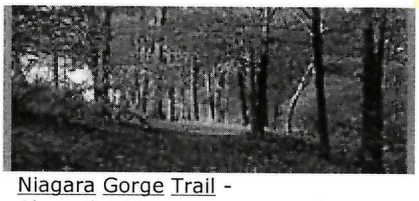


Niagara Falls -A treasure in our own backyard

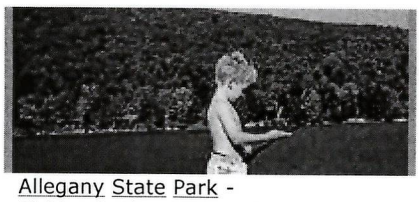
Letchworth State Park - "Grand Canyon of the East"



Zoar Valley State MUA - Whitewater rafting and hiking



Niagara Gorge Trail - Along the Niagara escarpment



Allegany State Park - Fishing in the summertime

Skiing in WNY - Swain, Kissing Bridge, Holiday Valley and many others

About 17,000 years ago, the planet's glaciers began receding, carving deep depressions into the landscape of the Buffalo Niagara region. This geological activity shaped the landscape of the region and created two "great" lakes - Lake Ontario and Lake Erie. The Niagara River, a straight connecting the two lakes, has over thousands of years cut a steep gorge as it travels backward into the rock. Where it flows over the Niagara Escarpment, about half way between the two lakes, it creates Niagara Falls, a stunning natural wonder of the world and the region's premier tourist attraction (source: Eberle, Scott and Grand, Joseph A. *Second Looks: A Pictorial History of Buffalo and Erie County*. Virginia: The Donning Co., 1987).

Although these geological events took place thousands of years ago and certainly are far removed from human history, they are intricately connected to the natural assets, people, and history of this region. Indeed, they created many natural wonders in the Buffalo Niagara region. From the distictly flat lake plains and the series of escapments cutting across these plains in the northern part of Buffalo Niagara, to the hills and valleys of the

Iroquois National Refuge - A haven for wildlife

southern portion of the region, Buffalo Niagara has a plenum of natural assets to be enjoyed by residents and visitors alike (source: State of the Region: Performance Indicators for the Buffalo Niagara Region in the 21st Century).

In Niagara County, the Niagara Reservation State Park features one of the natrual wonders of the world - Niagara Falls - and is the nation's oldest state park. Cattaraugus County's Allegany State Park offers 65,000 acres of dense forests and lush, grassy meadows, trails, rolling hills, lakes, rivers, and rocky gorges. East to Wyoming County, Letchworth State Park, a 14,350-acre park known as the "Grand Canyon of the East," features the winding Genesee River, countless hiking trails, and breathtaking vistas from its gorge walls. In Orleans and Genesee Counties, the "Oak Orchard," a collection of three wildlife refuges - Iroquois National Wildlife Refuge and the Tonawanda and Oak Orchard State Wildlife Management Areas - is a historic wetland featuring migratory bird observation, fishing, and nature trails. Western Erie County's Evangola State Park sits on the shores of Lake Erie and offers nature trails, bikepaths, camping, and a scenic beachfront. In Chautauqua County's Canadaway Creek State Wildlife Management Area visitors can hike, fish, boat, observe wildlife, and even cross country ski in the winter. In Allegany County thousands of acres of

preserved forests, including the Turnpike State and Palmer's Pond State Forests, feature scenic hiking trails and camping. Likewise, the Niagara portion of Ontario abounds with natural resources, including the Grand River, which flows through Southern Ontario, Niagara Falls, and scores of parks with wildlife, waterfront, outdoor activities, and pristine settings.

These parks, wildlife refuges, and forests are just a snapshot of the natural wonders of the Buffalo Niagara region. For more information, links, pictures, and descriptions of the region's natural assets, please visit the Life and Community section of the Institute's Buffalo Niagara Regional Information Network (wnyrin.com). To explore southern Ontario's parks and natural wonders, please visit www.ontarioparks.com, the Ontario Ministry of Natural Resources' parks web site.

regional-institute.buffalo.edu Contact the Institute

Lake Erie

New York's most extensive vineyards are planted along Lake Erie in the Chatauqua region of New York. The majority of these vineyards are planted to Concord grapes, which are used primarily for juice, but also for some wine coolers and for the familiar Kosher wines. Some native varieties like Catawba, Niagara and Delaware are used in the production of sweet, pungent, grapey wines. Here, as well as in the Finger Lakes, French-American hybrid grapes such as Seyval Blanc and Vignoles were created by French viticulturalists during the 19th century phyloxera epidemic. Their goal was to combine the superior taste characteristics of vinifera with the cold hardiness and disease-resistance of the native species.

Lake Erie is one of the largest inland seas in North America, providing insulation for fragile vineyards against early frosts and harsh winters in western New York. Because it is the most significant of the Great Lakes in protecting the vineyards of western New York from the extreme winter temperatures generated by arctic air masses that hover over L Superior and Huron, the Lake Erie AVA was established in 1983. More than 19,000 acres of grape planted on vineyards that stretch across the Allegheny Plateau, making it the largest grape-growi region in New York. However, there are just eight wineries because most of the grapes planted in region are destined for grape juice and table grapes. The majority of the wineries in this region ar clustered on the fertile plain that stretches from the southeastern end of Chatauqua country north Lake Ontario. The prime vineyard sites are bordered by the Niagara River on the west, Lake Onta the north and the Niagara escarpment on the south.

Geology of the Escarpment

The Niagara Escarpment is recognized as one of the world's unique natural wonders. Essentially, it is a landform -- a ridge of rock several hundred metres high in some locations -- stretching 725 kilometres (450 miles) from Queenston on the Niagara River to Tobermory at the tip of the Bruce Peninsula. Today, in Ontario, the Escarpment contains more than 100 sites of geological significance including some of the best exposures of rocks and fossils of the Silurian and Ordovician Periods (405 to 500 million years old) to be found anywhere in the world.

The Niagara Escarpment has origins dating back into geological history some 430 to 450 million years, a time when the area lay under a shallow warm sea. This sea lay in a depression of the earth's crust, the centre of which is now the State of Michigan. Now geologically known as the Michigan Basin, the outer rim of this massive saucer-shaped feature governs the location of the Niagara Escarpment. In the shape of a gigantic horseshoe the Escarpment can be traced from near Rochester, New York, south of Lake Ontario to Hamilton, north to Tobermory on the Bruce Peninsula, beneath the waters of Lake Huron to appear again on Manitoulin Island, across northern Michigan and down the west side of Lake Michigan into the State of Wisconsin.

As occurs with present day water bodies such as Hudson Bay or the Gulf of Mexico, rivers flowing into this ancient sea carried sand, silt and clay to be deposited as thick layers of sediment. At the same time lime-rich organic material from the abundant sea life was also accumulating. Over millions of years these materials became compressed into massive layers of sedimentary rocks and ancient reef structures now visible along the Escarpment. Some rock layers now consist of soft shales and sandstones while others are made up of dolostone (a rock similar to limestone which contains magnesium and is more durable).

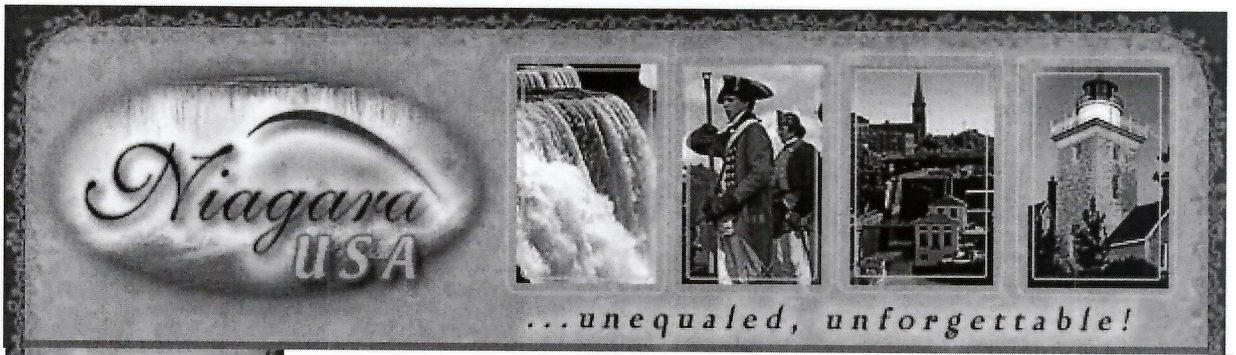
Today, fossil remains illustrating the various life forms can be found in many of the rocks as they are slowly exposed by the action of wind, water and ice.

CBRA ACRB

Niagara Escarpment Commission
232 Guelph Street, Georgetown, ON L7G 4B1
Tel: (905) 877-5191 · Fax: (905) 873-7452
Email: **nec@escarpment.org**

MaB

Last Modified on Mar. 5/03



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MARCH EVENTS

Niagara Landing Wine Cellars

NIAGARA LANDING WINE CELLARS

4434 Van Dusen Road
Lockport, NY 14094
(located in Cambria)

The Smith Family

(716) 433-8405
MAP

www.niagaralanding.com

Hours Open: Mon.-Fri. 2-6, Sat. 10-6 & Sun. 12-6

Winter Hours: to be announced

Wheelchair Accessible

Parking Available

Admission: FREE

Description: Award Winning winery, located at the base of the Niagara Escarpment in the midst of vineyards dating back to late 1800's. Free Wine Tasting from our generous list of Native Labrusca and European Vinifera Wines. Gallery and gift shop for your enjoyment. 20 minutes from Niagara Falls.

JOIN OUR SITE!

Niagara USA...unequaled, unforgettable!

Enjoy family fun and adventure while making vacation memories as you explore Niagara Falls and all that Niagara USA has to offer!

~ Niagara Tourism & Convention Corporation ~

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I ♥ NY

WELCOME to the Town of Cambria

Niagara County
Parks & Recreation
Cultural Interests
The Arts
Libraries

WELCOME to Niagara County

The Town of Cambria (pop. 5393 in 2000) is in the center of Niagara County, west of the Town of Lockport. It is predominantly an agricultural town, divided in the middle by the Niagara Escarpment. Nearby recreational assets include the parks along the Lake Ontario shoreline, due north from Cambria, and the Bond Lake County Park in the adjacent Town of Lewiston.

For questions on transportation, accommodations, and dining, contact the following offices
- Niagara County Department of Planning and Development
- Town of Cambria

Check the Maps for the Town of Cambria
- Town of Cambria Maps

Annual Events

Tuscarora Picnic & Field Day

July
Traditional foods, crafts, sports and native social dances. Smoke dance competition Saturday. Tuscarora princess and children's pageant. Free Parking.Tuscarora Nation, Cambria.
Location: Town of Cambria
Phone: (716) 297-5553

Greater Niagara Region

Attractions

Albright-Knox Art Gallery - The Albright-Knox Art Gallery is among the oldest public arts organizations in the United States. The Gallery's collection is especially rich in post-war American and European art, abstract expressionism, pop art, and art of the 1970s through the end of the century are well represented.

Artpark - Artpark is a a 200 acre theme park dedicated to visual and performing arts. As one of North America's most innovative summer festivals, Artpark produces its own musical theatre, and is host to major big band orchestras, diverse concerts and festivals, and celebrity entertainers.

Becker Farms - - Becker farms is a family owned 340 acre working fruit and vegetable farm. Becker Farms also offers a farm animal petting zoo, hay rides, pony rides, and several weekend festivals in June, July, Sept., and Oct.

Buffalo Museum of Science - Discover an exciting world of hands-on learning. See dinosaurs and backyard insects, or stroll through Whem Ankh: the Cycle of Life in Ancient Egypt and experience life in Egyptian culture as it was in 200 B.C. More than a dozen fun-filled exhibit halls trace natural history and the human experience.

Buffalo & Erie County Botanical Gardens - When visiting the Buffalo & Erie County Botanical Gardens you can actually see three historic attractions in one: Olmsted's South Park, the 1894 tri-domed glass conservatory building, and the Victorian-style gardens of plants.

Niagara Falls State Park - Located in Niagara Falls, New York, Niagara Falls State Park is America's oldest State Park. Experience a thrill by getting close to the American and Horsehoe Falls on the Maid of the Mist and Cave of the Winds.

Six Flags Darien Lake - With over 100 rides, shows and attractions, Six Flags Darien Lake offers world-class thrills and adventure. It's a resort destination with something for the entire family including your favorite characters, coasters, concerts and more.

Herschell Carrousel Factory Museum - The Herschell Carrousel Factory offers visitors with a history of carousel making. Wood carving classes and demonstrations are offered and a historic operating carousel. The museum also hosts family entertainment each Sunday during the summer, with performances as diverse as youth theatre, mime, interactive poetry, magic, music and puppetry.

Toy Town Museum - The Toy Town Museum occupies 8,000 square feet and showcases a permanent collection of Fisher-Price Toys as well as changing exhibits throughout the year. The Museum also features a theater, research library, gift shop and reading area.

Skateland Family Fun Center - Niagara Falls Skateland offers family fun in a clean well supervised environment for all ages. Activities include roller skating, laser tag, mini-golf, video arcade, and a snack bar.

Buffalo and Erie County Naval & Military Park - The Buffalo and Erie County Naval & Military Park opened to the public on 30 June 1979. It is the largest inland naval park of its kind in the United States. It is also home to guided missile cruiser USS Little Rock (CLG-4), destroyer USS The Sullivans (DD-537), and Submarine USS Croaker (SSK-246).

Explore & More... A Children's Museum - Explore & More is a children's museum designed to introduce young children and the adults who care about them to a lifetime of exploration and discovery through unique exhibits that encourage creativity, curiosity and imagination.

JELL-O Museum - The Jell-O Museum is a gallery devoted to the history of Jell-O and features a variety of Jell-O memorabilia as well as the history behind one of America's favorite desserts.

Lancaster Opera House - The Lancaster Opera House is a restored turn-of-the-century theater featuring musicals, plays and a variety of productions.

Lockport Cave - The Lockport Cave is actually a man made hydraulic race blasted out of solid rock over 140 years ago. Tours include an underground boat ride and a view of the Erie Canal Locks.

Lockport Locks and Erie Canal Cruises - Experience a unique 2-hour cruise which includes 'locking through' and being raised the 49 ft. elevation of the Niagara Escarpment (the same one that creates Niagara Falls) in the only double set of locks on the Erie Canal. You will pass under bridges that raise straight up, see water cascade over Lockport's famous 'Flight of Five' 1840's locks.

Maid of the Mist Boat Tours - As one of North America's oldest attractions , Maid of the Mist Boat Tours offer a thirty-minute, guided boat ride of the American and Horseshoe Falls in Niagara Falls.

Martin's Fantasy Island - Experience over 100 rides, shows and attractions in a clean, park like setting covering 80 acres. You'll enjoy rides for all ages from kiddy

Old Fort Niagara - Preserved as they stood in the 1700's when France and Britain controlled Niagara, the Fort's structures include the oldest building in the Great Lakes. The site of historic battles and sieges, trading and conquest, Old Fort Niagara is an exciting place where the past lives on.

Buffalo Zoological Gardens - The Buffalo Zoological Gardens is the third oldest zoo in the nation and is currently celebrating its 125th Anniversary. Located in 23.5 acres of beautiful Delaware Park, the Buffalo Zoo exhibits a diverse collection of wild and exotic animals, and more than 320 different species of plants.

Pedaling History Bicycle Museum - The Pedaling History Bicycle Museum features one of the largest collections of antiques and classic bicycles and memorabilia covering 181 years of bicycle history.

Niagara Aerospace Museum - The Niagara Aerospace Museum is dedicated to the tens of thousands of Western New Yorkers who contributed so much to the world's aviation and space flight endeavors. The museum's collection includes the Bell X-22A VSTOL, Bell 47 helicopters, Lockheed F-94A, Bell P-39Q, and Taylor J-2 Cub.

Niagara Falls - Visit the world-famous Niagara falls which were formed 10,000 years ago. The falls are considered one of the 7 natural wonders of the world.

Amherst Museum - Amherst Museum invites you to experience 19th century life on the Niagara Frontier. Learn through exhibits on local history, agriculture, costumes, antique radios and decorative arts. Climb aboard a replica packet boat and learn about the historic Erie Canal.

Motherland Connextions - Motherland Connextions offers customized African-American heritage tours of the Underground Railroad in NYS. Visitors follow the footsteps of those brave and hearty souls who took the secret passageways north to Canada in search for freedom.

Shea's Performing Arts Center -

rides to thrill rides.

Miss Buffalo -Niagara Clipper Cruise Boat - Dining, scenic views, romance, great entertainment and fun for the whole family! City skylines and picturesque sunsets await you aboard these cruise boats.

Whether it's the best of Broadway, concerts, fantastic shows for children, classic movies, or the drama of the opera, you're sure to find something for everyone on stage at Shea's.

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FOR IMMEDIATE RELEASE:
April 24, 2001

GOVERNOR: $1.8 MILLION FOR WESTERN NY PARKS, RECREATION

$250,000 for Buffalo Museum of Science to Reopen Kellogg Observatory

Governor George E. Pataki today announced nearly $1.8 million to conserve open space, enhance recreation opportunities and preserve historic resources throughout Erie and Niagara counties. The awards include $250,000 to the Buffalo Museum of Science to restore and reopen the museum's Kellogg Observatory and strengthen exhibits and programming throughout the entire facility.

"The Buffalo Museum of Science has been a cornerstone of learning for generations of Western New Yorkers," Governor Pataki said. "This grant will help restore the Kellogg Observatory as an exciting, instructive destination for schools, families and visitors who can enjoy all the natural marvels that science has to offer.

"By recognizing opportunities to combine recreation and job creation, local governments are building on the value of their scenic parklands, waterfronts and historic treasures," the Governor said. "These grants will allow Western New York communities to enhance their environmental, recreational and cultural resources, while encouraging smart economic growth."

Representative Thomas M. Reynolds said, "For well over a century, the Buffalo Museum of Science has captured the imagination of our community and piqued our interest in science through fascinating exhibits and innovative educational programs. The Kellogg Observatory has been an integral part of that history, and thanks to Governor Pataki's leadership and assistance, its familiar copper dome will open to a new generation reaching toward the stars."

Erie County Executive Joel A. Giambra said, "Restoring the Museum's observatory allows our children to explore an exciting new world. Governor Pataki's commitment to the Museum of Science will make the Museum a first-class center for learning about the natural sciences. Thanks to the Governor's efforts the Kellogg Observatory will reopen by the end of the year."

City of Buffalo Mayor Anthony M. Masiello said, "Reinvesting in our city's cultural institutions strengthens and solidifies the very spirit and essence of Buffalo. I applaud Governor Pataki for his leadership in providing the greatly needed monies for the renovation of the Kellogg Observatory. The reopening of the Observatory will provide for future generations what earlier generations enjoyed routinely at the Buffalo Science Museum."

Senator Dale M. Volker said, "Over the past six years, Governor Pataki has made enormous inroads in engaging more of our young people in mathematics and sciences. Today's announcement reinforces this commitment to our children by ensuring that the Buffalo Museum of Science is funded at an appropriate level so that our young people have access to our region's rich history in the sciences."

Senator Mary Lou Rath said, "This will bring a major part of Buffalo's past into the present. Linking history with enhanced opportunities for learning, this funding will provide a major educational source for years to come. The Governor's foresight will ensure that the Buffalo Museum of Science will remain a vital part of our community."

Assemblyman James P. Hayes said, "Governor Pataki's announcement today is welcomed news for western New York and is yet another example of the Governor's strong commitment to enhancing our regional educational and cultural assets. This $250,000 grant is a solid example of the public-private partnership that is a necessary factor in helping to improve the quality of life in western New York."

Assembly Majority Leader Paul Tokasz said, "As former chair of the Assembly's committee on Tourism, Arts and Sports Development, I am well aware of the tremendous benefits and future potential of these projects. I have long supported these arts and historic preservation initiatives and am pleased the residents of Western New York will benefit from these investments for years to come."

The Buffalo Museum of Science has been in operation for 139 years and was established at its present location on Humboldt Parkway by the Buffalo Society of Natural Sciences in 1929. Renowned for its science education, the museum currently focuses on the natural sciences and anthropology, providing the community with the study and interpretation of the physical universe and its lifeforms. The Museum also provides science programs at the nearby 265- acre Tifft Nature Preserve and Allegany State Park in Salamanca, New York. Last year, the institution served more than 216,000 children and adults through its various programs and sites.

David Chesebrough, President of the Buffalo Museum of Science said, "We applaud the Governor's support that will strengthen our ability to be a major science education resource for western New York schools. The funds the Governor has provided give us a critical boost as we take our first step in reinvesting in the museum. Reopening the Kellogg Observatory with quality programs will greatly add to our capacity to excite students about science."

Approximately $180,000 of the grant will be used for needed structural repairs to the Museum's Kellogg Observatory dome and structure. The Kellogg Observatory opened in 1930 and its distinctive copper dome serves as a landmark and historic icon for the city of Buffalo. The dome has not been renovated in the more than seventy years since construction, necessitating the Observatory's closing due to structural and safety concerns. Once the critical repairs are made, the Observatory will re-open with improved exhibit space.

An additional $70,000 of the grant would be used to enhance the visitor experience for the general public and provide key educational programming for students. With the structural improvements completed, the Observatory and its related space and astronomy programs will be made available to all schools in western New York. Special efforts are underway by the Museum to assist school districts in preparing students for the newly implemented science standards tests for 4th and 8th graders.

Today's announcement will allow the Museum of Science to reopen the Kellogg Observatory, which closed early this year due to needed structural repairs. The Observatory is expected to reopen by year end.

The remaining projects throughout the two counties are awarded through the Environmental Protection Fund (EPF). Five of the grants are distributed through the Department of State's Local Waterfront Revitalization Program, and seven are being awarded through the Parks, Historic Preservation and Heritage Areas component of the Fund, administered by State Parks. Among the awards are projects for local park improvements in Lewiston, Lockport, and the Town of Niagara, and funds for Shea's Performance Arts Center, the Darwin Martin House and the Old Customs House in Niagara Falls.

Senator George Maziarz said, "The Western New York Delegation has been working extremely hard to develop tourism in this area. I want to commend Governor Pataki's efforts and I believe that the Niagara

Town Park is a worthwhile recipient of these funds."

Niagara County Legislative Chairman Clyde Burmaster said, "Niagara County is pleased and excited to be provided these economic development initiatives to help improve the quality of life for us all. It is a double benefit when Niagara and Erie grow together in a regional approach. We thank Governor Pataki for keeping the promises made in his state-of-the-state address and look forward to an exciting Year 2001."

State Office of Parks, Recreation and Historic Preservation Commissioner Bernadette Castro said, "The Governor's commitment and support are an important first step in expanding valuable services at this popular museum that will benefit the city of Buffalo for generations to come. The additional grants awards will provide further improvements to parklands, strengthen efforts to preserve significant historic properties and increase access to unparalleled recreation opportunities for generations to come."

Niagara County

Town of Niagara, Niagara Town Park Development, $330,000.

The Town of Niagara is committed to preserving valuable green space within its boundaries and establishing a natural resource for future generations. The town will develop 126 acres of land in its northern central portion to provide amenities that currently do not exist or are in very limited supply. Those amenities include an athletic complex; play equipment; a trail system for pedestrians, walkers and rollerbladers; and a roadway system to service park users year round.

Town of Lewiston, Town of Lewiston Scenic Pathway Phase I, $323,338.

The Town of Lewiston has developed a plan to construct a scenic pedestrian pathway along the Niagara Gorge. This plan is consistent with the Regional Bicycle and Pedestrian Master Plan for western New York, which identifies a recreational pathway to be constructed from Niagara Falls to the village of Youngstown. Once implemented, this 1.1-mile pathway will provide heightened public access to the dramatic Niagara Gorge vistas, State Park facilities, the communities along the route, and Niagara University - particularly opening access for the elderly or handicapped, who will benefit from the availability of a paved pathway.

Old Fort Niagara Association, Inc., Pathway Rehabilitation Old Fort Niagara, $37,000. Old Fort Niagara, a New York State Historic Site and a National Historic Landmark in Youngstown, will rehabilitate the pedestrian pathways throughout its site.

The existing pathways, which were installed during the 1930's, are not historically accurate and they represent a serious safety hazard for visitors to the site. This project will replace the pathways with an appropriate surface that promotes visitor access to the site's historic resources.

City of Lockport, Outwater Memorial Park Escarpment Stairway Restoration, $33,404.

The city will make critical masonry repairs on its Escarpment Stairway in Outwater Memorial Park. This will prevent ongoing deterioration and preserve the stone stairway that descends the Niagara Escarpment for public appreciation. This site serves as the sole entrance to the entire 48-acre park from the north side and provides the population in Lowertown ingress to the Outwater Park Rose Gardens, established in 1931, and to the balance of the surrounding park land from the northernmost end of the park.

City of Niagara Falls, Old Customs House Renovation & Conversion Planning, $71,000.

The grant will allow the city to undertake an evaluation of the costs and issues associated with the renovation and conversion of the Old Customs House as part of a proposal for the relocation of the Niagara Falls Amtrak Station. The project will preserve one of the city's historic resources while developing a state-of-the-art, international, intermodal, transportation facility. Relocating the train station from an industrial section of the city, to one of the city's commercial districts, will provide visitors with immediate access to restaurants, shops, hotels and other tourist amenities.

City of Niagara Falls, Niagara Falls Historic Trail Study, $30,000.

The second grant announced by the Governor will provide a $30,000 award to allow the City of Niagara Falls, in partnership with Niagara University, to complete the Niagara Falls Historic Trail Study. This will produce a citywide map and trail that defines the cultural heritage of the City of Niagara Falls. The study will identify the city's key heritage destinations. In addition, the city will produce maps and brochures, install signage, and construct an information booth. The trail will provide visitors and residents with the tools needed to explore the city's rich history and heighten awareness of its past culture and heritage.

Village of Lewiston, Access Enhancements to Lewiston Landing, $113,000.

The village will complete Phase 1 of access enhancements to the Lewiston Landing area of the Niagara River, an area targeted in the village's Local waterfront Revitalization Program. The project will implement public access projects at two sites. The improvements will include trail connections, overlooks, a fish cleaning station, and restrooms. This will further work developed under a previous LWRP grant from the EPF and will enhance public access and increase public water-dependent uses in the village at this key location.

City of Lockport, Niagara Brownfields Waterfront Coalition Strategic Reuse Plan, $85,000.

The City of Lockport will receive the funding to work with Niagara County and the cities of Niagara Falls and North Tonawanda to develop the Niagara Brownfields Waterfront Coalition Strategic Reuse Plan. This project will result in a strategic reuse plan for the Erie Canal, Niagara River, and Eighteen-Mile Creek waterfronts. This initiative will be coordinated by the Niagara Brownfields Waterfront Coalition and will serve to link brownfields development to the economic, social, and ecological restoration of these waterfront cities.

Erie County: City of Buffalo, Shea's Exterior Restoration, $200,000. Shea's Performing Arts Center is the cornerstone of the locally designated Theatre District. Grant funds will be used for exterior renovation and restoration of the existing terra cotta and brick facades back to the original 1926 appearance.

This will involve the partial replacement of 4,800 square feet of brick on the north, south and east elevations of the building. This preservation project also entails removing the entire granite and marble façade on the exterior front of the building, repairing all cracked segments, identifying and eliminating the water source that has caused the panel separation, and polishing and attaching the repaired marble and granite.

Graycliff Conservancy, Restoration of Windows, $82,138.

The Graycliff Conservancy, Inc., is dedicated to the preservation of the Isabelle R. Martin House (Graycliff) in Derby, NY, designed in 1926-1927 by Frank Lloyd Wright as the summer estate of the

Darwin D. Martin family. Funds will be used to restore the metal casement windows, roll screens and steel doors of the Main House. Restoring Graycliff (a New York State Landmark and listed on the National Register of Historic Places) will provide greater public access to this historic Wright site; enhance an appreciation and understanding of Wright's architectural legacy; provide a regional architectural heritage tourism destination; provide public access to lakefront property; promote the waterfront as a natural resource for public enjoyment and tourism; increase the number of tourist attractions in western New York, and protect this historic property from threats due to past negligence and inappropriate treatment.

Darwin D. Martin House, Darwin Martin House Restoration, $162,000.

The Martin House Restoration Corporation is dedicated to the restoration of the Frank Lloyd Wright-designed Darwin D. Martin and George Barton Houses in Buffalo. Grant funds will be used to demolish an apartment building on the site originally occupied by the pergola and conservatory, which were demolished in the 1960s. The project will also involve the actual reconstruction of the conservatory and the pergola.

Town of Hamburg, Seaway Trail Visitor's Center - Phase III, $71,000.

The Town of Hamburg will receive a $71,000 Environmental Protection Fund Local Waterfront Revitalization Program grant to redevelop an underused publicly owned waterfront site to provide improved public access to Lake Erie. The former Wanakah Water Works facility is being redeveloped as the Seaway Trail Visitor's Center. This grant will enable the Town to complete site improvements that will create direct access to 400 feet of beachfront. In addition, the Town will increase visual access and passive recreation at the site by building an observation deck and a fishing platform. Other site improvements include seawall repairs and upgrades, repairs to the foundation of a building, and the realignment of rip-rap.

In 1996, Governor Pataki became the first governor to fully fund the state's Environmental Protection Fund, which now provides more than $100 million annually for a wide variety of environmental programs, including $30 million for open space purchases.

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TABLE B

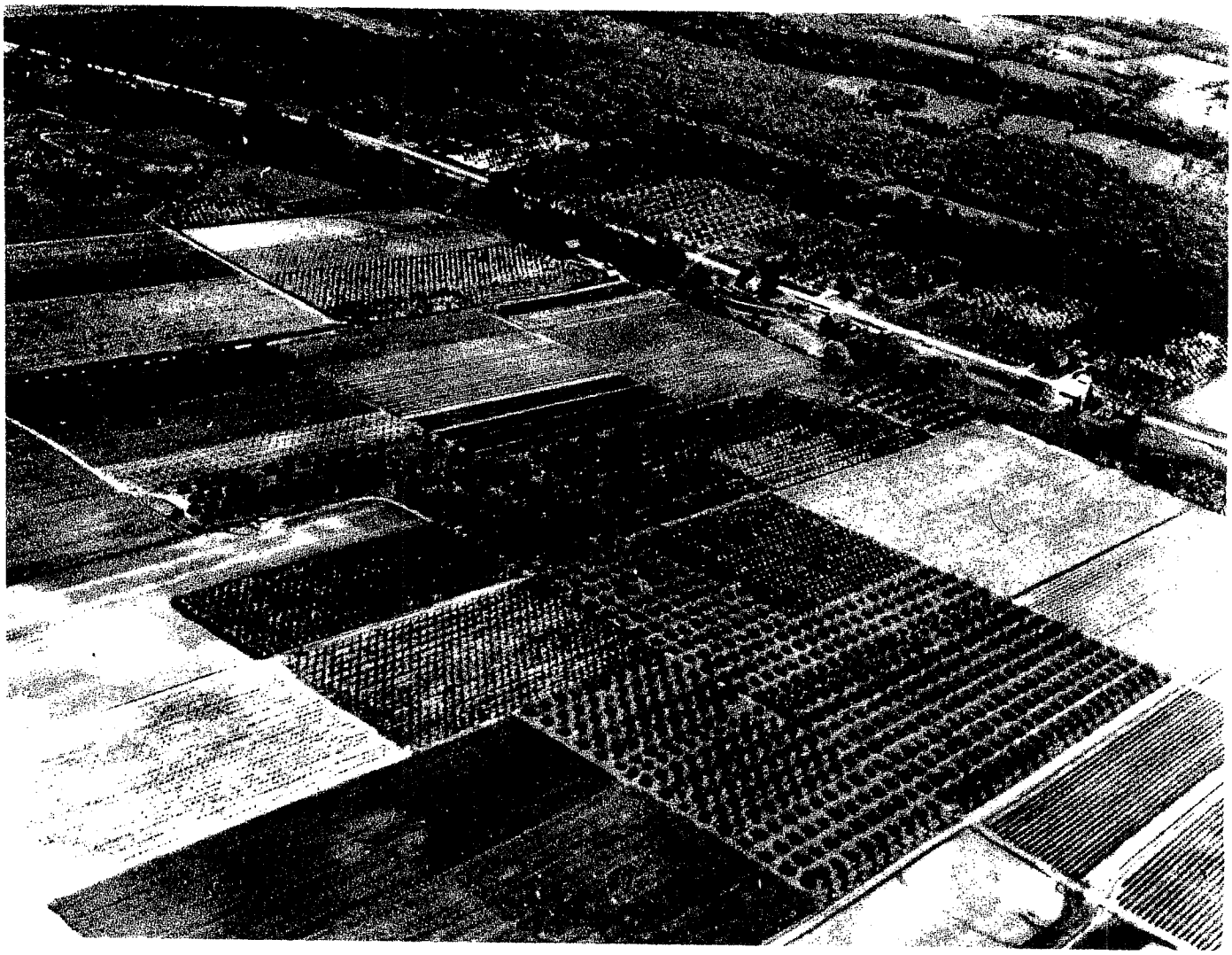
SOIL SURVEY OF NIAGARA COUNTY, NEW YORK

GEOGRAPHY, PHYSIOGRAPHY AND DRAINAGE

The Niagara Escarpment
A New Proposed American Viticultural Area

SOIL SURVEY OF

Niagara County, New York



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Cornell University Agricultural Experiment Station

Issued October 1972

This section provides general information about Niagara County. It discusses geology, physiography, drainage, climate, farming, and other subjects of general interest.

Geology

The soils of Niagara County formed in glacial material that was deposited during and shortly after the ice age. During the Pleistocene epoch, or ice age, the advancing ice sheet moved slowly southward and picked up rocks and soil material. This material was transported farther south and was later dumped to form hills, ridges, and plains. This dumped material is called glacial till.

When the ice halted or started to melt back, great streams and rivers carrying soil material poured out from the ice mass. The coarser material was dropped out to form eskers, kames, terraces, and large outwash plains. This material is called outwash. The finer material, such as silt and clay, settled out in small and large bodies of water. This finer material is called lacustrine deposits.

Where a lake, such as postglacial Lake Tonawanda, overflowed into another large lake, such as Lake Iroquois, a delta was formed. A delta is formed when a large stream carrying soil material flows into a large body of water such as a lake. Occasionally, a lake remained for a long period and built up a distinctive shoreline. Postglacial Lake Iroquois shows a good example of an old shoreline. The gravel along U.S. Highway No 104 (Ridge Road) was deposited by the waves at the edge of the lake. The area north of Ridge Road was occupied by glacial Lake Iroquois. A discontinuous beach, called the Newfane Beach, is thought to be a remnant of a lower lake level.

The many cobbly areas located near the Lake Iroquois beach were formed by the incessant movement of the waves near the shoreline. During one of the earlier glacial periods, the entire county was covered by glacial Lake Lundy. This lake is responsible for a large amount of the reddish-colored lake sediments. The Odessa, Lakemont, and Schoharie soils are among those that formed principally in these lake sediments. A large part of the reddish-colored glacial till areas was modified by these lake sediments.

Somewhat later the area adjacent to Tonawanda Creek was covered by glacial Lake Tonawanda. This lake received olive and brownish sediments that were deposited over the red clay. The Raynham, Rhinebeck, Canandaigua, and other soils formed in these sediments. The thick-surface variant of Rhinebeck soils is in an area that nearly marks the shoreline of Lake Tonawanda and the beginning of the reddish sediments of postglacial Lake Lundy.

The last large lake to disappear was glacial Lake Iroquois. The water that covered the area north of U. S. Highway No. 104 (Ridge Road) was relatively shallow. In this area are the Lockport, Lairdsville, Hilton, Appleton, Cazenovia, Ovid, and similar soils. The deepest water of Lake Iroquois that covered th present land surface was near the present shorelin of Lake Ontario. Consequently, the soil areas nea Lake Ontario have thicker lake sediments. Some of these thicker sediments contain lacustrine soils such as the Collamer, Niagara, Hudson, and Rhinebeck.

The principal bedrock formations are Queenston shale, Lockport dolomitic limestone, and Rochester shale. Soils of four series are strongly influenc by these bedrock formations. The Lairdsville and Lockport soils are nearly residual soils that developed in material weathered from Queenston shale The Brockport soils are nearly residual soils that developed in material weathered from Rochester sha The Farmington soils have only a thin glacial deposit over the Lockport dolomitic limestone. Queen ton shale is well exposed in the Niagara River Gor and near the banks of the many smaller streams. T Rochester shale is well exposed in a road cut sout of the village of Gasport. The Lockport dolomitic limestone is exposed along the Niagara Escarpment and Barge Canal and in the large limestone quarrie As the glacier crossed the Niagara Escarpment, it plucked large boulders and rock fragments from it. Many of these large fragments were deposited a sho distance south of the escarpment. Some of the soil especially the rock substratum phases of the Ontar Hilton, Cayuga, and Ovid series, contain these lar fragments in the soil or on the surface.

Glacial till occupies a large part of the surfa area in the county. It also underlies most areas lake sediments. Four types of glacial till deposi occur in the county. These are ground moraines, drumlins, elongated till ridges, and terminal moraines.

The ground moraine is by far the largest till deposit. It occupies most of the Appleton-Hilton-Sun and the Hilton-Ontario-Ovid soil associations, which are the largest in the county. A ground moraine occupies a low undulating till plain. The least modified ground moraine is in a belt 3 to 5 miles wide that extends from Lockport to the Niaga River. This ground moraine has been modified in most areas, especially where it was covered by gla cial Lake Iroquois. The average thickness of the ground moraine in Niagara County is 10 to 15 feet.

Drumlins and drumloid forms are smoothly rounde hills that were molded beneath the ice. A few of them have rock cores, but many have cores of very compact glacial till. Most of the drumlins in Niagara County are very subdued or modified by lak The best examples of drumlins are south of Pendlet Center near the Tonawanda Game Club.

Elongated till ridges are very thin ridges that extend in a northeast-southwest direction. They are located in the Ontario Plain north of Ridge Ro These ridges have some characteristics of drumlins, but they are believed to be related to giant flutings in the underlying Queenston shale (5). The ridges consist of pebbly till containing generally more coarse fragments than the surrounding ground moraine.

Terminal moraines have a general east-west trend and were formed when the ice stagnated for a long period. They are more likely to contain gravel than other glacial till deposits. The two principal terminal moraines in Niagara County are the Barre Moraine and the Rochester-Albion Moraine. The Barre Moraine parallels the escarpment and is dominantly water-worked glacial till. The Rochester-Albion Moraine is between the Barge Canal and the escarpment. It contains much sand, silt, and gravel.

The largest outwash deposit is located in a 1- to 2-mile belt that extends 3 miles westward and 5 miles eastward from the village of Olcott. This deposit is 1 to 10 feet thick. The coarser gravel is in the southern part of the belt. Another small outwash area is in the city of North Tonawanda near the Niagara River.

The principal beach deposit is the Iroquois beach ridge. This ridge stretches nearly all the way across the county and provides the road base for the Ridge Road. Some lesser beaches are located north of Ridge Road. The most recognizable of these are in the Newfane beach area. Outwash and beach deposits provide the best source of gravel in the county. They also contain the best soils for crops grown for an early market.

Physiography and Drainage

Niagara County lies in the eastern lake section of the Central Lowland physiographic province (8). This section is divided into the Erie, Huron, and Ontario Plains. The county occupies part of the Huron and Ontario Plains. The Ontario Plain extends from the shore of Lake Ontario to the foot of the Niagara Escarpment, and the Huron Plain from the crest of the escarpment southward beyond the county line.

The Niagara Escarpment consists of a steep northward slope, along which perpendicular bluffs are exposed in places. The crest has an elevation of slightly more than 600 feet. It is steeper and narrower in the western part. Its width ranges from only a few rods at Lewiston to nearly 2 miles in the eastern part. North of the 400-foot contour line, the nearly level lake plain slopes at the rate of 20 feet a mile toward the lake, which is 8 miles from the escarpment. The surface of the lake is 246 feet above sea level, and the lakeshore is nearly everywhere bordered by low bluffs 15 to 60 feet high. The land surface is fairly uniform, but it is dissected in a few places by shallow valleys of minor streams. The minor irregularities of relief have a northeast-southwest trend. This is chiefly indicated by the courses of the streams, most of which flow northeastward.

A low but well-marked, fairly sinuous ridge runs along the inner margin of the Ontario Plain. In some places this ridge is close to the base of the escarpment, and in others it is more than 4 miles north of it. The ridge rises 10 to 30 feet above the level of the surrounding land. It extends in a general westerly direction from Johnson Creek and the eastern part of the county to Ridge Road, where it turns south-westward and continues to Wrights Corners. The ridge is not well developed across the valley of Eighteenmile Creek, but it reappears near Warrens Corners and extends westward to the base of the escarpment east of Lewiston. Although low and in places inconspicuous, the ridge is an important topographic feature, as it is traversed by a main highway, United States Highway No. 104, or the Ridge Road, and is everywhere thickly settled. It represents an old beach ridge formed by a predecessor of Lake Ontario (5), and a well-worn Indian trail followed it before the arrival of white men.

For the last few miles of their courses, the larger streams flowing into Lake Ontario descend through narrow gorges 10 to 30 feet deep. About 4 miles above its mouth, Eighteenmile Creek flows through a gorge that is 70 feet deep and one-eighth mile wide and has precipitous walls in places. The broad, shallow valley of the Niagara River crosses the Ontario Plain on the west.

About half the area of the county is occupied by the Huron Plain. The central part of this plain extends from Wolcottsville westward past North Tonawanda. It is nearly level and slopes gently westward from an altitude of 600 feet or more on the east to 570 feet along the Niagara River. The evenness of most of the surface is broken in places by low, narrow, irregular ridges that have a northeast-southwest direction. These irregular ridges range from 1.4 to nearly 2 miles in length and rise 20 to 50 feet above the general land surface. West of Lockport a long, narrow ridge that is roughly parallel to the Niagara Escarpment lies along the northern margin of the plain. This ridge rises 20 to 40 feet above the plain and reaches an altitude of 660 feet at one or two points near Pekin and of 680 feet about 2 miles east of Dysinger. East of Lockport the surface is more or less irregular, and there are several low ridges that have a general east-west trend.

The general elevation of the Huron Plain is 600 feet. Elevation ranges from 575 feet at the mouth of Tonawanda Creek to a maximum of 680 feet near Dysinger. The elevation at Lockport is 600 feet, which also is the elevation at Niagara Falls. The elevation of the Ontario Plain at the base of the escarpment ranges from 400 feet at Lewiston to 500 feet at the point where the escarpment leaves the county on the east.

Drainage of the Ontario Plain is northward into Lake Ontario. The streams have crooked channels, which meander through comparatively narrow flood plains that are not deeply cut. Within the plain there are several broad, level or slightly depressed, basinlike areas that have poorly developed outlets. The drainage of these and of numerous other level areas has been attempted by ditching, but most of the ditches are too small for efficient drainage, and many are choked with weeds and shrubs. Many of the soils of the lake plain are somewhat poorly drained to poorly drained.

Drainage of the Huron Plain is southward into Tonawanda Creek, which flows westward and empties into the Niagara River. As on the Ontario Plain, drainage here is not well developed. The almost level surface makes artificial drainage a problem because runoff is slow.

Water Supply

Niagara County has an abundant water supply. The county is surrounded on three sides by fresh water. Tonawanda Creek is on the south, the Niagara River is on the west, and Lake Ontario is on the north. Most residents obtain their water from municipal water systems. The county has a public water district that was the first of its kind in New York State. This district obtains water from the Niagara River and is connected with the municipal water systems for emergency service.

Many rural residents depend on deep and shallow wells for their water. Most deep wells that are north of the Niagara Escarpment are dug into the red Queenston shale. The quantity and quality of the available water is erratic. In many places deep wells dug or drilled into the red shale produce water that has a high salt or sulfide content. The yield of water is often inadequate during extended dry periods.

Deep wells south of the escarpment that are drilled into the Lockport limestone formation yield water that is generally high in bases, especially calcium. This high content of bases makes the water hard. Water softeners are generally needed for the most efficient use of this water. The yield of water is generally much better from limestone than from shale.

The best areas for springs and shallow wells are in three of the 11 soil associations. The three associations are the Otisville-Altmar-Fredon-Stafford association, the Howard-Arkport-Phelps association, and the Hilton-Ovid-Ontario association. Because population and septic tank disposal are increasing, shallow wells and springs are in danger of contamination.

Climate [9/]

Niagara County has a humid, continental type of climate. The North American continent is the primary source for air masses and weather systems that affect the county. Air flow from the south or southwest brings moisture to the region from the Atlantic Ocean and Gulf of Mexico.

The county has pleasantly warm summers. The winters are fairly long and cold, and they have frequent spells of cloudy, unsettled weather. Precipitation generally is evenly distributed du the year, though minimum monthly precipitation i slightly less during winter than during other se sons. The county does not have distinct seasona differences in maximum precipitation. Tables 12 13 give climatic data taken from the records at Lockport.

Most atmospheric pressure systems affect Niag County as they move across the continent or up t Atlantic Coast. The result is a variety of weat Temperatures and other atmospheric elements usua undergo noticeable change within an interval of few days. On the average, the weather during a given week is often quite different from that du the preceding or following week. Seasonal weath differs from year to year.

The climate is greatly influenced by the clos proximity of Lakes Ontario and Erie. In spring cold lake waters function as a heat sink that re tards the normal warming of the air temperature. Plant growth is delayed, and tender crops are ai in passing more safely through critical periods freezing temperatures. The lakes tend to restri the occurrence of extreme high temperatures in s mer. Niagara County is therefore less subject t severe thunderstorms caused by strong summer hea than are other counties farther inland. In fall lake waters are a source of heat that reduces co ing at night and increases the length of freeze-free growing season. Lake Ontario, and Lake Eri a lesser extent, remains largely unfrozen in the winter, and this modifies the occurrence of extr cold temperatures in comparison with more inland areas of similar elevation and latitude.

Nearness to the Great Lakes is an important fa tor in the amount of snow that falls in the count Air flow from the southwest is heated and moiste as it moves across the open, relatively warm wat of Lake Erie. Moving inland, the air masses rel moisture in the form of heavy snowfall. These la affected storms are most common in November and December. They are characterized by substantial snow over a wide area and very heavy amounts in n row bands or local areas. The frequency and int ity of these storms decrease later in winter as m of the lake surface becomes covered with ice. Ni gara County is less affected by such storms aris over Lake Ontario.

Elevation is of minor influence on the climat because of the relatively small differences in th county. The climate is comparatively uniform, ex cept as it may be affected by distance from the Great Lakes. Thus, with slight adjustment the te erature data for Lockport contained in tables 12 13 are reasonably applicable to other sections of Niagara County.

The county has much cloudiness in the winter. High winds often accompany the lake-affected snow storms and hamper travel. Otherwise, severe and damaging storms of various types are not a seriou weather hazard to the inhabitants and economy of this area.

9/ By A. BOYD PACK, climatologist for New York, National Weather Service, U.S. Department of Commerce.

TABLE C

THE OXFORD COMPANION TO WINE

SOIL AND WINE QUALITY

The Niagara Escarpment
A New Proposed American Viticultural Area

THE OXFORD COMPANION TO WINE

EDITED BY

JANCIS ROBINSON

difficult to work—produce an average 1.8 million hl/48 million gal of wine a year. The average size of the properties, whether in DOC zones or not, is hardly more than half a hectare, most of them yielding a particularly low annual income. The total DOC production of the region is only three per cent of the region's annual wine crop and almost 90 per cent of the wine produced is red.

The most important DOC by far is Cirò (on the sole of Italy's boot), where a certain viticultural tradition exists and where Tancredi BIONDI-SANTI of MONTALCINO operated as a consultant during the decades immediately following the Second World War. Even Cirò produces only a quarter of its potential, however, with barely 670 ha of the 2,500 ha of DOC Cirò vineyards planted actually employed in the production of a strong, dark, DOC wine.

So uncommitted is Calabria to the business of making wine officially regarded as of superior quality that certain DOC wines have virtually disappeared from the market: Melissa Bianco, Donnici, Savuto (10 producers, and close to 200 hl/5,300 gal produced in the official production declarations in the mid 1990s), Sant'Anna Isola Capo Rizzuto—and Pollini reappeared with less than 400 hl. In a certain sense, therefore, the DOC system has ceased to function in Calabria.

GAGLIOPPO, the principal red grape of the region, is the base of Cirò, Savuto, and Pollini and seems to have real potential; interesting experiments with small oak BARREL MATURATION have begun in Cirò in an effort to give the wine a more international character. It may be blended with red and white GRECO, TREBBIANO, and NERELLO grapes to produce Calabria's hefty reds and rosés. The white Greco grape, partially dried, produces a strong, coppery dessert wine of real interest and personality in its DOC zone around the town of Bianco almost at the tip of the boot, making the confusingly named Greco di Bianco Calabria's most distinguished wine. Cabernet Sauvignon and Cabernet Franc, Chardonnay, and Sauvignon Blanc are being experimented with in a desultory fashion, although real conviction and truly convincing results are rare. This is all too predictable in a region where, in the early 1990s, only three firms among the 65,000 registered grape-growers managed to export their wines. D.T.

Anderson, B., *The Wine Atlas of Italy* (London and New York, 1990).
Gleave, D., *The Wines of Italy* (London and New York, 1989).

CALADOC is a black grape variety created by French AMPELOGRAPHER Paul Truel under INRA auspices by crossing Grenache and Côt (Malbec) to produce a Grenache-like crossing less prone to COULURE. It has been planted in the southern Rhône but is not allowed into any APPELLATION CONTRÔLÉE wine, although it may be used to add TANNIN and aroma to red VINS DE PAYS in Provence. It is grown only in limited quantities.

CALANDRE, a system of DISTILLATION in which the raw material is first heated by steam in three interconnected vessels each holding about 400 l/105 gal. The fumes they give off, which are about 20 per cent alcohol, are then distilled to about 70 per cent. The biggest installation is at the Distillerie Goyard at Ay, which buys all the surplus wine and lees from the Champagne region. N.F.

CALATAYUD, denominated wine zone in ARAGON in north east Spain, in arid country on either side of the river Jalon, a tributary of the Ebro (see map on p. 907). As in much of central Spain, YIELDS rarely rise above 20 hl/ha (1 ton/acre). The DO regulations limit growers to indigenous grape varieties, which are mostly sold to one of nine local CO-OPERATIVES. The GARNACHA grape which accounts for around two-thirds of the Calatayud's production makes heady, potent red wine, although TEMPRANILLO is slowly gaining in popularity among the more quality-conscious producers. Investment in new technology, particularly STAINLESS STEEL and REFRIGERATION, is increasing the proportion of crisp white wines made from VIURA and Garnacha-based rosés, but in 1993 few wines had yet reached an exportable standard. R.J.M.

CALCAIRE, French word for LIMESTONE, a rock largely made up of calcium carbonate, which may in English be described as **calcareous**. The term is used to describe, for example, the vineyard soils of the CHAMPAGNE region of France, as well as some of those in the south of BEAUJOLAIS. Soils described in French as *argilo-calcaire* are a mixture of clay and limestone. See entries prefixed SOIL. M.J.E.

CALCIUM, a major element required for vine growth, but one in which vineyards are hardly ever deficient. Calcium is very important to many aspects of the vine's metabolism, not least as a basic constituent of cell walls. The calcium content of soils is important in affecting SOIL STRUCTURE, encouraging as it does good friability and hence water infiltration. All CALCAREOUS soils are high in calcium. A high LIMESTONE content can affect vine health because of lime-induced CHLOROSIS. R.E.S.

CALDARO, or **Kaltern** in German, township in the ALTO ADIGE of northern Italy. It gives its name to **Lago di Caldaro** or **Kalterersee**, a large DOC zone for lightish red wines which extends into neighbouring TRENTINO.

CALIFORNIA, state on the Pacific coast of the UNITED STATES and the largest source of American wine by far, producing 90 per cent of all American wine in the early 1990s. California was also for years the only source of *vinifera* wine in the USA: it is deservedly called 'the Wine State'. California wine, like most things Californian, has arrived at its current position by a series of bold investments, natural disasters, scientific achievements, external pressures, and political calamities. That the USA is not a nation of wine drinkers has tended to exaggerate the cycle of giant strides and general retreats, and even relatively recent events can fast become history (see below).

Other than Haut-Brion's inclusion in the 1855 Médoc classification, the red wines of the GRAVES district were not officially classified until 1953. This one-class list, together with an official classification of the white wines made in 1959, appears on p. 247. It avoided some possible controversy by employing a democratically alphabetical order (Ch Haut-Brion Blanc was added in 1960). It should be said, however, that there is a wide differential between the prices commanded by Ch Haut-Brion and its close rival Ch La Mission-Haut-Brion, and those fetched by Chx Bouscaut and de Fieuzal, for example. The Graves district was subsequently divided into Graves and PESSAC-LÉOGNAN.

The classification of ST-ÉMILION, formally drawn up in 1955, is most frequently amended. There were modifications in both 1969 and 1985 and these are likely to continue on the basis of monitoring of wine quality, vineyard boundaries, and the like (vineyards cannot be extended between re-classifications). The St-Émilion classification's laudable topicality is mitigated by over-generosity, however. The top two properties Chx CHEVAL BLANC and AUSONE are ranked, somewhat inelegantly, premiers grands crus classés A, while nine (10 until 1985) properties qualify as premiers grands crus classés B. Below this are more than 60 grands crus classés, whose quality can vary considerably, and then in each vintage, on the basis of tastings, the deceptively grandiose rank of GRAND CRU (minus the classé) is awarded to scores of individual wines from properties below grand cru classé status. The 1985 classification is reproduced on p. 248; a revision based on tastings of wines made between 1984 and 1994 is expected to be published in 1996.

POMEROL is the only important fine wine district of Bordeaux never to have been classified, although its star Ch PÉTRUS is conventionally included with Chx Lafite, Latour, Margaux, Haut-Brion, Mouton-Rothschild, Cheval Blanc, and Ausone as a first growth.

There have been regular attempts to revise and assimilate the various classifications of Bordeaux, most notably that drawn up by Alexis LICHINE in 1959. Most serious writers on bordeaux make their own revisions, more or less confirmed by the market.

See also CRU BOURGEOIS for those MÉDOC properties classified as just below the status of a fifth growth.

Burgundy

Burgundians were also well aware of the considerable variation in quality of the wines produced by different plots of land, or *climats*, as they are known in Burgundy. In 1855 Dr Lavalle published his influential *History and Statistics of the Côte d'Or* which included an informal classification of the best vineyards. This was formalized in 1861 by the Beaune Committee of Agriculture, which, with Lavalle's assistance, devised three classes. Most *climats* included in the first class eventually became grands crus when the APPELLATION CONTRÔLÉE system was introduced in the 1930s. See p. 165 for a full list of Burgundian grands crus, and see under individual village names for details of their premiers crus.

Elsewhere

Few other regions of France have anything approaching an official classification, although see ALSACE for a list of those vineyards accorded grand cru status, and CHAMPAGNE for some details of the classification of individual villages there.

There have been attempts, typically by wine writers and/or wine waiters, to produce classifications of the best vineyards, or best wines, of many countries, notably Germany and Italy (see VERONELLI), but these have so far been too controversial to be generally adopted. With the exception of the DOURO, where individual vineyards have been classified for the quality of port they produce, the wine regions of Portugal and Spain are in too great a state of flux to submit satisfactorily to classification, like those of eastern Europe and the rest of the Mediterranean.

In the New World, Australia prefers to classify not vineyards but individual wines, often much blended between areas, by awarding them medals and trophies in their famous SHOWS, while classification may never appeal to the democratic California wine industry.

See also CLIMATE CLASSIFICATION.

Penning-Rowsell, E., *The Wines of Bordeaux* (6th edn., London, 1989).

Pitiot, S., and Servant, J.-C., *Les Vins de Bourgogne; Collection Pierre Poupon* (11th edn., Paris, 1992).

CLAY, description of sediment or soil which is made up of particularly small particles. See SOIL TEXTURE, and GEOLOGY, for more details of this particular form of soil classification. The terms used in this classification are unrelated to the soil's mineral composition—although in general soils whose texture is described as clay tend to be dominated by clay minerals (a geological term with a technical meaning), while they may also contain considerable quantities of clay grade (particularly small particles of) quartz. To have a stable SOIL STRUCTURE, a soil must contain at least a moderate amount of clay. In viticultural terms, clay is especially celebrated as a vineyard SUBSOIL, often being more important than is obvious from the surface of the soils, as in parts of POMEROL, for example. J.G.

CLEANLINESS, an important quality in wine (a wine should not have any off-odours) and in wineries, for which see HYGIENE.

CLEAR LAKE, CALIFORNIA wine region and AVA. See LAKE COUNTY.

CLEFT GRAFTING, a popular method for changing VINE VARIETY in the vineyard (see FIELD GRAFTING). The severing of the trunk may be at ground level or just below the head; the latter is preferred because DESUCKERING is simpler, less vine training is required, and the extra wood of the trunk aids the rapid establishment of the new vine. The trunk is cut horizontally in early spring and the stump split across the middle to about 5 cm/2 in depth. SCION pieces of one or two nodes are prepared from dormant canes with a long-tapered

has better drainage properties, but is rare in vineyards outside CHAMPAGNE and parts of southern ENGLAND. If a soil contains a substantial quantity of fragmented limestone, it can be described as calcareous, or *calcaire* in French, which has often been wrongly translated as chalk in English wine literature. Similarly, the French word *schiste* means SLATE as well as schist, and is sometimes used loosely to mean SHALE, and its direct translation as schist has caused further confusion. (The word 'limy' is sometimes used by writers instead of calcareous, but should more properly be limited to those soils whose PH is greater than about 7.6.)

Effect on temperature

General air temperatures around vines are modified by the TOPOGRAPHY, itself largely a product of geology, in two ways: by controlling the amount of radiant heat from the sun which reaches the grapes; and by varying the quantity of heat reradiated from the ground on to the vines and grapes. The physiological significance of the latter is discussed in CLIMATE AND WINE QUALITY.

In vineyards in which the ground is kept clear of WEEDS and COVER CROPS, the effects of reradiation can be considered in terms of bare soils. The albedos (the diffuse reflectivity) of most soils and rocks are in the range of 0.1 to 0.3. In other words, 10 to 30 per cent of radiation from the sun is reflected back. Sandy soils have higher albedos than clays; dry ground has a higher albedo than damp. Hence a dry, sandy soil reflects back about twice as much radiation as a damp clay.

Effect on water balance

A balanced supply of water to the vines' roots is needed to produce high-quality wine grapes. The capacities of soils to supply this are discussed under SOIL WATER and SOIL AND WINE QUALITY. Underlying rocks can also play a significant role in vine-water relations because of the exceptional length of vine roots.

The ideal ground (soil and bedrock) for water balance has a high porosity for storing water; a sufficiently low matrix-permeability to stop it draining away too fast; but a high mass-permeability to ensure good drainage. Permeability is a measure of the ease with which a liquid passes through a sediment. The passage of water from one microscopic pore to another between the particles is known as the matrix-permeability. Most rocks and soils are traversed by cracks along which water can flow much more easily. The total possible rate of flow is known as the mass-permeability (see diagram).

Some examples of common vineyard rock types are given in the table, together with very approximate typical values of porosity in percentages, and permeabilities in millidarcys in fresh rock.

Of the rocks listed in the table, the ideal is chalk. The values given in this table are for fresh rock; in many vineyards there may be a thick cover of weathered and broken-up rock which, for water balance, behaves as an unconsolidated sediment. On the GRANITES of Beaujolais, for example, there are often several metres of material that behave like an unconsolidated sand in terms of both porosity and permeability.

And regions which are indicated as limestone on a simple geological map, may actually have sufficient clay interbedded with the limestone or along joint planes to hold adequate supplies of water. Sandstones and conglomerates, which dry out easily, may have lenticular patches out of sight below the surface, with much lower matrix-permeabilities which can hold reserves of water during periods of DROUGHT. Examples include the finer sand with its low matrix-permeability in the Méric conglomerate of the Médoc, lenticles of silt beneath the conglomerates of the central Torres vineyards in Penedès. Very approximately, permeabilities increase with the square of the grain size, but the subject as a whole is complicated.

Rock type	Porosity %	Matrix-permeability (mD)	Mass-permeability (mD)
Sandstone and conglomerate	20–40 seldom below 5	35–400	50–3,000
Clay and shale	8–20	0.05–0.3	10–10,000
Limestone:			
Regular	less than 5; occasionally up to 25	typically under 0.1	100 but very variable
Chalk	30–45	2–3	30–3,000
Granite	very low	very low	high

Effect on vine nutrition

Even in vineyards with some soil, vine roots usually extend below it into the underlying rock. The mineral composition of the rock as well as the soil affects the nourishment of the vine. Vines do best with the slow but regular supply of potassium ions from the breakdown by weathering of primary potassium-bearing minerals.

A significant proportion of the world's famous wines are from vineyards whose underlying rock contains potassium feldspar (a group of minerals), or is rich in illite (a clay mineral visible only with an electron microscope). Examples include the feldspar and illite-bearing Méric conglomerate of the Médoc; the potassium feldspar in the granites beneath Beaujolais and Hermitage; the illitic clays within the limestones of the Côte d'Or; the feldspathic sandstones of the Rotliegend formation west of Nierstein in the Rheinhessen and some of the grands crus vineyards in Alsace; the muscovite-illite rich phyllites of parts of the Upper Mosel; the feldspar porphyry of Schlossböckelheim in the Nahe; and the alluvial sediments in the Napa Valley derived from volcanic and pyroclastic rocks lining the sides of the valley.

For more detail, see SOIL, SOIL AND WINE QUALITY, ROCK, TOPOGRAPHY, TERROIR, and for details of specific soil and rock types, see under their individual names. J.M.H.

Bibliographical note: There is little general literature on the relationships between geology and wine. A pioneering work was by P. Wallace, *International Geological Congress 24* (Canada, 1972) 6, 359–65. A more recent and lavishly illustrated book is C. Pomerol (ed.), *Terroirs et vins de France* (Paris, 1984–6), trans. as

can include FERTILIZERS (such as superphosphate) to overcome mineral nutrient deficiencies, LIME, which will overcome SOIL ACIDITY, and gypsum and ORGANIC MATTER, which will improve SOIL STRUCTURE. These ameliorants are spread on the soil surface, and occasionally turned in by cultivation. Where there is a need for deep placement, as in LIMING, then large and powerful bulldozers are used, normally before planting.

R.E.S.

Coombe, B. G., and Dry, P. R. (eds.), *Viticulture, ii: Practices* (Adelaide, 1992).

SOIL AND WINE QUALITY. The SOIL has many attributes that can influence the vine grown in it, and thence the quality of both grapes and wine. Quite how influential these attributes are remains a matter of debate, with a fairly marked divergence of opinion between the OLD WORLD and NEW WORLD.

Old World versus New World

Old World opinion, especially in France, strongly emphasizes soil effects. It is a principal basis for the concept of TERROIR which underlies the official French system of wine appellation, the APPELLATION CONTRÔLÉE system. In Germany, by contrast, large local differences in climate associated with TOPOGRAPHY are often considered to override soil effects (see MESOCLIMATE and CLIMATE AND WINE QUALITY), although they are still regarded as an important factor governing wine quality. SOIL COLOUR can be critical at the extreme cool limit of viticulture in determining whether grapes will ripen at all. Fregoni and Berry give examples.

New World opinion has tended to minimize the role of soil, and instead to stress major differences in regional climate, or MACROCLIMATE. Amerine and Winkler's 1944 CLIMATE CLASSIFICATION of California into five temperature regions, Regions I to V, epitomizes this view.

Much of the divergence in approach can be ascribed to differences in historical, geographical, and commercial background. Traditional European vineyards were small, and the identities of their wines sometimes established over many generations. It was observed that certain sites consistently produced different and/or better wines than others, apparently regardless of VITICULTURE management and WINEMAKING practices, and sometimes in the absence of discernible differences in mesoclimate. One general observation, especially marked in Bordeaux, was that the best sites stood out most clearly in poor VINTAGE YEARS. These sites maintained a relative consistency of high quality, whereas others, superficially similar and often very close, suffered greatly diminished quality. The only possible reason seemed to lie in unaltered (and perhaps invisible) properties of the soil.

New World viticulture generally lacks this experience. Moreover, its dominant commercial organizations tended to employ extensive BLENDING of wines from different soils and regions, so that any individualities were often masked or lost. Attempts to identify wine differences that could be related to soil type, for instance that of Rankine *et al.*, have generally yielded negative results. It is therefore hardly surprising that subtle differences in wine quality due to the soil should have commanded little attention in the New World.

Despite all this, the absolute need for quality (and in some cases, wine individuality) in a now highly competitive world market means that the New World can no longer afford to neglect any avenue to excellence. The Old World meanwhile needs to identify more closely the reasons why some soils can give better wines than others, so that ways can be found to bypass the old constraints of soil and terroir, and thus to attain the best wine qualities more widely. Pre-eminent in this field has been the work of the Bordeaux researcher Dr Gérard Seguin, which forms a background to the discussion that immediately follows. Other French studies of note are of PREMIER CRU vineyards in Burgundy by Meriaux and Chrétien reported by Berry. In this account we distinguish between chemical and physical soil attributes.

Physical soil attributes

Scientific opinion now almost universally agrees with Seguin's conclusion that soil physical characteristics predominate as the main influence over grape and wine qualities other than CLIMATE; and further, that, among the physical characteristics, the most important are those which govern water supply to the vine. These and their relationship to individual soil types are discussed in some detail under TERROIR. See also SOIL WATER, SOIL TEXTURE, DRAINAGE, and VINE PHYSIOLOGY.

Here we may note briefly that the best wines come from soils that are very well drained, and furnish a steady, but only moderate, water supply to the vines. When combined with appropriate restrictive mineral VINE NUTRITION, this ensures that growth is restrained. The leaves remain relatively small, and nearly all leaves and bunches are well exposed to SUNLIGHT. The grape berries do not become over-sized (see BERRY SIZE), so their skin to pulp ratios remain high, and the PIGMENTS and FLAVOUR COMPOUNDS that reside largely in the skins are not diluted. The smaller berries are also usually less liable to congestion and compression within the bunch, and are therefore less likely to split or suffer spoilage as a result of FUNGAL DISEASES OR BACTERIA. WATER STRESS needs to be just enough to attain these ends, and not enough to interfere with normal leaf functioning.

Some other physical properties of soils almost certainly influence wine qualities in subtle ways.

SOIL COLOUR affects soil temperature and that of the air immediately above. Dark coloured soils absorb and convert nearly all of the light falling on them into heat, and so are warmer than light coloured soils, and, at night and during daytime cloud cover, radiate more warmth back to the vines and bunches. This can be critical in some cold to marginal viticultural climates, allowing fuller RIPENING and thus better wine quality (as in the bituminous soils of the Neckar valley in WÜRTTEMBERG or the Meuse valley of southern BELGIUM for example). More speculatively the amount and spectral quality of the light reflected back into the vine CANOPY might have effects of their own in some situations (see SUNLIGHT).

The presence of STONES AND ROCKS in the soil or on its

TABLE D

VITICULTURE AND THE ENVIRONMENT

CLIMATE

The Niagara Escarpment
A New Proposed American Viticultural Area

NIAGARA ESCARPMENT
SUITABILITY FOR
VITIS VINIFERA

- John Gladsone Viticulture and Environment Determined Ripening

Pinot Noir	Riesling	Cabernet Sauvignon
2102*	2192	2372

- Niagara Escarpment Site Adjusted Degree Days
  - 2098 within 0.2% of Pinot Noir

    4% Too cold for Riesling

    12% Too cold for Cabernet Sauvignon

* = Degree Days above 50^0F and below 66^0F

11/27/97

Niagara Escarpment
Temperature Suitability
for
Vitis Vinifera

	April	May	June	July	August	Sept	October			
Lockport 4 NE, 440Ft										
Mean Temperature	44.8	55.9	65.4	70.4	68.6	61.5	50.8			
Truincated @ 66F	50.4	55.9	65.4	66	66	61.5	50.8			
Minus 50	0.4	5.9	15.4	16	16	11.5	0.8			
Month Days	30	31	30	31	31	30	31			
Degree Day Sum	12	182.9	462	496	496	345	24.8	2018.7		
Latitude Adj 42D	1.007	1.013	1.015	1.014	1.009	1.002	0.995			
Latitude Adj 44D	1.014	1.026	1.031	1.028	1.019	1.005	0.989			
Latitude Adj 43 D	1.0105	1.0195	1.023	1.021	1.014	1.0035	0.992			
Lat Adj Temps	12.13	186.47	472.63	506.42	502.94	346.21	24.60	2051.4		
Normal Max	54.1	66.4	75.8	80.8	78.9	71.6	60.2			
Normal Min	35.4	45.4	54.9	60	58.3	51.4	41.3			
Daily Temp Range	18.7	21	20.9	20.8	20.6	20.2	18.9	20.2		
Values over 11.7F	6.3	8.37	8.28	8.19	8.01	7.65	6.48			
Adjusted Max	48.4	59.3	69.3	74.3	72.0	64.2	53.2			
Adjusted Min	29.5	37.9	47.9	53.1	51.1	43.9	34.5			
Adjusted Temp Range	18.9	21.4	21.4	21.2	20.9	20.3	18.7	20.4		
Diurnal Adjustment	5.83	178.10	464.35	498.23	494.93	338.56	18.12	1998.1		
34.2F Cieling Check	0.1942	5.7451	15.478	16.072	15.966	11.285	0.58457			
Site Adjustments						Slope		50		
						Calcarous		50		
			Niagara Escarpment Range				2078	2098	2118	
							-1.2%	0.2%	0.8%	
Pinot Noir, Sauvignon Blanc, Chardonnay, Tinta Amarella						Recommended		2102		
Riesling								2192	-4%	
Cab Sav								2372	-12%	

11/27/97
2:32 PM

Per John Gladstone, Viticulture and the Environment, 1992

VITICULTURE *and* ENVIRONMENT

JOHN GLADSTONES

son is that the usual infertility of stony soils is needed to maintain vine balance and fruitfulness in cool, summer-rainfall climates. Stony soils have the additional advantage of usually being well drained.

A stony or rocky surface also gives valuable resistance to soil erosion. This is especially important on slopes – which happen, in most cases, to provide the best mesoclimates for viticulture, as discussed in the second half of this chapter.

Traditional wisdom says, however, that stony or rocky soil surfaces bestow an additional benefit for viticulture. By efficiently absorbing and storing more heat than normal soils during the day, and re-radiating it to the vines through the night and during cloudy periods, they are held to reduce frost and allow fuller ripening. This is illustrated in Figure 3. Among other things, it makes viticulture possible in colder climates than would be so otherwise. Present knowledge of the thermal properties of soils, reviewed by Geiger (1965) and van Eimern (1966), confirms this.

But the old beliefs seem to have gone further. Not only is ripening on stony or rocky soils more complete; it is also qualitatively better. Portes and Ruyssen (1886) stated:

> That principle which give wines their bouquet, and which the great Bordeaux chemist has called 'oenanthine', or flower of wine, above all needs complete maturation of the grapes for its production. It is always much greater on dry, stony or pebbly soils than in the same grape varieties planted on soils that are fat, strong and clayey.

Such a statement could hardly refer merely to an assurance of quantitative ripeness resulting from extra heat. Stony soils feature as much, or almost so, as a quality factor in quite hot climates as at the cool limit of viticulture. I have already mentioned the 'pudding stones' of Chateauneuf du Pape in southern France. Both Rendu and Portes and Ruyssen document many other examples of the high proportion of stones or rocks in the vineyards making the best wines of southern France, Spain and elsewhere. In Western Australia the lateritic gravels are highly reputed for wine quality, even in the hot Swan Valley.

Several mechanisms seem possible for such a relationship. Undoubtedly one is generally low soil fertility, and its effect on vine vegetativeness and canopy light relations, as discussed in Chapter 3 and further in Chapter 5.

At least part, however, is equally or better explainable in terms of temperature variability. Heat absorbed during the day, and re-radiated at night or under cloud cover, can be seen as enhancing berry metabolism and completeness of flavour ripening relative to sugar accumulation and acid loss (Chapter 3). Even in hot ripening environments, the air temperature at night commonly falls below optimum for the importance when temperatures through much of the day are above optimum for it.

The direct effects of stony soils on canopy microclimate during the day are more speculative. The better heat conductivity of rock, compared with fine (and especially dry) soil, means that more heat is absorbed and transmitted to a greater soil depth, so that the surface does not reach such high temperatures. Presumably less heat is immediately re-radiated to contribute to the heat load on the vines and bunches during the day. Thus at least there is no ground for thinking that a stony or rocky soil surface will impair vine temperature relations during the day. More probably it is beneficial.

A stony surface has the additional benefit that it acts to capture moisture because of its unevenness, but later forms a shield against surface evaporation. To the extent that soil beneath the stones remain moister, both its heat storage capacity per unit mass (specific heat) and thermal conductivity are greatly increased. This further increases the depth of warming and minimizes soil temperature rise per unit of heat input. Re-radiation in the heat of the day is thus reduced, and that at night and under cloud is steadier and more prolonged.

The same factors might be expected to benefit vine root development between the rows. Experience in cool viticultural climates shows that rocks and stones accelerate soil warming in spring, resulting in earlier root growth, earlier and more even budburst, more rapid early top growth, and greater fruitfulness. In summer there is earlier and greater subsoil warming, combined with a moderation of high temperature extremes and a reduced diurnal amplitude of temperature in the surface layers. The likely result across all climates is a greater capacity for root growth and feeding in both the deeper and the near-surface layers, starting earlier in spring and continuing with less interruption through the season. Consequences later in the season should theoretically include greater cytokinin supply during ripening, and probably better vine balance.

A light to reddish-coloured rocky soil surface will increase the direct reflection of useful light wavelengths back into the vine canopy, as already noted. This is instead of the re-radiation being more or less exclusively as heat wavelengths, as takes place from dark-coloured soils. If at the same time the surface is rocky and heat-absorbent, it achieves the best possible combination of directly reflecting useful light wavelengths, while absorbing a maximum of the heat wavelengths and holding the heat long enough to be re-radiated to the vines when it is most useful.

What, then, was the 'oenanthine' of the 19th century researchers? Clearly it was something which develops only in ultimate ripeness, as they themselves believed. But more specifically, that surely means ulti-

mate *physiological* ripeness[1]. To reach that, the berries must maintain their full health and metabolic integrity to the end. This requires in turn continuous sufficient cytokinin supply to both berries and leaves, from a strongly functioning root system throughout ripening. Ample sugar flux to the berries from well-illuminated leaves, and from various buffering storages within the vine, must continuously supply the surplus needed for greatest colour and flavourant biosynthesis in the berry skins. Finally, equable optimum berry temperatures are needed to allow maximum rates of biosynthetic and physiological ripening, relative to acid loss and pH rise. Full physiological ripeness can then be attained while natural balance is still optimal for winemaking, and ahead of any onset of senescence in the berries.

None of this detracts from the major contribution of soil moisture relations to vine growth and wine qualities, as expounded by Seguin (1983, 1986) and others. It is fully consistent with a prime control by soil moisture. Nevertheless the circumstantial and theoretical evidence suggests that other soil physical qualities can also contribute significantly. They should not be overlooked.

Soil inorganic chemistry

Little *objective* evidence is available that soil chemical attributes directly influence wine qualities, provided that there are no gross nutritional deficiencies or imbalances.

A luxury supply of nitrogen can over-stimulate vegetative growth. This may reduce both yield and quality, especially if not adequately accommodated by trellising. Excess nitrogen exacerbates disease susceptibility (Bavaresco 1989). It can also precipitate deficiencies of other elements, both through increased growth and nutrient demand, and, in some cases, probably by complexing them into inactive forms within the plant.

On the other hand there is no evidence at all that a deficiency of nitrogen is beneficial, unless it is the only way to contain growth which is over-vigorous for other reasons. Given proper trellising to accommodate the growth, responses to nitrogen at least up to maximum fruit yield seem unlikely to threaten fruit and wine quality. Indeed, there is strong evidence that wine quality can be reduced by *lack* of sufficient nitrogen in the grapes and musts. The question of vine and yeast nitrogen nutrition is discussed fully in Chapter 5, under 'Fertilizing and green manuring'.

Unnecessarily high potassium in the soil is undesirable in hot, arid climates, because of its potential effect on wine pH. But as we have already seen in Chapter 3, there is much less risk of this in cool and humid climates. Deficiency is more to be feared in such climates. Besides reducing growth and yield, potassium deficiency is well known to increase vine susceptibility to a number of fungal and bacterial diseases (Huber and Arny 1985; Bavaresco 1989). According to Bavaresco this is associated with elevated contents of cell constituents having low molecular weights, and a reduction in those with high molecular weights such as proteins and cellulose, which are responsible for the organizational and structural integrity of the cells. Such a change might arguably affect the ability of grapes to reach the desired state of full maturity before senescence and/or the onset of Botrytis infection. More speculatively, weaker or leaky cell membranes in potassium-deficient berries might allow the faster passage and evaporative loss of aroma compounds. Loss of leaves due to potassium deficiency in any case reduces photosynthesis, and exposes the bunches to greater aroma loss and sunburn.

Greater bunch exposure may, of course, sometimes be beneficial in cool climates; but any such benefit appears always to be more than offset by adverse factors. Grapes from potassium-deficient vines typically lack colour and sugar content (Champagnol 1984). At the same time neither the vine literature (Winkler 1962) nor, by and large, the literature on fruits generally (Usherwood 1985) contains any strong suggestion that fruit quality continues to improve with potassium supply beyond that needed for fully normal growth and yield.

The effects of luxury potassium availability in the soil are likely to be minimal in cool, humid climates, as already explained. But in hot, atmospherically arid climates, the postulated greater potassium uptake per unit of vine growth and yield (Chapter 3) will cause soil differences to be more strongly reflected in the vine and fruit. Stress, and the often unfavourable canopy light relations with irrigation in these environments, also lead to the danger that this potassium will be unduly mobilized from the leaves etc. to the fruit (Chapters 3 and 5). Large increases in must and wine pH can result.

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1 The 19th century French speculations find a parallel in the contemporary Australian and New Zealand debate on wines made from grapes picked at differing stages of maturity, and from ripening conditions of differing temperatures and canopy shading. In particular the debate touches on the incidence of 'herbaceous' and 'vegetable' characters, such as are associated with methoxypyrazines, as opposed to the ripe berry and other fruit characters of wines made from fully ripe and well illuminated bunches. See, for instance, Jordan and Croser (1984); Champagnol (1984, p.314); Smith *et al.* (1988); Duval (1988); Brakjovich (1988); Allen *et al.* (1990a, 1990b); and Judd (1990). I suggest that the initial welcome afforded to herbaceousness in Australia and New Zealand arose largely from a misinterpretation of cool-climate wine style. It is a legitimate enough subsidiary component lending freshness and contributing to complexity in some white wines, for instance those made from Sauvignon Blanc and Sémillon. A small element from the use of a controlled range of grape maturities can also lend complexity to red wines. But in general, I believe that obvious herbaceousness and vegetable characters will come in future, as they are in Europe, to be regarded as a fault, symptomatic of incomplete or imperfect ripening. Great wines can only be made when most of the grapes are fully and perfectly ripened.

quality. Potassium availability greatly above that can, however, contribute seriously to reduced wine quality in hot, arid climates.

Calcium (as in limestone) and magnesium (present with calcium in dolomitic limestone) are both antagonistic to potassium in plant nutrition, and may limit its uptake from the soil. At first sight one might expect that to be an advantage in hot, dry climates and a disadvantage in cool, moist climates. However, the reverse, if anything, seems to apply, with calcareous soils valued most towards the cool limit of viticulture (Winkler 1962) but not especially so in hotter regions (see below).

The overriding reason for the value of calcareous soils in cool regions is almost certainly physical. Calcareous soils are nearly always well structured and drained; they provide a *steady* water supply to the vine; and, most importantly in cool areas, they warm easily. Grapes can therefore ripen earlier and more fully, and later-ripening varieties can be grown, than on most other soils in the same climate. Equally, the relative warmth of the soil in autumn probably allows ripening to continue longer into late autumn than would otherwise be so. This should be especially significant for varieties which are very sensitive to heat during ripening, such as Pinot Noir, by allowing them to ripen fully under atmospherically cool and non-damaging temperatures. Another mechanism might be the roles of must calcium and magnesium in protecting against the inhibition of fermentation by high alcohol contents (Kunkee 1991): thereby perhaps allowing fermentation to continue to the desired extent under low winter temperatures, or under other conditions where this might not otherwise occur.

According to Winkler, limestone-based soils are not specially valued in Italy. Similarly Champagnol (1984) notes that the reputed superiority of calcareous soils for wine quality does not extend to the Mediterranean region of southern France. Indeed, non-calcareous soils derived from schist, softly cemented conglomerates, sandstone and ancient alluvium are reckoned there to give wines that are finer, rounder and more harmonious than those from calcareous soils, despite the usually better moisture relations of the latter. Champagnol acknowledges, however, that important interactions exist between soil type and vine variety, with Shiraz, Gamay, Cabernet Sauvignon, Carignan and Chenin Blanc giving their best qualities on non-calcareous soils, and Pinot Noir, Cabernet Franc, Chardonnay and Sauvignon Blanc their best on calcareous soils. Champagnol is emphatic that at least some of the so far undefined differences in wine qualities associated with soil result directly from mineral nutrition, and that the differences become more apparent and consistent, the higher the quality levels of the wines.

these are typically components of co-enzymes, which participate chemically in enzyme reactions. Balances among available trace elements could therefore conceivably influence the balances among enzyme reactions responsible for flavourant formation in the grapes and fermenting musts. Soil pH, and the presence or absence of limestone, could have indirect effects through their profound influence in the availability of the individual trace elements to plants. This varies greatly from element to element.

Across all soils a red, brown or yellow colour in the subsoil is an extremely useful indicator of good drainage, being due to oxidized iron compounds. Bleached subsoils contain their colourless reduced equivalents, indicating waterlogging. Mottled subsoils are found where there is intermittent waterlogging.

The most important overall chemical attribute of any soil, however, is undoubtedly its capacity to provide steady, balanced nutrition for growth of the vine. Fully adequate vine nutrition cannot, in itself, have deleterious effects on grape quality. Indeed, the reverse is almost certainly the case for most nutrients (Bavaresco 1989). The only potential ill-effects from *more-than-adequate* nutrition (short of toxicity) appears to be in the case of nitrogen, together with potassium in some circumstances.

Soils with moderate to high clay contents have the best ability to supply steady nutrition to the vine. This is partly because they have the greatest capacity to store nutrients within their finely-divided clay colloid structure, in physically or chemically bound forms which to varying degrees are only slowly soluble. The same applies whether the nutrients are native or whether they are residual from earlier fertilizer applications. Natural rock materials in the soil also break down to soluble, and therefore plant-available, forms, though mostly at an extremely slow rate. If finely enough divided, rock material can be a significant – though seldom large – source of mineral nutrients to the vines and to associated green manure crops.

In very sandy soils there is little fine material for nutrients to adhere to or react with. Nutrients applied in fully soluble form can therefore readily produce an immediate surfeit, followed by rapid leaching and ultimate disappearance from the soil profile. This is especially so with nitrogen. The result for the vine is an alternation of feast and famine, unless fertilization can be in very frequent small doses. A practical approach for sandy soils in dry climates is to supply nutrients continuously, at very low concentration, through irrigation water ('fertigation'). An alternative for intensive systems is to incorporate nutrient-rich clay or rock in finely divided form, or special fertilizers having very low solubility, deep into the soil before planting.

Table 5. Winegrape maturity groups and corresponding biologically effective day degrees to ripeness, for making dry or semi-sweet table wines

	Red wines	White or rosé wines
Group 1 1050 day °	-	Madeleine, Madeleine-Sylvaner
Group 2 1100 day °	Blue Portuguese	Chasselas, Müller-Thurgau, Siegerrebe, Bacchus, Pinot Gris, Muscat Ottonel, Red Veltliner, Pinot Noir, Meunier
Group 3 1150 day °	Pinot Noir, Meunier, Gamay, Dolcetto, Bastardo, Tinta Carvalha, Tinta Amarella	Traminer, Sylvaner, Scheurebe, Elbling, Morio-Muskat, Kerner, Green Veltliner, Chardonnay, Aligoté, Melon, Sauvignon Blanc, Frontignac, Pedro Ximenes, Verdelho, Sultana
Group 4 1200 day °	Malbec, Durif, Zinfandel, Schiava (= Trollinger), Tempranillo, Tinta Madeira, Pinotage	Sémillon, Muscadelle[1], Riesling[2], Welschriesling, Furmint, Leanyka, Harslevelu, Sercial, Malvasia Bianca, Cabernet Franc
Group 5 1250 day °	Merlot[3], Cabernet Franc, Shiraz, Cinsaut, Barbera, Sangiovese, Touriga	Chenin Blanc, Folle Blanche, Crouchen, Roussanne, Marsanne, Viognier, Taminga, Cabernet Sauvignon
Group 6 1300 day °	Cabernet Sauvignon, Ruby Cabernet, Mondeuse, Tannat, Kadarka, Corvina, Nebbiolo, Ramisco, Alvarelhão, Mourisco Tinto, Valdiguié	Colombard, Palomino, Dona Branca, Rabigato, Grenache
Group 7 1350 day °	Aramon, Petit Verdot, Mataro, Carignan, Grenache, Freisa, Negrara, Grignolino, Souzão, Graciano, Monastrell	Muscat Gordo Blanco, Trebbiano, Montils
Group 8 1400 day °	Tarrango, Terret Noir	Clairette, Grenache Blanc, Doradillo, Biancone

1 Previously (Gladstones 1991) in Maturity Group 3. However Dubourdieu (1990) describes Muscadelle as the latest ripening of the Bordeaux white varieties, suggesting that it must be transferred at least to Group 4. The literature variously describes it as 'early' and 'midseason'.

2 The maturity characteristics of Riesling appear to vary significantly with environment. Ripening capacity in Germany fairly clearly indicates Group 4, but in southern Australia it is not infrequently picked after red varieties of Groups 5 and 6, even, apparently, for dry wines. Some of the Australian record may nevertheless be confused by its use for both dry and late-picked, sweet wines.

3 Dubourdieu (1990) describes Merlot as the earliest of the red grape varieties to ripen in Bordeaux, 10-14 days before Cabernet Sauvignon and seven days before Cabernet Franc, suggesting that it might be better placed in Maturity Group 4 along with Malbec. I retain it in Group 5 on the general opinion of the literature, but is appears at least to be among the earliest varieties of the group.

TABLE E

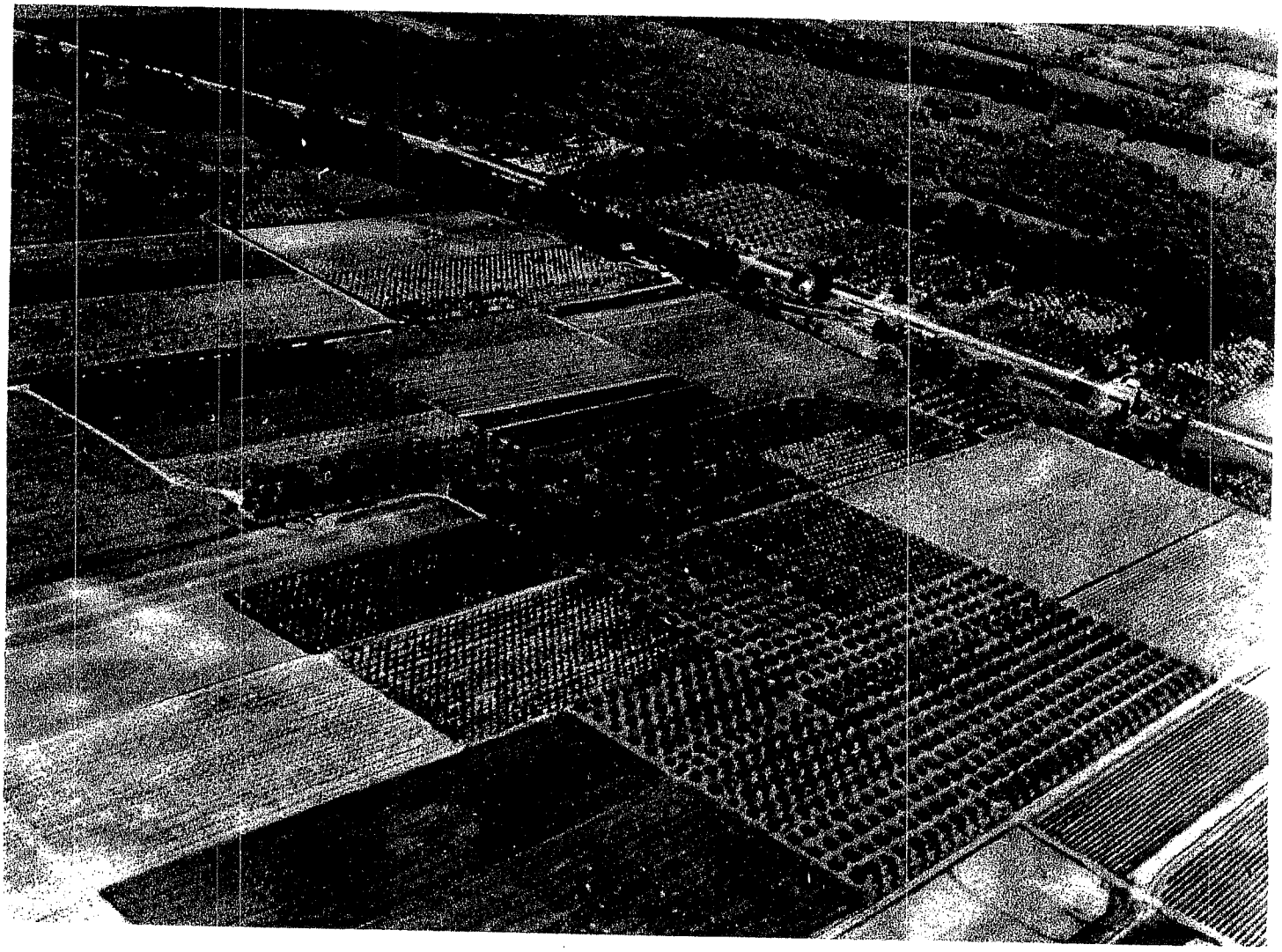
SOIL SURVEY OF NIAGARA COUNTY, NEW YORK

SOIL

The Niagara Escarpment
A New Proposed American Viticultural Area

SOIL SURVEY OF

Niagara County, New York



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Cornell University Agricultural Experiment Station

Issued October 1972

HOW THIS SURVEY WAS MADE

Soil scientists made this survey to learn what kinds of soil are in Niagara County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steep ness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and soil phase (13) 2/ are the categories most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Appleton and Lockport, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ontario loam, 2 to 8 percent slopes, is one of several phases within the Ontario series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. The one such kind of mapping unit shown on the soil map of Niagara County is the undifferentiated group. An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Hilton and Cayuga silt loams, limestone substratum, 0 to 3 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in Niagara County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. The soil scientists then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

2/ Underscored numbers in parentheses refer to Literature Cited, p.

GENERAL SOIL MAP

The general soil map at the back of this survey shows, in color, the soil associations in Niagara County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The eleven soil associations in Niagara County are discussed in the following pages. They are grouped according to the nature of the material in which the dominant soils formed.

Areas Dominated by Soils Formed in Glacial Till

These associations make up about 33 percent of the county. The soils are deep to moderately deep and well drained to very poorly drained. They have a medium-textured to fine-textured subsoil. Glacial lake sediments have modified the soils in these associations to some extent. Dairying is the major farm enterprise. A large acreage is idle, and a large acreage is in nonfarm use.

1. Appleton-Hilton-Sun association

Deep, moderately well drained to very poorly drained soils having a medium-textured subsoil

This association occupies nearly level to gently sloping glacial till areas (fig. 2). About 10 percent is slightly depressional. Most of this association is located in the central parts of Wilson and Newfane, the southern part of Somerset, and the northern part of Hartland. More than 95 percent of the acreage is north of U. S. Highway No. 104 (Ridge Road).

This association occupies about 14 percent of the county. About 37 percent of this is Appleton soils.

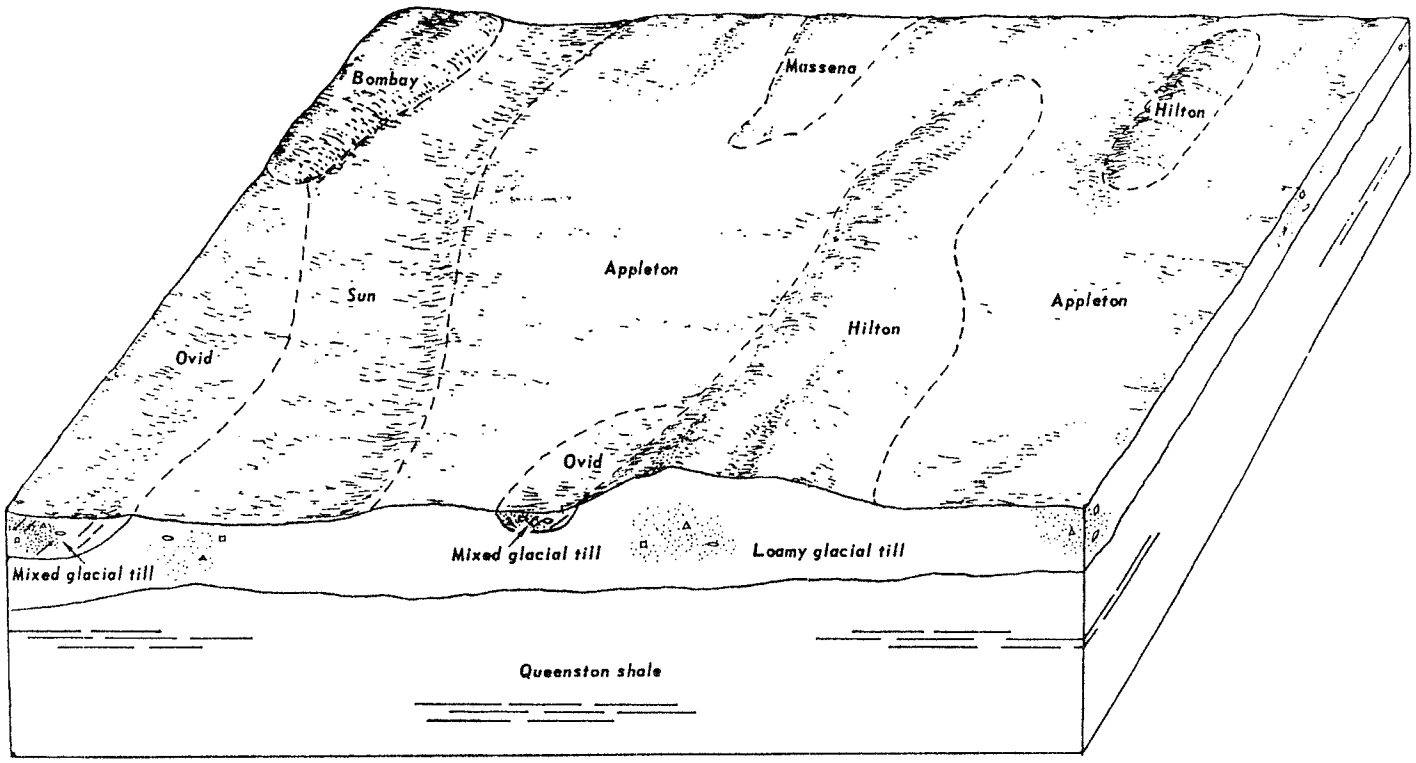


Figure 2.--Typical cross section of the Appleton-Hilton-Sun association.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and an adequate drainage system are needed. Because the soils in most of this association are underlain by firm glacial till, bearing strength and soil stability are generally favorable for foundations.

About 75 percent of the association is open land. The remaining 25 percent is scattered farm woodlots or idle land that is reverting to forest. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species. The potential for wetland wildlife is good. Many dug-out ponds are in this association. Marsh occurs in the northern part of Hartland. Recreation consists mostly of hunting and fishing. Scenic areas are few.

2. Hilton-Ovid-Ontario association

Deep, well-drained to somewhat poorly drained soils having a medium-textured or moderately fine textured subsoil

This association occurs in nearly level to strongly sloping areas in which till deposits are dominant (fig. 3). One continuous area occupies the central part of the county. The association crosses the county in a general east-west direction. A limestone escarpment is prominent, and there is a sandy delta in an area that begins near the city of Lockport and extends eastward to the village of Gasport.

The Hilton-Ovid-Ontario association occupies about 15 percent of the county. About 24 percent of this association is Hilton soils, 14 percent is Ovid soils, 7 percent is Ontario soils, and the remaining 55 percent is soils of minor extent.

The Hilton soils are deep, moderately well drained, and medium textured. They have a gravelly loam or silt loam surface layer, have a heavy loam or silt loam subsoil, and are underlain by calcareous loamy glacial till. In some areas limestone bedrock is at a depth of 3 1/2 to 6 feet. These areas have large stones above the bedrock in many places. Hilton soils are nearly level or gently sloping. They commonly are at intermediate elevations on the glacial till plain. In a few places, they are on fairly large lateral moraines or small drumlins.

The Ovid soils are deep and somewhat poorly drained, and they have a moderately fine textured subsoil. Typically, they have a silt loam surface layer, have a silty clay loam subsoil, and are underlain by heavy loam glacial till. They are nearly level to gently sloping and occur at a slightly lower elevation than the Hilton soils. In some places Ovid soils are along drainageways. Some areas of Ovid soils are underlain by limestone bedrock at a depth of 3 1/2 to 6 feet.

The Ontario soils are deep, well drained, and medium textured. Typically, they have a loam surface layer, have a heavy loam subsoil, and are underlain by calcareous loamy glacial till. Ontario soils are nearly level to strongly sloping. They occupy the higher elevations, such as the tops and sides of drumlins or lateral moraines. In places the Ontario soils have limestone bedrock at a depth of 3 1/2 to 6 feet. In these areas they are nearly level or gently sloping and contain some large stones.

The minor soils are mainly of the Appleton, Cazenovia, Cayuga, Churchville, Sun, and Arkport series. The Appleton and Cazenovia soils are intermingled with the major soils on the till plain. The Cayuga and Churchville soils are along the fringes of the till plain where lacustrine sediments cap the till. Sun soils are in depressions, and Arkport soils are mainly on the sandy delta between the city of Lockport and the village of Gasport. Also, Rock land occurs in small areas.

This association has a medium value for farming. In much of the area, farming competes with nonfarm uses. Most of the city of Lockport and the villages of Sanborn, Gasport, and Middleport are in this association. Many estate-type homes are near the limestone escarpment.

Dairying is the major farm use. In the sandy area along the escarpment between Lockport and Gasport, fruit growing is fairly intensive. The 1958 Conservation Needs Inventory indicates that about 50 percent of the association is cropland, 15 percent is forest or woodland, 10 percent is urbanized, and the remaining 25 percent is pasture and miscellaneous open land.

In places stones and bedrock are limitations for farming and urban development. Natural drainage is a limitation in the wetter areas. Slope and erosion are concerns, mainly near the escarpment. In many places installing artificial drainage is difficult because of stones and underlying bedrock.

This association has a high potential for dairying, raising livestock, and part-time farming. Stones and depth to bedrock are limitations to use locally. Lime needs generally are low. Vegetable growing is mostly restricted to the relatively stone-free, level or nearly level soils. Fruit is more susceptible to frost damage than in areas closer to Lake Ontario.

Wet areas, stones, and bedrock near the surface are the most limiting factors for urban development. Sanitary sewers are needed for concentrated housing developments. In many places underground installations are costly. Most soils in this association have adequate strength for building foundations. The association contains some of the most scenic sites for homes in the county.

This association contains five county parks and most of the Tuscarora Indian Reservation. Also, there are several municipal parks and playgrounds. Some of the most scenic views in the county are in this association. Especially near the scenic escarpment, there is a potential for more hiking, nature, and horseback-riding trails.

ubsurface drainage is needed in most areas. Erosion is a hazard where the soils are sloping.

Most of this soil association is farmed. The ncluded alluvial soils along creeks and drainageays are mostly idle or in woods. Openland kinds of ildlife, especially pheasants, are plentiful. Small oodlots and hedgerows provide cover. Recreation in his association consists mostly of hunting and ishing. Scenic areas and swimming and boating reas are confined mostly to the parts of the association that border Lake Ontario.

9. Canandaigua-Raynham-Rhinebeck association

Deep, somewhat poorly drained to very poorly drained soils having a dominantly medium-textured to fine-extured subsoil

The soils in this association are level and occur n areas that border Tonawanda Creek in the extreme outhern part of the county. The association includes the city of North Tonawanda and part of onawanda Indian Reservation.

This association makes up about 11 percent of he county. About 26 percent of this is Canandaigua oils, 23 percent is Raynham soils, and 17 percent s Rhinebeck soils. The remaining 34 percent is ade up of minor soils.

The Canandaigua soils are deep and poorly drained o very poorly drained. They typically have a silt oam to silty clay loam surface layer, a silty clay oam subsoil, and underlying material of silt, clay, nd fine sand. They are level and occupy broad reas.

The Raynham soils occupy the slightly higher levations and normally are closely associated with he Canandaigua soils. They are deep and somewhat oorly drained to poorly drained. They typically ave a silt loam surface layer, a silt loam to loamy ery fine sand subsoil, and underlying material of ilt and very fine sand.

The Rhinebeck soils are nearly level and occupy road areas. They are deep and somewhat poorly rained. They typically have a silt loam or silty lay loam surface layer, a silty clay or silty clay oam subsoil, and underlying material of varved ilt and clay. These soils generally become coarser extured as depth increases, and in many places hey have sandy layers below a depth of 40 inches.

The minor soils are mainly of the Lakemont, adalin, Odessa, Niagara, Minoa, and Lamson series. he poorly drained and very poorly drained Lakemont nd Madalin soils are commonly in depressions adacent to the Rhinebeck soils. The somewhat poorly rained Odessa soils are intermingled with the hinebeck soils on the same kind of landscape in he lake plains. The somewhat poorly drained, silty iagara soils are slightly higher than, and are adacent to, the Canandaigua soils. Coarser textured inoa and Lamson soils are intermingled with Canandaigua and Raynham soils on the same kind of landcape in the lake plains.

This association has medium to low value for farming. The 1958 Conservation Needs Inventory indicated that 59 percent is cropland, 2 percent pasture, 15 percent woodland, 12 percent urban or built-up areas, and 12 percent other open land.

Community or farm development is limited mainly by natural drainage. The flatness of the area is the main consideration in planning drainage. Group drainage projects are needed in most places to provide suitable outlets.

Most of the farmed areas are not farmed intensively. With adequate drainage, the potential is good for hay, grain, and certain vegetable crops. In most places the soils are free of stones. Vegetables could be grown intensively in many areas, but maintaining soil tilth is difficult. The need for lime is generally low.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and an adequate drainage system are generally needed. The soils in this association formed in deep lacustrine deposits that normally contain wet, compressible, unstable layers. Care is needed in constructing foundations and in developing a road base.

Most of this association is open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to ash, soft maple, and other native hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife, and the potential for wetland wildlife is good. Some of the association is in the New York State Tonawanda Reservation. Besides hunting and fishing there is a potential for camping, athletic fields, and picnic areas. Scenic areas are few.

Areas Dominated by Soils Formed in Lake-laid Clays and Silts

These associations make up about 36 percent of the county. The soils are nearly level to gently sloping, deep, and somewhat poorly drained to very poorly drained. They have a moderately fine textured or fine textured subsoil. These associations have a medium to low value for farming. Much of the area is idle or in cropland that is not intensively used. Natural drainage is the major limitation to use. The moderately fine textured and fine textured subsoil presents problems for farming and for town and country planning.

10. Rhinebeck-Ovid-Madalin association

Deep, somewhat poorly drained to very poorly drained soils having a fine textured or moderately fine textured subsoil that is dominantly brown or olive in color

This association consists of nearly level to gently sloping soils on the lake plain north of the limestone escarpment. The largest single areas are

in the northwestern part of the county near the village of Youngstown. Three smaller areas also occur.

This association makes up about 15 percent of the county. About 32 percent of this is Rhinebeck soils, 10 percent is Ovid soils, and 9 percent is Madalin soils. The remaining 49 percent consists of minor soils.

The Rhinebeck soils are deep and are somewhat poorly drained. These soils typically have a silt loam surface layer, a silty clay or silty clay loam subsoil, and underlying material of varved silt and clay. They occupy the broad areas within the association and are slightly dissected by erosion in a few places, especially in areas that border Lake Ontario.

The Ovid soils occupy the slightly elevated areas where there has been some reworking of the fine-textured lake deposits and the glacial till or glacial beach deposits. The Ovid soils are deep and somewhat poorly drained. They typically have a silt loam surface layer and a silty clay loam subsoil and are underlain by loamy glacial till. Some coarse fragments are generally in and below the surface layer.

The Madalin soils occupy the more nearly level, more depressional areas within the broad, level lake plain. They are deep and poorly drained to very poorly drained. Madalin soils typically have a dark silt loam surface layer that is high in organic-matter content, a silty clay subsoil, and underlying material of varved silt and clay.

The minor soils are mainly of the Collamer, Hudson, and Niagara series. These soils are intermingled with the major soils in this association. The Collamer and Hudson soils occupy knolls or higher elevations and are intermingled with the Ovid soils. The Niagara soils are mainly nearly level.

This association has a medium value for farming. Much of it is idle or is cropland that is not used intensively. A fairly small acreage that is close to Lake Ontario is used intensively for fruit. The area near Youngstown is in community development, mostly for rural homes. The acreage in grapes is increasing, especially near the Model City area in the town of Lewiston.

Natural drainage is the principal concern in town and country planning and in farm development. The flatness of the area is the biggest factor to consider in planning artificial drainage. The soils in most of the association can be drained readily by installing adequate surface ditches. Tile lines help in draining some of the wet, coarser textured inclusions. The major need is group drainage projects that provide suitable outlets.

If drainage is adequate, this association has a good potential for apples, grapes, pears, and other fruit. Peaches and cherries normally are not suited. Some vegetables can be grown intensively, but maintaining soil tilth is difficult. Grain and hay crops are suited if drainage is adequate. The need for lime is generally small.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and adequate surface drainage are needed. In many places the soils are unstable because they formed in deep lake deposits.

About 85 percent of the acreage is in open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to ash, soft maple, and other native hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species, and there is a potential for wetland wildlife. Recreation in this association consists mostly of hunting, fishing, camping, and golfing. Scenic areas are confined mostly to the part of the association that borders the Niagara River and Lake Ontario.

11. Odessa-Lakemont-Ovid association

Deep, somewhat poorly drained to very poorly drained soils having a fine textured or moderately fine textured subsoil that is dominantly reddish in color

This is the largest soil association in Niagara County. It consists of level or nearly level soils on lake plains south of the limestone escarpment (fig. 5). There are two large areas that are dotted with small knolls and ridges of till. The largest area is west of the Barge Canal, and the other area is in the same topographical position as the larger area but is east of the Barge Canal.

This association makes up about 21 percent of the county. About 24 percent of this is Odessa soils, 14 percent is Lakemont soils, and 11 percent is Ovid soils. The remaining 51 percent consists of minor soils.

The Odessa soils are deep and somewhat poorly drained. They typically have a silty clay loam surface layer, a silty clay subsoil, and clay and silt underlying material. These soils are level and occupy the broad areas between the poorly drained, depressional areas and the slightly elevated till ridges.

The Lakemont soils are level to slightly depressional and are generally adjacent to the better drained Odessa soils. Lakemont soils typically have a silty clay loam surface layer, a silty clay subsoil, and underlying material of clay and silt. They have a darker surface layer than the Odessa soils and show more indications of wetness.

The Ovid soils are nearly level to gently undulating and are on till landscapes at slightly higher elevations above the lake plain. They are deep and somewhat poorly drained. Ovid soils typically have a silt loam surface layer, a silty clay loam subsoil, and underlying material of loamy glacial till.

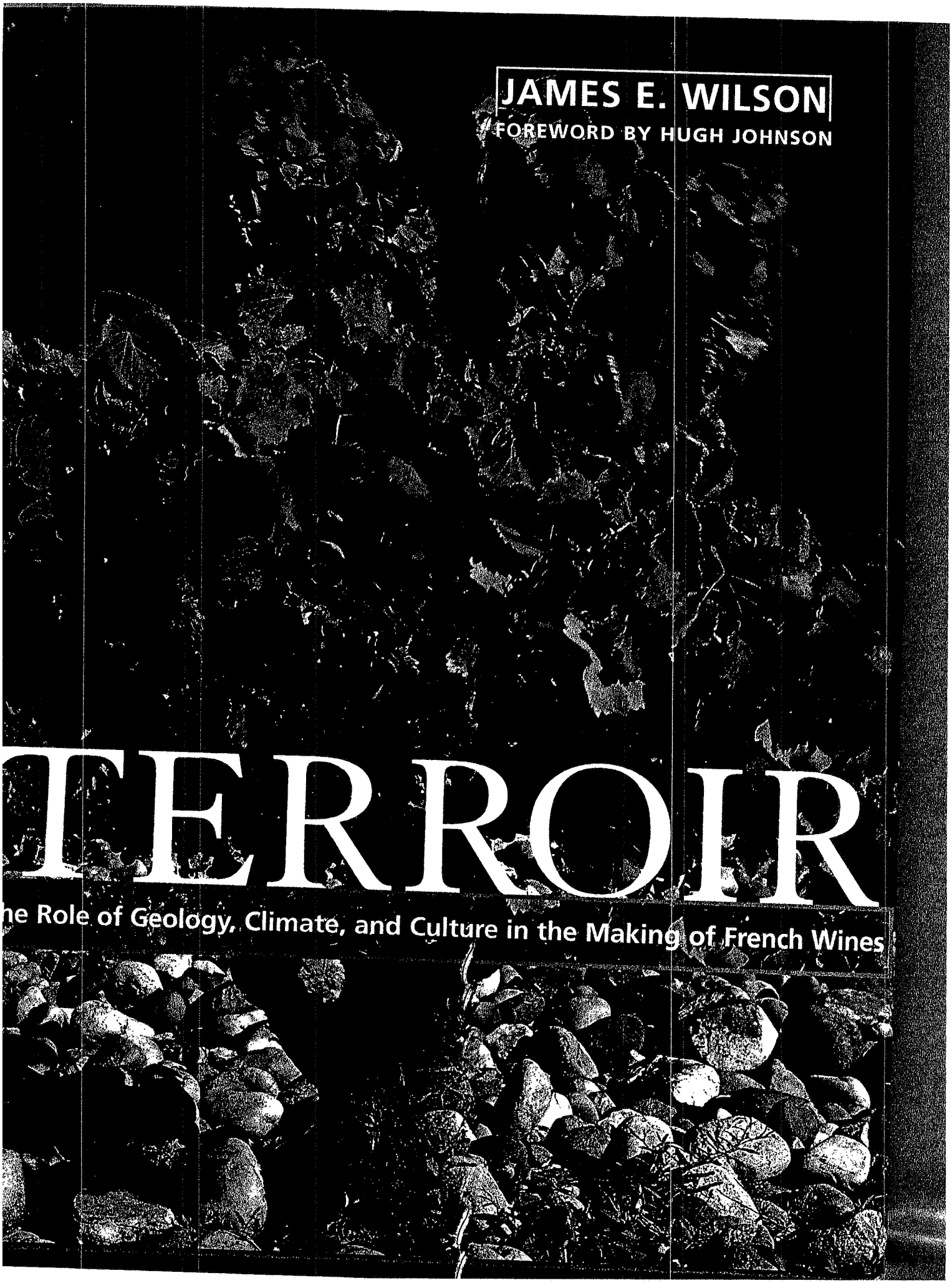
The minor soils are mainly of the Churchville, Cayuga, Cazenovia, Fonda, and Hilton series. Also included are some areas of shallow muck. In many places the moderately well drained Hilton and Cazenovia soils occupy the higher parts of the knolls and

TABLE F

TERROIR

SOIL

The Niagara Escarpment
A New Proposed American Viticultural Area

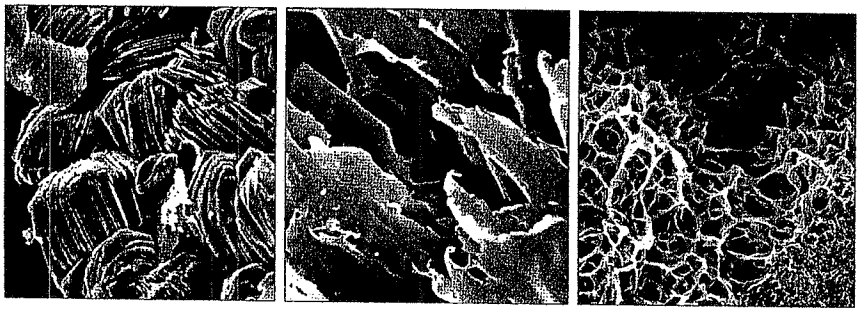

JAMES E. WILSON
FOREWORD BY HUGH JOHNSON
TERROIR
he Role of Geology, Climate, and Culture in the Making of French Wines

According to Dr. Gérard Seguin at the University of Bordeaux, active calcium carbonate is the one chemical soil constituent generally associated with wine quality. The quality factor is due to the soil structure organized by the carbonate solution which favors moisture retention, and hence the feeding of the vineplant.

Biological activity in decomposition of plant litter works best in an alkaline (basic) environment due to carbonates. However, in one of nature's ironies, as Professor Philippe Duchaufour notes, calcium carbonate solutions form a skin around fresh or slightly altered organic matter, thus slowing its decomposition. Approximately two-thirds of France is underlain by carbonate rocks producing excellent agricultural soils, so this skin cannot be too serious.

Neutral to alkaline soil conditions also favor chemical availability of mineral nutrients (*see* Figure 1.2). The extensive outcropping of calcareous rocks in France ensures that most soils inherit a parental immunity from acidity. This is not to say that acidic soils do not produce some fine wines: the granitic soils of Alsace and Haut-Beaujolais are two examples. Granitic and sandy soils tend to be acidic because of the absence of carbonates (limestones) in the parent material. Early-day vignerons did not have litmus paper, so it was by trial and error that they found which grape varieties were most adaptable to which soil conditions.

Clay, the wonder substance



Photograph 1.2
Clay mineral characteristics revealed by scanning electron microscope imagery. On the left is kaolinite magnified x 1400. The field of imagery is about the size of a pinhead. The crystals are from weathered feldspars. The center photograph shows illite-smectite (about 70% illite), magnified x 4100. Crystals are growing into the tiny pore space of a rock. In the right-hand photograph the white material is the contorted crystal plates of montmorillonite, magnified x 9500. The honeycomb pattern is typical of the way the mineral from weathering solution precipitates around solid nuclei. It is evident from the extremely high magnification that the clay mineral crystals are very small indeed (imagery and interpretation courtesy Dr. Thomas Tieh, Texas A&M University)

Clay is the principal glue that sticks soil particles together. Loose, sandy soil has little clay; "gumbo" (not the soup) is all clay. A lump of clay may look like a formless hunk of thick mud, but believe it or not, clays are a mass of crystals. Under powerful magnification, clays are seen indeed to be tiny, plate-like minerals. The molecular structure of clay minerals has strong bonds within the plates but weak attraction between them. That is what makes clay slippery – the platelets slide easily, like a new deck of playing cards. Molecular structure also plays an integral role in the feeding of mineral nutrients to the plant.

The extent of the crystal surfaces of the mineral plates in a chunk of clay is absolutely unbelievable. The molecular structure of the plates resembles a lattice, whose "holes" attract or release anions and cations. The soil must be sufficiently moist, however, for this movement to take place. (Cations are atoms or molecules with a positive electrical charge. Those negatively charged are anions.) The extensive molecular lattice gives clay a great capacity for "cation exchange." A familiar example of cation exchange is in the action of chemical water softeners. Mineral cations which make the water "hard" are exchanged in the process for "soft" cations found in a chemical softener such as zeolite.

This cation-exchange capability is as vital to the life functioning of the vineplant as oxygen is to the human bloodstream. It is how plants get their nutrients and neutralize toxic chemicals. Of the several clay minerals, certain ones are more effective in the exchange process than others. Dominance of the kind of clay in the soil is why some vineyard plots may be better than others mere paces apart. How clay minerals function in the soil is worth knowing more about.

Clay minerals are classified according to their crystal structure. The most widely distributed clay mineral in soils is kaolinite, the end product of long-time weathering of feldspars and micas. Unfortunately, for winegrowing, this most abundant clay mineral has a low cation-exchange capability; the reason being, the plates as seen in the electron microscope imagery (Photograph 1.2) stick together tightly, plate to plate. Exchange molecules have a difficult time getting in or out of the lattice between the plates. This plate-to-plate attraction is why kaolinite can be molded into thin-walled forms which do not shrink or crumble when kiln-fired. Kaolinite is therefore ideal for pottery, but not so desirable as the dominant clay in a soil. Clay minerals that are products of less severe weathering than kaolinite and much better for soils are chlorite and illite.

Kaolinite, a china clay, named for Kao Ling, or "high hill" near Jiaxian in the Hunan Province of China. Montmorillonite was named for Montmorillon near the city of Limoges in west-central France. Limoges is famous for its china which utilizes local deposits of kaolinite.

The best clay minerals for agricultural soils are montmorillonite (smectite) and vermiculite, products of even less severe weathering than illite. Molecular attraction is very strong horizontally within their plates, but is notoriously weak between them. As a consequence, water and other molecules readily enter between the plates and find places in the lattice. These are the "swelling clays" or "heaving shales," so-called because of the readiness and high degree to which they expand when wetted. Weak plate-to-plate attraction gives montmorillonite a tremendous cation-exchange capacity (vermiculite has considerably less). Soils made of these clays are wonderful for agriculture but disastrous for road beds and building foundations. However, the expansion feature has other useful applications. As the commercial product Bentonite, montmorillonite makes a very slick "mud" and excellent "plastering agent" in oil-well drilling fluid. Also known commercially as Fuller's Earth, the clay is an excellent absorbent used especially for fulling (shrinking and thickening) woolen fabric. In vineyards, montmorillonite "thickens" soils composed of silt, sand, and broken rock.

Bentonite has another use in winemaking: it fines or clarifies wine which has developed a haziness during fermentation. The clay absorbs the precipitates causing the cloudiness, but, unfortunately, also some of the preferred flavors.

If clay forms the body of agricultural soils, montmorillonite is its spirit – a free spirit at that. This mineral is a real chemical "flirt." However, it is a selective flirt. Being negatively charged, it takes up only with positively charged ions or cations. With its very large exchange capacity, montmorillonite does a supermarket business by hosting and trading cations of the various mineral nutrients in the plant-feeding process to be described in the following section.

Mineral-feeding the vineplant

Plants don't eat rocks *per se*, but sip on mineral concoctions dissolved from them. Different rocks offer different menus of mineral constituents. Balance in the nutrient diet is undoubtedly one of the factors in the mystery of why the wines of one vineyard plot may be judged superior to its look-alike neighbor.

Weathering puts the minerals in edible form, but they have to be in solution in the soil to be "swallowed." (A "soil solution" only needs to be damp, not saturated.) It is water in the ground that puts wine in the bottle. Too much water is as bad as not enough. Since irrigation is not permitted in France's *appellation contrôlée* vineyards (the officially delimited areas), the water supply depends on nature's blessings.

The "meat and potatoes" of the working plant's diet are the macro-nutrients (those needed in quantity): oxygen, nitrogen, phosphorus, calcium, magnesium, potassium, sulfur. Other staples are carbon and hydrogen from the air and the soil. Then there are little side dishes that, although needed only in small portions, are critical for a healthy, grape-making diet. These are the micro-nutrients: iron, zinc, manganese, copper, boron, molybdenum, and chlorine.

The plant's underground food-processing factory, the soil, is not just one big, happy workplace. There are competitions, slowdowns, lockouts, and shortages. For example, as shown in Figure 1.2, iron, zinc, manganese, and copper are most easily assimilable in acidic soils (low pH), whereas the macronutrients prefer neutral to alkaline conditions. Phosphorus, after nitrogen, is the most critical element for total plant growth and grape development. When it is in its soluble form as a phosfate, it also readily combines with other metallic elements to form an insoluble compound, a chemical "lock-out."

Normally, in most soils there exists sufficient iron for the plant's needs, but having it in a digestible form may be a problem. Unfortunately, in limy (alkaline) conditions iron tends to become an oxide that is poorly soluble. "Lime-induced chlorosis" (loss of normal green color in the leaves) indicates where highly alkaline soils have caused a chemical "lock-out" of iron. This problem is particularly vexing in the chalky soils of the Touraine region of the Loire where iron gets latched onto by oxygen as soon as it weathers from the mineral glauconite, a complex iron-rich mica. The source of iron in the chalk terrain of Champagne is pyrite (iron sulfide) found in lignites of the Tertiary slope wash. The slope wash of sands, clays, lignites, and marls is mixed with chalk from the underlying Cretaceous. Although roots commonly plunge to considerable depths, the chalk is fractured and does not "pond" super-saturated lime water.

Normally, calcium and magnesium are chemically quite congenial, but when calcium is the more abundant mineral in soils, it combines in compounds at the expense of magnesium. This competition is unfortunate, for each molecule of chlorophyll in the leaves requires one atom of magnesium.

The really puzzling question is: how do these mineral elements get from the soil into the plant system? The response that they are taken up through the roots does not explain how they got into the roots. The answer varies from complicated to mysterious to essentially unknown. Any attempt to explain the process has to get down to some pretty fine points – down to the atomic level, as a matter of fact.

I have already indicated, for the process to function, that there must be sufficient moisture for the nutrient substances to be diffused in solution throughout the soil. (Diffusion is the way whiskey mixes with water in a highball glass.) The "feeding" takes place through root hairs which are fine, tubular growths on the outer wall of a root cell.

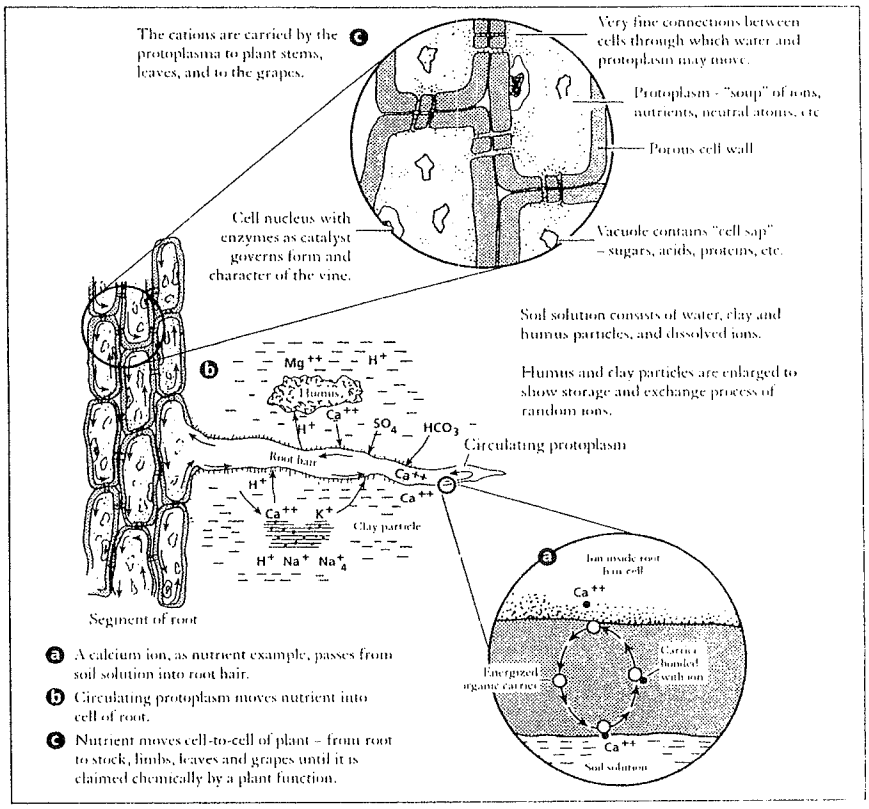


Figure 1.3
Mechanism of absorption of nutrients by root hairs
(Diagram a modified from N.C. Brady, *The Nature and Properties of Soils*, 1974, Macmillan Publishing Co.; Diagrams b and c from R L. Donahue, R.W. Miller, and J.C. Schickluna, *Soils: An Introduction to Soils and Plant Growth*, 6th edn, © 1990, p. 254. Adapted by permission of Prentice-Hall, Inc, Englewood Cliffs, NJ 07632)

How plants absorb minerals

Authorities on plant physiology continue to puzzle over how mineral ions are selectively absorbed through the cell wall of the root into the plant system. It is largely unknown. A mineral atom or group of atoms which may be either positively or negatively charged. In introducing his *Plant Physiology*, Professor P.S. Meyer and his co-authors describe one possible way in which this absorption may take place. With apologies to Dr. Meyer and his colleagues, I have rewritten their theory to read like a little skit.

"The extremely thin membranes of root hairs are permeable to water and allow the water molecules to pass through without challenge. But molecules of the other mineral nutrients are held up at the border. They have to have a passport and an escort. Remember negatively charged montmorillonite and her cation-exchange capacity? She also runs a travel agency linked with an escort service. Clay particles and humus (partially decomposed plant or animal matter) swap, borrow, or store ions from the soil solution and position them to "get through customs" into the plant. For some happy reason, most of the nutrient ions are positively charged and are attracted to the negatively charged root surfaces (unlikes attract, likes repel).

One of the positively charged nutrient ions shows up at the cell wall, but is halted by the membrane. An escort molecule of opposite electrical charge residing in the inner space as part of the plant tissue unites with the ion wanting to gain entrance. The fee for this escort service is paid by the vineplant with a bit of energy resulting from the chemical reaction in respiration (evaporation) in the leaves. The carrier molecule, now joined to the candidate ion, escorts it to inner space. Once inside, this little marriage of convenience is broken, freeing the ion. The wandering ion now "captured" inside the cell resumes its positive electrical charge. The escort molecule can go back to help other ions wishing to gain entrance.

The itinerant nutrient ions now inside the plant cell are no longer vagabonds. They are put to work. Some of the macronutrients such as nitrogen, potassium, calcium, and sulfur build plant tissue. The micronutrients, being highly skilled, are given high-tech jobs. Some are assigned to the chlorophyll laboratory; some activate the enzymes which act as catalysts making carbohydrates in the sugar factory.

The mechanism of absorption, the complicated and mysterious part, is described opposite. While science may not fully understand how plant physiology works, the plants signal with their leaves when their diet of nutrients is deficient – or when they have had too much of one thing. Deficiencies are indicated when leaves become faded, discolored, or brown around the edges. Brown speckling and leaf-cupping indicate mineral toxicity – an excess of a particular nutrient.

Soils of the various rock types seem to contain most of the nutrient elements that are needed by the vine. Those with the better balanced menu are most likely to grow the finer wines. Nitrogen, potassium, and phosphorus are nearly always deficient because they are removed in solution (leached) so readily. Although nitrogen is in excess in the air, it is the most universally deficient nutrient in the soil because it must be in the ammonium or nitrate form in the soil solution to be absorbed. Requirements for these nutrients have to be supplied by chemical additives and fertilizers along with some natural mulching and manuring.

I have already pointed out that climate ranks right along with parent material in the weathering process and soil formation. Its sunshine and rain are the seasonal variants that directly affect the wine.

Climate

Climate is the long-term result of temperature, moisture, and winds. Weather is what is going on outside and in the five-day forecast. Our climatic temperature and its seasonal variations come from the sun, in particular the angle with which it strikes the earth. It was the difference in the angle of the sun at different north–south locations that led to the development of the word *climate*. The Greeks had a word for it, *klimata*. Observations by Eratosthenes at Alexandria, Egypt, were to the affect that there were differences in the length of shadows at the same time of day and season between southern Egypt, Alexandria, and Greece. Eratosthenes correlated these differences with the angle of the sun. He drew equally spaced lines which he called *klimata* representing the inclination of the sun above the earth at a given time. Eratosthenes' *klimata* were later converted to degrees of latitude, with the equator being zero and the north and south poles being 90 degrees.

Climate in concert with geologic processes began when the world was young, varying over time as the seas and landmasses evolved. The climatic cycle that we are experiencing today began about 10,000 years ago as a warm period following the last glacial stage of the Pleistocene. The climate of western Europe had some readjusting to do. Much of France was tundra-like and treeless. Tage Nilsson, a Swedish geologist who is expert on the Pleistocene, thinks this was due more to dryness than to extreme cold.

The Gulf Stream, western Europe's giant radiator system, resumed its former northward circulation path, after having been diverted much further south by the icecap. As temperatures became warmer (during the Boreal and Atlantic climatic periods), plants and animals that had retreated south, migrated northward. As vegetation flourished, it aided rock weathering and soil formation. It was the freeze-thaw climate of the periglacial zone that "stirred" the ground and chiseled at rock faces during the Ice Age phases.

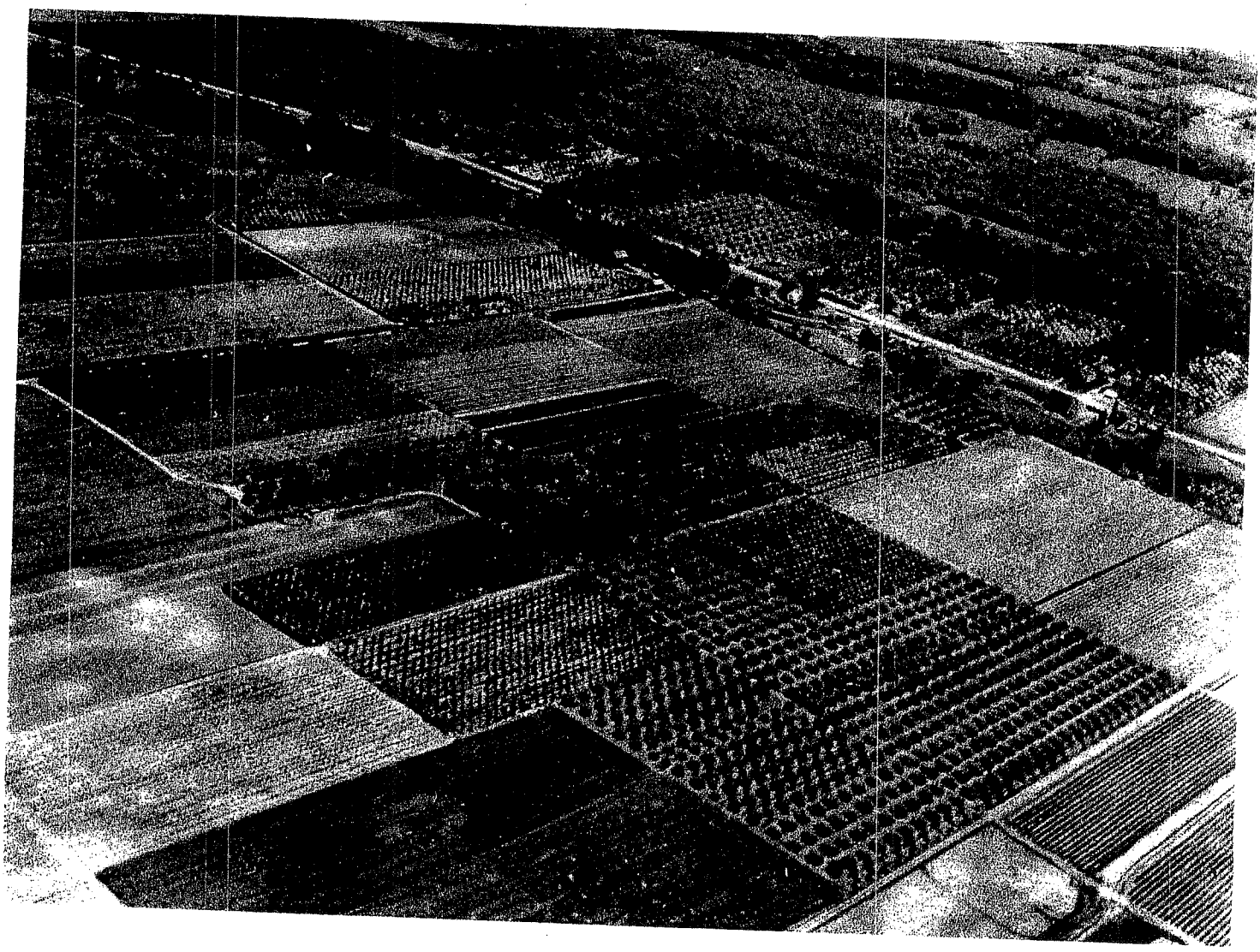
TABLE G

SOIL SURVEY OF NIAGARA COUNTY, NEW YORK

NIAGARA COUNTY BORDERS

The Niagara Escarpment
A New Proposed American Viticultural Area

SOIL SURVEY OF
Niagara County, New York



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Cornell University Agricultural Experiment Station

Issued October 1972

SOIL SURVEY OF NIAGARA COUNTY, NEW YORK

BY BRADFORD A. HIGGINS, P.S. PUGLIA, R.P.LEONARD, T.D. YOAKUM
AND W.A. WIRTZ, SOIL CONSERVATION SERVICE[1/]

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

NIAGARA COUNTY borders the southern shore of Lake Ontario in the extreme northwestern corner of New York State (fig. 1). The county is bounded by Lake Ontario on the north, Tonawanda Creek on the south, Orleans and Genesee Counties on the east, and the Niagara River on the west.

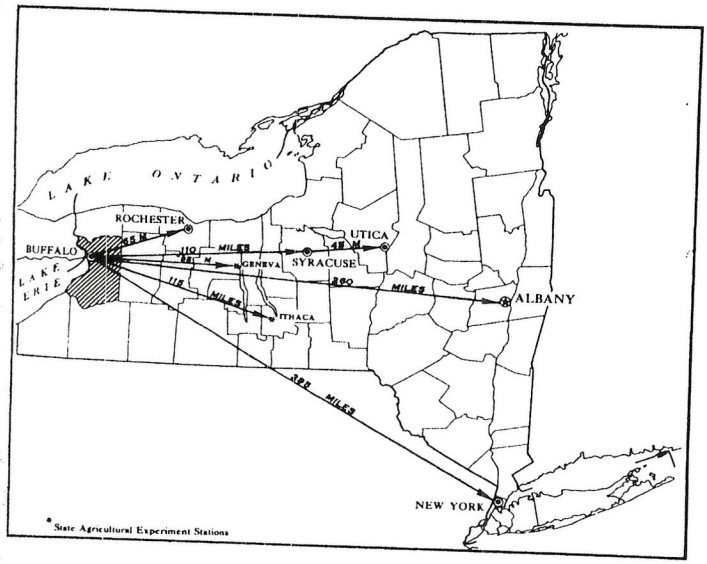


Figure 1.--Location of Niagara County in New York.

The county extends about 18 miles from north to south and about 30 miles from east to west. It has a total area of 341, 120 acres, or 533 square miles. Lockport, the county seat, is 20 miles northeast of Buffalo and 55 miles west of Rochester (8).

The Niagara Escarpment divides the county into two plains, the Ontario Plain on the north and the Huron Plain on the south. Drainage of the Ontario Plain is northward into Lake Ontario. The streams have crooked channels, and these meander through comparatively narrow flood plains that are not deeply cut. The Niagara Escarpment consists of a steep northward slope, along which perpendicular bluffs are exposed in places. Drainage of the Huron Plain is southward into Tonawanda Creek, which flows westward into the Niagara River.

Niagara County has a humid, continental climate. The flow of atmospheric air is dominantly from continental sources. Summers are pleasantly warm, but winters are fairly long and cold, and there are frequent spells of cloudy, unsettled weather in winter. Precipitation generally is evenly distributed during the year, though it is slightly less in winter than in other seasons. The climate is greatly influenced by the close proximity of Lake Ontario and Lake Erie.

The growing of fruits and vegetables is confined mainly to the Ontario Plain, where the tempering influence of Lake Ontario on climate is most pronounced. The Huron Plain is used mostly for hay and grain crops. Other important farm enterprises on the plain are dairying and raising livestock for beef.

About half the county is in farms. The dominant kinds of farming are dairying and fruit growing. A large amount of fluid milk is sold. The principal crops grown are hay, corn, small grains, and many kinds of fruits and vegetables. The acreage in woodland is only a small percentage of the total area. The woodland consists mainly of scattered farm woodlots.

Developments of water power has led to the establishment at Lockport and Niagara Falls of many industries that use electrical power. Niagara Falls, Lockport, and North Tonawanda are the principal manufacturing centers. Some of the smaller villages, such as Middleport, Barker, and Newfane, also contribute to the total manufacturing in the county.

1/ Others who participated in the field survey were J.P. WULFORST, W.E. HANNA, D.D. MONTS, J.H. JOHNSON, and T. FEDAK, Soil Conservation Service.

LETTERS OF SUPPORT

The Niagara Escarpment
A New Proposed American Viticultural Area

2469 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-3615

3120 FEDERAL BUILDING
100 STATE STREET
ROCHESTER, NY 14614
(585) 232-4850

465 MAIN STREET, SUITE 105
BUFFALO, NY 14203
(716) 853-5813

1910 PINE AVENUE
NIAGARA FALLS, NY 14301
(716) 282-1274

E-mail: louiseny@mail.house.gov
Web: http://www.slaughter.house.gov

CONGRESS OF THE UNITED STATES
LOUISE M. SLAUGHTER
28TH DISTRICT, NEW YORK

COMMITTEE ON RULES
SUBCOMMITTEE ON
LEGISLATIVE AND BUDGET PROCESS

SELECT COMMITTEE ON
HOMELAND SECURITY

CONGRESSIONAL CAUCUS FOR
WOMEN'S ISSUES
DEMOCRATIC CO-CHAIR

CONGRESSIONAL ARTS CAUCUS
DEMOCRATIC CO-CHAIR

COMMITTEE ON ORGANIZATION,
STUDY, AND REVIEW

WHIP PARLIAMENTARY GROUP

COMMISSION ON SECURITY AND
COOPERATION IN EUROPE

February 26, 2004

Mr. Michael J. VonHeckler
Warm Lakes Estate Vineyard and Winery
3869 Lower Moutain Road
Lockport, NY 14094-9739

Dear Mr. VonHeckler,

As a strong advocate for grape growers in my district, I strongly support your petition to create a new American Viticultural Area (AVA) to be known as "The Niagara Escarpment".

I applaud your efforts to bring more recognition to the wine growers on the Niagara Escarpment in Niagara County. The Niagara Escarpment has all the right ingredients to produce world class wine grapes; fertile soil, favorable wind currents and moderate temperatures. An AVA designation will be a strong marketing tool for the established and emerging wineries within the proposed AVA. This designation will also give Niagara County wine growers more credibility and allow them to compete on an even playing field with their counterparts in Canada.

Once again, I support your petition for an American Viticultural Area in Niagara County. Please be sure to keep me informed on the progress of this initiative.

Sincerely,

Louise Slaughter
Member of Congress

LMS:js

CHAIRMAN
TOURISM, RECREATION & SPORTS DEVELOPMENT COMMITTEE
COMMITTEE MEMBER
AGING
BANKS
COMMERCE, ECONOMIC DEVELOPMENT & SMALL BUSINESS
CRIME VICTIMS, CRIME & CORRECTION
ENERGY & TELECOMMUNICATIONS
HEALTH
HOUSING, CONSTRUCTION & COMMUNITY DEVELOPMENT

THE SENATE
STATE OF NEW YORK

GEORGE D. MAZIARZ
Senator, 62nd District

ALBANY OFFICE:
ROOM 805
LEGISLATIVE OFFICE BUILDING
ALBANY, NY 12247
(518) 455-2024
FAX: (518) 426-6987

DISTRICT OFFICE:
60 PROFESSIONAL PARKWAY
LOCKPORT, NY 14094
(716) 438-0655
FAX: (716) 438-0955

INTERNET ADDRESS:
maziarz@senate.state.ny.us

March 22, 2004

Michael J. VonHeckler
Founder and Managing Partner
Warm Lake Estate Vineyard and Winery
3868 Lower Mountain Rd.
Lockport, NY 14094

Dear Mr. VonHeckler:

Thank you very much for informing me of Warm Lake Estate Vineyard and Winery's application to form the Niagara Escarpment American Viticultural Area and incorporate this distinction on wine labels. Please know that I am thoroughly pleased to learn of this development and I am happy to give you my full support in your request.

The unique AVA wine label will be a powerful marketing tool for the emerging wineries in our area. As you know, the Niagara Region is already making a name for itself among wine connoisseurs around the world, and this distinction will help draw more attention to the high quality wines produced here.

I am very proud of the fact that the State of New York has already demonstrated its commitment to this burgeoning industry through the creation of the Niagara Wine Trail two years ago. Together, with our public and private partners, I am fully confident that we can continue to improve upon our pro-business, pro-agriculture record.

I greatly appreciate this opportunity to support the designation of the Niagara Escarpment American Viticultural Area. If I can be of any further assistance to you during the application process or in the future, please do not hesitate to contact me.

Sincerely,

George D. Maziarz
Senator, 62nd District

GDM:at

NEW YORK
STATE
SENATE
ALBANY, NEW YORK 12247

MARY LOU RATH
SENATOR 61ST DISTRICT

CHAIRMAN
COMMITTEE ON
CHILDREN & FAMILIES

COMMITTEE
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CO-CHAIRMAN
• HEALTH & WELLNESS TASK FORCE

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LOCAL EMERGENCY PREPAREDNESS
• TASK FORCE ON YOUTH
VIOLENCE & THE
ENTERTAINMENT INDUSTRY
• TASK FORCE ON PRIVACY
INVASION

PLEASE RESPOND TO:

☑ 5500 MAIN STREET
SUITE 260
WILLIAMSVILLE, NY 14221
(716) 633-0331
(716) 633-0830 FAX

☑ GENESEE COUNTY
TOLL FREE 1-800-597-3517

☐ LEGISLATIVE OFFICE BUILDING
ROOM 707
ALBANY, NY 12247
(518) 455-3161
(518) 426-6963 FAX
☐ E-MAIL: RATH@SENATE.STATE.NY.US
☐ WEBSITE: WWW.SENATORRATH.COM

March 26, 2004

Mr. Michael J. VonHeckler
Founder and Managing Partner
Warm Lake Estate Vineyard and Winery
3868 Lower Mountain Road
Lockport, New York 14094

Dear Mr. VonHeckler:

Thank you for informing me of the application by Warm Lake Estate Vineyard and Winery to establish the designation of the Niagara Escarpment American Viticultural Area and to incorporate this distinction into wine labels. I am pleased to add my enthusiastic support to your application.

The Niagara Region is, of course, already making a name for itself among wine connoisseurs around the world. The American Viticultural Area (AVA) wine label is a powerful marketing tool, which I believe will enhance interest in the high quality wines produced in the region. I applaud your initiative in seeking this designation.

Two years ago, New York State demonstrated its commitment to the burgeoning wine industry in our area through the creation of the Niagara Wine Trail. I am confident that we can continue to improve on our pro-business, pro-agriculture record together with our public and private partners to further strengthen our wine industry.

Again, thank you for bringing your proposal to my attention. I am delighted to add my support to your application to establish the designation of the Niagara Escarpment American Viticultural Area. I hope you will keep me informed of progress toward achieving this goal. You have my best wishes as your business moves forward. Please do not hesitate to contact me if I can be of further assistance.

Very truly yours,

Mary Lou Rath

MARY LOU RATH
State Senator

MLR/bd

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

FRANCINE DELMONTE
Member of Assembly
138th District

COMMITTEES
Agriculture

Economic Development, Job Creation, Commerce and Industry

Racing and Wagering
Tourism, Arts and Sports Development

March 12, 2004

Mr. Michael J. VonHeckler
Warm Lake Estate Vineyard and Winery
3868 Lower Mountain Road
Lockport, NY 14094

Dear Mike:

I was very pleased to see that you are seeking to have "The Niagara Escarpment" declared as an "American Viticultural Area" (AVA).

This AVA designation will not only serve to increase exposure for the wonderful wine that the Niagara Escarpment produces but it will go a long way in helping to "get the word out" to the nation, and indeed, the world as to the wonderful wine producing conditions that we have right here in Niagara County.

This AVA designation will blend perfectly with the Niagara Falls and Niagara County tourism promotion efforts and will assist in giving our visitors yet one more reason to stay and enjoy themselves. As you know the name "Niagara" is known across the globe and this incredible visibility results in attracting more than five million visitors to the greater Niagara Falls area each tourism season. It is clearly time for us to marshal our resources and work to make the world aware that Niagara County is not only home to the most famous waterfall in the world but also home to some of the finest grape and wine production in all the world.

You have my utmost support as you move forward in seeking to have the Niagara Escarpment declared as an American Viticultural Area. Please do not hesitate to contact me should you need further support or assistance.

Sincerely

Francine

Francine DelMonte
Member of Assembly

ALBANY OFFICE: Room 428, Legislative Office Building, Albany, New York 12248, (518) 455-5284
DISTRICT OFFICE: 1700 Pine Avenue, Niagara Falls, New York 14301, (716) 282-6062

ROBIN SCHIMMINGER
140th District

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

CHAIRMAN
Committee on Economic Development,
Job Creation, Commerce and Industry

COMMITTEES
Codes
Health
Rules
Ways & Means

March 8, 2004

Edgar Domenech, Acting Director
U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives
650 Massachusetts Ave., N W
Washington, D.C. 20226

Dear Mr. Domenech:

I write this letter in support of the petition proposed by Warm Lake Estate Vineyard and Winery in Lockport, New York, for the designation and creation of a new American Viticultural Area to be known as "The Niagara Escarpment."

It is often customary for wine enthusiasts and others to select their wines by their appellation of origin or American Viticultural Area. This designation is listed on the wine label and offers the consumer the ability to choose wines by their distinctive range of flavor that wines from designated areas exhibit.

The ability to have an AVA designation listed on a wine label is a powerful tool to help market and aid in the expansion and development of the wine industry in this area. Certainly this designation will encourage established and emerging wineries on "The Niagara Escarpment" in Niagara County to flourish and grow.

Therefore, I lend my full support for the proposal to designate and create a new American Viticultural Area to be known as "The Niagara Escarpment."

Sincerely,

Robin Schimminger

RS/vkk

3514 Delaware Avenue, Kenmore, New York 14217-1298, (716) 873-2540
Room 847, Legislative Office Building, Albany, New York 12248-0001, (518) 455-4767

SANDRA LEE WIRTH
Assemblywoman 142ND District

THE ASSEMBLY
STATE OF NEW YORK
ALBANY

RANKING MINORITY MEMBER
Real Property Taxation

COMMITTEES
Rules
Aging
Codes
Insurance

Administrative Regulations Review Commission

Legislative Commission on
Skills Development and Career Education

March 1, 2004

RE: "NIAGARA ESCARPMENT" AVA APPLICATION

Dear Gentlemen:

I am writing to express my support for consideration of the application of the creation of a new American Viticultural Area to be known as "The Niagara Escarpment", in Niagara County.

As the proposed AVA is located in Niagara County, New York just across the border from the Canadian viticultural area known as the Niagara Peninsula. The proposed new AVA is a physical extension of the established Ontario viticultural area. The area within the proposed AVA boundary has the potential to grow wine grapes of exceptional quality. This ability is attributed to the geographical features, soil types and climate of the proposed AVA. Once approved the "Niagara Escarpment" AVA will be used as a powerful marketing tool for the established and emerging wineries within the proposed AVA.

Thank you for your consideration and your attention to my request that this application be approved.

Sincerely,

Sandra Lee Wirth
Member of Assembly
142nd District

SLW/sjj

ALBANY OFFICE: Room 546, Legislative Office Building, Albany, New York 12248, (518) 455-4601, FAX (518) 455-5257
DISTRICT OFFICE: 5763 Seneca Street, Elma, New York 14059, (716) 675-7170, FAX (716) 675-1608
E-MAIL: wirths@assembly.state.ny.us

STATE OF NEW YORK
DEPARTMENT OF AGRICULTURE AND MARKETS
10B Airline Drive, Albany, New York 12235
518-457-8876 Fax 518-457-3087
www.agmkt.state.ny.us

George E. Pataki
Governor

Nathan L. Rudgers
Commissioner

April 7, 2004

Mr. Michael J. VonHeckler
Founder and Managing Partner
Warm Lake Estates Vineyard and Winery
3868 Lower Mountain Rd.
Lockport, NY 14094

Dear Mr. VonHeckler:

Thank you for your letter proposing the designation of the "Niagara Escarpment" as an American Viticultural Area (AVA). I agree with you that such a designation is warranted, and support your efforts to achieve this distinction.

I am optimistic that the Niagara Escarpment will grow to be a significant and prosperous part of our already successful series of wine trails throughout New York State. The Escarpment's unique climate, combined with fine wine-making by establishments like Warm Lake Estates, will distinguish your product and identify your American Viticultural Area as a vibrant part of New York's wine industry. Please keep me informed as to your progress in this effort.

Sincerely,

Nathan L. Rudgers
Commissioner

NIAGARA COUNTY LEGISLATURE

FROM: Legislators Clyde L. Burmaster, Kyle R. Andrews and John Syracuse, et al DATE: 3/16/2004 RESOLUTION # IL-016-

APPROVED BY CO. ATTORNEY	REVIEWED BY CO. MANAGER	COMMITTEE ACTION	LEGISLATIVE ACTION
			Approved: Ayes _____ Abs. _____ Noes (
			Rejected: Ayes _____ Abs. _____ Noes ___
			Referred: _____

RESOLUTION IN SUPPORT OF THE CREATION OF THE "NIAGARA ESCARPMENT" AMERICAN VITICULTURAL AREA (AVA)

WHEREAS, the fertile soils nestled between the world-famous Niagara Escarpment and Lake Ontario, along with the unique microclimate of that area, create conditions suitable for the production of World Class Wines, and

WHEREAS, Niagara County, New York is experiencing a rebirth of its winery industry with two existing award winning wineries being established within the last few years, and several new wineries opening up over the next several months, and

WHEREAS, this new activity in the local winery industry has seen the wineries come together in a unique partnership to promote their fledgling industry, prompting the State of New York to create "The Niagara Wine Trail", which will soon traverse through the heart of Niagara County from Niagara Falls to the Town of Hartland, and

WHEREAS, a newly designated American Viticultural Area (AVA) known as "The Niagara Escarpment" will greatly assist the wineries in Niagara County in their efforts to promote Niagara County, New York as a premier place to grow grapes and promote the local winery industry, now, therefore, be it

RESOLVED, that the Niagara County Legislature go on record in support of the effort to create the "Niagara Escarpment" AVA, and be it further

RESOLVED, that a copy of this resolution be sent to Mr. Edgar Domenech, Acting Director, United States Bureau of Alcohol, Tobacco Firearms & Explosives, Honorable Thomas M Reynolds, United States Congressman, 26th District, Honorable Louise M. Slaughter, United States Congresswoman, 28th District, Honorable Charles E. Schumer, United States Senator, Honorable Hillary Rodham Clinton, United States Senator, New York State Senator Byron W. Brown, New York State Senator George Maziarz, New York State Assemblywoman Francine DelMonte, New York State Assemblyman Charles Nesbitt, New York State Assemblyman Robin Schimminger, New York State Assemblywoman Sandra Lee Wirth, New York State Assemblyman Jim Hayes and Mr. Michael J. VonHeckler, Founder & Managing Partner, Warm Lake Estate Vineyard & Winery, and that a response be requested from each elected official.

LEGISLATOR CLYDE L. BURMASTER

LEGISLATOR KYLE R. ANDREWS

LEGISLATOR JOHN SYRACUSE

LEGISLATOR RICHARD E. UPDEGROVE

LEGISLATOR REBECCA E. CUDDAHEE

LEGISLATOR DANNY W. SKLARSKI

LEGISLATOR GERALD K. FARNHAM

LEGISLATOR PETER E. SMOLINSKI

LEGISLATOR LEE SIMONSON

LEGISLATOR GERALD E. MEAL

LEGISLATOR GLENN S. ARONOW

LEGISLATOR WILLIAM L. ROSS

LEGISLATOR RENAE KIMBLE

LEGISLATOR WILLIAM M. DAVIGNON

LEGISLATOR DENNIS F. VIRTUOSO

LEGISLATOR SEAN J. O'CONNOR

LEGISLATOR HARRY J. APOLITO

Clyde L. Burmaster
Niagara County Legislator, 12th District
Vice Chair,
Niagara County Legislature

2512 Parker Road
Ransomville, NY 14131
(716) 791-3111

February 26, 2004

Mr. Michael J. VonHeckler
Founder & Managing Partner
Warm Lake Estate
3868 Lower Mountain Road
Lockport, NY 14094

Dear Mr. VonHeckler:

I read your proposal for a New American Viticultural area in Niagara County with great interest, and would like to commend you for your efforts. You have my full support in your efforts to secure a designated American Viticultural Area (AVA) for Niagara County, New York.

An AVA designation for "The Niagara Escarpment" will be a boon for the new wineries that have begun operations on the newly established Niagara Wine Trail. This new trail, which runs along the geographically significant Niagara Escarpment, will also be home to three more wineries within the next seven months. A new Niagara Escarpment AVA will greatly assist these wineries in their efforts to promote Niagara County as a premier place to grow grapes, and promote the winery industry. It is my understanding that our neighbors in Southern Ontario, Canada have an established Canadian Viticultural Area known as "The Niagara Peninsula." Since we in Niagara County, New York share the same escarpment, microclimate and soils with our Canadian neighbors that lend themselves to a productive grape and winery industry, a new Niagara Escarpment AVA makes a lot of sense.

Your hard work in establishing Warm Lake Estate as a premier vineyard and winery and your involvement in the promotion of the newly established Niagara Wine Trail is to be commended. It is through your hard work, and the hard work of the other existing and emerging wineries on the trail, that Niagara County is back on the map as a destination for those residents and visitors alike who enjoy these types of agri-tourism venues. In March, I will be sponsoring a resolution on the floor of the Niagara County Legislature that will support your efforts in establishing a new "Niagara Escarpment" AVA.

Once again, it is with great enthusiasm, that I endorse your petition and application with the United States Bureau of Alcohol, Tobacco and Firearms, for a new AVA known as "The Niagara Escarpment." I wish you good luck in your endeavor.

Sincerely,

Clyde L. Burmaster
Vice Chairman, Niagara County Legislature

NIAGARA COUNTY
DEPARTMENT OF
ECONOMIC DEVELOPMENT

SAMUEL M. FERRARO
COMMISSIONER

MICHAEL A. CASALE
DEPUTY COMMISSIONER OF
BUSINESS DEVELOPMENT

Thursday, February 26, 2004

Mr. Michael J. VonHeckler, Founder & Managing Partner
Warm Lake Estate
3868 Lower Mountain Road
Lockport, NY 14094

Dear Mr. VonHeckler:

It is with great enthusiasm that I wholeheartedly support your efforts to secure a designated American Viticultural Area (AVA) for the Niagara Escarpment here in Niagara County, New York.

A new AVA known as "The Niagara Escarpment" will greatly assist the wineries in Niagara County in their efforts to promote Niagara County, New York as a premier place to grow grapes, and to promote the winery industry. This new AVA designation will also assist the fledging winery industry in Niagara County, which has seen a rebirth of activity in recent years. An AVA designation makes a lot of sense for "The Niagara Escarpment", in that we share the same escarpment, microclimate and soils that our neighbors in Canada do in the Canadian Viticultural Area known as the "Niagara Peninsula."

Your hard work in establishing Warm Lake Estate as a premier vineyard and winery as well as your involvement in the promotion of the newly established Niagara Wine Trail is to be commended. It is through your hard work, and the hard work of the other existing and emerging wineries on the trail, that Niagara County, New York is back on the map as a destination for those residents and visitors alike who enjoy these types of tourism venues.

Once again, it is with great enthusiasm, that I endorse your petition and application with the United States Bureau of Alcohol, Tobacco and Firearms, for a new AVA known as "The Niagara Escarpment." I wish you good luck in your endeavor.

Sincerely,

Samuel M. Ferraro, Commissioner
Niagara County Department of Economic Development

VANTAGE CENTRE, SUITE ONE • 6311 INDUCON CORPORATE DRIVE •
SANBORN, NEW YORK 14132 • (716) 278-8750 • FAX: (716) 278-8757

NIAGARA COUNTY
DEPARTMENT OF ECONOMIC DEVELOPMENT

SAMUEL M. FERRARC
COMMISSIONER

MICHAEL A. CASALE
DEPUTY COMMISSIONER OF
BUSINESS DEVELOPMENT

Friday, February 27, 2004

Mr. Michael J. VonHeckler
Warm Lake Estate
3868 Lower Mountain Road
Lockport, NY 14094

Dear Michael:

Enclosed you will find two support letters that you had requested in support of the proposed "Niagara Escarpment" AVA.

Legislator Clyde Burmaster will be sponsoring a resolution in support of this effort at the March 16th meeting of the Niagara County Legislature. The meeting is scheduled for 7:00pm, and you are invited to attend if you like.

Once again, thank you for all of your efforts to promote Niagara County.

Sincerely,

Samuel M. Ferraro, Commissioner
Niagara County Department of Economic Development

Michael A. Casale, Deputy Commissioner of Business Development
Niagara County Department of Economic Development

Enclosures

VANTAGE CENTRE, SUITE ONE • 6311 INDUCON CORPORATE DRIVE •
SANBORN, NEW YORK 14132 • (716) 278-8750 • FAX: (716) 278-8757

NIAGARA USA CHAMBER

February 27, 2004

Mr. Michael Von Heckler
Warm Lake Estates Winery
3868 Lower Mountain Rd.
Lockport, NY 14094

Dear Mr. Von Heckler:

It is my pleasure to provide you with a letter of support for your pursuit of the American Viticultural Area designation for the Niagara Escarpment.

Niagara County is fortunate to have the Escarpment in our backyard. It is a geographic touchstone and a source of pride for those familiar with it. The benefits that the local residents --and farmers-- enjoy as a result of the Escarpment are innumerable. The Escarpment provides a barrier against harsh weather, a scenic look out, a place to recreate and as a result, a higher quality of life for those living and working in Niagara County.

Designation of the Niagara Escarpment as an American Viticultural Area will only serve to add to the already quality products being produced on the Escarpment. As the Niagara Wine Trail develops and Warm Lake Estates moves forward in producing world class pinot noir grapes, this designation will serve as an invaluable marketing tool.

Please do not hesitate to call on me if I can be of further assistance regarding this matter.

Sincerely,

Angela P. Berti

Angela P. Berti
Vice President of Government and Public Affairs

345 THIRD STREET, SUITE 500, NIAGARA FALLS, NEW YORK 14303-1117 716.285.9141 FAX 716.285.0941
151 WEST GENESEE STREET, LOCKPORT, NEW YORK 14094-3686 716.433.3828 FAX 716.433.1154
www.niagarachamber.org

niagaradems.org
FRANK A. SODA, CHAIRMAN
NIAGARA COUNTY DEMOCRATIC COMMITTEE
4221 MCKOON AVENUE
NIAGARA FALLS, NEW YORK 14305
(716) 282-0383
WWW.NIAGARADEMS.ORG

March 15, 2004

Mr. Michael J. VonHeckler
Warm Lake Estate Vineyard & Winery
3868 Lower Mountain Road
Lockport, New York 14094

Dear Mr. VonHeckler,

On behalf of the Niagara County Democratic Committee, I am please to submit this letter of support regarding your attempt to secure the designation of "American Viticultural Area" for the wineries of the Niagara Escarpment.

Those of us who have grown up in Niagara County have taken the vineyards of our area for granted. Quite simply, these prime growing areas were "always there." One never considered the geographic features and climatic conditions that created the unique quality of the grapes of this region. Now, as the wineries of the Niagara Escarpment begin to emerge as a critical industry for the local economy, those of us involved in the political and governmental process want to assist in any way we can in the positive promotion of these businesses.

Since agriculture and tourism rank as the two greatest generators of economic activity in Niagara County, we are especially pleased with the efforts of the Niagara Escarpment wineries to pursue such an important designation. As the traditional industries of our area continue to decline, it is essential for new ones to take their place. The nearly 10,000 acres of prime agricultural land contained in the proposed area will become a major catalyst for the development of jobs for the residents of Niagara County. Obviously, we would very much like to see the 400 acres of established vineyard in this region greatly expanded. The wineries of the Niagara Escarpment have the potential of complementing the "eco-tourist" features of Niagara County, and adding to the ever-important "length of stay." No longer will tourists to the area complain about a lack of interesting venues.

Please be aware that the Niagara County Democratic Committee stands ready to support your proposal. Simply let us know how best to help.

Sincerely,

Frank A. Soda

Frank A. Soda, Chairman

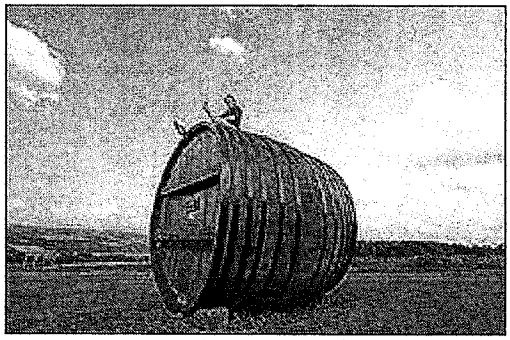
TORONTO STAR
www.thestar.com

Jul. 21, 2004. 07:15 AM

Roll out the barrel

There are dozens of wineries and plenty of great wine discoveries

GORDON STIMMELL



KEITH BEATY/TORONTO STAR
Winemaker Steve diFrancesco has a barrel of laughs on the lawn of Glenora Wine Cellars. The property boasts an inn with 30 guest rooms and a restaurant with views of the vineyards and Seneca Lake.

FINGER LAKES WINE COUNTRY—A hidden world of picturesque wineries dotting the sides of slender lakes — gouged out in ancient times by glaciers — lurks just across Lake Ontario.

Few Ontarians have made the trek by car to the 75 wineries in the Finger Lakes here in upstate New York.

The LCBO doesn't have New York wines on its general list, and only 300 or so cases trickle into Vintages stores a year.

It's as if the region, out of sight and mind, doesn't exist for Canadians.

Then along came the Breeze, the new high-speed ferry between Toronto and Rochester, opening the door to a supposedly speedier winery discovery. But it certainly wasn't a breeze on my recent two-day trip.

After paying for a $179 round trip for a van with two passengers, we arrived at Cherry St. at 9:45 a.m. for the ferry. Enduring several lineups and a boat that left 45 minutes late, we arrived at Rochester customs at 1:45 p.m. — four hours after setting out.

Driving at least allows you to leave Toronto at 7 a.m., get to the Finger Lakes by 11 a.m., and tour several wineries before doors close at 5 p.m. We had to rush to even get to a couple of wineries. And the ferry departure the next day was too early, so we drove back to Toronto instead.

Transportation quandaries aside, the Finger Lake wineries are really worth visiting.

Ontario and New York State wineries are loosely tied together in the huge "Northeast Wine Route," which embraces separate vital wine regions in Niagara, Pelee Island, Lake Erie, the Finger Lakes, the Hudson River and Long Island.

My mission embraced the Finger Lakes Region (which includes Lakes Seneca, Keuka, Canandaigua, and Cayuga), where each lake has its own wine trail acting as a voyage of discovery for the senses.

My micro-mission was to explore the high-quality wineries clustered on the Lake Seneca Wine Trail (http://www.senecalake wine.com). My guide was Robert Ketchin, who represents New York wines in Canada.

We made some great discoveries, including amazing pinot noir in Lockport, near Niagara Falls, and stellar rieslings south of Rochester.

Casa Larga winerey is in the suburbs of Rochester, in Fairport, on a windy knoll just north of the New York State Thruway.

Its elevation captures moderating Lake Ontario breezes, which extends its growing season by a month for 11 grape varieties. To protect the vineyard, winemaker Mike Countryman has to bank earth over the vines in winter.

The Casa Larga stone building hosts dozens of marriages a year, and the Colaruotolo family makes several tasty wines.

Commendable are **2002 Reserve Viognier ($18.99, rating 88/100)**; **2001 Reserve Pinot Noir ($16.99, 88)**; **2002 American Oak Chardonnay ($16.99, 89)** and **Fiori Vidal Icewine ($30, 92)**. (All wine prices are in U.S. dollars.)

To access Lake Seneca, drive to exit 42 on I-90 to Geneva. Wineries flank both sides of the lake.

For those overnighting, the Inn at Glenora on the west side is the place to stay, with spectacular views of the lake and a fine restaurant, Veraisons. The winery has three tasting bars just a stroll up the hill from the inn.

Glenora winery's biggest seller is a glorified sugar water called Cranberry Chablis. The winery plows these mass revenues into its sophisticated oak barrel program and the creation of sparkling wines, which are world- class.

Pace-setters here are **2002 Barrel Fermented Pinot Blanc ($12.99, 89)**; **2003 Dry Riesling ($11.99, 89)**; the total bargain **2003 Seyval Blanc ($8.99, 89)** and the amazing **1998 Blanc de Noirs ($19.95, 91)**, a first-class bubbly made 100 per cent from pinot noir grapes.

The most amazing rieslings in New York State are sculpted at nearby Hermann J. Wiemer Vineyard.

I didn't drop by this time, but on previous visits, I found these racy, steely-hearted whites range from bone-dry to hedonistically sweet late harvest rieslings. The Wiemer Semi-Dry Riesling is coming to Vintages in September.

Fox Run Vineyards has a little café and deli on site, and the wines made by Peter Bell include some winners.

The **2003 Semi-Dry Riesling ($11.99, 88)** and **2001 Reserve Chardonnay ($13.99, 89)** are good, but the **2001 Cabernet Franc ($17.99, 89)** and **2002 Lemberger ($16.99, 90)** both show smoky complexity. Well-made Lemberger is rare as hen's teeth in the east.

Prejean Winery, owned by Elizabeth Prejean and son Tom, makes a kick-ass spicy Alsatian-styled **2002 Dry Gewurztraminer ($12.99, 90)**.

Cabernet Franc is one of the signature reds of western New York, and **Prejean 2001 Cabernet Franc ($15.99, 89)** shows jammy raspberry spiciness. Most intriguing is **Prejean Bird of Paradise White**

Port, ($15.99, 89), made from chardonnay fortified with brandy, with pear and crushed pineapple flavours.

An overnight stay is absolutely a must if you want to taste the best of both sides of Seneca, or drive on to Lake Keuka, which also has some idiosyncratic wineries along its flanks, including the pioneering Dr. Konstantin Frank's Wine Cellars.

On the eastern side of Lake Seneca, the most stunningly designed winery is Lamoreaux Landing Wine Cellars, resembling a wooden Greek temple overlooking the lake.

For my money, the signature wine of owner Mark Wagner is chardonnay at both regular and reserve levels.

In fact, **2001 Chardonnay ($11.99, 89)** shows lively buttery poise at a great price. Also highly recommended are **2003 Gewurztraminer ($15.99, 89)** and **2002 Merlot ($15.99, 89)**.

Among boutique wineries on Seneca, Hazlitt 1852 Vineyards, owned by Elaine Hazlitt and sixth-generation Hazlitts Doug and Leigh, makes a few stellar wines, fuelled by huge sales of "Red Cat," a blend of catawba and baco noir grapes with a cat in a hot tub on its label. It's designed for tailgate parties.

My nose recoiled at its Concord grape nose and sweet flavours, but fortunately, winemaker Mike Sutterby makes a zingy **2002 Homestead Reserve Riesling ($15, 89)**, a racy mineral-rich **2002 Pinot Gris (sold out, 90)** and an opulent **2001 Cabernet Franc ($15, 90)**, 10 cases of which is coming to Vintages in November.

Most wine lovers know Long Island is the place for ripe big reds, but the Finger Lakes can produce blockbusters, too.

Witness Red Newt Cellars, with its meritage-style **2002 Viridescens ($39.50, 92)** with huge ripe plum and chocolate layers, and its **2002 Syrah ($28.50, 92)** with monster black cherry power. Big prices, small quantities produced — just like in Niagara.

At nearby Atwater Estate Vineyards, the opposite held true — weak reds, but nice whites, including a well-priced, crisp, pear-driven **2003 Vidal Blanc ($9, 88)** and decadent **2000 Late Harvest Vignoles ($16, 91)**, a dessert sweetie with goldenrod, apricot and lovely peach intensity.

The greatest New York discovery, however, comes far closer to home.

Ontario wine lovers are keenly aware of the Niagara Escarpment, and "the Bench" creating a special microclimate for grape growing in Niagara. Well, guess what: It comes up in New York State on the other side of the lake, in Lockport, north of Lewiston.

And while every vigneron and back-to-nature city slicker is rushing to Prince Edward County to plant grapes, this is an amazingly mild microclimate with land prices a fraction of Niagara's.

Here Michael J. VonHeckler has created Warm Lake Estate winery, specializing in pinot noir.

And as is done in Prince Edward County, a burgeoning region east of Toronto, VonHeckler buries his

vines in the winter using special earth-moving equipment he has designed.

VonHeckler was at Lockheed Martin in Long Island for 25 years and married a gourmet chef. He has passed most of the levels toward his Master of Wine degree.

Stepping inside the winery tasting room is startling. On the lengthy counter are 60 bottles VonHeckler has hand-picked from more than 900 New York wines as the best the state has to offer. He sells $250,000 of these wines a year to visitors.

But it is his 44 acres of pinot noir that have captured the most attention. His pinots are already cult wines. With 41 partners owning half the winery and VonHeckler the other half, he has already sold most of his 2,500 cases of 2004 pinot noir before the buds even formed on the vines — as "futures." Many of the partners, of course, were the buyers, at $23.99 a bottle now instead of $36 at release in 2005.

Is the pinot noir as good as the hype? The **2003 Warm Lake Estate (sold out, 89)** showed nice spicy vanilla, cherry and cedar with a hint of nuttiness from Vosges barrels. The **2002 Warm Lake Pinot Noir (sold out, 88)** showed restrained cedar accented nutty black cherry flavours. Certainly not world-class, but fascinating, coming from an unknown area.

VonHeckler comes on like Michael Moore and has applied for the Niagara Escarpment to be declared an appellation (a designated wine district) in New York State. But what really gripes him is what bothers all other wineries in New York: New Yorkers can visit Niagara wineries and bring back up to five cases of Ontario wine, only incurring a 21 cents per $14 bottle charge at U.S. customs, a flat tax which is often waived.

Ontarians, however, returning from New York State can take in two bottles duty-free, but face heavy taxes equating to $9.54 on a $14 bottle at Canada customs. This adds up to hundreds of dollars difference on the up to five cases of wine we're allowed for personal consumption.

This border inequity, which totally favours Ontario wineries, frustrates New York winemakers. They are looking for more fair play. Not to mention fair trade. But no one is holding their breath.

Like everything else in the winery business, it won't be a breeze.

Gordon Stimmell *is the Star's wine writer. He rates wines using a 100-point system. E-mail gstimmell@thestar.ca.*

Additional articles by Gordon Stimmell