# Subsurface Tully Limestone New York and Northern Pennsylvania

**Nancy A. Wright**

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by Nancy A. Wright [2]

## ABSTRACT

An investigation of the subsurface extent of the Middle Devonian Tully Limestone of New York and northern Pennsylvania reveals both the occurrence of this limestone and the fact that it has been confused with other limestones in southwestern New York and northwestern Pennsylvania. Gamma ray and lithic logs of approximately 250 petroleum and gas exploration wells were compared and correlated for this study.

Petroleum geologists and well drillers have suggested that the Tully Limestone is present in western Cattaraugus and Chautauqua Counties, New York, and in northwestern Pennsylvania. This investigation shows that this limestone occurs well within the Hamilton Group, and appears to be a combination of the Tichenor Limestone and a heretofore unrecognized subsurface limestone, herein called Unit "B," which does not outcrop in New York State. The Tichenor and other Hamilton limestones were identified in the subsurface through the correlation of certain wells with nearby outcrops.

The western limit of the Tully Limestone in the subsurface extends from its westernmost outcrop on Canadaigua Lake through southern Ontario, Livingston, and Wyoming Counties, and eastern Cattaraugus County, New York, into central McKean County, Pennsylvania. The thickness of the formation varies from 1 to 30 feet in the outcrop, but exceeds 120 feet in the subsurface of north central Pennsylvania.

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# Introduction

For a number of years there has been some uncertainty among geologists, especially in the petroleum industry, concerning the extent of the Tully Limestone in the subsurface of central and western New York and northern Pennsylvania. It appears that well drillers have erroneously called the Tully Limestone from well samples in areas where it is now known to be absent. Gamma ray logs from wells in these same areas also have been mistakenly interpreted to show the presence of the Tully Limestone.

This study was begun in the fall of 1967 to determine the exact extent of the Tully Limestone, and its relationship to carbonates within the Hamilton Group in the subsurface. Gamma ray or radioactivity logs, and sample logs were the principal sources of data. The logs of 209 control wells in New York and 53 control wells in Pennsylvania were compared and correlated. All of the sources used in this study are on file with the Geological Survey of the New York State Museum and Science Service. By projecting from surface exposures to nearby key wells, the Tully Limestone and Hamilton carbonate units were identified in the subsurface. Knowing their gamma ray and lithologic characteristics, it was then possible to trace these units in the subsurface.

The area of study covers that portion of the Appalachian Basin located in central and western New York and northern Pennsylvania. It extends northward to the Tully outcrop, eastward to Delaware and Otsego Counties, and southward into the second tier of counties in northern Pennsylvania.

The Tully Limestone was first recognized and described by Lardner Vanuxem in 1838. After this early survey of New York State, almost no attention was paid to the Tully until 1887, when Samuel G. Williams published a general outcrop description and summary of existing knowledge of the limestone. Tully correlation data subsequently was provided by H. S. Williams in 1890. In 1917, A. W. Grabau contributed to our understanding of the Tully Limestone and the Geneseo Shale. A thorough outcrop description and correlation was provided by G. Arthur Cooper and J. Stewart Williams in 1933. This improved Cooper's work of 1930, when he incorporated the Tully into his Hamilton study. David Trainer provided petrographic data on the Tully Limestone in 1932. Philip Heckel's unpublished work of 1966 added much to stratigraphic, petrographic, and depositional information on the limestone in New York. Data on the Tully Limestone in Pennsylvania was published by Heckel in 1969. Recently K. G. Johnson and G. M. Friedman (1969) have completed a study of the eastern clastic correlatives of the Tully Limestone in New York.

The author is gratefully indebted to the generous advice and assistance of Lawrence V. Rickard of the New York State Museum and Science Service, Geological Survey.

# Outcrop

The Tully Limestone outcrops in New York State in a thin band extending from the Chenango River westward to the east side of Canadaigua Lake. West of the lake the Tully is not present, but the Leicester Pyrite occupies a homotaxial position. The outcrop band extends generally east-west but is quite irregular owing to the topography of the area. The average dip of the limestone is about 50 feet per mile to the south. In outcrop the Tully is usually a relatively pure, medium- to thick-bedded limestone, neutral gray in color. Its thickness varies from less than 1 foot at the western end of the outcrop belt near Canandaigua Lake to almost 30 feet at Tinker's Falls in Cortland County. East of Tinkers Falls the limestone begins a gradual facies change to shale and sandstone (Laurens and New Lisbon Formations). The last limestone beds occur near the village of Smyrna in the Chenango River valley.

Stratigraphically the Tully Limestone lies at the top of the Middle Devonian. It discomformably overlies shales of the Hamilton Group. It is overlain by the Geneseo black shale, this relationship being disconformable at the western end of the outcrop area.

The Portland Point, Tichenor, and Centerfield Limestones of the Hamilton Group occur at various intervals below the Tully Limestone. All of these outcrop in New York State. Two new units, herein called limestones "A" and "B" also were recognized in the Hamilton Group in the subsurface. These units, however, do not outcrop in New York State.

# Thickness

Plate I, an isopachous map of the Tully Limestone, indicates the variation in thickness of the formation. This plate also indicates the subsurface extent of the limestone by means of the zero isopach. The western limit of the Tully in the subsurface passes from Ontario County, where it disappears in outcrop just before reaching Canandaigua Lake, across southern Livingston County and through southeastern Wyoming County, where it bends to the south. It crosses the eastern portion of Cattaraugus County into central McKean County, in northern Pennsylvania. The Tully Limestone has been reported from many wells west of the zero isopach, but it is now known that this supposed "Tully" actually is an older limestone, a member of the Hamilton Group. It is shown on plate III, and appears to be the Tichenor Limestone or a combination of the Tichenor Limestone and limestone unit "B" depending on the area involved.

In Allegany and Steuben Counties, New York, and in Potter County, Pennsylvania, there is a broad area of the Tully Limestone where its thickness is quite uniform, varying only 20 feet. This appears to be a shelf or platform area, perhaps controlled by a structure to the east. Heckel (unpublished, 1966) refers to a subsurface platform of the Tully in the same general area.

The area of thickest Tully has elongated oval isopachs. The thickest portion of the Tully Limestone in outcrop lies directly in line with the axis of this area. This axis runs northeast-southwest through Cortland and Tioga Counties, New York, into Bradford County, Pennsylvania. It appears to extend further to the southwest, beyond the scope of this study.

Southward in the subsurface it becomes increasingly more difficult to determine the base of the Tully Limestone, and therefore its thickness, owing to the fact that to the south the Tully gradually accumulates shale interbeds. In Pennsylvania where the Tully equivalent outcrops, it is essentially a calcareous shale with scattered limestone beds. In northern Pennsylvania where these shale interbeds begin to appear in the Tully Limestone, the lowest limestone bed was utilized as the base of the Tully.

# Structure

Plate II displays structure contours drawn on the top of the Tully Limestone. Additional control points were necessary to make a contour map with the desired structural detail. These additional unnumbered control points are driller's calls, in wells reported by W. L. Kreidler (1959, 1963). Having established the western limits of the Tully Limestone in the subsurface, it is possible to separate accurate calls from those which are erroneous. The Tully Limestone is a fairly easy unit for drillers to recognize, particularly the top.

The structure contour map demonstrates that the Tully Limestone participates in the general northeast-southwest anticlinal and synclinal trends known over much of the study area. It is believed that these structures were formed during the Alleghanian Orogeny of the late Paleozoic. The area of greatest folding is in Tioga County, Pennsylvania.

Here the top of the Tully varies from 3500 feet below sea level to 1500 feet below sea level in less than 25 miles—a difference of 2000 feet between the trough of a syncline and the crest of an anticline. Another pronounced fold occurs in Potter County, Pennsylvania, apparently branching into two segments to the southwest. In contrast to these two areas, throughout the remainder of the map area, the Tully is fairly regularly and gently folded.

# Subsurface Stratigraphy

Plate III, containing two cross-sections, shows the subsurface stratigraphic relationship of the Tully Limestone to the carbonate units of the Hamilton Group. Section 1 extends south from Wyoming County and then bends west into Allegany, Cattaraugus, and Chautauqua Counties, New York. Section 2 extends southwestward from Tompkins County, New York, to Warren County, Pennsylvania. In both sections the top of the Tichenor Limestone was chosen as the datum because the Tichenor is present throughout the area of these cross sections. Using the Tichenor as the datum serves to emphasize any thinning or thickening taking place in the overlying Hamilton shales. The gamma ray pattern for each control well extends from within the Geneseo black shale above the Tully horizon to below the top of the Onondaga Limestone. On the gamma ray logs radioactivity increases from left to right—limestones display lower readings, gray shales and sandstones display higher readings. Black shales usually contain greater amounts of radioactive material and consequently produce very high readings—high peaks to the right in the gamma ray logs. The Geneseo black shale displays this feature quite nicely, and therefore is an excellent marker for recognizing the base of the Upper Devonian or the top of the Hamilton Group, particularly where the Tully Limestone is not present.

The northern end of Section 1 is north and west of the Tully outcrop. In wells NY 156 and NY 149 the low gamma ray reading at the top of the Hamilton group, which might be mistaken for the Tully, probably is a calcareous shale. Well NY 135 marks the first appearance of the Tully Limestone in this section. In this well it is about 45 feet thick and from this well to the west the Tully thins to final disappearance. The last beds of limestone are present in well NY 175 in eastern Cattaraugus County. Through the use of the high peaks of the Geneseo black shale in the gamma ray logs it is possible to trace the top of the Hamilton group westward to the end of the cross section. The Tichenor Limestone appears clearly in the gamma ray logs of all the wells of Section 1. Its thickness appears to vary slightly across the section.

Well NY 199 in Section 1 contains the first appearance of unit "B," an unnamed limestone which does not outcrop in New York State. West of well NY 199 unit "B" thickens and merges with the Tichenor Limestone into one limestone unit in well NY 203. In this well it is not possible to differentiate these two limestones. The Tichenor Limestone appears to be an eastward tongue or extension of the thick limestone of well NY 203.

In Section 1 a second new limestone, not known to outcrop in New York, is discernible in the subsurface. This limestone, herein called unit "A," first appears in well NY 209 and can be traced to the western end of the section. Its exact position within the Hamilton Group has not been determined.

In Section 1 the Centerfield Limestone cannot be traced westward in the subsurface beyond well NY 135. However, to the South in Section 2, the Centerfield appears to be present across the entire section. In both sections the Onondaga Limestone is overlain by the Marcellus Formation of the Hamilton Group. This shale unit gives a characteristic high reading on the gamma-ray log and provides an easy means for recognizing the top of the Onondaga.

In Section 2 the Tully Limestone is present across much of the cross section. At the northeast end of the section in well NY 20 the limestone is about 20 feet thick. To the southwest it thickens to a maximum of about 54 feet in well NY 120. Farther southwest the Tully thins and disappears in eastern Cattaraugus County as in Section 1.

In Section 2 the Portland Point Limestone, lying above the Tichenor Limestone, can also be traced for a short distance in the subsurface. This limestone is present in Steuben County but disappears before reaching well NY 120 in Allegany County.

The new subsurface units "A" and "B" are recognized clearly in Section 2. Unit "A" can be traced to the northeast to well PA 28 in McKean County. In this well the low level of the gamma ray log at this position is no longer obvious, suggesting that the unit is changing facies to the northeast into shales. Southwest of well PA 32, unit "B" thickens and merges with the Tichenor Limestone, as described earlier for Section 1.

Both sections clearly demonstrate the westward thinning of the Hamilton Group. In Section 1 the Hamilton changes from 530 feet in the north to 250 feet in the west; in Section 2 it thins from 1100 to 300 feet.

# Conclusions

1. In the subsurface the Tully Limestone does not extend west of eastern Cattaraugus County, New York, and central McKean County, Pennsylvania. Unit "B" and the Tichenor limestone previously mistaken for the Tully in western New York and northwestern Pennsylvania, occur well within the Hamilton Group. Oliver, et al. (1967, p. 1020), suggested that the "Tully" in this area, is equivalent to the Centerfield Limestone. However, Section 2 shows that this is not probable.

2. The Tichenor appears to be a tongue of Unit "B" extending farther eastward into the Hamilton Group than the remainder of the unit. Unit "A' is a limestone that appears to be an eastward extension of a unit west of the study area. Its exact age and correlation are presently uncertain, although unit "A" appears to be younger than the Stafford Limestone and older than the Centerfield Limestone.

3. Separation of the subsurface Tully Limestone into its members is not possible using only lithic and gamma ray logs. Further investigation of lithic and gamma ray logs from Ohio and Ontario should prove fruitful in determining more precisely the exact age and correlation of units "A" and "B" and their extent to the west.

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# Appendix A

## Identification of Control Wells

*NEW YORK:*

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE | GS NO. |
|---|---|---|---|---|---|---|
| 1 | Delaware | Roxbury | Gulf Oil | Lanzilotta #1 | Hobart H | 4379 |
| 2 | Delaware | Hamden | Gulf Oil | Campbell #1 | Andes A | 4214 |
| 3 | Delaware | Sidney | Gulf Oil | Finch #1 | Oneonta G | 4364 |
| 4 | Delaware | Franklin | Warner et al. | Hazlet #1 | Oneonta F | 879 |
| 5 | Delaware | Franklin | Gulf Oil | Hirsch #1 | Oneonta F | 4073 |
| 6 | Delaware | Franklin | Gulf Oil | Leslie #1 | Oneonta F | 4455 |
| 7 | Otsego | Worcester | N.Y.S.N.G.C. | Lum #1 | Richmondville D | 4055 |
| 8 | Otsego | Maryland | N.Y.S.N.G.C. | Baum #1 | Cooperstown H | 4245 |
| 9 | Otsego | Maryland | N.Y.S.N.G.C. | Russ #1 | Cooperstown H | 4429 |
| 10 | Otsego | Pittsfield | Prensett et al | Elliot #1 | Hartwick D | 4050 |
| 11 | Madison | Brookfield | N.Y.S.N.G.C. | Danisevich #1 | Sangerfield H | 4032 |
| 12 | Madison | Lebanon | N.Y.S.N.G.C. | Branagan #1 | Morrisville H | 3970 |
| 13 | Madison | Lebanon | N.Y.S.N.G.C. | Seeley #1 | Morrisville H | 4045 |
| 14 | Chenango | Smithville | Genegantslet Co. | Decker #1 | Greene F | 4475 |
| 15 | Broome | Maine | Lamphere et al. | Hotchkiss #1 | Apalachin F | 1803 |
| 16 | Cortland | Harford | Pen York Gas | Woodward #1 | Harford A | 555 |
| 17 | Cortland | Homer | N.Y.S.N.G.C. | Butler #1 | Cortland D | 644 |
| 18 | Cortland | Cortlandville | N.Y.S.N.G.C. | Mc Cloy #1 | Moravia F | 433 |
| 19 | Tompkins | Lansing | Int. Salt. Co. | Int. Salt. Co. #20 | Genoa I | 3938 |
| 20 | Tompkins | Ulysses | Great Lakes Gas | Agard #1 | Genoa H | 5017 |
| 21 | Tompkins | Enfield | N.Y.S.N.G.C. | Grund #1 | Ithaca B | 4130 |
| 22 | Tompkins | Newfield | N.Y.S.N.G.C. | Fee #1 (N-914) | Ithaca F | 4467 |
| 23 | Tompkins | Danby | N.Y.S.N.G.C. | Shepherd #1 | Ithaca F | 3973 |
| 24 | Tompkins | Danby | N.Y.S.N.G.C. | Smiley #1 | Ithaca F | 4007 |
| 25 | Tompkins | Danby | Bentley et al. | Turk #1 | Dryden D | 4446 |
| 26 | Tioga | Oswego | Susquehanna Gas | Pompelli #1 | Owego F | .... |
| 27 | Chemung | Van Etten | N.Y.S.N.G.C. | Pyhtila #1 | Waverly B | 4350 |
| 28 | Chemung | Van Etten | N.Y.S.N.G.C. | Haywood #1 | Waverly C | 4148 |
| 29 | Chemung | Van Etten | Felmont Oil | Bailey #1 | Waverly B | 3248 |
| 30 | Chemung | Van Etten | N.Y.S.N.G.C. | Kesselring #1 | Waverly C | 443 |
| 31 | Chemung | Van Etten | N.Y.S.N.G.C. | English #1 (N-60) | Waverly C | 508 |
| 32 | Chemung | Erin | Nat. Exp. & Dev. | Wheaton #1 | Waverly A | 2314 |
| 33 | Chemung | Erin | B.Q.D.C. | Treat #1 (118) | Waverly A | 509 |
| 34 | Chemung | South Port | Hanley & Bird | May #1 | Elmira H | 3974 |
| 35 | Chemung | South Port | Rio Oil, Inc. | Richards #1 | Elmira G | 4923 |
| 36 | Chemung | Big Flats | Elmira Nat. Gas | Berthod #1 | Elmira E | 476 |
| 37 | Chemung | Elmira | Updegraff | Barcus #1 | Elmira F | 610 |
| 38 | Chemung | Veteran | Felmont-S. Penn | Coleman #1 | Elmira C | 4087 |

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE | GS NO. |
|---|---|---|---|---|---|---|
| 39 | Chemung | Veteran | Dearth et al. | Turner #1 | Elmira C | 599 |
| 40 | Chemung | Veteran | Rio Oil | Boor #1 | Watkins I | 4863 |
| 41 | Chemung | Catlin | Peterman, et al. | Willis #1 | Elmira B | 600 |
| 42 | Chemung | Catlin | Trans-Eastern | De Munn #1 | Watkins G | 3933 |
| 43 | Chemung | Catlin | Felmont Oil | Callahan #1 | Watkins G | 4026 |
| 44 | Schuyler | Montour | Dearth et al. | Hines #1 | Watkins I | 533 |
| 45 | Schuyler | Orange | Donovan et al. | N.Y.S. Lands #2 | Hammondsport I | 3254 |
| 46 | Schuyler | Orange | Tri-State Gas | Webb #1 | Watkins D | 534 |
| 47 | Schuyler | Hector | Felmont Oil | Morris #1 | Ithaca D | 4187 |
| 48 | Schuyler | Hector | Burdett O. & G. | Kellog #1 | Watkins F | 532 |
| 49 | Schulyer | Reading | Int. Salt Co. | Int. Salt Co. #29 | Watkins B | 3940 |
| 50 | Schuyler | Tyrone | Home Gas Co. | Malloy (H-110) | Hammondsport C | .... |
| 51 | Schuyler | Tyrone | Home Gas Co. | Vaugh (H-121) | Hammondsport C | .... |
| 52 | Schuyler | Tyrone | Home Gas Co. | Gasper (H-155) | Hammondsport B | .... |
| 53 | Yates | Barrington | Home Gas Co. | Bassett (H-165) | Hammondsport C | .... |
| 54 | Yates | Barrington | Home Gas Co. | Alszenski (H-169) | Hammondsport B | .... |
| 55 | Yates | Barrington | Pentaga O. & G. | Stoutenberg #1 | Penn Yan I | 425 |
| 56 | Yates | Benton | C.G.S. Mgmnt. | Borglum #1 | Penn Yan C | 4796 |
| 57 | Yates | Benton | C.G.S. Mgmnt. | Jepson #1 | Penn Yan C | 4795 |
| 58 | Yates | Benton | C.G.S. Mgmnt. | Lorec #1-X (2) | Penn Yan C | 4797 |
| 59 | Ontario | Seneca | Williams, et al. | Fordon #1 | Phelps F | 4160 |
| 60 | Ontario | Hopewell | N.Y.S.N.G.C. | Bill (N-910) | Phelps D | 4449 |
| 61 | Ontario | Canandaigua | Duchscherer et al. | Pierce #1 | Canandaigua E | 4947 |
| 62 | Ontario | Bristol | Franchot | P. Gladding #1 | Canandaigua G | 4035 |
| 63 | Ontario | Bristol | Franchot | Mills #1 | Canandaigua G | 4027 |
| 64 | Ontario | Bristol | W. C. Hurtt | Rolsin #1 | Canandaigua G | 3918 |
| 65 | Ontario | South Bristol | G. Drury | Hale #1 | Naples A | 3866 |
| 66 | Steuben | Dansville | Estrn. States Gas | Magin #1 | Hornell B | 57 |
| 67 | Steuben | Hornellsville | Appalachian Gas | Falzarano #1 | Hornell G | 42 |
| 68 | Steuben | Hornellsville | Minter et al. | Doster #1 | Hornell E | 4433 |
| 69 | Steuben | Howard | Penn-York Gas | Freeborn #1 | Hornell F | 138 |
| 70 | Steuben | Bath | Anchor Pet. | Blair #1 | Bath I | 2679 |
| 71 | Steuben | Pulteney | Great Lakes Gas | Smolos #1 | Hammondsport A | 5063 |
| 72 | Steuben | Wayne | Home Gas Co. | Jurczak (H-172) | Hammondsport B | .... |
| 73 | Steuben | Urbana | Jackles et al. | Wood #1 | Hammondsport D | 326 |
| 74 | Steuben | Bath | Devonian Const. | Whitcomb #1 | Hammondsport G | 1137 |
| 75 | Steuben | Bradford | N.Y.S.N.G.C. | Cathley #1 (N-115) | Hammondsport H | 73 |
| 76 | Steuben | Hornby | Felmont Oil et al. | N.Y.S. et al #1 | Hammondsport I | 3246 |
| 77 | Steuben | Hornby | L. Leiderbach | Stevens #1 | Elmira A | 3932 |
| 78 | Steuben | Hornby | Cavalier G. & O. | Roloson #1 | Corning C | 2965 |
| 79 | Steuben | Campbell | Harding et al. | Scudder #1 | Corning A | 4573 |
| 80 | Steuben | Campbell | Peterman, et al. | Pooley #1 | Corning A | 64 |
| 81 | Steuben | Erwin | Cabot | Collins #1 | Corning A | 109 |
| 82 | Steuben | Erwin | Empire-Keystone | Lilly #1 | Corning E | 111 |
| 83 | Steuben | Erwin | Joyce Pipeline | Dann #1 | Corning E | 4575 |
| 84 | Steuben | Erwin | N.Y.S.N.G.C. | Papa #1 | Corning E | 645 |
| 85 | Steuben | Corning | N.Y.S.N.G.C. | Cole #1 | Corning F | 391 |
| 86 | Steuben | Corning | N.Y.S.N.G.C. | Thrall #1 | Corning C | 3250 |
| 87 | Steuben | Cameron | B.Q.D.C. | Taft #1 | Woodhull D | 660 |
| 88 | Steuben | Woodhull | N.Y.S.N.G.C. | Herrington #1 | Woodhull H | 216 |
| 89 | Steuben | Woodhull | N.Y.S.N.G.C. | Olin #1 | Woodhull G | 3924 |
| 90 | Steuben | Woodhull | N.Y.S.N.G.C. | F. Hargrave #1 | Woodhull G | 3894 |
| 91 | Steuben | Jasper | N.Y.S.N.G.C. | House #1 | Woodhull D | 48 |
| 92 | Steuben | Jasper | Wittmer Co. | Broughton #1 | Greenwood C | 148 |
| 93 | Steuben | Canisteo | Acme Drlg. et al. | Allen #1 | Greenwood C | 1807 |
| 94 | Steuben | Canisteo | Freeman et al. | Porter #1 | Greenwood C | 61 |

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE | GS NO. |
|---|---|---|---|---|---|---|
| 95 | Steuben | Hartsville | Felmont Oil et al. | Belmont Quad. #1 | Greenwood A | 3864 |
| 96 | Steuben | Greenwood | Appalachian Dev. | Warriner #1 | Greenwood A | 434 |
| 97 | Steuben | Greenwood | Cabot | Webber H-229 | Greenwood D | 33 |
| 98 | Steuben | Greenwood | Home Gas Co. | McCaffrey H-212 | Greenwood D | 123 |
| 99 | Steuben | Greenwood | Empire G. & F. | Rogers #1 | Greenwood D | 53 |
| 100 | Steuben | West Union | Sylvania Nat. Gas. | McKeon #1 | Greenwood H | 413 |
| 101 | Steuben | West Union | Appalachian Dev. | Stebbins #2 | Greenwood G | 1809 |
| 102 | Steuben | Troupsburg | Allegany Prod. | White #1 | Greenwood E | 3897 |
| 103 | Allegany | Independence | Empire G. & F. | Crandall #1 | Wellsville F | 20 |
| 104 | Allegany | Independence | Empire G. & F. | Bassett #2 | Wellsville I | 256 |
| 105 | Allegany | Independence | Empire G. & F. | Graves #1 | Wellsville H | 44 |
| 106 | Allegany | Willing | Empire G. & F. | Wilson #1 | Wellsville H | 9 |
| 107 | Allegany | Willing | B.Q.D.C. | Hilligass #108 | Wellsville H | 5 |
| 108 | Allegany | Willing | Sinclair Ref. | Ryan #1 | Wellsville G | 390 |
| 109 | Allegany | Willing | Empire G. & F. | Costello #1 | Wellsville G | 387 |
| 110 | Allegany | Alma | Empire G. & F. | Dean Est. #1 | Wellsville G | 389 |
| 111 | Allegany | Andover | Empire G. & F. | Clark Est. #1 | Wellsville F | 55 |
| 112 | Allegany | Ward | Pennzoil | Angell #1 | Wellsville B | 4777 |
| 113 | Allegany | Bolivar | Flanigan Bros. | Homestead #1 | Belmont H | 4865 |
| 114 | Allegany | Bolivar | Flanigan Bros. | Beers #1 | Belmont H | 4833 |
| 115 | Allegany | Bolivar | Allegany Gas | Gadsby #1 | Belmont H | 235 |
| 116 | Allegany | Wirt | Bradley Prod. | Shaner #1 | Belmont D | 4849 |
| 117 | Allegany | Wirt | Bradley Prod. | Ames #1 | Belmont D | 4654 |
| 118 | Allegany | Wirt | B.Q.D.C. | Chadwick #1 | Belmont D | 246 |
| 119 | Allegany | Wirt | B.Q.D.C. | Gilbert #KW57 | Belmont E | 247 |
| 120 | Allegany | Scio | Bradley Prod. | Black Est. #1 | Wellsville A | 5060 |
| 121 | Allegany | Cuba | Swan Bell Oil | Smith #1 | Olean C | 3856 |
| 122 | Allegany | New Hudson | Parsons Bros. | Botens-Swift #1 | Franklinville I | 3986 |
| 123 | Allegany | New Hudson | Bentley-Gregg | Eberl #1 | Franklinville I | 4168 |
| 124 | Allegany | New Hudson | Felmont Oil | Clark | Angelica D | 4025 |
| 125 | Allegany | Belfast | Bentley et al. | Hillabush #1 | Angelica H | 3995 |
| 126 | Allegany | Angelica | Delwood O. & G. | Herdman #1 | Angelica I | 3264 |
| 127 | Allegany | Caneadea | Parsons Bros. | Chase #1 | Angelica A | 850 |
| 128 | Allegany | Allen | Parsons Bros. | Atherton Est. #1 | Angelica F | 3952 |
| 129 | Allegany | Hume | N.Y.S.N.G.C. | Wolfer #1 | Angelica B | 4248 |
| 130 | Allegany | Alfred | Joyce Pipeline | Burdick #1 | Canaseraga I | 4463 |
| 131 | Allegany | Angelica | Great Lakes Gas | Lytle #1 | Canaseraga G | 4925 |
| 132 | Allegany | Angelica | Donahue | Duffy #1 | Canaseraga G | 2312 |
| 133 | Allegany | Angelica | N.Y.S.N.G.C. | Fleming #1 | Canaseraga D | 3922 |
| 134 | Allegany | Almond | Great Lakes Gas | Shay #1 | Canaseraga F | 4388 |
| 135 | Allegany | Hume | Parsons Bros | Cook #2 | Angelica A | 3956 |
| 136 | Allegany | Centerville | Buters Oil | McElroy #1 | Portage G | 2967 |
| 137 | Livingston | Sparta | Blair, et al. | Kennedy #1 | Nunda F | 4630 |
| 138 | Livingston | Leicester | N.Y.S.N.G.C. | Yunkers #1 | Caledonia G | 4089 |
| 139 | Livingston | Leicester | Partee | Christiano #1 | Caledonia H | 4217 |
| 140 | Livingston | Geneseo | N.Y.S.N.G.C. | Austin #1 | Caledonia I | 4188 |
| 141 | Livingston | Geneseo | N.Y.S.N.G.C. | Wadsworth #2 | Caledonia F | 4213 |
| 142 | Livingston | York | Retsof Mining | Fuller Shaft | Caledonia H | .... |
| 143 | Livingston | York | N.Y.S.N.G.C. | McClurg #1 | Caledonia D | 4552 |
| 144 | Livingston | York | N.Y.S.N.G.C. | MacDonald #1 (N-795) | Caledonia D | 4069 |
| 145 | Livingston | York | N.Y.S.N.G.C. | Walton #1 (N-860) | Caledonia D | 4218 |
| 146 | Livingston | Livonia | Livonia Salt | Livonia Shaft | Honeoye G | 3277 |
| 147 | Livingston | Conesus | Livingston O. & G. | Martuccio #1 | Wayland B | 3942 |
| 148 | Wyoming | Gainesville | Great Lakes Gas | Johns #1 | Portage E | 4385 |
| 149 | Wyoming | Gainesville | N.Y.S.N.G.C. | Veith #1 | Portage F | 4092 |

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE | GS NO. |
|---|---|---|---|---|---|---|
| 150 | Wyoming | Gainesville | Morton Salt | Fee #17 | Portage B | 4162 |
| 151 | Wyoming | Gainesville | Flint O. & G. | Cummings #1 | Portage B | 940 |
| 152 | Wyoming | Bennington | Great Lakes Gas | Schuelte #1 | Attica F | 4432 |
| 153 | Wyoming | Middlebury | Trans American | Warren #1 | Batavia H | 4447 |
| 154 | Wyoming | Middlebury | Trans American | Page #1 | Batavia H | 4536 |
| 155 | Wyoming | Middlebury | Trans American | Cox #1 | Batavia E | 4464 |
| 156 | Wyoming | Perry | N.Y.S.N.G.C. | Cornwell #1 | Caledonia G | 4008 |
| 157 | Wyoming | Covington | N.Y.S.N.G.C. | Wallace #1 | Caledonia G | 4132 |
| 158 | Wyoming | Genesee Falls | Farmers Oil | Lockwood #1 | Portage I | 3865 |
| 159 | Wyoming | Castile | Morton Salt | Fee #14 | Portage F | 3880 |
| 160 | Erie | Concord | Iroquois Gas | Iroquois Gas #796 | Eden F | 3296 |
| 161 | Erie | Collins | Iroquois Gas | Marsh #1143 | Eden H | 4406 |
| 162 | Erie | Evans | Iroquois Gas | Iroquois Gas #807 | Silver Creek C | 4101 |
| 163 | Cattaraugus | New Albion | Humble Oil | Heron #1 | Cattaraugus G | 4153 |
| 164 | Cattaraugus | Ischua | Bentley et al. | Laubacker #1 | Olean B | 3895 |
| 165 | Cattaraugus | Ischua | Sunburst O. & G. | Pettingill #1 | Olean B | 3920 |
| 166 | Cattaraugus | Ischua | Penn Drlg. | Doner #1 | Olean A | 3909 |
| 167 | Cattaraugus | Humphrey | Bozard Hill O. & G. | Smith-Tucker #1 | Olean A | 2963 |
| 168 | Cattaraugus | Hinsdale | Felmont Oil | Brown #1 | Olean B | 3898 |
| 169 | Cattaraugus | Hinsdale | Thropp O. & G. | Crosby #1 | Olean B | 4574 |
| 170 | Cattaraugus | Hinsdale | Mathews et al. | Kent #1 | Olean D | 4631 |
| 171 | Cattaraugus | Hinsdale | Thropp O. & G. | Dutton #1 | Olean D | 4694 |
| 172 | Cattaraugus | Olean | Comaco Oils | Messer #1 | Olean G | 4820 |
| 173 | Cattaraugus | Olean | Parsons Bros. | Torrey #1 | Olean H | 3987 |
| 174 | Cattaraugus | Olean | Comaco Oils | Lockwood #1 | Olean D | 5029 |
| 175 | Cattaraugus | Allegany | Felmont Oil | Smith #1 | Olean D | 4832 |
| 176 | Cattaraugus | Allegany | J. Flanigan | (F183) Russell #1 | Olean D | 5013 |
| 177 | Cattaraugus | Allegany | Flanigan et al. | Potter #1 | Salamanca F | 4373 |
| 178 | Cattaraugus | Allegany | Flanigan et al. | Andrews #1 | Salamanca F | 3307 |
| 179 | Cattaraugus | Allegany | Flanigan Bros. | Wolf #1 | Salamanca F | 4731 |
| 180 | Cattaraugus | Allegany | Kinley Oil | Fee #72 | Salamanca I | 4169 |
| 181 | Cattaraugus | Allegany | Parsons Bros. | Kinley #1 | Salamanca I | 3992 |
| 182 | Cattaraugus | Great Valley | N.Y.S.N.G.C. | NYS Cons. Dept. #1 | Salamanca E | 4675 |
| 183 | Cattaraugus | Carrollton | Felmont Oil | Seneca Nation #2 | Salamanca E | 3857 |
| 184 | Cattaraugus | Carrollton | Heiser et al. | De Wolfe et al Matson #102 | Salamanca G | 3870 |
| 185 | Cattaraugus | Carrollton | Pennzoil | Potter #1 | Salamanca H | 4554 |
| 186 | Cattaraugus | Carrollton | Benedum | Lockwood #6 | Salamanca G | 4081 |
| 187 | Cattaraugus | Red House | Felmont Oil | Wixon #1 | Salamanca G | 4951 |
| 188 | Cattaraugus | Red House | Blue Rock Drlg. | Keery #1 | Salamanca G | 2626 |
| 189 | Cattaraugus | Red House | Flanigan et al. | Goodrich #1 | Salamanca G | 3314 |
| 190 | Cattaraugus | Red House | Felmont Oil | Veach #1 | Randolph I | 3308 |
| 191 | Cattaraugus | Elko | Felmont Oil | Seneca Nations #3 | Randolph H | 3883 |
| 192 | Cattaraugus | South Valley | Devonian O. & G. | Hotchkiss #1 | Randolph G | 4088 |
| 193 | Cattaraugus | Randolph | Nat. Gas Drlrs. | See #1 | Randolph D | 4238 |
| 194 | Cattaraugus | Conewango | Dusenberry et al | Lunn, et al. #1 | Randolph A | 2673 |
| 195 | Cattaraugus | Olean | Mathews et al | Marsh #1 | Olean D | 4529 |
| 196 | Chautauqua | Poland | Hart el al | Barmore #1 | Jamestown F | 2955 |
| 197 | Chautauqua | Gerry | Flanigan et al | Gage #1 | Jamestown A | 2964 |
| 198 | Chautauqua | Ellery | Minard Run | Harrington #1 | Chautauqua B | 4561 |
| 199 | Chautauqua | Ellery | Wolf's Head Oil | Morse #3 | Chautauqua B | 4437 |
| 200 | Chautauqua | Harmony | Univ. Delta Drlg. | Donelson #1 | Chautauqua H | 3249 |
| 201 | Chautauqua | Busti | Pettigrew | | Chautauqua I | 51 |

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE | GS NO. |
|---|---|---|---|---|---|---|
| 202 | Chautauqua | Mina | Pennsylvania Gas | Neckers #1 | Clymer D | 3887 |
| 203 | Chautauqua | Mina | Apache-Texaco | Carnahan #1 | Clymer D | 4152 |
| 204 | Chautauqua | Mina | Appalachian Gas | E. Stetson | North East F | 878 |
| 205 | Chautauqua | Mina | Texaco | H. Stetson #1 | Clymer D | 4347 |
| 206 | Chautauqua | Westfield | Lapag Corp. | Kiester #1 | Westfield F | 2672 |
| 207 | Chautauqua | Chautauqua | R. K. Petroleum | Tucker #1 | Westfield I | 4190 |
| 208 | Chautauqua | Chautauqua | R. K. Petroleum | Breads #1 | Dunkirk G | 4161 |
| 209 | Chautauqua | Cherry Creek | Humble Oil | Shadle #1 | Cherry Creek E | 4154 |

*PENNSYLVANIA:*

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE |
|---|---|---|---|---|---|
| 1 | Bradford | Wilmot | Pure Oil Co. | Blemle #1 | Monroeton I |
| 1A | Bradford | Wysox | Fenix & Scisson | Strickland #1 | Towanda H |
| 2 | Bradford | Columbia | J. H. Duff | Olsen #1 | Troy E |
| 3 | Tioga | Jackson | Hanley & Bird | Allen #1 | Troy A |
| 4 | Tioga | Brookfield | N.Y.S.N.G.C. | Simmons N-62 | Gaines C |
| 5 | Potter | Harrison | N.Y.S.N.G.C. | N-2225 | Gaines B |
| 6 | Potter | Harrison | New Penn. Dev. Co. | Berry #1 | Gaines B |
| 7 | Potter | Harrison | Lycoming Nat. Gas | Schofield #1 | Gaines A |
| 8 | Potter | Bingham | Updegraff et al. | Patterson #1 | Genesee C |
| 9 | Potter | Bingham | Cabot, Inc. | Johnson #1 | Genesee B |
| 10 | Potter | Allegany | Hammondsport Gas | Gale #1 | Genesee E |
| 11 | Potter | Allegany | Slocum | Wells #1 | Genesee D |
| 12 | Potter | Sharon | N.Y.S.N.G.C. | Dickerson #1 | Coudersport B |
| 13 | Potter | Allegany | G. L. Cabot | Lewis #1 | Genesee E |
| 14 | Potter | Ulysses | N.Y.S.N.G.C. | Wallis #1 | Genesee F |
| 15 | Potter | Abbott | Felmont Oil | Tract 88 #1 | Galeton D |
| 16 | Potter | Abbott | Phillips Pet. Co. | Tract 82 #1 | Galeton H |
| 17 | Potter | Stewardson | Phillips Pet. Co. | Tract 81 #2 | Galeton G |
| 18 | Potter | Stewardson | Phillips Pet. Co. | Tract 81 #1 | Galeton G |
| 19 | Potter | Stewardson | N.Y.S.N.G.C. | Tract 68 #2 | Galeton H |
| 20 | Potter | Stewardson | N.Y.S.N.G.C. | Tract 45 #5 | Renovo East A |
| 21 | Potter | Stewardson | Cons. Gas Supply Co. | Dpt. F & W N-972 | Renovo West C |
| 22 | Potter | Abbott | Allegany et al. | St. Land 4689 | Conrad F |
| 23 | Potter | Wharton | Cabot, Inc. | St. of Pa. #11 | Driftwood C |
| 24 | Potter | Sylvania | Felmont Oil Co. | N. Penn Gas #1 | Emporium F |
| 25 | McKean | Liberty | Allegany Gas | Nunn #2 | Smethport E |
| 26 | McKean | Lafayette | S. Penn Oil Co. | Wilson #18 | Bradford G |
| 27 | McKean | Bradford | Kendall Ref. Co. | Freeman #1 | Bradford E |
| 28 | McKean | Bradford | Healy Petr. | West Branch #4 | Kinzua F |
| 29 | McKean | Foster | Thunder Rock Prod. | Mallory et al. #1 | Bradford A |
| 30 | McKean | Corydon | Anchor Gas Co. | Corydon Prospect #1 | Kinzua B |
| 31 | Warren | Elk | Felmont Oil Corp. | Collins Co. #1 (F-180) | Kinzua A |
| 32 | Warren | Glade | Mallory et al. | Lindblom #1 | Warren F |
| 33 | Warren | Kinzua | French et al. | S.P. Oil Co. (Lot 74) | Warren I |
| 34 | Warren | Limestone | Biery & Johnson | Shaw #1 | Tidioute E |
| 35 | Warren | Triumph | Pa. Oil & Gas Mgmt. | J. Bowman Proper #1 | Tidioute D |
| 36 | Warren | Limestone | P. Benedium | Wheeler-Dusenberry #1 | Tidioute B |
| 37 | Warren | Limestone | Biery & Johnson | Kapp #1 | Tidioute B |
| 38 | Warren | Broken Straw | Pennsylvania Gas | Keester #1 | Youngsville F |
| 39 | Warren | Farmington | Transamerican | Marsh-Childs #1 | Warren A |

| NO. | COUNTY | TOWNSHIP | OPERATOR | LEASE | QUADRANGLE |
|---|---|---|---|---|---|
| 40 | Warren | Sugar Grove | Pettigrew et al. | Anderson #1 | Youngsville C |
| 41 | Warren | Eldred | Mid East Oil Co. | Smith #1 | Corry I |
| 42 | Warren | Southwest | Northern Ordinance | Reeves #1 | Titusville C |
| 43 | Elk | Benezette | Arrowhead G. & O. Co. | Ahlborn Coal Co. #1 | Benezette H |
| 44 | Cameron | Shippen | N.Y.S.N.G.C. | Pardee #4 (N-820) | Benezette C |
| 45 | Cameron | Lumber | Felmont | Pa. Tract #103 | Emporium H |
| 46 | Cameron | Gibson | Fairman | N. Beth R & G Club #1 | Driftwood D |
| 47 | Cameron | Grone | Dougherty et al. | Logue #1 | Driftwood C |
| 48 | Cameron | Shippen | N.Y.S.N.G.C. | N-813 | Benezette C |
| 49 | Cameron | Shippen | Sylvania Corp. | Hercules Powder #1 | Colegrave I |
| 50 | Lycoming | Pine | The California Co. | Schneider #1 | Morris I |
| 51 | Clinton | Leidy | Cabot, Inc. | Foley #1 | Renova West B |
| 52 | Clinton | Gallager | Manufatrs. L. & H. | Chatham Wts. Wks. #1 | Waterville G |
| 53 | Sullivan | Davidson | The California Co. | Bennett #1 | Eagles Mere F |

# Appendix B

## Subsurface Data

Log Type:
G—Gamma Ray
S—Sample

*NEW YORK:*

| No. | Log Type | Elev. | Depth to Tully Ls. | Depth to Hamilton Gp. |
|---|---|---|---|---|
| 1 | G | 1835 | | |
| 2 | G | 1740 | NI | NI |
| 3 | G | 1658 | | |
| 4 | S | 1457 | | 1245(?) |
| 5 | S | 1990 | | 1625(?) |
| 6 | G | 1485 | | |
| 7 | S | 1979 | | 1070(?) |
| 8 | GS | 1607 | | 70 |
| 9 | G | 1851 | | |
| 10 | GS | 1530 | | 130 |
| 11 | S | 1506 | | |
| 12 | S | 1544 | | |
| 13 | S | 1640 | | |
| 14 | S | 1365 | 1294 | 1320 |
| 15 | S | 965 | 2006 | 2038 |
| 16 | S | 1200 | 1030 | 1085 |
| 17 | S | 1509 | 647 | 667 |
| 18 | S | 1481 | 795 | 819 |
| 19 | G | 590 | 99 | 118 |
| 20 | GS | 855 | 364 | 384 |
| 21 | GS | 1454 | 1292 | 1352 |
| 22 | GS | 1048 | 980 | 1040 |
| 23 | GS | 1292 | 1055 | 1118 |
| 24 | GS | 1328 | 1030 | 1095 |
| 25 | S | 1448 | 1563 | 1604 |
| 26 | S | 980 | 2230 | 2330 |
| 27 | G | 1441 | 2020 | 2100 |
| 28 | G | 1490 | 2037 | 2123 |
| 29 | S | 1275 | 1938 | 2034 |
| 30 | GS | 1077 | 1620 | 1715 |
| 31 | S | 1284 | 1835 | 1920 |
| 32 | S | 1670 | 2402 | 2495 |
| 33 | S | 1663 | 2125 | 2205 |
| 34 | G | 1570 | 3110 | 3195 |
| 35 | G | 1240 | 2950 | 3040 |
| 36 | S | 911 | 2150 | NS |
| 37 | S | 849 | 1434 | 1525 |
| 38 | GS | 1115 | 1565 | 1625 |
| 39 | S | 1083 | 1530 | 1612 |
| 40 | G | 1526 | 3245 | 3300 |
| 41 | S | 1227 | 1995 | 2055 |
| 42 | S | 1501 | 1963 | 2025 |
| 43 | S | 1637 | 1990 | 2045 |
| 44 | S | 1040 | 956 | 993 |
| 45 | S | 1923 | 2342 | 2390 |
| 46 | S | 1679 | 1660 | 1677 |
| 47 | S | 1571 | 1543 | 1573 |
| 48 | S | 1870 | 1852 | 1883 |
| 49 | G | 605 | 415 | 445 |
| 50 | G | 1420 | 975 | 998 |
| 51 | G | 1400 | 880 | 904 |
| 52 | G | 1190 | 823 | 843 |
| 53 | G | 1450 | 1077 | 1100 |
| 54 | G | 1325 | 947 | 965 |
| 55 | S | 1081 | 496 | 502 |
| 56 | G | 961 | 324 | 339 |
| 57 | G | 884 | 256 | 274 |
| 58 | G | 828 | 95 | 105 |
| 59 | G | 768 | | |
| 60 | G | 905 | | |
| 61 | G | 1050 | | 100 |
| 62 | GS | 1477 | | 685 |
| 63 | G | 1529 | | 754 |
| 64 | G | 1132 | | |
| 65 | S | 1375 | | 1255 |
| 66 | S | 2071 | 2713 | 2743 |
| 67 | S | 1376 | 2626 | 2667 |
| 68 | S | 1639 | 2699 | 2745 |
| 69 | S | 1865 | 2964 | 2998 |
| 70 | S | 1073 | 1815 | 1855 |
| 71 | GS | 1417 | 1420 | 1440 |
| 72 | G | 1205 | 810 | 827 |
| 73 | S | 738 | 1131 | 1166 |
| 74 | S | 1633 | 2298 | 2336 |
| 75 | S | 1689 | 2307 | 2347 |
| 76 | S | 1798 | 2326 | 2377 |
| 77 | S | 1271 | 2145 | 2200 |
| 78 | S | 1741 | 2646 | 2686 |
| 79 | GS | 1438 | 2460 | 2502 |
| 80 | S | 1046 | 2018 | 2055 |
| 81 | S | 1718 | 2912 | 2968 |
| 82 | S | 1624 | 2867 | 2905 |

NS—No Sample
NI—Not Identified

| No. | Log Type | Elev. | Depth to Tully Ls. | Depth to Hamilton Gp. |
|---|---|---|---|---|
| 83 | S | 1115 | 2437 | 2486 |
| 84 | S | 1674 | 3016 | 3063 |
| 85 | S | 1553 | 2854 | 2910 |
| 86 | S | 1027 | 1995 | 2048 |
| 87 | S | 1807 | 3429 | 3478 |
| 88 | S | 1546 | 3147 | 3190 |
| 89 | S | 1642 | 3270 | 3324 |
| 90 | GS | 1718 | 3188 | 3233 |
| 91 | S | 1722 | 3740 | 3788 |
| 92 | S | 1545 | 3270 | 3318 |
| 93 | S | 2125 | 3594 | 3645 |
| 94 | S | 1889 | 3431 | 3492 |
| 95 | S | 2344 | 4072 | 4127 |
| 96 | S | 2069 | 3855 | 3901 |
| 97 | G | 1804 | 3576 | 3620 |
| 98 | G | 2072 | 3900 | 3947 |
| 99 | S | 2190 | 4124 | 4172 |
| 100 | S | 2083 | 4132 | 4185 |
| 101 | S | 2263 | 4578 | 4630 |
| 102 | S | 2269 | 4202 | 4247 |
| 103 | S | 2280 | 4247 | 4305 |
| 104 | S | 2188 | 4272 | 4320 |
| 105 | S | 2183 | 4260 | 4305 |
| 106 | S | 2221 | 4253 | 4310 |
| 107 | S | 2146 | 4190 | 4240 |
| 108 | S | 2074 | 4215 | 4275 |
| 109 | S | 2008 | 4145 | 4190 |
| 110 | S | 1960 | 4000 | 4045 |
| 111 | S | 2135 | 4208 | 4272 |
| 112 | G | 1875 | 3173 | 3220 |
| 113 | G | 2185 | 4320 | 4378 |
| 114* | GS | 1987 | 4103 | 4200 |
| 115 | S | 2109 | 4357 | 4400 |
| 116 | G | 2038 | 3942 | 3980 |
| 117 | G | 2228 | 4110 | 4150 |
| 118 | S | 1860 | 3848 | 3884 |
| 119 | G | 2072 | NI | NI |
| 120 | G | 1983 | 3683 | 3737 |
| 121 | S | 1817 | 3407 | 3435 |
| 122 | S | 2077 | 3172 | 3217 |
| 123 | S | 2009 | 3261 | 3293 |
| 124 | S | 1676 | 2730 | 2760 |
| 125 | S | 1593 | 2871 | 2909 |
| 126 | S | 1952 | 3255 | 3296 |
| 127 | S | 1501 | 2080 | 2131 |
| 128 | S | 1877 | 2545 | 2625 |
| 129 | GS | 1560 | 2033 | 2075 |
| 130 | GS | 1753 | 3172 | 3220 |
| 131 | GS | 1610 | 2860 | 2915 |
| 132 | GS | 1504 | 2798 | 2842 |
| 133 | S | 2138 | 3397 | 3450 |
| 134 | S | 1880 | 2702 | 2737 |
| 135 | G | 1680 | 2220 | 2265 |
| 136 | S | 1964 | 2436 | 2477 |
| 137 | GS | 584 | | 380 |
| 138 | G | 951 | | 208 |
| 139 | S | 576 | | |
| 140 | G | 1146 | | 500 |
| 141 | G | 563 | | |
| 142 | S | 737 | | |
| 143 | S | 983 | | 96 |
| 144 | GS | 881 | | |
| 145 | G | 893 | | |
| 146 | S | 1082 | | 280 |
| 147 | G | 1630 | | 1300 |
| 148 | S | 1768 | | 1590 |
| 149 | GS | 1561 | | 1525 |
| 150 | S | 1472 | | 1243 |
| 151 | S | 1400 | | 1080 |
| 152 | S | 1442 | | 630 |
| 153 | G | 1556 | | 775 |
| 154 | G | 1501 | | 648 |
| 155 | G | 1163 | | 285 |
| 156 | G | 1080 | | 368 |
| 157 | G | 1051 | | 320 |
| 158 | S | 1592 | 1685 | 1722 |
| 159 | G | 1329 | | 1133 |
| 160 | S | 1560 | | 1458 |
| 161 | G | 1090 | | |
| 162 | S | 600 | | 100 |
| 163 | GS | 1824 | | 2623 |
| 164 | S | 1970 | 3287 | 3318 |
| 165 | S | 1746 | 3055 | 3077 |
| 166 | S | 2153 | 3486 | 3523 |
| 167 | S | 1899 | 3222 | 3233 |
| 168 | S | 2007 | 3545 | 3580 |
| 169 | GS | 1822 | 3313 | 3335 |
| 170 | G | 1950 | 3415 | 3430 |
| 171 | G | 1850 | 3410 | 3420 |
| 172 | G | 2158 | 4260 | 4267 |
| 173 | S | 1492 | 3385 | 3409 |
| 174 | G | 1850 | 3487 | 3496 |
| 175 | G | 1832 | 3396 | 3406 |
| 176 | G | 1630 | 3232 | 3240 |
| 177 | S | 1866 | 3470 | 3475 |
| 178 | S | 1754 | | 3300(?) |
| 179 | G | 1441 | | 3068 |
| 180 | S | 2385 | 4442 | 4453 |
| 181 | G | 2381 | | 4417 |
| 182 | S | 2175 | | 3790(?) |
| 183 | S | 1630 | | 3260 |
| 184 | S | 2266 | | 3950 |
| 185 | GS | 1861 | | 3600 |
| 186 | G | 2280 | | 4160 |
| 187 | G | 2195 | | 3793 |
| 188 | G | 1799 | | 3563 |
| 189 | GS | 1982 | | 3787 |
| 190 | S | 2075 | | 3650 |
| 191 | S | 2003 | | 3812 |
| 192 | S | 1300 | | 2920 |
| 193 | S | 1802 | | 2932 |
| 194 | S | 1787 | | 2680 |
| 195 | S | 1750 | 3392 | 3403 |
| 196 | S | 1359 | | 2624 |
| 197 | S | 1772 | | 2480(?) |
| 198 | GS | 1524 | | 2185 |

* Fault Well-Fault at 4140'

| No. | Log Type | Elev. | Depth to Tully Ls. | Depth to Hamilton Gp. |
|---|---|---|---|---|
| 199 | GS | 1760 | | 2340 |
| 200 | S | 1579 | | NS |
| 201 | S | 1521 | | 2928 |
| 202 | S | 1572 | | 2352 |
| 203 | GS | 1486 | | 2120 |
| 204 | S | 1452 | | 2073 |
| 205 | S | 1495 | | 2148 |
| 206 | S | 675 | | 875 |
| 207 | G | 1410 | | 1875 |
| 208 | S | 1350 | | 1849 |
| 209 | GS | 1606 | | 2005 |
| *PENNSYLVANIA:* | | | | |
| 1 | G | 1561 | 5895 | 5970 |
| 1A | G | 705 | 3450 | 3670 |
| 2 | S | 1856 | 4376 | 4463 |
| 3 | G | 1480 | 3173 | 3254 |
| 4 | S | 2145 | 4352 | 4400 |
| 5 | G | 2159 | 4376 | 4425 |
| 6 | G | 2225 | 4442 | 4489 |
| 7 | S | 1923 | 4052 | 4097 |
| 8 | G | 1783 | 4254 | 4296 |
| 9 | G | 2106 | 4587 | 4632 |
| 10 | S | 2220 | 4794 | 4833 |
| 11 | S | 2088 | 4562 | 4608 |
| 12 | G | 2127 | 4387 | 4440 |
| 13 | S | 2318 | 4383 | 4436 |
| 14 | G | 2401 | 4485 | 4532 |
| 15 | G | 2255 | 6406 | 6484 |
| 16 | G | 2213 | 6155 | 6240 |
| 17* | G | 1969 | 5564 | 5640 |
| 18 | S | 2166 | 5882 | 5973 |
| 19 | G | 1863 | 5762 | 5850 |
| 20 | G | 1851 | 4955 | 5045 |
| 21 | GS | 1847 | 5530 | 5640 |
| 22 | S | 1941 | 5475 | 5525 |
| 23 | G | 1920 | 5320 | 5395 |
| 24 | G | 1345 | 5490 | 5545 |
| 25 | S | 1488 | 3934 | 3954 |
| 26 | G | 1550 | | 4215 |
| 27 | G | 1529 | | 3715 |
| 28 | G | 2086 | | 4232 |
| 29 | G | 2342 | | 4220 |
| 30 | G | 2098 | | NA |
| 31 | G | 1689 | | 3518 |
| 32 | G | 2026 | | 4067 |
| 33 | G | 1882 | | 4243 |
| 34 | G | 1705 | | 4156 |
| 35 | G | 1624 | | 4077 |
| 36 | G | 1725 | | 4170 |
| 37 | G | 1583 | | NA |
| 38 | S | 1262 | | NI |
| 39 | G | 1633 | | 3304 |
| 40 | S | 1357 | | NI |
| 41 | S | 1745 | | 3595 |
| 42 | S | 1646 | | 3830 |
| 43 | G | 1090 | 5603 | 5713 |
| 44 | G | 1560 | 6133 | 6215 |
| 45 | S | 1762 | 6120 | 6169 |
| 46 | S | 967 | 5410 | 5499 |
| 47 | S | 1006 | 4695 | 4770 |
| 48 | S | 1592 | 6137 | 6215 |
| 49 | S | 1187 | 4491 | 4252 |
| 50 | G | 1745 | 5490 | 5595 |
| 51 | S | 1338 | 5670 | 5757 |
| 52 | S | 1681 | 7250 | 7372 |
| 53 | GS | 1478 | 6697 | 6763 |

* Fault Well
NA—Not Available

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Hugo Jamback, Director

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE EDUCATION DEPARTMENT

GEOLOGICAL SURVEY
James F. Davis, State Geologist

79° 78° 77° 76° 75°

43° 42° 41°

Lake Ontario

CANADA

Lake Erie

NIAGARA ORLEANS MONROE WAYNE OSWEGO HAMILTON FULTON HERKIMER ONEIDA MONTGOMERY MADISON ONONDAGA

Rochester Syracuse Buffalo

Type section

GENESEE ONTARIO CAYUGA SENECA SCHOHARIE OTSEGO

ERIE WYOMING LIVINGSTON YATES CORTLAND SCHUYLER TOMPKINS CHENANGO DELAWARE

Binghamton

Section 1 Jamestown

CHAUTAUQUA CATTARAUGUS ALLEGANY STEUBEN CHEMUNG TIOGA BROOME TOMPKINS ULSTER

NEW YORK PENNSYLVANIA

Section 2

CRAWFORD WARREN McKEAN POTTER TIOGA BRADFORD SUSQUEHANNA WAYNE SULLIVAN ORANGE

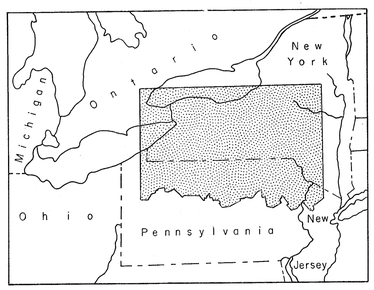
FOREST WYOMING PIKE N.Y. PA. N.J.

VENANGO ELK CAMERON LYCOMING LUZERNE LACKAWANNA

CLINTON SUSSEX MONROE

0 20 40 60 80 100 120

20 40 60 80 100 120




N

MILES
5 0 5 10 15 20
5 0 5 10 15 20 25 30
KILOMETERS

EXPLANATION

Outcrop of Tully Limestone
Outcrop of eastern terrigenous equivalents
Isopach – Interval 20 feet

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# PLATE I. ISOPACHOUS MAP OF TULLY LIMESTONE WITH LOCATION OF CROSS SECTIONS

by N. A. Wright

B.S.

NEW YORK STATE MUSEUM AND SCIENCE SERVICE

Hugo Jamnback, Director

THE UNIVERSITY OF THE STATE OF NEW YORK

THE STATE EDUCATION DEPARTMENT

GEOLOGICAL SURVEY

James F. Davis, State Geologist

78° 77° 76°

43°

42°

Buffalo

Syracuse

Binghamton

Type section

MONROE

GENESEE

WAYNE

ONTARIO

ONONDAGA

MADISON

CAYUGA

LIVINGSTON

ERIE

WYOMING

SENECA

YATES

CORTLAND

SCHUYLER

TOMPKINS

CHENANGO

CATTARAUGUS

ALLEGANY

STEUBEN

CHEMUNG

TIOGA

BROOME

SUSQUEHANNA

McKEAN

POTTER

BRADFORD

NEW YORK

PENNSYLVANIA

-250 0 250 500 750 1000 1250 1500 -500 -750 -1000 -1250 -1500 -1750 -2000 -2250 -2500 -2750 -3000 -3250 -3500

N

MILES

5 0 5 10 15 20

KILOMETERS

5 0 5 10 15 20 25 30

EXPLANATION

Outcrop of Tully Limestone

Outcrop of eastern terrigenous equivalents

Subsurface Margin of Tully Limestone

● 90 Control wells used in this study

• Other wells

Contour Interval 250 feet

Datum is Mean Sea Level

Michigan Ontario New York Ohio Pennsylvania New Jersey

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# PLATE II. STRUCTURE CONTOURS ON TOP OF TULLY LIMESTONE

by N. A. Wright

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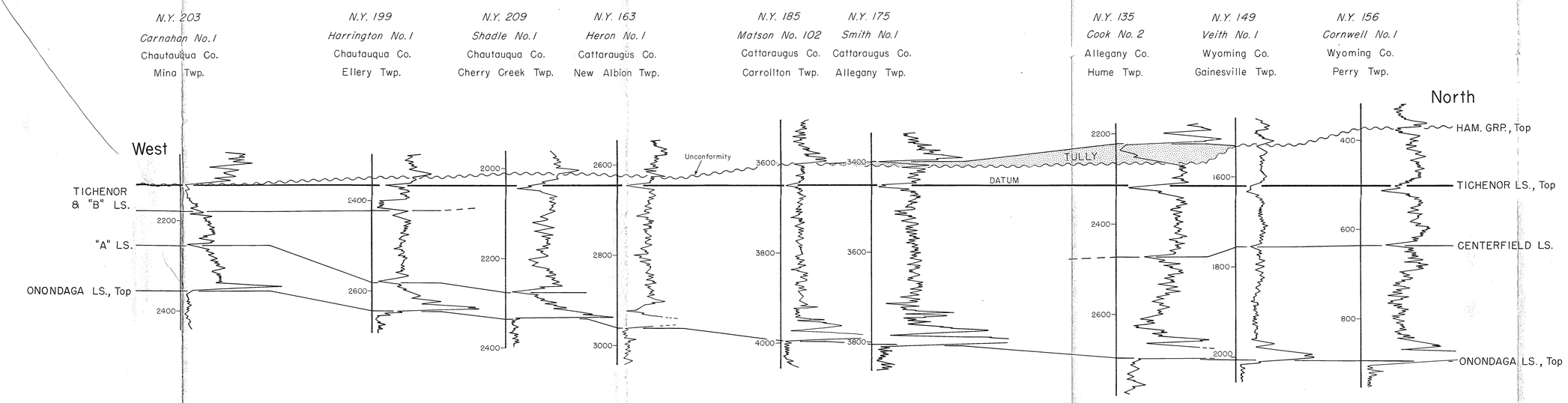
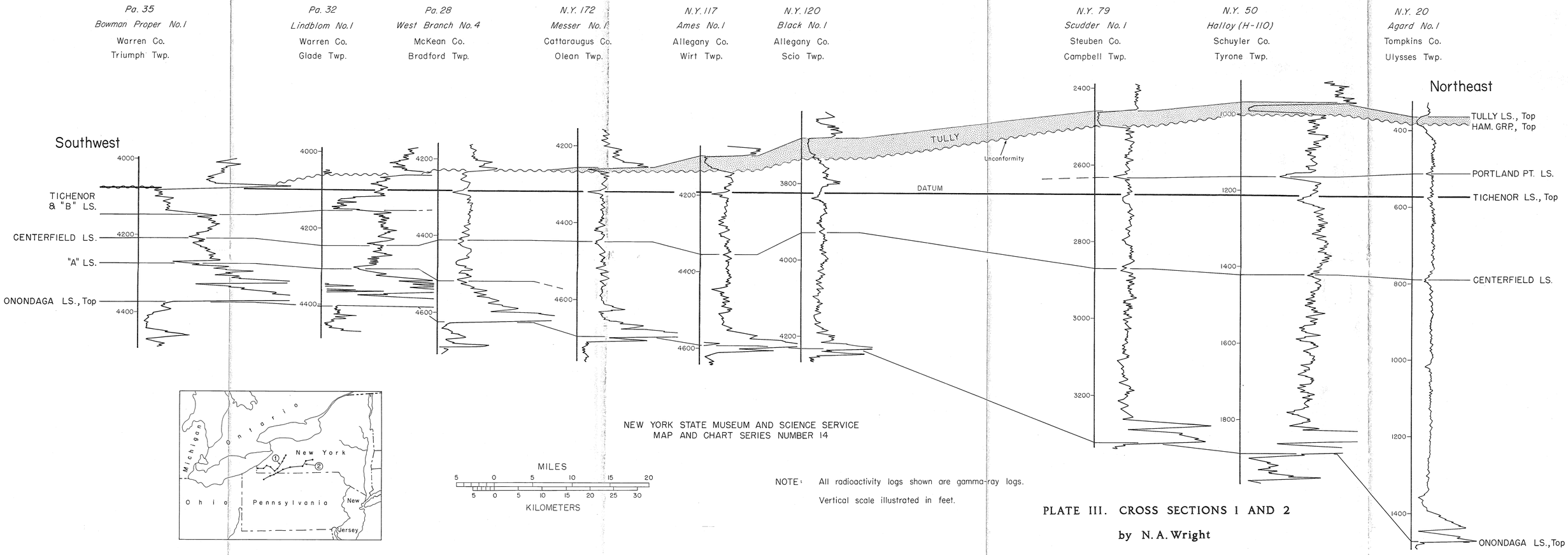
GEOLOGICAL SURVEY
James F. Davis, State Geologist

# SECTION 1




# SECTION 2







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MILES
5 0 5 10 15 20
5 0 5 10 15 20 25 30
KILOMETERS

NOTE: All radioactivity logs shown are gamma-ray logs.
Vertical scale illustrated in feet.

## PLATE III. CROSS SECTIONS 1 AND 2

by N. A. Wright

B.S.