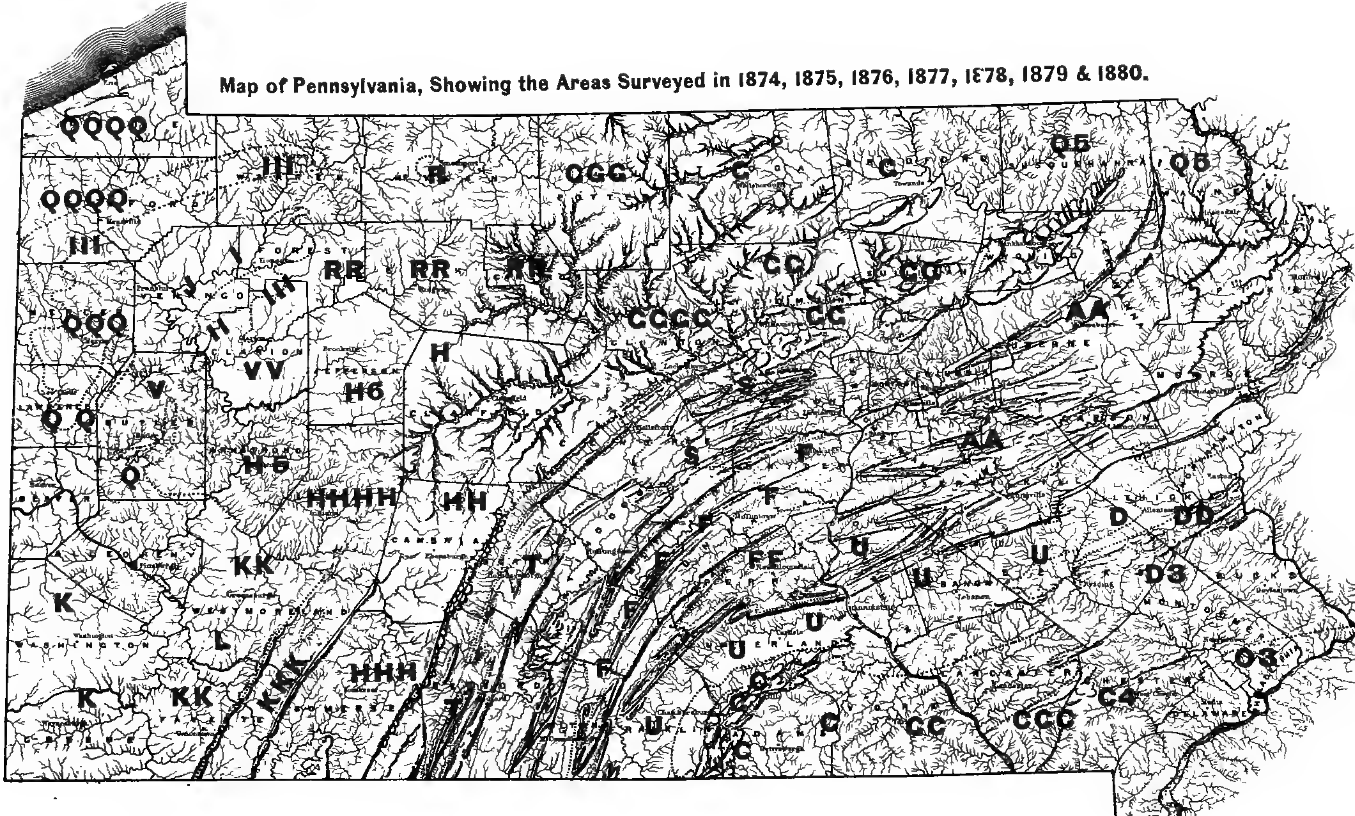
Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876, 1877, 1878, 1879 & 1880.



SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:
1880 to 1883.

GEOLOGICAL REPORT

ON

WARREN COUNTY

AND

THE NEIGHBORING

OIL REGIONS,

WITH

ADDITIONAL OIL WELL RECORDS.

BY

ranklin

JOHN F. CARLL.

WITH A COLORED GEOLOGICAL MAP OF WARREN COUNTY; TWO SHEETS OF OIL WELL SECTIONS; AND A MAP OF THE WARREN OIL REGION.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.
1883.

Electrotyped and printed by
LANE S. HART, State Printer,
Harrisburg, Pa.

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LETTER OF TRANSMITTAL.

To His Excellency, ROBERT E. PATTISON, *Governor of Pennsylvania, Chairman of the Board of Commissioners of the Second Geological Survey of Pennsylvania:*

SIR: I have the honor to transmit to you the fourth report of Mr. John F. Carll; geologist in charge of the survey of the Oil Regions, marked I 4.

Part I consists of 685 selected oil well records, added to the 1654 records published in Report I 4.

Part II contains Mr. Carll's report on the geology of Warren county, with special discussions of the mutual relations of the coal beds, conglomerates, and oil sand rocks.

Mr. Carll's thorough acquaintance with all the phenomena of this region, so unique in its character, and so important to the wealth of the State, is now too well appreciated by intelligent oil producers to need a word of praise on my part. His reports are models of conscientious investigation and scientific description. They will retain their place in the classical literature of geology among the most valuable and reliable memoirs of our days.

Discovery is the business of the well sinker; explanation is the business of the geologist. But the explanation of discovered facts does not consist in mere description. The relations of facts to each other can be understood only by genius and talent combined; by close observation, shrewd comparison, and wide generalization; by a patient gathering of items and a judicious application of science to their classification; by a wise cross-examination of testimony, and an unprejudiced sifting of evidence.

The present report shows in a signal manner how this can be done by a competent and self-devoted geologist, habituated to the work by years of unintermitted attention, and inspired by no other motive than a love for the absolute truth. The absolute truth indeed is not attainable;

but the love of it brings the geologist at least within sight of it; and when there, he can point it out to men of affairs; he can guide others in the right path to a nearer approach.

No one can say that the last word about Petroleum has been spoken. Much as we know, we have still more to learn. But the subjects for study vary from step to step of every investigation. It may be well to try to sum up the acquisitions which we have thus far made:

1. With regard to Petroleum, we know its nature; but we do not know its origin.

2. We know the many geological horizons at which it may be found by boring; but other horizons may exist of which we as yet know nothing.

3. We know very nearly the geographical limits of the belts and areas of country which it underlies; but we do not know how many isolated pools remain to be discovered even in explored territory, like the one in Cherry Grove township described at the end of this report.

4. We know that the Venango Oil group of three main oil sands is a distinct geological formation—distinct from the formations above and beneath it; but we do not yet know with precision whether to name it a member of the Chemung, the Catskill, or the Pocono series of Middle and Eastern Pennsylvania; a matter of no importance except to writers of text books.

5. With regard to the oil-sands beneath the Venango group, viz: the Warren sands, the Bradford sands, &c., we know that they are of Chemung age, and of a very different texture and outspread; that they are of much more local occurrence, and of less regular geographical outline; but we do not know their mutual relationships with sufficient accuracy to permit of grouping them into well-defined series. The reasons for this ignorance are sagaciously stated in this report; and among these reasons is that pernicious genius of gambling in oil which has taken possession of the region.

5. We know the characteristics of those remarkable Conglomerate formations which enclose the lowest coal beds, and make rock-cities on both sides of the State line; some

of them being ancient deposits of *round* pebbles, others of *flat* pebbles ; the shape of the pebbles being significant of the relative general age and position of the deposits. But the cause of roundness or flatness in the shape of the pebbles has not been discovered ; and there is still a doubt concerning the identity or non-identity of some of these gravel-rocks—a doubt discussedin this report.

7. With regard to the interval between the Olean conglomerate (the lowest of the round-pebble formations) and the sub-Olean conglomerate (the uppermost of the flat-pebble formations) we know that it is a well-defined horizon of discordance throughout northwestern Pennsylvania ; but we are not yet certain whether it represents merely the Mauch Chunk Red Shale formation No. XI, which surrounds the anthracite coal basins, or whether it also includes a considerable portion of the upper part of the Pocono gray sandstone formation No. X.

8. With regard to the coal beds of Warren and Venango counties we know that they do not belong to the Lower Productive coal measures of Clarion, Kittanning and Freeport ; but that they represent the Mercer and Sharon and Alton coals, locked up between the members of the Great conglomerate ; that they are very local and uncertain ; and that no important mining operations can ever be based upon them. That there are curious and perplexing open questions respecting them is sufficiently shown by Mr. Carll's description of the Quaker hill mines in this report.

9. Respecting the fossil forms embedded in the rocks, we know that they are all of Subcarboniferous, Waverly, or Chemung types ; and that certain horizons in the Warren city section are characterized by certain species of fishes or shells. But it is equally certain that the palæontology of this part of the State is only in its infancy ; and that years must pass before it can speak a coherent language.

The valuable contributions of Mr. F. A. Randall to this department of the survey of Warren county are acknowledged by Mr. Carll in various places in this report ; see the Index.

A memoir on the *Crustacea* from the Chemung and Waverly groups at Warren, Pa., has been obtained from Mr. Charles E. Beecher, of Albany, N. Y., with three plates of the fossil forms which he describes. This memoir with its plates will be published in Report P3, with plates and descriptions of *Crustacea* from Mr. Mansfield's mines at Cannelton, Beaver county, and with plates and descriptions of new coal plant fossils prepared by Mr. Lesquereux, since the publication of his Report on the Coal Flora, P.

I desire to publish in the most unequivocal manner the fact that Mr. Carll was the first geologist to comprehend the structure of the Oil regions, and to furnish a reliable exposition of its essential features. Familiar as he was with the early history of the oil development, by personal experience previous to his appointment in 1874 as the official geologist of the region, he brought to his work a fund of accurate observations already systematized in his own mind.

In his first report he demonstrated the integrity of the Venango group; the shape of the basins; the regularity and variability of the oil sands; the impossibility of the Garland (Olean) conglomerate being the outcrop of one of the oil sands; the lower position of the Panama conglomerate in the series; the identity of the 1st, 2d, and 3d sands of the Venango belt with the 2d, 3d, and 4th sands of the Butler belt. He indicated the probability of a fixed and general distinction between the flat and round pebble conglomerates; and he placed on a sound basis our knowledge of the Northern Ice on the highlands, the reversal of the drainage of the country and of opening the gates through the barrier outcrop of No. XII towards the south.

In his subsequent reports he has added largely to the number of facts bearing on all these points, and demonstrated much that was at first theoretically incomplete. It is not too much to say that, however much was previously guessed at, or suspected to be true, the Geology of Petroleum has been virtually created by him; and that his services to science in sweeping away popular fallacies have equalled those which he has conferred by his discoveries and demonstrations. For eight years he has exerted an influence upon the more thoughtful part of the population of the

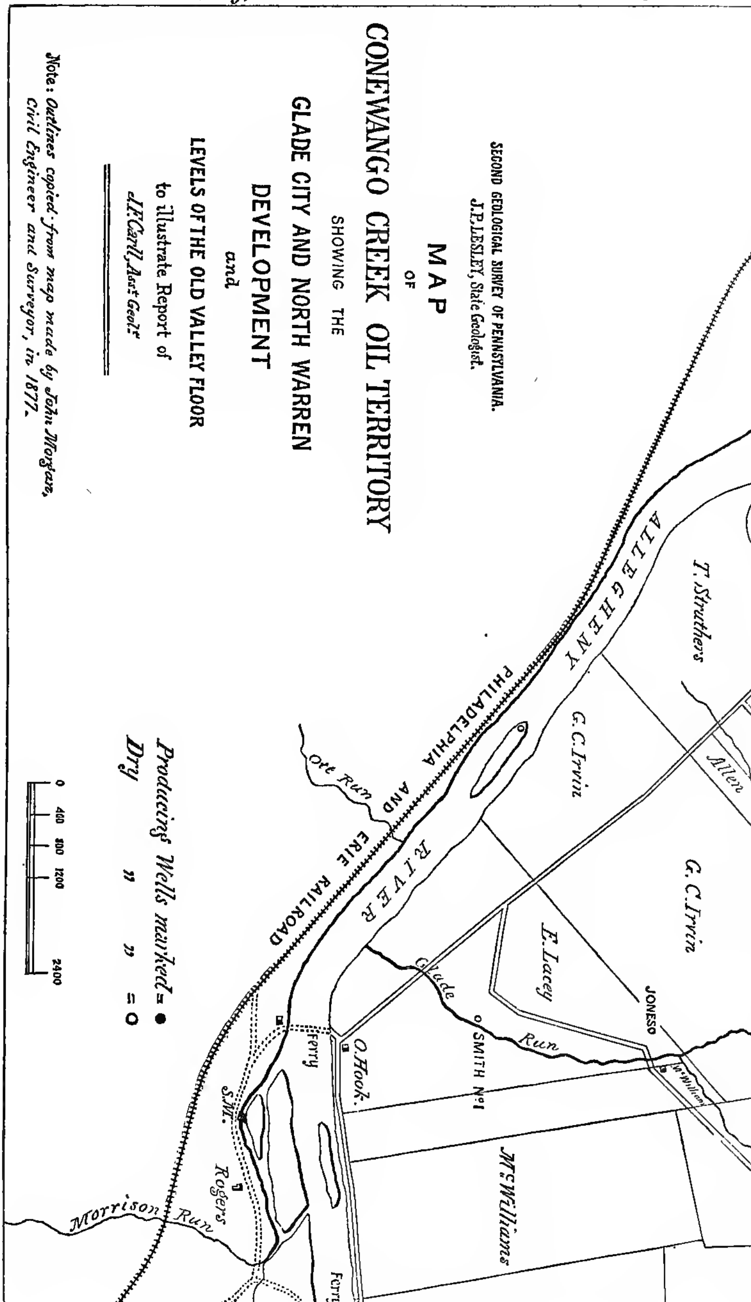
Oil regions so unpretentious, steady and consistent as almost to elude observation, but so real and fundamental as to illustrate in an admirable manner the true function of a geological survey.

This personal influence, the effects of which are not susceptible of statement in words, and cannot be included in any official report, is something very different from what is vulgarly expected of a State geological survey. It is one thing to follow a train of active enterprise and rapid discovery with illustrated scientific and statistical descriptions of the same, officially reported and officially published months or even years after their novelty is worn off and they have been forgotten in subsequent excitements. It is quite another thing to anticipate such official reports by a daily communication of more and more correct ideas to a multitude of persons engaged in the current business of a region like the Oil region of Pennsylvania. A geologist may do the one without being able to do the other. But when, as in the case of the able geologist whose fourth official report I present, both are done, the State is well served, and the law establishing a State geological survey is fully justified.

The recent discovery of an abundance of oil stored away in a small area south of Warren, which produced so disastrous an excitement, and added such a pile of fuel to the gambling fire of the oil exchanges, seemed at first to overthrow the scientific conclusions of the survey. But the small extent and rapid exhaustion of this pool of oil have shown the soundness of our acquired knowledge; for it is merely a repetition of what has happened before, and may happen again. It is not from such local pools that the vast demands of trade are to be supplied. Spurting and flowing wells are no longer marvels of nature calculated to upset the principles of geology, and therefore to let loose the demon of unreflecting speculation upon the community. The figures given in this report will satisfy reasonable people that such events are mere ripples in the stream of oil production; and if they affect the market are made to do so by shrewd and heartless monopolists for their own purposes. It is equally manifest that violently fluctuations of the market would be impossible but for a still prevalent ignorance of the geology of Petroleum, and an equally prevalent epidemic of the gambling spirit. This spirit no amount of published information can cure. On the contrary, it is a spirit hostile to the acquisition of information; as Mr. Carll explains in this report. It virtually renders impossible the contemporaneous collection of data; for the geologist can learn nothing when new wells, both productive and unproductive, are guarded against investigation, and what is said of them is more probably false than true. Pennsylvania may be vain of her possession of this most wonderful treasure; but she cannot be proud of the utter demoralization of the crowded population which scrambles for it in so unmanly and thriftless a manner. The next generation will gather from our oil history, with angry astonishment, a lesson of warning in political economy, only useless because coming too late.

It is certain that petroleum is not now being produced in the Devonian rocks, by distillation or otherwise. What has been stored up can be got out. When the reservoirs are exhausted there will be an end of it. The discovery of a few more pools of two or three million barrels each can make little difference in the general result; they will enrich a few gamblers; and only such gamblers as can corner the market. If this geological truth were accepted by the multitude, as it should be, it would save the multitude from needless ruin; but it would take from the multitude the pernicious privilege of perpetually indulging in the delightful excitement of ruining themselves. Man is the only gambling animal; and the most elaborate geological investigations cannot change the bent of human nature. The geologist looks sadly on, while he collects from the débris of wasted work materials for the demonstration of truths to be engrossed in the story of human enterprise.

Illustrations.—The reader will find appended a colored geological map of Warren county; a new map of the Cherry Grove region, prepared by Mr. Howland; two sheets of comparative oil sections; and three page plates showing the



SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA.
J. P. LESLEY, State Geologist.
MAP
OF
CONEWANGO CREEK OIL TERRITORY
SHOWING THE
GLADE CITY AND NORTH WARREN
DEVELOPMENT
and
LEVELS OF THE OLD VALLEY FLOOR
to illustrate Report of
J. F. Carll, Asst Geol.
Note: Outlines copied from map made by John Morgan, Civil Engineer and Surveyor, in 1877.
Producing Wells marked = ●
Dry " " = ○
0 400 800 1200 2400
ALLEGHENY RIVER
PHILADELPHIA AND ERIE RAILROAD
T. Struthers
G. C. Irvin
G. C. Irvin
Allen
E. Lacey
JONES
SMITH No. 1
McWilliams
McWilliams
O. Hook.
Ferry
Ferry
S. M.
Rogers
Ott Run
Glade Run
Morrison Run

depth of the ancient water channel of the Conewango above Warren.

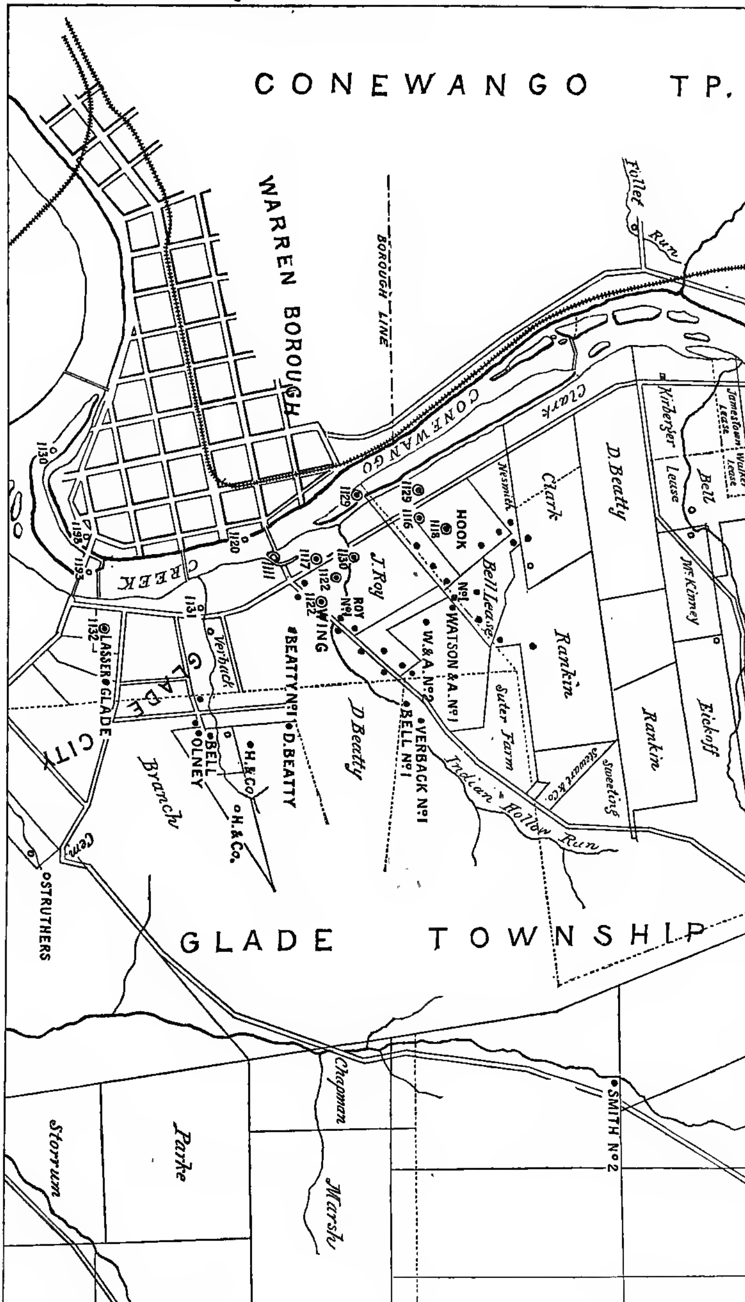
The following letter from Mr. Howland to Mr. Carll, dated from the Enterprise Transit Co.'s Agent's Office in Titusville, December 19, 1882, will sufficiently explain the map of the Cherry Grove oil field and surrounding region:—

Dear Sir: Herewith I hand you the map I have been preparing, of what I term the "*Middle Oil Field*," embracing portions of Forest, Warren, Elk, and McKean, and a small part of Clarion county.

I originally made up this map, as you know, entirely for my own convenience, for use in connection with purchases of lands, examinations of titles, surveys, &c., as agent for the Enterprise Transit Company.

My design in getting up this map was mainly to show the correct relative position of the original *land* lines and of such sub-division lines as I have been able to obtain from authentic notes and records, and especially to give correct connections between the Holland Land Company's surveys and the surveys around the Mead, Murray, Biddle, and Baynton warrants in Forest and Warren counties. Every line on the map, except in Glade and a portion of Kingsley township, is plotted directly from copies, in my possession, of original and recent field notes, survey drafts, and recorded deeds, and without reference to any published map. Some of the original State surveys were "fearfully and wonderfully made," and to reconcile the many discrepancies (in the absence of recent and reliable re-surveys) some "fudging" has been required, as any one will know who has attempted to make a map of Forest county. But the map, so far as its *land* lines are concerned, is believed to be substantially correct.

The principal streams shown in Mead, Cherry Grove, Kinzua, Sheffield, Howe, Wetmore, the south-west part of Hamilton, in all except the south-east portion of Jenks, and in most of Pleasant township, and on the lands owned by the Enterprise Transit Company in Highland township, and the public roads in Sheffield, Howe, and Jenks, and the westerly part of Highland townships, are plotted mainly


CONEWANGO TP.
WARREN BOROUGH
BOROUGH LINE
CONEWANGO
Follet Run
Clark
Kirberger
Jamestown Lease
Walker Lease
Lease
Bell
D. Beatty
Nesmith
Clark
HOOK
J. Roy
Bell Lease
McKinney
Rankin
Rankin
Eickoff
Suter Farm
Stewart & Co.
Sweeting
Indian Hollow Run
CREEK
GLADE
CITY
Verback
Branch
D Beatty
LASSER
GLADE
BELL
OLNEY
H. & Co.
H. & Co.
BEATTY No. 1
D. BEATTY
WING
ROY No. 1
WATSON & A. No. 1
W. & A. No. 2
BELL No. 1
VERBACK No. 1
STRUTHERS
Cem.
GLADE TOWNSHIP
Chapman
SMITH No. 2
Storrum
Parke
Marsh

from survey notes. The remaining public roads and streams, especially the small streams tributary to the Allegheny river and to Tionesta creek south of Balltown, are given partly from county maps and partly from my personal knowledge of them.

If the map will be of any service to the Geological Survey you are at liberty to publish it in your reports.

Yours truly,

A. B. HOWLAND,

C. E.

The Conewango map, prepared long ago, has been re-drawn on a reduced scale, and will be found in the form of three page plates. It is intended to illustrate the depth of the ancient valley now occupied by the Conewango creek flowing south; showing the positions of the principal wells, and the *elevation above tide* of the *bottom of the drive pipe* in each well. The length of the drive pipe will be found by reference to the well record; and this can be found by means of the Index to the volume.

The following note to the third paragraph, on page 210, respecting the Warren oil wells was overlooked in preparing copy for the press. It is an extract from Mr. Chance's field note-book of 1877:

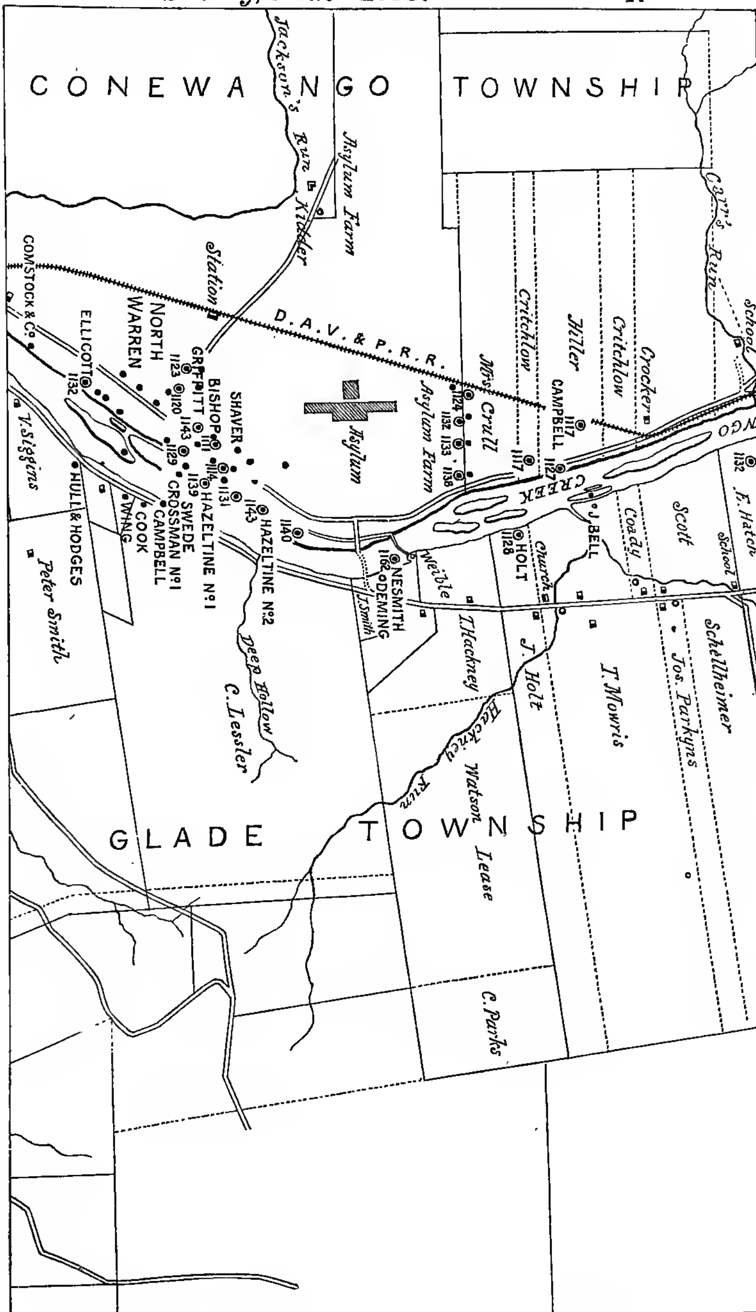
"Messrs. Hodge & Hull say that oil is found at North Warren in no regular horizon. Some of the wells on the flats have got paying quantities (20 barrels or more) at 360′. Others go 460′ to 500′, and others again go over 600′.

"The larger wells found oil at 460′ to 500′ in what is called the Second sand.

"No regular, well-defined sands are found—nothing but bands of thin shells; and the oil comes in from crevices.

"Wells sunk within 45′ of some of the larger wells (such as the Osmer well) have been found 'dry as a bone.'"

An *Index* of all proper names of persons and places mentioned in this report, including oil wells, will be found at the end of the volume; but an Index to the geology has not been prepared; partly on account of the labor involved in such an undertaking; partly because the first part of the report gives a systematic account of the only important


CONEWANGO TOWNSHIP
GLADE TOWNSHIP
Jackson's Run
Asylum Farm
Kidder
Station
D.A.V. & P.R.R.
NORTH WARREN
COMSTOCK & Co.
ELLIGOTT
GRIFFITT
BISHOP
SHAVER
Asylum
Mrs Crull
Critchlow
Hiller
Crocker
CAMPBELL
Carr's Run
School
CREEK
V. Siggins
HULL & HODGES
WING
COOK
CROSSMAN No 1
SWEDE
CAMPBELL
HAZELTINE No 1
HAZELTINE No 2
NESMITH
DEMING
HOLT
J. BELL
Church
Coady
Scott
F. Hatch
Peter Smith
Deep Hollow
C. Lessler
J. Smith
Weible
T. Hackney
J. Holt
T. Mowris
Jos. Parkyns
Schellheimer
Hackney Run
Watson Lease
C. Parks

geological formations arranged in an easily understood order.

A large collection of rocks, specimens, and fossils, suits of sand pumpings arranged in geological sequence, and of oils from various parts of the Oil region, collected by Mr. Carll during the progress of his survey, remains for the present at Pleasantville, but will form part of the Museum of the Survey when a place is provided for its permanent entertainment.

This will be the last of the Reports of Progress of the Geological Survey in the Oil Regions, unless the Legislature sees proper to continue the survey of the State.

J. P. LESLEY.

1008 CLINTON STREET, PHILADELPHA, *January 11, 1883.*

Key to the Numbering of the Oil Well Records.

Note.—The other numbers can easily be interpolated.

ADDITIONAL

OIL WELL RECORDS.

1874–1881.

BY J. F. CARLL.

GROUP I.

Wells near Warren, in Glade and Conewango townships, Warren county. Pennsylvania.

1655. Beatty Well, No. 1.

March, 1875.

Near Mr. Beatty's residence, at East Warren, Glade township. Record compiled from specimens of sand-pumpings preserved by Mr. F. A. Randall:

Well mouth above ocean, 1217 feet,					1217
Drive pipe,	90	to	90	=	1127
Shales,	170	to	260	=	957
Chocolate shale, slaty, (specimen 1,)	8	to	268	=	949
Dark slaty shale, micaceous, hard, (2,)	52	to	320	=	897
Chocolate shale—mud, (3,)	8	to	328	=	889
Shales, blue and brown, some red layers,	57	to	385	=	832
SS. and shale, gray, fossiliferous, hard, (4,),	10	to	395	=	822
SS. and shale, gray, softer, less fossiliferous, (5,)	45	to	440	=	777
Mud rock with sand shells at 465′ and 475′, (6*a*, 6*b*, 7,)	35	to	475	=	742
? (Shales?)	34	to	509	=	708
SS. with shale, gray, (8,)	18	to	527	=	690
Shale and slate, (specimens lost,) (9,)	33	to	560	=	657
Muddy shale, with hard streaks, (10,)	32	to	592	=	625
Sandy slate, micaceous, bluish, (11,)	12	to	604	=	613
Very fine, flaky SS., some fossils and slate, (12,) say	2	to	606	=	611
? Probably same as above,	4	to	610	=	607
Same as No. 12, less slate and grayer, (13,)	5	to	615	=	602
Very fine-grained and very fossiliferous SS., hard, (14,)	5	to	620	=	597
Gray SS., soft and friable, (15.)	5	to	625	=	592
Gray SS., soft and friable, with some pebbles and slate, (oil here,) (16,)	4	to	629	=	588
Same as No. 16, (17,)	3	to	632	=	585

Oil and gas from 620′, increasing to 629′. Natural production probably about 5 barrels.

Wing Well, No. 2.

1877.

Roy farm, East Warren, in Glade township. Authority, D. J. Lucas, per A. B. Howland.

Well mouth above ocean in feet,		1204
Drive pipe,	78 to 78 =	1126
Slate,	287 to 365 =	839
1st SS.,	35 to 400 =	804
Slate,	91 to 491 =	713
2d SS , (oil at 506′,)	40 to 531 =	673

Roy Well, No. 2.

1877.

On Roy farm, East Warren, in Glade township. Authority, D. J. Lucas, per A. B. Howland.

Well mouth above ocean in feet,		1223
Drive pipe,	90 to 90 =	1133
Slate, blue,	290 to 380 =	843
1st SS.,	40 to 420 =	803
Slate,	80 to 500 =	723
2d SS.,	10 to 510 =	713
Slate,	112 to 622 =	601
Shell, (oil at 625′,)	3 to 625 =	598
3d SS.,	47 to 672 =	551

Hall Well.

1877.

On land of O. Hall, East Warren, Glade township, 100 rods north of 5th Street bridge and 400 rods east of Anderson's saw-mill. Authority, Mr. Hall, per F. A. Randall.

Well mouth above ocean in feet,		1197
?, (water at 145′,)	180 to 180 =	1017
Red rock, very pale red,	20 to 200 =	997
?,	265 to 465 =	732
SS.,	20 to 485 =	712
?, (mud vein, oil and gas at 528′,)	95 to 580 =	617
SS.,	50 to 630 =	567

Logan Well, No. 1.

1876.

Rankin farm, Glade township, 200′ south-west of Verback. Authority, S. B. Logan, per F. A. Randall.

Well mouth above ocean in feet,	1430
Drive pipe,	87 to 87 = 1343
?, cased at 290′,	483 to 570 = 860
1st SS., estimated,	20 to 590 = 840
?,	50 to 610 = 790
2d SS., estimated,	20 to 660 = 770
?,	125 to 785 = 645
3d SS.,	50 to 835 = 595
Pocket,	1 to 836 = 594

Good producing well.

Logan Well, No. 3.

1877.

Rankin farm, Glade township, 800′ south-east of No. 4. Authority, S. B. Logan, per F. A. Randall.

Well mouth above ocean in feet,	1464
Drive pipe,	52 to 52 = 1412
?, cased at 287′,	751 to 803 = 661
3d SS., oil,	53 to 856 = 608
?,	74 to 930 = 534
4th SS., no oil here,	12 to 942 = 522
?,	49 to 991 = 473

A small paying well.

Logan Well, No. 4.

1877.

Rankin farm, ¾ mile north-east of Warren, Glade township. Authority, S. B. Logan, per F. A. Randall.

Well mouth above ocean in feet,	1374
Drive pipe,	117 to 117 = 1257
?,	591 to 708 = 666
3d SS., oil,	10 to 718 = 656
Sandy shales,	70 to 788 = 586
Shale,	38 to 826 = 548
4th SS.,	6 to 832 = 542
Shale,	2 to 834 = 540

Cased at 244′. Production small.

Clemons & Bell Well, No. 1.

300′ south-east of No. 2, Kirberger farm, Glade township.

Well mouth above ocean in feet,	1285
Conductor,	19 to 19 = 1266
?,	631 to 650 = 635
4th SS., oil,	40 to 690 = 595

First 15′ 4th SS. very white. Casing 145.

Clemons & Bell Well, No. 2.

Kerberger farm, $1\frac{1}{4}$ miles north-east of Warren, Glade township. Authority, Mr. Clemons, per F. A. Randall.

Well mouth obove ocean in feet,		1280
Conductor,	18 to 18 =	1262
?,	632 to 650 =	630
SS., oil,	40 to 690 =	590

Production small. Casing 145.

Bovard & Nesmith Well, No. 1.

1876.

Clark farm, 1 mile north-east of Warren, Glade township. Authority, D. Nesmith, per F. A. Randall.

Well mouth above ocean in feet,		1330
Drive pipe,	119 to 119 =	1211
?,	546 to 665 =	665
3d SS., oil,	75 to 740 =	590

Cased 200′. Oil found 6′ from top of sand.

Struthers, Taylor & Co.

1876.

On Hook farm, Glade township, half a mile north-east of Warren. Authority, J. J. Taylor, per F. A. Randall.

Well mouth above ocean, in feet,		1258
Drive pipe,	140 to 140 =	1118
?,	439 to 579 =	679
SS., (dark shells and slate,)	49 to 628 =	630
3d SS., white, oil,	12 to 640 =	618
Shale and sand shells,	35 to 675 =	583

Fresh water at 226′. Salt water 370′. Cased 378′. Production about 2 barrels per day.

Magee Well, No. 2.

1877.

On J. Magee farm, Glade township, half a mile north-east of Warren. Authority, Mr. Magee, per F. A. Randall.

Well mouth above ocean, in feet,		1340
Conductor,	30 to 30 =	1310
Slate,	10 to 40 =	1300
SS., grey,	30 to 70 =	1270
?, including 1st and 2d sands,	650 to 720 =	620
3d SS., (oil at 720′,)	55 to 775 =	565

Production about 4 barrels per day.

In this locality an increase of oil is said to have been obtained about 150′ below the 3d. SS.

Magee, No. 1, elevation 1314′. A. T. depth to oil 700′.
" No. 3, " 1366′. " " " 740′.

Verback No. 1, Magee farm. Elevation 1310 A. T. Oil first at 714′ and increased down to 860′. About a three-barrel well.

J. A. Magee, No. 4.

1878.

Magee farm, ¾ mile north-east of Warren, Glade township.
Authority, J. A. Magee, per F. A. Randall.

Well mouth above ocean, in feet,		1393
Drive pipe,	35 to 35 =	1358
?,	165 to 200 =	1193
SS.,	4 to 204 =	1189
?,	321 to 525 =	868
1st SS., with pebbles,	25 to 550 =	843
?,	90 to 640 =	753
2d SS., estimated,	20 to 660 =	733
?,	94 to 754 =	639
3d SS., estimated,	20 to 774 =	619

Cased 247′. Oil in top of 3d SS. Good producing well.

Magee & Nesmith Well.

1877.

On Kerberger farm, Glade township, one mile north of Warren.
Authority, Mr. Magee, per F. A. Randall.

Well mouth above ocean, in feet.		
?,	460 to 460 =	
1st SS.,	50 to 510 =	
?,	15 to 525 =	
2d SS.,	60 to 585 =	
?,	55 to 640 =	
3d SS.,	20 to 660 =	

Unproductive.

Smith Bros., No. 1.

1876.

On Sutter farm, one mile northeast of Warren, Glade township. Authority, Mr. Smith, per F. A. Randall.

Well mouth above ocean, in feet,		1511
Conductor,	17 to 17 =	1494
?, (Cased at 245′,)	618 to 635 =	876
1st SS.,	12 to 647 =	864
?,	108 to 755 =	756
2d SS.,	25 to 780 =	731
?,	90 to 870 =	641
3d SS ,	50 to 920 =	591
Shales,	10 to 930 =	581

Oil at 875′; and the well has steadily produced about 5 barrels per day up to the present time, (February, 1879.)

Smith Bros., No. 2, Sutter farm. Elevation, 1464 A. T. Oil at 850′; three-barrel well.

Brown Bros.' Well.

1877.

Stewart farm, (11 acre lease,) Glade township, on Quaker Hill road, one mile north-east of Warren. Authority, the drillers, per F. A. Randall.

Well mouth above ocean, in feet,	1577
Conductor,	4 to 4 = 1573
?,	96 to 100 = 1477
SS.,	12 to 112 = 1465
Shale, no sand,	93 to 205 = 1372
SS., hard, (water here,)	18 to 223 = 1354
Shale,	2 to 225 = 1352
Red rock, (cased at 252′,)	27 to 252 = 1325
?, *with two red streaks*,	48 to 300 = 1277
?, no sands, (oil show at 625′)	325 to 625 = 952

Still drilling June 25, 1877.

Smith Bros.' Well, No. 1.

1876.

Near mouth of Glade run, 1½ miles southeast of Warren, Glade township. Authority, Smith Bros., per F. A. Randall.

Well mouth above ocean, in feet,	1203
Drive pipe,	48 to 48 = 1155
?,	232 to 280 = 923
Red rock, with brown shale partings,	20 to 300 = 903
?,	100 to 400 = 803
Red rock,	10 to 410 = 793
?,	135 to 545 = 658
2d SS.,	30 to 575 = 628
?,	120 to 695 = 508
3d SS.,	65 to 760 = 443
Shales and flaggy layers,	40 to 800 = 403

Cased 158′. Small show of oil from 3d SS. Struck oil at 20′ from top SS. Unremunerative. "This well is two miles directly south of Smith Bros.' well, No. 2, on Knoph farm."

Smith Bros.' Well, No. 2.

1877.

Knoph farm, north branch of Glade run, 2 miles north-east of Warren, Glade township.

Authority, Smith Bros., per F. A. Randall.

Well mouth above ocean, in feet,		1574
Conductor,	15 to 15	= 1559
?,	45 to 60	= 1514
SS.,	20 to 80	= 1494
?,	135 to 215	= 1359
SS., green, with brown layers,	15 to 230	= 1344
Flaggy sands,	15 to 245	= 1329
Red shales,	10 to 255	= 1319
?,	95 to 350	= 1224
Red rock,	30 to 380	= 1194
?,	300 to 680	= 894
Purple shale,	10 to 690	= 884
?,	40 to 730	= 844
1st SS.,	20 to 750	= 824
Shales and shaly sands,	73 to 823	= 751
2d SS.,	25 to 848	= 726
?,	82 to 930	= 644
3d SS.,	65 to 995	= 579
Flaggy sandstones with layers of shales,	70 to 1065	= 509

Cased 197′. Small amount of oil in 3d SS. Unremunerative, tested and abandoned.

Watson & Jones', No. 1.

1876–77.

On E. N. Lacy farm, Glade run, 1½ miles south-east of Warren. About half a mile north of Smith Bros' Well, No. 1, near the mouth of Glade run. Authority, the drillers, per F. A. Randall.

Well mouth above ocean, in feet,		1239
Drive pipe,	50 to 50	= 1189
?,	625 to 675	= 564
Stray SS.,	15 to 690	= 549
Shale,	20 to 710	= 529
3d SS., (not through,)	70 to 780	= 459

Third sand coarse. Oil came in at 748′. Production about 10 bbls. per day at first, but declined in a few months to one barrel. Fresh water at 140′, and salt water at 512′, which required to be cased out.

This oil is a light amber color, quite different from that of Warren and North Warren.

Watson & Jones', No. 2.

1877.

On the McWilliams farm, Glade run, one and a half miles south-east of Warren, and quite near No. 1, on the Lacy farm. Authority, Mr. McWilliams, per F. A. Randall.

Well mouth above ocean, in feet,	1292
Conductor,	37 to 37 = 1255
?,	743 to 780 = 512
3d SS.,	72 to 852 = 440
Shales and sand shells,	148 to 1000 = 292

Oil at 799′. Production very small. Fresh water at 200′. Salt water at 475′. Quality of oil the same as in No. 1.

Cobham Well.

1866-67.

On S. E. corner of land of Henry Cobham, tract 5974, Glade township, 2½ miles southeast of Warren, near Hertzell's Ferry, 50 feet from the river, and 35 feet above water level. Authority, Henry Cobham, (Sept. 5, 1877.)

Well mouth above ocean, in feet,	1221
Conductor,	33 to 33 = 1188
Blue slate, &c.,	267 to 300 = 921
Red rock, (paint,)	20 to 320 = 901
Blue slate, (including 1st SS.,)	240 to 560 = 661
2d SS.,	30 to 590 = 631
Blue slate?	120 to 710 = 511
3d SS., micaceous, fine, ashy,	27 to 737 = 484
Slate and shells,	111 to 848 = 373
Mud,	1 to 849 = 372
Shells,	16 to 865 = 356
4th SS., bluish white, fine, gritty,	20 to 885 = 336
Shells to bottom,	30 to 915 = 306

Cased at 258′. No salt water. Gas and oil at 848′. Gas increased from this point all the way down; sufficient to run the boiler.

Vicinity of Warren, Conewango township.

Phillhart & Co.

1876.

Spade farm, one mile west of Warren, Conewango township. Authority, Mr. Phillhart, per F. A. Randall.

Well mouth above ocean, in feet,	1216
Conductor,	35 to 35 = 1181
?,	395 to 430 = 786
1st SS.,	6 to 436 = 780
Shales,	114 to 550 = 666
2d SS.,	15 to 565 = 651
Shales,	80 to 645 = 571
Sandy shale,	47 to 692 = 524

3d SS., oil show,	13 to 705 = 511
Blue shaly SS.,	8 to 713 = 503

Unproductive.

Struthers' Well.

1876.

At the mouth of Follett run, in Conewango township, half a mile north of Warren. Authority, D. J. Lucas, per A. B. Howland.

Well mouth above ocean, in feet,	1237
Conductor,	17 to 17 = 1220
Slate and *red rock*,	396 to 413 = 824
1st SS.,	55 to 468 = 769
Slate and *red rock*,	30 to 498 = 739
2d SS.,	80 to 578 = 659
Slate and shells,	305 to 883 = 354

A little show of oil at 860′, but not enough to warrant a test.

McClintock Well.

1876–77.

On farm of Emery Dailey, near Jackson's Station, D. A. V. & P. Ry., Conewango township. Authority, Emery Dailey.

Well mouth above ocean, in feet,	1170
Drive pipe,	64 to 64 = 1106
Slate and some shells,	616 to 680 = 490
SS., shelly,	8 to 688 = 482
?,	112 to 800 = 370
SS., (a little gas,)	25 to 825 = +345
Shells, black slate, coal?	
Soapstone, mud, &c., a great variety in color and quality,	1216 to 2041 = −871

Cased at 160′. No water, no oil after casing.

GROUP II.

Wells near N. Warren, Conewango township, Warren county.

Hazeltine, No. 1.

1877.

Situated at North Warren, Conewango township, near the woolen mills, on an island. Authority, F. A. Randall, from drillers, while drilling.

Well mouth above ocean, in feet,		1204
Drive pipe,	65 to 65 =	1139
?,	55 to 120 =	1084
Red rock,	40 to 160 =	1044
?,	160 to 320 =	884
Sandy shale,	100 to 420 =	784
2d SS.,	15 to 435 =	769
Shales,	90 to 525 =	679
3d SS., oil show,	20 to 545 =	659
Shales,	55 to 600 =	604
4th SS.,	15 to 615 =	589
Black shales, oil at 640′,	121 to 736 =	468

Cased at 130′. Shale oil at 320′. Oil and gas at 550′. Small well; not remunerative, and soon abandoned.

Crull Well.

1877.

North Warren, Conewango township. Authority, Mr. R. Watson.

Drive pipe, 105′. Cased at 159′. Depth of well, 475′ through slate and shells all the way. No well-defined sandstones.

1st oil show, (slight,) at	185′
2d " " (filled up,) at	215′
3d " " (flowed heavily,) at	475′

Watson, Raydure & Co. Well, No. 4.

1878.

Crull farm, near the D. A. V. & P. railroad track, three-fourths of a mile north of North Warren, Conewango township. Authority, Frank Brown, driller, per F. A. Randall.

Well mouth above ocean, in feet,		1240
Conductor,	116 to 116 =	1124
?,	28 to 144 =	1096

Red rock,	10 to 154 =	1086
Shale,	106 to 260 =	980
Shale and sand shells,	220 to 480 =	760
Hard sand, } 2d SS., {	10 to 490 =	750
Soft sand, } 2d SS., {	10 to 500 =	740
Shaly sand,	18 to 518 =	722
Common sand,	12 to 530 =	710

Cased off fresh water at bottom of red rock, 154′. Salt water came in and cased again at 260′. Oil at 500′, just below 2d SS. A small well.

Wing Well.

1877.

On Cowan lot, Jackson Run road, North Warren, Conewango township, opposite Hoffman Well, No. 1. Authority, John Harman, driller, per F. A. Randall.

Well mouth above ocean, in feet,		1223
Drive pipe,	103 to 103 =	1120
Shale,	42 to 145 =	1078
Red rock,	20 to 165 =	1058
?,	400 to 565 =	658
3d SS., (top medium, bottom shaly,)	30 to 595 =	628
Shale,	50 to 645 =	578
4th SS.,	10 to 655 =	568
Shale with sandy shells,	545 to 1200 =	23

A small show of oil in the 3d SS., where the well was tested for some time, and then deepened to 1200′, without finding anything worthy of a further test.

Osmer & Company.

1877–78.

Well on Miner Curtis' lot, 500′ north-west of R. R. station, North Warren, Conewango township. Authority, Dr. M. Curtis, per F. A. Randall.

Well mouth above ocean, in feet,		1225
Drive pipe,	80 to 80 =	1145
?,	40 to 120 =	1105
Red rock,	40 to 160 =	1065
?,	170 to 330 =	895
1st SS.,	10 to 340 =	885
?,	110 to 450 =	775
2d SS,	25 to 475 =	750
Shales,	85 to 560 =	665
3d SS., hard shells at top,	20 to 580 =	645
?,	95 to 675 =	550
4th SS., coarse and soft, large flow of gas,	10 to 685 =	540
Shales, with slaty layers,	243 to 928 =	297
Shales,	37 to 965 =	260

Oil vein at 928. Production 15 barrels per day, (shale oil.) Cased at 161′. Gas at 784′.

"This well is remarkable as having produced no oil at the usual horizons. The Hoffman Well, 50 rods from it flowed 75 to 100 bbls. from the SS. at 675′, while this produced only from a depth of 928′, being the lowest producing horizon found in the district."

Struthers & Co. Well.

1877–78.

On west bank of Jackson run, Wetmore farm, Conewango township, about one mile north of Warren, and ½ a mile S. W. of North Warren. Authority, G. R. Wetmore, per F. A. Randall.

Well mouth above ocean, in feet,		1215
Conductor,	15 to 15 =	1200
Shale, blue and shelly,	125 to 140 =	1075
Red rock,	6 to 146 =	1069
Shale,	179 to 325 =	890
1st SS., in layers with shale,	15 to 340 =	875
Shale, blue,	110 to 450 =	765
2d SS., some pebbles,	4 to 454 =	761
Shale,	66 to 520 =	695
3d SS., (shaly sand with mud,)	25 to 545 =	670
Shale, (mud vein at 650′,)	135 to 680 =	535
Shale, hard, sandy, blue,	45 to 725 =	490
Shale, soft,	52 to 777 =	438
SS., fine, (large flow of gas,)	23 to 800 = +	415
Shale with sand shells,	612 to 1412 = −	197
Sand shell, with show of black oil,	— to 1412 = −	197
Shale,	303 to 1715 = −	500
SS., dark, fine,	9 to 1724 = −	509
Slate and shale, nearly black,	111 to 1835 = −	620

Cased at 140′. A dry hole, and abandoned without testing.

Watson & Raydure Well.

1876.

Reese farm, near residence of H. R. Siggins, Conewango township, 3 miles north of Warren. Authority, Jonathan Watson, per F. A. Randall.

Well mouth above ocean, in feet,		1221
Conductor,	120 to 120 =	1101
?,	200 to 320 =	901
1st SS.,	20 to 340 =	881
?,	75 to 415 =	806
2d SS.,	30 to 445 =	776
?,	120 to 565 =	656

3d SS, coarse; small show of oil,	40 to 605 = 616
Shale,	30 to 635 = 586
4th SS.,	100 to 735 = 486
Shale and flaggy sandstone,	69 to 804 = 417

Cased at 300′. Unproductive.

Miles' Mill or Clark Well.

1877.

Located at Miles' Mill, on Jackson run, Conewango township, five miles north-west of Warren. Authority, Mr. Clarke, per F. A. Randall.

Well mouth above ocean, in feet,	1354
Conductor,	57 to 57 = 1297
Red shale,	10 to 67 = 1287
?,	208 to 275 = 1079
Red rock,	30 to 305 = 1049
?,	175 to 480 = 874
SS., white, "1st sand,"	28 to 508 = 846
?,	122 to 630 = 724
SS., thin, "2d sand,"	7 to 637 = 717
?, "No 3d sand found,"	198 to 835 = 519
SS., "4th sand," (no oil,)	75 to 910 = 444
Shales to bottom of well,	490 to 1400 = —46

Cased at 239′. Unproductive.

Vicinity of North Warren, Glade township.

Hull & Hodge's Well, No. 1.

1877.

Siggins farm, 1½ miles north-east of Warren, Glade township. Authority, Mr. Hull, per F. A. Randall.

Well mouth above ocean, in feet,	1228
Drive pipe,	62 to 62 = 1166
?,	416 to 478 = 750
SS., estimated,	10 to 488 = 740
?,	22 to 510 = 718
SS., large flow of oil,	32 to 542 = 686

Cased at 162′. Started off at 100 barrels per day, at depth of 542′.

Hull & Hodge's, No. 2.

1877.

Situated on south end of M. Lesler farm, Glade township, 200′ north-east of No. I. Authority, Mr. Hull, per F. A. Randall.

Well mouth above ocean, in feet,	1222
Drive pipe,	54 to 54 = 1168

?,	489 to 543 = 679
3d SS., sand and shells, estimated,	15 to 558 = 664
Shale, with slaty layers,	215 to 773 = 449

Cased at 144′. Oil in 3d SS., at 548′. Mud vein at 558′.

Campbell Well.

1877.

C. Lesler farm, Glade township, 1½ miles north of Warren. Authority, T. Campbell, per F. A. Randall.

Well mouth above ocean, in feet,	1202
Conductor,	34 to 34 = 1168
?,	386 to 420 = 782
2d SS.,	6 to 426 = 776
?,	94 to 520 = 682
3d SS.,	20 to 540 = 662
?,	40 to 580 = 622
4th SS.,	22 to 602 = 600
Shale, sandy,	23 to 625 = 577

Cased at 149′. Oil in 4th sand at 590′, and again in shale at 625′, where it at first produced 65 bbls. per day, but soon declined to a small well.

Campbell Well, Hiller Farm.

1877.

On E. bank of Conewango creek, near the residence of Mr. Critzelow, 2 miles north of Warren, Conewango township. Authority, J. H. Hiller.

Well mouth above ocean, in feet,	1223
Conductor,	95 to 95 = 1128
?, (oil and salt water at 370′,)	275 to 370 = 853
?, (gas and a little oil at 430,)	60 to 430 = 793
?, (mud vein, and flowed some oil at 497,)	67 to 497 = 726
?, (" " " " 545,)	48 to 545 = 678
?, (no sand or oil to bottom,)	142 to 687 = 536

Cased at 380′. Settled to a production of 3 bbls. per day.

Brace & Co's. Well.

1877.

Hatch farm, near the bridge, Glade township, 3 miles north by east of Warren. Authority, Thos. Campbell, per F. A. Randall.

Elevation of well mouth above ocean, in feet,	1239
Conductor,	56 to 56 = 1183
Shale and sand shells,	544 to 600 = 639
3d SS.,	12 to 612 = 627
Shale,	88 to 700 = 539
Shaly sand,	10 to 710 = 529

4th SS.,	10 to 720 = 519
Shale,	149 to 869 = 370

Cased at 170′. Unproductive.

Holt & Clemon's Well.

1877.

On the E. bank of Conewango creek near the north line of Holt farm, Glade township, half a mile above North Warren. Authority, J. Clemons, per F. A. Randall.

Well mouth above ocean, in feet,	1215
Drive pipe,	87 to 87 = 1128
Shale, (cased at 370 ,)	343 to 430 = 785
2d SS ,	8 to 438 = 777
Shale,	245 to 683 = 532

A vein of oil was struck at 430′, and the well flowed about 100 barrels per day for three or four days, and then stopped. It was then drilled deeper, encountering a mud vein and some oil at 645′. On a final test it proved to be a small producer.

Parshall, Dennison & Co.

1876.

On Hatch run, three miles north-east of Warren. B. Mowers' farm, Glade township. Authority, Parshall & Dennison, per F. A. Randall.

Well mouth above ocean, in feet,	1471
Conductor,	18 to 18 = 1453
?,	32 to 50 = 1421
Red rock, (estimated,)	10 to 60 = 1411
?,	120 to 180 = 1291
Red rock, (estimated,)	20 to 200 = 1271
Flaggy and shaly sands,	26 to 226 = 1245
SS.,	6 to 232 = 1239
Flaggy sands, with fresh water,	58 to 290 = 1181
Shale,	210 to 500 = 971
SS.,	15 to 515 = 956
Shale,	60 to 575 = 896
SS , "1st sand,"	15 to 590 = 881
Shale,	110 to 700 = 771
SS., "2d sand," (no oil,)	20 to 720 = 751
Shale,	100 to 820 = 651
SS., flaggy, "3d sand," (no oil,)	40 to 860 = 611
Shale and sand shells to bottom,	540 to 1400 = 71

Cased at 290′. Unproductive.

Notes by H. M. Chance, May 30, 1877.

Near North Warren –Glade and Conewango townships.

Elev.

1241 Wing, No. 1, Chas. Lesler's farm, 650′ to oil.

1218 Berry, No. 1, 470′ to oil.

1216 Bishop, 340′ to oil; 20 bbls.

1214 Allen, No. 1, 490′ and 520′ oil. This well was a good well, at first, yielding 30–40 bbls. It was subsequently drilled to its present depth, and by so doing, spoiled.

1214 Allen, No. 3, 800′ deep; dry.

1216 Kenton & Strong, No. 2, 505′ (?) to oil; 17 bbls.

1210 " " No. 1, 475′ " 17 bbls.

1218 Headman's Q.—4 wells; 3 dry and 4th small.

1217 Osmer & Co., No. 3; 1st oil about 450′–500′. Pumped about 3 weeks; drilled (about 2 months ago) to 615′–620′, and obtained 300 bbl. well. Now doing 60 bbls.

1207 Osmer & Co., No. 4; oil at 600′; 700′+deep, 8–10 bbls.

1222 Hoffman well, 672′ to oil.

1221 Sweed well, over 700 deep; 3–4 bbls.

1223 Ellicott Oil Co., No. —; Wetmore farm; oil 550′.

1201 Phillips & Taylor, No. 1. Pumped three weeks, from 335′, 12–15 bbls; drilling deeper; increase of oil at 440′.

1200 Phillips & Taylor, No. 2. Pumping from 335′; small.

1200 Stewart lease, Ellicott Co. No oil until 750′ deep, when a five bbl. well was obtained.

Pine Grove township.

Patterson Well, No. 1.

1876.

Briggs farm, Pine Grove township, five miles north of Warren, and one mile south-south-east of Russellburg. This well is about 100 rods E. S. E. of Patterson, No. 2. Authority, D. R. W. Patterson.

Well mouth above ocean, in feet,		1434
Conductor,	37 to 37 =	1397
?,	443 to 480 =	954
1st SS., white,	22 to 502 =	932
?,	108 to 610 =	824
2d SS.,	20 to 630 =	804
?,	80 to 710 =	724
3d SS., show of oil,	40 to 750 =	684

Cased at 150′. Unproductive.

Russellburg Well, or Patterson, No. 2.

Spring of 1877.

Situated on Thos. Briggs' farm, Russelburg, 100 rods west north-west of Patterson No. 1. Owned by J. B. Jennings and others. Authority, D. R. W. Patterson.

Well mouth above ocean, in feet,		1235±
Drive pipe,	127 to 127 =	1108
Gray shale,	23 to 150 =	1085
Red shale,	20 to 170 =	1065
Gray shale,	230 to 400 =	835
1st SS., shelly,	143 to 543 =	692
2d SS., fine, close, muddy,	100 to 643 =	592
?, soft drilling, some shells,	142 to 785 =	450
3d SS., heavy gas,	8 to 793 =	442
Slate, sandy, a few shells,	312 to 1105 =	130

Cased at 322′. Salt water at 315′, none below. Very heavy gas at 786. No oil.

Niver Well.

May, 1877.

On the C. Niver farm in Pine Grove township, about one mile and a half north-east of Russelburg. Authority, Mr. Niver, per F. A. Randall.

Well mouth above ocean, in feet,		1694
?,	740 to 740 =	954
SS., grey, soft,	18 to 758 =	936
?,	92 to 850 =	844
SS., blue, hard, fine,	35 to 885 =	809
?,	115 to 1000 =	694
SS., white, "like flour,"	20 to 1020 =	674

A dry hole.

Weeks or Fentonville Well.

Spring of 1877.

Located on the east bank of Conewango creek, Pine Grove township, a short distance below Fentonville, and 200 feet south of the New York and Pennsylvania State line. Authority, D. Palmer, one of the owners.

Well mouth above ocean, in feet,		1240
Drive pipe, { Blue clay, . . . 245′, Gravel and clay, 25, Soft rock, . . 6, }	276 to 276 =	964
SS., blue, "mixed with white pebbles,"	29 to 305 =	935
Slate, soft, (cased first time at 330′,)	125 to 430 =	810
Hard shell and salt water at	430 =	
?,	44 to 474 =	766
SS., grey; (smell of oil,)	20 to 494 =	746
?,	2 to 496 =	744
Hard shell and salt water at	496 =	
?,	44 to 540 =	700
Salt water, (well filled up with it,) at	540	
SS.,	46 to 586 =	654
Slate; (cased second time at 590′,)	94 to 680 =	560
SS., grey,	20 to 700 =	540
Slate and sand shells,	385 to 1085 =	155

SS., very good, ...	10 to 1095 =	145
Slate, ...	80 to 1175 =	65
Red rock, (a little gas,)	10 to 1185 = +	55
Slate and shells, ...	535 to 1720 = —	480
Red rock, very dark, (more gas,)	15 to 1735 = —	495
Slate and sand shells, ...	95 to 1830 = —	590

The indications of oil in this well were so unsatisfactory that it was abandoned without testing.

In reply to a letter of inquiry concerning the drive pipe, Mr. Palmer says:

"No water was found while driving the long string of pipe in this well and it was always necessary to pour water in at the top while cleaning out. After driving about 100 feet we cleaned out every joint as it was driven and often found the pipe filled up 30 or 40 feet. Could not drill below the casing for the walls would cave in. [This looks like quicksand.] Got no water in the gravel bed. Struck bed-rock at 270′, drilled ahead and drove the pipe six feet into it. The hole was dry so that we had to put water in to drill with down to 280 feet, where water came in and rose at once to within about 100 feet of the casing head.

GROUP III.

Wells in Pleasant township, Warren county.

*Dingley Well, No. 2.**

1874.

Sill run, Pleasant township, 40 rods south of No. 4. Authority, Capt. A. Dingley, per F. A. Randall.

Well mouth above ocean, in feet,		1259
?,	600 to 600 =	659
2d SS.,	28 to 628 =	631
?,	110 to 738 =	521
3d SS.,	80 to 818 =	441

Below 3d SS., blue shales. Small show of oil, mud and gas, in 3d SS.

Dingley Well, No. 4.

1875.

Sill run, Pleasant township, 40 rods south of No. 6. Authority, Capt. A. Dingley, per F. A. Randall.

Well mouth above ocean, in feet,		1343
?,	690 to 690 =	653
2d SS.,	31 to 721 =	622
?,	115 to 836 =	507
3d SS.,	48 to 884 =	459
Shales,	16 to 900 =	443

Unproductive.

Dingley Well, No. 6.

1877.

Near mouth of Sill run, Pleasant township, 2½ miles south-west of Warren. Authority, Capt. A. Dingley, per F. A. Randall.

Well mouth above ocean, in feet,		1226
?,	485 to 485 =	741
1st SS.,	15 to 500 =	726
?,	82 to 582 =	644
2d SS.,	4 to 586 =	640
?,	114 to 700 =	526
SS.,	4 to 704 =	522
?,	27 to 731 =	495
3d SS.,	65 to 796 =	430

Third sand, good quality. Small production of oil for a short time. Unremunerative.

* For Dingley, No. 3, see II, page 194.

Watson township.

Shaw Bros. & Green Well.

1878.

On warrant, No. 573, Watson township, about 10 miles north-east by east of Tidioute, and 8 miles south-west of Warren. Authority, J. M. Clapp.

Well mouth above ocean, in feet, (barometer,)			1755
?, (cased at 150′,)	408 to	408 =	1347
1st SS.,	10 to	418 =	1337
?,	110 to	528 =	1227
2d SS.,	15 to	543 =	1212
?,	116 to	659 =	1096
3d SS., (water, with show of oil,)	6 to	665 =	1090
?,	613 to	1278 =	477
4th SS.,	28 to	1306 =	449
?,	86 to	1392 =	363
5th SS.,	33 to	1425 =	330
?,	67 to	1492 =	263
6th SS.,	30 to	1522 =	233
?,	78 to	1600 =	155
7th SS.,	25 to	1625 = +	130
—?, (sand and shells at 1640′,)	175 to	1800 = —	45
8th SS., (some red rock at about 1800′,)	40 to	1840 = —	85
?,	66 to	1906 = —	151
9th SS.,	10? to	1916 = —	161
?,	20 to	1936 = —	181

Unproductive.

Vicinity of Stoneham, Mead Township.

Tolles' Well, No. 1.

Jan. 12, 1878.

Bugbee Lands, south-westerly part of warrant No. 55, Mead township, three fourths mile south-east of Stoneham station P. & E. R. R. and 5 miles south-east of Warren. Authority, Mr. Tolles, per F. A. Randall.

Well mouth above ocean, in feet,			1435
?,	25 to	25 =	1410
SS., gray, fine,	10 to	35 =	1400
Slaty sands,	15 to	50 =	1385
Red shales,	10 to	60 =	1375
Light shale,	55 to	115 =	1320
Blue shale,	10 to	125 =	1310
SS.,	25 to	150 =	1285
Blue slaty sands,	30 to	180 =	1255
Blue sands, coarse and hard,	20 to	200 =	1235
Shale or slate,	10 to	210 =	1225

Red rock,	40 to	250 =	1185
Blue shale and slate,	100 to	350 =	1085
SS., black, fine,	70 to	420 =	1015
Red rock,	30 to	450 =	985
Shaley sands,	30 to	480 =	955
Red rock,	20 to	500 =	935
Shales, blue, sandy,	80 to	580 =	855
Purple shales,	20 to	600 =	835
Blue shales,	20 to	620 =	815
Dark sand,	50 to	670 =	765
Dark shales,	80 to	750 =	685
Dark sand,	50 to	800 =	635
Shales,	83 to	883 =	552
Sand,	25 to	908 =	527
Shale,	85 to	993 =	442
Sand,	32 to	1025 =	410

Oil struck at 1003′ 10″ in sand, sand course with pebbles, producing about 10 barrels. Afterwards torpedoed and much improved.

Struthers' Well.

1878.

On north-east corner of Grossenburg farm, tract 467, Mead township; about one fourth of a mile south-west of Stoneham. Authority, the drillers, per F. A. Randall.

Well mouth above ocean, in feet,			1460±
Drive pipe,	43 to	43 =	1417
Shale,	23 to	66 =	1394
SS., pebbly,	9 to	75 =	1385
Shale,	125 to	200 =	1260
SS., pebbly,	25 to	225 =	1235
Red rock,	5 to	230 =	1230
Shale, blue,	770 to	1000 =	460
2d SS.,	30 to	1030 =	430
Shale, soft,	25 to	1055 =	405
3d SS., (oil,)	75 to	1130 =	330

Production, 5 to 10 barrels per day.

Logan Well.

June, 1878.

On the north-east corner of the Ridelsparger farm, tract 496, Mead township about three fourths of a mile south-east of Stoneham. Authority, Mr. S. B. Logan, per A. B. Howland.

Well mouth above ocean, in feet,			1510 ?
Drive pipe,	40 to	40 =	1470
?, (cased at 286′,)	775 to	815 =	695

1st SS.,	25 to	840 =	670
?,	100 to	940 =	570
2d SS., (gas at 988′,)	137 to	1077 =	433
Shale, soft,	4 to	1081 =	429
3d SS., (pebbly from 1081′ to 1086′, *oil,*)	59 to	1140 =	370
Shale,	114 to	1254 =	256

Production about two barrels per day. Oil light amber color; gravity 48°.

Turner & Duncan Well.

1877.

In the valley of Morrison run, in Mead township, 2¾ miles south-east of Warren, and on lands belonging to the estate of Alanson Rogers, deceased. Authority, the drillers, per F. A. Randall.

Well mouth above ocean, in feet,			1235
?,	830 to	830 =	405
SS., gray,	15 to	845 =	+ 390
?,	640 to	1485 =	— 250
SS., (top white, bottom very dark,)	115 to	1600 =	— 365

The Warren 3d sand was not noticed in drilling, and the well was abandoned as a dry hole; but it was afterwards carried down to 1600′ as a test of the lower rocks. No good sands were found. A little show of oil appeared at 1500′, but not enough to indicate that it could be made a paying well. Consequently the hole was never torpedoed or tubed.

Brown Bros.' Well.

Nov., 1878.

On Hook's run, Warrant No. 35, Mead township, about 4 miles south-east of Warren. Authority, the drillers, per F. A. Randall.

Elevation of well mouth above ocean, (aneroid,)			1325
?,	50 to	50 =	1275
SS.,	25 to	75 =	1250
?,	50 to	125 =	1200
Red rock,	15 to	140 =	1185
?,	130 to	270 =	1055
Red rock,	20 to	290 =	1035
?,	50 to	340 =	985
SS.,	5 to	345 =	980
?,	80 to	425 =	900
Red rock,	25 to	450 =	875
?,	105 to	555 =	770
SS., (gas,)	5 to	560 =	765
?,	58 to	618 =	707

SS., (gas,)	10 to 628 =	697
?, (mud vein and gas at 648′,)	85 to 713 =	612
SS., (gas,)	15 to 728 =	597
?,	82 to 810 =	515
SS., white,	15 to 825 =	500
?, (from 870′ to 970′, shelly, with gas,)	155 to 980 =	345
SS., very dark,	25 to 1005 =	320
Black, hard rock to bottom of well,	115 to 1120 =	205

Berry Well, No. 1.

1879?

At the head of Dutchman's run, and near the S. W. corner of Warrant No. 76, Mead township, Warren county.

Well commences very near the base of the sub-conglomerate, the flat pebbles of which are exposed in a steep pitch in the road, just west of the well. The spring supplying the well with water appears to issue from the sub-cong. Above it lie bands of yellow SS. and shale, full of large Waverly ? spirifers.

Imperfect record given by Mr. Berry.

Well mouth above ocean, in feet, (barometric,)		1710
?,	1226 to 1226 =	484
"Stray sand,"	56 to 1282 =	428
Slate,	10 to 1292 =	418
"3d SS.," { 15′ white, 43′ gray, }	58 to 1350 =	360
Pocket,	5 to 1355 =	355

Well put down and abandoned without testing. Opened up and torpedoed Oct. 7–10, 1880, but only resulted in a production of about one barrel per day.

Sheffield Township.

Hague, or "Sheffield Gas Well," No. 1.

Sept., 1875.

Two and a half miles east of Sheffield Station, on land of Horton & Co., Sheffield township, Warren county. Record given by Mr. Horton, Sept. 20, 1877. See record previously published, No. 1037, II.

Well mouth above ocean, in feet, (barometer,)		1440
Conductor,	16 to 16 =	1424
?, some red rock,	434 to 450 =	990
1st SS., salt water, no oil,	10 to 460 =	980
?,	590 to 1050 =	390
2d SS., amber oil, sooty gas,	15 to 1065 =	375
?,	85 to 1150 =	290
3d SS., green oil and gas,	5 to 1155 =	285
?, some red rock,	195 to 1350 =	90

4th SS., some pebbles, "Big gas vein,"	45 to 1395 = +	45
?,	100 to 1495 = —	55
5th SS., close, green oil, light gravity,	6 to 1501 = —	61
Soft drilling to bottom,	144 to 1645 = —	205

"The Second sand was called pumice-stone, and furnished a sufficient quantity of smoky gas to fire the boiler from this point down."

"The Fourth sand contained no oil. It was coarse and pebbly on top 25′; close and slaty on bottom 20′." See Mr. Hague's record, II, page 193.

Hague Well, No. 2.—Gas Well.

1876-7.

On McNair farm, about one mile east of Sheffield, and a mile and a half south-west of Sheffield Gas Well, No. 1. Authority, Mr. Horton, and sand pumpings preserved in his office.

Well mouth above ocean, in feet,			1410±
Conductor,		12 to 12 =	1398
?, some red rock,		145 to 157 =	1253
SS., gray, soft,	(specimen 1,)	20 to 177 =	1233
?,		699 to 876 =	534
SS., gray, soft,	(" 2,)	6 to 882 =	528
?,		158 to 1040 =	370
SS., gray,	(" 3,)	15 to 1055 =	355
?,		88 to 1143 =	267
SS., gray,	(" 4,)	25 to 1168 =	242
?,		170 to 1338 =	72
SS., yellow-white, coarse, (gas,)	(" 5,)	20 to 1358 = +	52
?,		117 to 1475 = —	65
SS., gray and hard,	(" 6,)	43 to 1518 = —	108
?,		32 to 1550 = —	140

Gas from SS., 1338′ to 1358′, but not $\frac{1}{5}$ as much as from well No. 1. No oil except drippings from gas pipe.

Specimens Nos. 5 and 6 might be considered very fair oil sands. They somewhat resemble the yellowish Venango sands. The others appear in color and composition like the Warren sands.

"Barnesille Gas Well."

1879.

Belonging to the Onondaga Oil Company and located on land of E. Barnes near the center of warrant No. 367, Sheffield township, Warren county. Commenced August 29, 1878, and completed February 10, 1879. Record compiled from drillers' diary furnished by Mr. T. E. Barnes, May, 1879.

Well mouth above ocean, in feet, (barometer,)						1360
Conductor, clay and gravel, 47½′; ?, 19′=	66½	to	66½	=		1293½
SS., hard,	3½	to	70	=		1290
Red rock, soft,	11	to	81	=		1279
SS., very hard,	2	to	83	=		1277
Hard rock,	4	to	87	=		1273
Slate, very hard,	13	to	100	=		1260
Slate, soft,	20	to	120	=		1240
Red rock,	55	to	175	=		1185
Slate,	10	to	185	=		1175
Shell, hard,	2	to	187	=		1173
Slate, (cased at 200′,)	13	to	200	=		1160
Slate and shell, "two streaks, 25′,"	50	to	250	=		1110
Slate, blue, with hard streaks,	90	to	340	=		1020
Slate, blue,	110	to	450	=		910
Slate, soft,	80	to	530	=		830
Slate, shelly, hard,	110	to	640	=		720
?, (probably shelly,) gas and salt water at 672′,	68	to	708	=		652
Slate and shells,	40	to	748	=		612
Slate, with hard shells and *red* streaks,	18	to	766	=		594
Slate, blue, soft,	59	to	825	=		535
Slate, with hard shells,	45	to	870	=		490
Slate, with a few hard shells,	90	to	960	=		400
SS., dark,	45	to	1005	=		355
Slate, blue,	57	to	1062	=		298
SS., pebbly,	17	to	1079	=		281
Slate, blue,	43	to	1122	=		238
SS., white, *large flow of gas*,	18	to	1140	=		220
Slate, blue,	68	to	1208	=		152
Shells, 2′ at bottom, very hard,	6	to	1214	=		146
Slate, blue,	66	to	1280	=	+	80
Slate, soft, with hard shells,	95	to	1375	=	—	15
SS., oil show,	10	to	1385	=	—	25
Slate with hard shells,	15	to	1400	=	—	40
Red shell,	1	to	1401	=	—	41
Slate, soft, with shells,	99	to	1500	=	—	140
SS., top shelly,	25	to	1525	=	—	165
Slate,	17	to	1542	=	—	182
Shells,	7	to	1549	=	—	189
Slate and shells,	27	to	1576	=	—	216
Slate,	24	to	1600	=	—	240

This well was first drilled to 1500′ and then sunk 100′ deeper. No oil was obtained, but the heavy flow of gas at 1125′ still continues, (April, 1882.)

Magee & Horton Well, No. 1.

April, 1881.

On J. Donaldson farm, tract 408, (E. side,) Sheffield township, Warren county, 3 miles S. of Sheffield. Authority, H. C. Marsh, (driller,) Bear Lake.

Well mouth above ocean, in feet, (barometer,)				1355±
Drive pipe,	85	to	85 =	1270
SS.,	50	to	135 =	1220
Red rock,	*100*	to	235 =	1120
SS., dark gray, salt water,	40	to	275 =	1080
Red rock,	*40*	to	315 =	1040
Slate and shale cased at 385′, (salt water, 400′,)	400	to	715 =	640
SS., "good,"	40	to	755 =	600
Slate and shale,	330	to	1085 =	270
SS., "good,"	25	to	1110 =	245
Slate and sand shells,	90	to	1200 =	155
SS., small pebbles, *gas,*	20	to	1220 = +	135
Slate and sand shells,	165	to	1385 = —	30
Soft slate, white,	15	to	1400 = —	45
SS., white, quartz; oil and gas,	35 ±	to	1435 = —	80

Production at first about 50 barrels per day.

Cherry Grove Township.

Landsrath Well.

December, 1879.

On the farm of Montgomery Farnsworth, warrant No. 668, Cherry Grove township, about 6½ miles south-east of the Shaw Bros. & Green well. Authority, H. Landsrath.

Well mouth above ocean, in feet, (aneroid,)				1865
Conductor, Surface clay, &c.,	16	to	16 =	1849
Conductor, Coal and rock, (coal 2″,)	2	to	18 =	1847
?, (cased at 338,)	424	to	442 =	1423
1st SS., (gas sufficient to fire boiler,)	8	to	450 =	1415
?,	85	to	535 =	1330
2d SS.,	45	to	580 =	1285
?,	200	to	780 =	1085
3d SS.,	20	to	800 =	1065
?,	172	to	972 =	893
4th SS.,	8	to	980 =	885
?,	235	to	1215 =	650
5th SS.,	35	to	1250 =	615
?,	240	to	1490 =	375
6th SS,	30	to	1520 =	345
?,	80	to	1600 =	265
7th SS.,	25	to	1625 =	240
?, show of gas at 1800′,	217	to	1842 =	23
8th SS.,	8	to	1850 = +	15
?,	154	to	2004 = —	139

"We had several red slate formations." Unproductive.

Badger Well.

1878.

Located on warrant No. 745, in Cherry Grove township, Warren county, on or near Minister run, and about 3 miles northeast of Berry well, at Ball-town, on Tionesta. Authority, Mr. Green, one of the drillers. Communicated to A. B. Howland, (Feb., 1879.) Elevation said to be 370′ above Berry well.

			Berry well =	1250
			+	370
Well mouth above ocean, in feet,				1620
?,	400	to	400 =	1220
SS., say	20 ±	to	420 =	1200
?,	280	to	700 =	920
SS., white, say	10 ±	to	710 =	910
?,	490	to	1200 = +	420
Dry crevice draining the well at			1200	
?, to bottom of well;	677	to	1877 = −	257

Unproductive.

Kinzua Township.

Van Scoy Well.

1879.

Wolf Creek, Kinzua township. About three fourths of a mile E. of Kinzua Corners. Authority, Dr. Van Scoy; from memory.

Well mouth above ocean, in feet, (aneroid,)				1295
Drive pipe.				
?,	—	to	80 =	1215
Red rock,	90	to	170 =	1125
Slate, uniform in composition,	255	to	425 =	870
SS., gray,	13	to	438 =	857
Slate, (Bradford type,)	147	to	585 =	710
SS.,	15	to	600 =	695
Slate,	125	to	725 =	570
SS., and some gas, which soon stopped,	10	to	735 =	560
Slate and red rock,	140	to	875 =	420
SS., (oil and gas show,)	25	to	900 =	395
Soft drilling,	148	to	1048 =	247

Shelly below this as far as drilled, but how much deeper the drill went is unknown.

Cased at 186′ just after passing the first red rock. But little gas in the hole, (April 24th, 1879,) and apparently not much fluid. Gas looks like smoke, and rises heavily as smoke does.

Smith Well, Widow Morrison Farm.

Kinzua Creek, Kinzua township, near McKean county line. Drilled to 760′ in 1862, to 860′ in 1863, to 1010′ in 1864, and to 1085′ in 1876. (From owner's record book, Mr. Smith.)

Well mouth above ocean, in feet, about			1260
Drive pipe, (2′ quicksand at 64′,)	68 to	68 =	1192
Sand shell,	2 to	70 =	1190
Red rock,	20 to	90 =	1170
Slate,	110 to	200 =	1060
Red rock and slate,	150 to	350 =	910
Mud rock with hard shells,	15 to	365 =	895
SS.,	20 to	385 =	875
Shale and soapstone,	113 to	498 =	762
SS.,	32 to	530 =	730
Slate,	13 to	513 =	717
" with shells,	47 to	590 =	670
SS., "3d SS.,"	25 to	615 =	645
Slate,	32 to	647 =	613
Shells,	53 to	700 =	560
Shelly sand,	58 to	758 =	502
?,	161 to	919 =	341
SS., dark, (some oil at 919,)	10 to	929 =	331
?, (some sand said to have been found,)	156 to	1085 =	175

Show of oil at 760 and 919. Seed bag at 373′. Wet hole. Unproductive. Not tested after 1010.

Beatty Well.

1879.

On tract No. 48, Kinzua township, Warren county, (near Centre.) Authority, Mr. Beatty, (note book.)

Well mouth above ocean, in feet, (Mr. Beatty, by aneroid,)			1905
Conductor,	51½ to	51½ =	1853½
?,	28½ to	80 =	1825
SS., surface sand,	25 to	105 =	1800
?,	45 to	150 =	1755
SS., pebbly,	8 to	158 =	1747
Shelly measures, (cased 296½,)	242 to	400 =	1505
Red rock,	50 to	450 =	1455
?,	30 to	480 =	1425
SS., hard, (pebbly and white at bottom,)	8 to	488 =	1417
?, (salt water at 575′,)	87 to	575 =	1330
SS.,	15 to	590 =	1315
"*Pink rock,*"	510 to	1100 =	805
Putty rock,	20 to	1120 =	785
Sand shells,	37 to	1157 =	748
Putty rock, white,	143 to	1300 =	605
Sand shells,	57 to	1357 =	548
Putty rock, white, and slate,	90 to	1447 =	458

Sand shells and slate,	20	to 1467	=	438
" " "	57	to 1524	=	381
SS., top pebbly, (little oil and gas,)	8	to 1532	=	373
Putty rock, (shelly at the top,)	268	to 1800	=	105
SS.,	15	to 1815	=+	90
Putty rock and slate,	406	to 2221	=—	316
SS., Red, "gas and oil," ("supposed to be Bradford 3d,")	5	to 2226	=—	321
Slate, soft, (to bottom,)	59	to 2285	=—	380

Unproductive.

Logan Well.

August, 1879.

On Warrant No. 72, Kinzua township, Warren county, about 5 miles E. by N. of Clarendon station. Authority, Mr. Logan, per A. B. Howland.

Elevation of well mouth above ocean, in feet, said to be about 1800

Conductor,		30 to	30
?,		35 to	65
SS., yellowish, pebbly,	(specimen 1,)	4 to	69
?,		116 to	185
SS., yellow-gray, some pebbles,	(" 2)	56 to	241
SS., dark blue gray, fine, cased at 304′,	(" 3)	66 to	307
?,		13 to	320
Red rock, gritty shale (purplish and green,)	(" 4,)	10 to	330
(Chocolate,) SS., fine micaceous, shaly,	(" 5,)	14 to	344
?, Probably red,		31 to	375
Red, same as 14′ rock above; probably,	(" 6,)	40 to	415
" like above, but turning to gray, probably near bottom of red rock,	(" 7,)	10 to	425
?,		848 to	1273
SS., gray sand,		16 to	1289
?,		61 to	1350
SS., some small pebbles,		6 to	1356
?,		14 to	1370
SS., gray sand,		13 to	1383
?,		57 to	1440
SS., gray, fine,		20 to	1460
Shells and gray slate,		140 to	1600
Soft rock,		15 to	1615
Shells and gray slate,		70 to	1685
Soft rock,		18 to	1703
Shell and gray slate,		172 to	1875
SS., gray,		6 to	1881
Thin shells and soft rock,		124 to	2005
Thin shells and soft dark slate,		200 to	2205
SS., dark brown, smell of oil and gas,		4 to	2209
Slate, dark, to bottom of well,		31 to	2240

Unproductive.

Elk township.

Hodge Run Well.

1878.

Located on south branch of Hodge run, Elk township, Warren county, three quarters of a mile E. by N. from Quaker Hill coal bank, north drift—the elevation of which is 2000′ A. T. Well mouth 396′ below coal. Authority, record and level from coal, F. A. Randall.

Well mouth above ocean, in feet,			1604
Conductor,	15 to	15 =	1589
?,	35 to	50 =	1554
SS., hard, blue,	25 to	75 =	1529
Shale,	125 to	200 =	1404
Red rock, shale, (cased at 214′,)	12 to	212 =	1392
Shale, with sandy layers and soft red bands,	288 to	500 =	1104
Shale, soft,	300 to	800 =	804
Sand shell,	4 to	804 =	800
Shale, soft,	26 to	830 =	774
?,	20 to	850 =	754
SS., top 35′, dark, coarse; 10′, white, soft,	45 to	895 =	709
Shale,	105 to	1000 =	604
"3d SS.," white, coarse, (slight oil show at 1030′,)	50 to	1050 =	554
Shale, with hard shells,	390 to	1440 =	164
SS., dark,	10 to	1450 =	154
Shale, with hard blue flags,	50 to	1500 =	104

No gas; no oil; abandoned without testing.

GROUP IV.

Wells of the Economy Society at and near Tidioute, Limestone township, Warren county.

NOTE.—These records were copied from the company's books, by H. Martyn Chance, September, 1877.

Centre Well.

February 5, 1872.

Well mouth above ocean,	1556
Drive pipe,	43 to 43 = 1513
?,	23 to 66 = 1490
Stray, Mt. SS., water at 7′,	12 to 78 = 1478
?,	295 to 373 = 1183
Red rock,	3 to 376 = 1180
1st SS., (shelly,)	48 to 424 = 1132
?,	29 to 453 = 1103
2d SS.,	18 to 471 = 1085
?,	69 to 540 = 1016
3d SS.,	18 to 558′ = 998
?, pocket,	4 to 562 = 994

Started at 14 barrels, now doing 5 barrels.

Mud vein, good oil show at 555′, oil show at 544′. Cased at 200′.

Centre Well, No. 1.

?,	386 to 386
1st SS.,	31 to 417
Shells,	55 to 472
?,	64 to 536
3d SS.,	23 to 559
?, pocket,	3 to 562

Cased at 199′. Started at 5 barrels. Abandoned.

Centre Well, No. 2.

	1508
?,	336 to 336′ = 1172
1st SS., (estimated,)	30 to 366′ = 1142
Shells,	65 to 431′ = 1077
?,	67 to 498 = 1010
3d SS.,	11 to 509 = 999
?, pocket,	3 to 512 = 996

Cased at 175′. Started at 1 barrel, torpedoed and brought up to 25 barrels, now doing 2 barrels.

Centre Well, No. 3.

?,	341 to 341
1st SS., "say,"	30 to 371
2d SS.,	53 to 424
?,	78 to 502
3d SS.,	18 to 520
?, pocket,	6 to 526

Cased at 176′. Started at 8 barrels. Abandoned.

Centre Well, No. 4.

2d SS.,	— to 500
?,	68 to 568
3d SS.,	16 to 584
?, pocket,	4 to 588

Cased 196′. Fair sand, no oil.

Centre Well, No. 5.

2d SS.,	— to 527′
?,	64 to 591
3d SS.,	16 to 607
?, pocket,	4 to 611

Cased 239′. Show of oil.

Centre Well, No. 6.

?,	520 to 520
1st SS.,	25 to 545
2d SS.,	57 to 602
?,	64 to 666
3d SS.,	16 to 682
?, pocket,	4 to 686

Cased 272′. Show of oil.

Centre Well, No. 7.

2d SS.,	— to 555
?,	80 to 635
3d SS.,	17 to 652
?, pocket,	3 to 655

Cased 254′. Started $2\frac{1}{2}$ barrels. Now abandoned.

Centre Well, No. 8.

2d SS.,	— to 524
?,	70 to 594
3d SS.,	15 to 609
?, pocket,	3 to 612

Cased 210′. Show of oil.

Centre Well, No. 9.

2d SS.,	— to 575
?,	70 to 645
3d SS.,	15 to 660
?, pocket,	4 to 664

Centre Well, No. 10.

2d SS.,	— to 540
?,	78 to 518
3d SS., say	16 to 534

Cased 160′. Started at 3 bbls. Now abandoned.

Centre Well, No. 11.

	1509
2d SS.,	— to 402 = 1107
?,	92 to 494 = 1015
3d SS.,	16 to 510 = 999
?, pocket,	4 to 514 = 995

Cased at 150′. Mud vein at 500′. Started at 20 bbls.; now doing 3 bbls.

Centre Well, No. 12.

	1501
2d SS.,	— to 413 = 1088
?,	75 to 488 = 1013
3d SS.,	12 to 500 = 1001

Cased at 150′. Started at 10 bbls.; now doing 2 bbls. Mud vein 492′.

Centre Well, No. 13.

2d SS.,	— to 449
?,	72 to 521
3d SS.,	14 to 535
?, pocket,	3 to 538

Cased at 275′. Started at 12 bbls. Now abandoned.

Centre Well, No. 14.

	1528
2d SS.,	— to 443 = 1085
?,	73 to 516 = 1012
3d SS.,	16 to 532 = 996
?, pocket,	5 to 537 = 991

Cased 159′. Started at 12 bbls.; now doing 1½ bbls.

Centre Well, No. 15.

2d SS.,	— to 575
?,	65 to 640
3d SS.,	14 to 654

Cased at 242′. Dry hole. South of other wells.

Centre Wells, Nos. 16 and 17.

Dry. No record.

Nos. 16, 17, and 18 were dry, and were N. W. from other wells.

Centre Well, No. 18.

	1565
2d SS.,	— to 483 = 1082
?,	65 to 548 = 1017
3d SS.,	15 to 563 = 1002
?, pocket, (dry hole; cased 203′,)	1 to 564 = 1001

Centre Well, No. 19.

2d SS.,	— to 469
?,	76 to 545
3d SS.,	15 to 560
?, pocket,	1 to 561

Cased at 200′. Started at 8 bbls. Now abandoned.

Centre Well, No. 20.

	1537
2d SS.,	— to 453 = 1084
?,	70 to 523 = 1014
3d SS.,	16 to 539 = 998
?, pocket,	1 to 540 = 997

Cased at 189′. Started at 15 bbls.; now doing 4 bbls.

Centre Well, No. 21. "B."

Aug., 1876.

Conduotor,	18 to 18=
2d SS.,	— to 475=
?,	20 to 495=
Stray, "say" 10′,	10 to 505=
?,	54 to 559=
3d SS.,	19 to 578=
?, pocket,	3 to 581=

Near N. E. corner Irvine tract. Cased at 197′ and 176′. Started at 7 bbls.; now doing 2½.

Centre Well, No. 21.

March, 1876.

		1629
Drive pipe,	41 to 41	= 1588
?,	510 to 551	= 1078
Stray SS., "say"	10 to 561	= 1068
?,	55 to 616	= 1013
3d SS.,	6 to 622	= 1007
?, pocket,	25 to 647	= 982

Cased at 251′. Show of oil.

Centre Well, No. 22.

Oct., 1876.

Conductor,	18 to 18
2d SS.,	— to 445
?,	20 to 465
Stray SS., "say"	10 to 475
?,	54 to 529
3d SS.,	14 to 543
?, pocket,	4 to 547

Cased at 198′. Dry hole. Near Cushing old and new wells.

Centre Well, No. 23.

Oct., 1876.

Conductor,	23 to 23
2d SS.,	— to 456
?,	20 to 476
Stray SS., "say"	10 to 486
?,	62 to 548
3d SS., good coarse sand,	20 to 568
?, pocket,	11 to 579

Cased at 196′. Dry hole.

Centre Well, No. 24.

Nov., 1876.

Conductor,	22 to 22
2d SS.,	— to 479
?,	6 to 485
Stray SS., "say	15 to 500
?,	62 to 562
3d SS.,	20 to 582

Centre Well, No. 25.

March, 1877.

Conductor,	23 to 23
?,	592 to 615
3d SS.,	15 to 630
?, pocket,	13 to 643

Cased. Dry hole. Torpedoed with ½ gal. glycerine, with no benefit.

NOTE.—The "Centre" Wells are all on the south-western part (corner) of Tract 5277. The oil produced by them is much darker than the oil from No. 8 and No. 9, Fisher Lease.

Dry Hole Well.

April, 1876.

South of old field, Warren Road, tract 5205.

Conductor,	27 to 27
?,	503 to 530
1st SS.,	20 to 550
Red rock, "say,"	5 to 555
?,	35 to 590
Stray,	30 to 620
?,	75 to 695
Shell, "say,"	2 to 697
?,	46 to 743

Warren Road Well, No. 1.

May, 1877.

Tract 5279,	1665
Conductor,	22 to 22 = 1643
?,	198 to 220 = 1445
Mt. SS., "say,"	30 to 250 = 1415
?,	310 to 560 = 1105
Stray, "say,"	10 to 570 = 1095
?,	80 to 650 = 1015
3d SS., stopped in dark sand,	18 to 668 = 997

Started at 4 barrels, now doing 2 barrels, torpedoed at 653′ with no benefit.

Warren Road Well, No. 3.

August 31, 1877.

Tract 5279,	1669
Conductor,	43 to 43

Just struck; record not filled; doing 2 barrels.

Warren Road Well, No. 2.

July, 1877.

Tract 5279,	1655
Conductor,	10 to 10 = 1645
?,	210 to 220 = 1435
Hard shell and pebbles, "say,"	25 to 245 = 1410
?,	306 to 551 = 1104
Stray, SS., "say,"	10 to 561 = 1094
?,	84 to 645 = 1010
3d SS.,	16 to 661 = 994

First three days' production 1¼ barrels per day, torpedoed with 89 pounds nitro-glycerine with no benefit, now doing about 1 barrel.

Shingle Mill Well.

South of center of tract 5222,	1422
?,	166 to 166 = 1256
1st SS.,	8 to 174 = 1248
?,	9 to 183 = 1239
2d SS.,	7 to 190 = 1232
?,	10 to 200 = 1222
3d SS.,	6 to 206 = 1216
?, *red rock*, (at 207',)	13 to 219 = 1203
4th SS.,	24 to 243 = 1179
?,	28 to 271 = 1151
5th SS.,	11 to 282 = 1140
?,	117 to 399 = 1023

Dry.

Saw Mill Well, No. 1.

South of center of tract 5206, ¼ m. S. W. of No. 2,	1490
Conductor,	17 to 17 = 1473
?,	214 to 231 = 1259
1st SS.,	36 to 267 = 1223
Red rock,	6 to 273 = 1217
SS.,	7 to 280 = 1210
?,	10 to 290 = 1200
2d SS.,	15 to 305 = 1185
Soft and hard shell rock,	29 to 334 = 1156
3d SS.,	14 to 348 = 1142
?,	26 to 374 = 1116
4th SS., "say,"	10 to 384 = 1106
?,	93 to 477 = 1013
5th SS.,	8 to 485 = 1005
?,	125 to 610 = 880

Soot and gas at 348'; mud vein at 379'. "Tubed at 348." No oil.

Saw Mill Well, No. 2.

S. of center of tract 5206; no oil,	1534
?,	283 to 283 = 1251
1st SS.,	20 to 303 = 1231
?,	35 to 338 = 1196
2d SS.,	14 to 352 = 1182
?,	15 to 367 = 1167
3d SS.,	12 to 379 = 1155
?,	6 to 385 = 1149
4th SS.,	9 to 394 = 1140
?,	34 to 428 = 1106
5th SS.,	32 to 460 = 1074
?,	60 to 520 = 1014
Pebble shell, say,	2 to 522 = 1012
?,	34 to 556 = 978

Jay Buck Well, No. 1.

February, 1871.

?,	340 to 340
1st SS.,	20 to 360
?,	42 to 402
2d SS.,	8 to 410
?,	50 to 460
3d SS.,	10 to 470
?,	90 to 560
4th SS., mud vein at 465′,	5 to 565
?,	135 to 700

Jay Buck Well, No. 2, (center of tract 5205.)

?,	260 to 260
1st SS.,	10 to 270
?,	305 to 575
2d SS.,	6 to 581
?,	17 to 598
3d SS., mud vein at 620′,	25 to 623
?,	92 to 715

Hemlock Well, (east part tract 5277.)

?,	184 to 184
1st SS.,	16 to 200
?,	34 to 234
2d SS.,	19 to 255
?,	80 to 335
Shell and pebbles, (say)	3 to 338
?,	162 to 500
Red rock, (say)	*5 to 505*

No oil.

Stone Well.

?,	120 to 120
2d SS.,	12 to 132
?,	12 to 144
Stray SS.,	8 to 152
?,	57 to 209
3d SS., best sand at 219′,	12 to 221
?, pocket,	8 to 229

Merkle, Moore & Co. Well.

?,	315 to 315
Red rock, "say"	*5 to 320*
?,	40 to 360
1st SS., "say"	20 to 380
?,	74 to 454
2d SS., "say"	15 to 469
?,	63 to 532
3d SS., mud veins at 536′ and 546′,	19 to 551

Good Will Well.

June, 1868.

Conductor,	22 to 22
?,	238 to 260
Stray SS.,	10 to 270
?,	42 to 312
2d SS., (seed bag,)	18 to 330
?,	79 to 409
3d SS., (436 ?,)	17 to 426
?,	4 to 430

Mud vein at 426′.

Good Luck Well.

Conductor,	19 to 19
?,	418 to 437
1st SS.,	13 to 450
?,	111 to 561
2d SS.,	15 to 576
?,	76 to 652
3d SS.,	18 to 670
?,	4 to 674

Wells on the Fisher Lease.

Well A. Fisher Lease.

Conductor,	24 to 24
?, (1st, 2d, and stray SS. irregular; only shelly,)	450 to 474
3d SS.,	14 to 488
?,	17 to 505

Dry; torpedoed, no oil show.

Well No. 8. Fisher Lease.

		1529
?,	281 to 281	= 1248
1st SS.,	19 to 300	= 1229
?,	63 to 363	= 1166
2d SS.,	17 to 380	= 1149
?,	139 to 519	= 1010
3d SS., ("say,")	16 to 535	= 994
?,	2 to 537	= 992

Well No. 9, "B." Fisher Lease.

		1555
?,	325 to 325	= 1230
1st SS., "say,"	20 to 345	= 1210
?, cased at 347′,	55 to 400	= 1155
2d SS.,	13 to 413	= 1142
?,	43 to 456	= 1099
Stray, "say,"	10 to 466	= 1089
?,	80 to 546	= 1009
3d SS.,	25 to 571	= 984
?,	5 to 576	= 979

NOTE.—*No. 8 Well* was a large well, probably 100 barrels, now doing 8 or 10 barrels. Drilled about 1870. *Well No. 9, "B,"* drilled about 1872, started very small, but after putting on large gas pumps came up to a 10 to 15 barrel well, now doing 8 or 10 barrels. These wells pump green oil.

Well No. 10. Fisher Lease.

Drive pipe,	19 to 19
?,	308 to 327
1st SS.,	11 to 338
?,	77 to 415
2d SS.,	15 to 430
?,	125 to 555
3d SS., "say,"	16 to 571
?,	4 to 575

Well No. 11. Fisher Lease.

?,	262 to 262
1st SS.,	16 to 278
?,	77 to 355
2d SS.,	9 to 364
?,	70 to 434
Stray SS.,	6 to 440
?.	62 to 502
3d SS.,	14 to 516
?,	1 to 517

Well No. 12, "C." Fisher Lease.

2d SS.,	— to 363
?,	47 to 410
Stray SS.,	20 to 430
?,	78 to 508
3d SS., mud veins at 512′ and 523′,	24 to 532
?,	4 to 536

Well No. 15. Fisher Lease.

?, (conductor 22′,)	180 to 180
1st SS.,	20 to 200
?,	71 to 271
2d SS.,	16 to 287
?,	39 to 326
3d SS.,	15 to 341
?,	79 to 420
4th SS., mud veins at 424′ and 435′,	24 to 444
?,	8 to 452

Well No. 11, "B." Fisher Lease.

?,	320 to 320
1st SS.,	15 to 335
?,	37 to 372
2d SS.,	25 to 397
?,	83 to 480
3d SS.,	20 to 500
?,	3 to 503

Well No. 4.

June, 1868.

?, conductor 38′,	260 to 260
1st SS.,	20 to 280
?,	125 to 405
2d SS.,	10 to 415
?,	76 to 491
3d SS.,	15 to 506
?,	14 to 520

Mud vein at 493′, 499′ and 504′. Seed bag at 405′. Tubed to 504′.

Well No. 4, "B."

?,	190 to 190
1st SS.,	20 to 210
?,	315 to 525
2d SS.,	35 to 560
?,	20 to 580
Stray 3d SS., mud vein at 590′,	16 to 596
?,	76 to 672
4th SS., mud veins at 674′ and 680′,	18 to 690
?,	7 to 697

Well No. 4, "C."

?,	80 to 80
1st SS.,	20 to 100
?,	248 to 348
2d SS.,	10 to 358
?,	73 to 431
3d SS.,	19 to 450
?,	40 to 490
Stray SS., mud vein at 495′,	10 to 500
?,	76 to 576
5th SS., large pebble mud vein at 579′ and 586′,	17 to 593
?,	7 to 600

Well No. 5, "B."

?,	270 to 270
1st SS., "say,"	20 to 290
?,	133 to 423
2d SS.,	11 to 434
?,	81 to 515
3d SS., large pebble at 537′,	30 to 545
?,	3 to 548

Cased at 312½′.

Well No. 7, "C."

?,	278 to 278
1st SS.,	32 to 310
?, hard shell and 2d SS.,	200 to 510
3d SS.,	30 to 540
?,	8 to 548

The record of the "hard shell" and 2d SS. in this well is exactly like that of *Well No. 14*, "*B*," so that it was not copied throughout.

Well No. 12, "B."

?,	312 to 312
1st SS., "say,"	20 to 332
?,	62 to 394
2d SS.,	16 to 410
?,	30 to 440
Stray, "say,"	10 to 450
?,	90 to 540
3d SS., soot at 555′,	22 to 562
?,	6 to 568

Cased at 348′.

Well No. 13, "B."

?, Conductor, 16′	280 to 280
1st SS., "say"	20 to 300
?,	106 to 406
2d SS.,	14 to 420
?,	88 to 508
3d SS.,	23 to 531
?,	3 to 534

Cased at 298′.

Well No. 14.

May 27, 1869.

Conduotor,	16 to 16
Slate,	19 to 35
SS.,	25 to 60
Slate and soapstone,	322 to 382
2d SS.,	24 to 406
Soapstone,	34 to 440
3d SS., mud vein at 444′,	14 to 454
Soapstone,	78 to 532
4th SS., pebble from 540 to 550′,	18 to 550
Soapstone,	7 to 557

Cased at 480′.

Well No. 6, "C. & S."

December, 1868.

?, Conductor, 26′,	165 to 165
1st SS.,	10 to 175
?,	137 to 312
2d SS.,	18 to 330
?,	78 to 408
3d SS.,	23 to 431

Well No. 14, "B."

Conductor,	12 to 12
?,	268 to 280
1st SS.,	30 to 310
?,	62 to 372
Hard shell, "say"	3 to 375
?,	47 to 422
2d SS.,	10 to 432
?,	80 to 512
3d SS., mud veins at 516′ and 522′,	24 to 536
?,	7 to 543

Well No. 15, "A."

?,	60 to 60
1st SS., "say"	20 to 80
?,	314 to 394
2d SS.,	16 to 410
?,	43 to 453
3d SS., stray—mud vein, 457′,	15 to 468
?,	76 to 544
4th SS., mud vein at 548′ and 553′,	14 to 558
?,	16 to 574

Well No. 15, "B."

?, Conductor, 22′,	60 to 60
1st SS., "say"	20 to 80
?,	283 to 363
2d SS.,	8 to 371
?,	55 to 426
3d SS., stray,	15 to 441
?,	13 to 454
4th SS.,	12 to 466
?,	84 to 550
5th SS., mud veins, 551′ and 558′,	16 to 566
?,	7 to 573

Wells at or near Dunn's Run.

Well (new) A, Dunn Farm.

Conductor,	15 to 15
?,	103 to 118
1st SS.,	12 to 130
?,	20 to 150
2d SS.,	28 to 178
?,	38 to 216
3d SS.,	13 to 229
?,	77 to 306
4th SS., mud vein at 316′,	13 to 319
?,	7 to 326

Well (new) B, Stroup Farm.

?, Conductor, 18′,	128 to 128
1st SS.,	40 to 168
?,	143 to 311
2d SS.,	8 to 319
?,	19 to 338
3d SS.,	6 to 344
?,	101 to 445
4th SS., (1st SS.,) mud veins at 454′ and 462′,	25 to 470
?,	32 to 502

5th SS., mud veins at . . . . . 507′	10 to 512
?, ...	32 to 544
6th SS., (2d SS.,) mud veins at 548′	10 to 554
?, ...	80 to 634
7th SS., (3d SS.,) mud veins at 635′ and 642′, ...	18 to 652
?, "no oil to pay,"	2 to 654

Well A, (on branch of Dunn's Run.)

	1179
?, ...	184 to 184 = 995
2d SS., ...	16 to 200 = 979
?, ...	31 to 231 = 948
3d SS., mud vein at 239′, ...	12 to 243 = 936
?, pocket, ...	1 to 244 = 935

Started at 7 bbls. Now pumping about 3 bbls. Black oil.

Well 2, (near pumping Well A.)

June 26, 1871.

	1202
?, ...	123 to 123 = 1079
1st SS., ...	11 to 134 = 1068
?, ...	35 to 169 = 1033
2d SS., ...	11 to 180 = 1022
?, ...	77 to 257 = 945
3d SS., no oil, mud vein at 267′, ...	12 to 269 = 933
?, ...	5 to 274 = 928

Well No. 1, Dunn Farm.

	1159
?, ...	126 to 126 = 1033
2d SS., ...	8 to 134 = 1025
?, ...	80 to 214 = 945
3d SS., ...	11 to 225 = 934
?, ...	3 to 228 = 931

Dry.

Well No. 2, Dunn Farm.

	1164
?, ...	124 to 124 = 1040
2d SS., ...	16 to 140 = 1024
?, ...	86 to 226 = 938
3d SS., ...	12 to 238 = 926
?, ...	4 to 242 = 922

Dry.

Well "P," (near Tipton's land.)

June 14, 1871.

?,	169 to 169
1st SS., "extra,"	11 to 180
?,	286 to 466
1st SS.,	14 to 480
?,	40 to 520
Stray,	6 to 526
?,	36 to 562
2d SS.,	12 to 574
?,	77 to 651
3d SS., mud vein 665',	19 to 672
?,	3 to 675

Well "R."

?,	476 to 476
1st SS.,	21 to 497
?,	79 to 576
2d SS.,	14 to 590
?,	74 to 664
3d SS.,	18 to 682
?,	6 to 688

Well "S," (opposite new "A" well.)

?,	108 to 108
1st SS.,	12 to 120
?,	90 to 210
2d SS.,	6 to 216
?,	79 to 295
3d SS.,	12 to 307
?,	3 to 310

Well "T."

?,	184 to 184
2d SS.,	16 to 200
?,	32 to 232
3d SS.,	12 to 244
?,	4 to 248

Well "O," (above Swaggert's) up run.

?,	148 to 148
1st SS.,	16 to 164
?,	42 to 206
2d SS.,	11 to 217
?,	38 to 255
Stray,	8 to 263
?,	76 to 339
3d SS., mud vein at 345',	12 to 351
?,	5 to 356

Well "C," Swaggert Farm.

1st SS.,	— to 460
?,	52 to 512
2d SS.,	10 to 522
?,	32 to 554
Stray,	10 to 564
?,	80 to 644
3d SS., mud vein at 650′,	16 to 660
?,	5 to 665

Well "G," (on hillside at rock.)

?,	271 to 271
1st SS.,	15 to 286
?,	114 to 400
Hard shell, "say"	3 to 403
?,	58 to 461
3d SS., (10′ soft sand,)	25 to 486

Well "H," (Stroup Run.)

Conductor,	13 to 13
?,	148 to 161
2d SS.,	19 to 180
?,	73 to 253
3d SS.,	16 to 269
?,	4 to 273

Cased at 106′.

Well "I," (back of Dunn Farm.)

February, 1871.

?,	202 to 202
1st SS.,	15 to 217
?,	23 to 240
Stray,	10 to 250
?,	47 to 297
2d SS.,	8 to 305
?,	74 to 379
3d SS., mud vein 386½′,	20 to 399
?,	4 to 403

Well "K."

?,	102 to 102
1st SS.,	20 to 122
?,	42 to 164
2d SS.,	8 to 172
?, water 190′, dry crevice 216′,	155 to 327
3d SS.,	27 to 354
?,	6 to 360

Well "L," (Hunter Run.)

?,	90 to 90
1st SS., "say"	15 to 105
?,	45 to 150
2d SS.,	15 to 165
?, "say"	30 to 195
Red rock, "say"	5 to 200
?, hard shell at 202′,	84 to 284
3d SS., mud vein at 290′,	9 to 293
?,	3 to 296

Well at Log-House, on river.

Conductor,	31 to 31
?,	29 to 60
2d SS., "say"	15 to 75
?,	49 to 124
3d SS.,	31 to 155
?,	8 to 163

Well No. 4, "D," (Swaggert Farm ?)

?,	526 to 526
2d SS., "say"	10 to 536
?, *hard shell* at 595′,	130 to 666
3d SS., mud veins at 670′ and 680′,	15 to 681
?,	3 to 684

GROUP V.

Wells in South West Township, and in Eldred township, Warren County.

The following records of the Woodland Oil Company wells were furnished by Mr. A. B. Howland, General Manager:

Woodland Well, No. 1.

Finished November 20, 1878.

On N. W. cor. Tract No. 234, South-West Township, Warren county.

Well mouth above ocean, in feet,		*1513*
Drive pipe,	63 to 63	= 1450
Interval,	67 to 130	= 1383
Mountain sand,	15 to 145	= 1368
Slate, cased at 239′,	225 to 370	= 1143
1st sand, gray,	8 to 378	= 1135
Slate,	124 to 502	= 1011
2d sand, gray,	12 to 514	= 999
Slate,	81 to 595	= 918
3d sand,	40 to 635	= 878
Slate to bottom,	21 to 656	= 857

Strong smell of oil at 620.

No red rock, no oil, no water, very little gas.

On drawing casing after standing about a week about ½ barrel of good green oil was dipped from the well.

Woodland Well, No. 2.

Finished March 5, 1879.

On Tract No. 235, (near center of west line,) South-West Township, Warren county.

Well mouth above ocean, in feet,		*1598*
Conductor, to rock,	8 to 8	= 1590
Hard bowlder,	37 to 45	= 1553
Slate,	135 to 180	= 1418
Mountain SS.,	40 to 220	= 1378
Slate, cased at 297′,	226 to 446	= 1152
1st sand,	19 to 465	= 1133
Slate, (shell at 468′,)	112 to 577	= 1021
2d sand S., (merely 2 shells,)	8 to 585	= 1013
Slate,	88½ to 673½	= 924½
3d sand S.,	39½ to 713	= 885
Slate to bottom,	15 to 728	= 870

No gas, a little salt water. About ¾ of a barrel of oil (green) came in at about 678′ or 679′. A quart glycerine torpedo exploded in it March 11. Top of torpedo at 678 feet. It had no effect noticeable on the rock or in the well.

Woodland Well, No. 3.

Finished April 28, 1879.

On Tract No. 199, (near center of west line,) South-West Township, Warren county.

Well mouth above ocean, in feet,	*1465*
Drive pipe,	52 to 52 = 1413
Slate, &c., (mixed sand, slate, and shells,)	68 to 120 = 1345
Mountain sand,	123 to 243 = 1222
Slate, cased at 262½′,	127 to 370 = 1095
1st sand S., (mostly shells,)	20 to 390 = 1075
Slate,	100 to 490 = 975
2d sand S.,	13 to 503 = 962
Slate,	86 to 589 = 876
3d sand S., (streak of slate from 612 to 621,)	43 to 632 = 833
Slate to bottom,	15 to 647 = 818

No gas, no water, a little oil, but not enough to be worth saving.

Woodland Well, No. 4.

Finished to 814 feet, May 30, 1879.

On north part of Tract No. 196, South-West Township, Warren county. 50 rods from north line, 90 rods from east line.

Well mouth above ocean, in feet,	*1689*
Drive pipe,	44 to 44 = 1645
Slate and shale,	237 to 281 = 1408
Mountain sand,	19 to 300 = 1389
Slate, cased at 307,	224 to 524 = 1165
1st sand S., (shells,) hardly noticeable,	2 to 526 = 1163
Slate,	144 to 670 = 1019
2d sand S., mostly shells,	19 to 689 = 1000
Slate,	72 to 761 = 928
3d sand S.,	43 to 804 = 885
Slate, black,	116 to 920 = 769
Slate or shale, *red shade*,	100 to 1020 = 669
Shale, bluish,	150 to 1170 = 519
Shale, *red*,	24 to 1194 = 495
Shale, bluish; red streaks,	356 to 1550 = 139

First stopped drilling at 814′ with no gas, no salt water, no oil, except a slight show in the bottom of 3d sand. The third sand was soft and easily drilled all through.

Afterwards drilled down to 1550′. Driller reported streaks of reddish shade all the way from 920′ to bottom. No regular blue or black slate in this interval, and nothing but soft shales below 1194′.

Wood & Stewart Well.

1878.

On Wales farm, South-West township, Warren county. About 3½ miles N. N. E. of Enterprise. Authority, Wm. Wood.

Well mouth above ocean, in feet.

?,	590 to 590 =
1st SS.,	30 to 620 =
?,	170 to 790 =
2d SS.,	20 to 810 =
Slate,	10 to 820 =
SS.,	6 to 826 =
Slate,	24 to 850 =

Production at first, about 2 barrels per day. No red rock reported in the well.

The same, as reported by Lem. Siggins, contractor.

?,	510 to 510 =
1st SS.,	30 to 540 =
?, "no 2d sand,"	250 to 790 =
3d SS.,	30 to 820 =
Slate,	30 to 850 =

About 3′ of pale red between the 1st and 3d SS., true place of it not remembered.

Brown & Siggins Well.

May and June, 1878.

Anderson farm, South-West township, Warren county, 3½ miles N. N. E. of Enterprise. Authority, L. Siggins, contractor, &c. Record compiled from notes on packages of sand pumpings.

Well mouth above ocean, in feet.

Conductor.

?, (Spec. No. 1,)	173 to 173
Mountain SS, (Spec. No. 2,)	25 to 198
?,	37 to 235
Shell, (Spec. No. 3,)	1 to 236
Shelly slate,	110 to 346
Shell, (Spec. No. 4,)	1 to 347
Shelly,	43 to 390
Red rock, (Spec. No. 5 at 400′)	15 to 405
Shelly,	20 to 425
1st SS., A, (Spec. No. 6 at 430′,)	12 to 437
Slate,	5 to 442
1st SS., B, (Spec. No. 7 at 445′,)	10 to 452

?, (Spec. No. 8,)	198 to 650
3d SS., { Spec. No. 9 at 655′, Spec. No. 10 at 670′, }	24 to 674
Slate, (Spec. No. 11 at 680′,)	5 to 679
Pebble slate and sand mixed, (Spec. No. 12,)	41 to 720
Soft slate, (Spec. No. 13,)	20 to 740

Cased at 225. Production 1½ barrels.

White Well.

1880.

On Cutler farm near the center of tract No. 97, Eldred township, Warren county. Authority, J. H. Dickson, (Oct. 15, 1880.)

Well mouth above ocean, in feet, (bar,)	1610
?,	194 to 194 = 1416
1st SS.,	50 to 244 = 1366
?,	56 to 300 = 1310
2d SS.,	25 to 325 = 1285
?,	60 to 385 = 1225
3d SS., { 5 gray, 5 white, good, 7 gray, coarse, 7 white, 6 ?, }	30 to 415 = 1195

Oil came in about 8′ from top 3d sand. Well pumped (without a torpedo) about 1 barrel of oil with 10 barrels of salt water per day.

"Oil 47° gravity and about as dark as Pleasantville oil."

Ackerman Well.

1865-6.

On Tract No. 97, Eldred township, Warren county, about 10 rods south of north line of tract, and about 4 rods east of Spring Creek road. Authority, A. L. Ackerman, per A. B. Howland.

Well mouth above ocean, in feet,	1673
Drive pipe,	18 to 18 = 1655
?,	89 to 107 = 1566
SS., gray,	4 to 111 = 1562
Slate,	69 to 180 = 1493
SS. streak,	5 to 185 = 1488
Slate, hard grit and soapstone,	17 to 202 = 1471
SS., hard, broke bit badly,	11 to 213 = 1460
SS., hard slate and soapstone in layers of 5 to 10 ft., (considerable gas at 363 ft.,)	221 to 434 = 1239
SS., very hard on top, (large gas vein,)	43 to 477 = 1196
Soapstone to bottom,	4 to 481 = 1192

"The show of oil being good, the well was tubed and tested. The pressure of gas was so great that everything broke, and the well was left to blow gas for several months, making a roaring like the blowing of steam from a boiler. Three crevices of about one foot each were reported between 303 and 330 ft., and three others at 437′, 445′ and 447′."

GROUP VI.

Wells in Venango County.

Comer Well.

May, 1877 ?

On farm of S. Q. Brown, on the Titusville and Pleasantville plank road, at the head of McGee run, Oil Creek township, Venango county. A short distance from Watson well, Henderson farm. Authority, T. McLaughlin, contractor.

Well mouth above ocean, in feet, about		1510
Conductor.		
SS.		
Sandy shale to	250	to 250 =
Mountain sand,	20 ±	to 270 =
Slate,	200	to 470 =
1st sand,	40 ±	to 510 =
Slate,	90	to 600 =
2d sand,	20 ±	to 620 =
Slate,	135	to 755 =
3d sand, gray and poor,	20 ±	to 775 =
Slate,	127	to 902 =

Unproductive.

Watson Well.

1877 ?

On the D. W. Henderson farm, (adjoining S. Q. Brown's,) Oil Creek township, Venango county. Authority, L. Siggins, contractor.

Well mouth above ocean, in feet,		—
Conductor,	28 to	28 =
Surface sand,	65 to	93 =
Slate,	90 to	183 =
Mountain sand,	100 to	283 =
Slate and shells, (cased at 300′,)	217 to	500 =
Red rock,	25 to	525 =

Slate and shells, bard,	153 to 678 =
1st sand,	18 to 696 =
Slate,	89 to 785 =
2d sand,	10 to 795 =
Slate and shells,	205 to 1000 =

This well produced some oil from the second sand, color dark green; gravity 48°. The drilling below the second sand was so homogeneous that the drillers claimed to have found no third sand.

Watson Well.

December, 1877.

On the Caleb Shreeve farm, Oil Creek township, Venango county, 2 miles west of Pleasantville. Authority, L. Siggins, contractor.

Well mouth above ocean, in feet,	—
?,	180 to 180 =
Mountain sand,	65 to 245 =
?, (cased at 295′,)	380 to 625 =
1st sand, (considerable gas,)	35 to 660 =
?,	96 to 756 =
2d sand, (a little salt water,)	20 to 776 =
?,	77 to 853 =
Red shale,	4 to 857 =
?,	30 to 887 =
3d sand, good, but no oil,	8 to 895 =
Slate, black,	65 to 960 =

Unproductive.

Dalzell Well, No. 3.

1870.

On Hebert tract, in borough of Pleasantville. After having produced black oil for some time, this well was deepened with the following results. Authority, L. L. Benedict.

Well mouth above ocean, in feet, about	1660
?, to top of 4th sand,	864 to 864 =
4th sand, (Pleasantville black oil rock,)	14 to 878 =
Slate,	27 to 905 =
5th sand, (equivalent of Oil Creek 3d SS.,)	18 to 923 =
Slate,	15 to 938 =
Slate and shells,	90 to 1028 =
Red shale,	16 to 1044 =

No oil obtained below the 4th sand.

Wesley Well.

1877.

E. S. Prosser farm, 2 miles north-east of Pleasantville, near Cattaraugus school-house. Authority, W. Wesley.

Conductor,	12 to 12 =
Slate,	108 to 120 =
Mt. SS.,	45 to 165 =
Slate,	140 to 305 =
Slate, red,	15 to 320 =
1st SS., gas and salt water,	20 to 340 =
Slate,	190 to 530 =
Slate, red,	20 to 550 =
2d SS.,A	20 to 570 =
Slate,	30 to 600 =
2d SS.,B	20 to 620 =
Slate,	144 to 764 =
Flint shell, close and hard,	6 to 770 =
Slate, soft and muddy, no sand,	15 to 785 =
Shell, hard and fine,	6 to 791 =
Slate,	21 to 812 =
3d SS.,	15 to 827 =
Slate, soft, no red,	58 to 885 =

Drilled dry. Cased at 342′. Gas in last SS. and show of green oil. No black oil seen. Torpedoed, without effect. Unproductive.

The following partial records of a number of wells in the Octave District, in Cherry Tree township, Venango county, about two and a half miles south of Titusville, were kindly furnished by Mr. O. D. Wickham.

		Casing.	Conductor.	Top of 3d SS.	Thickness.	Bottom of 3d SS.	Depth of well.
	No. 1, Hyde farm,	233	30	852	46	898	898
	No. 2, " (cased in slate,)	223	37	843	48	891	900
Feb. 7, 1874,	No. 6, " (20 pebble, 25 blue SS ,)	260	26	882	45	927	937
Oct. 28, 1876,	No. 8, " (20 barrel well,)	276	12	895	40	935	952
Feb. 28, 1877,	No. 10, " (40 barrel well,)	283	12	898	40	938	963
Apr. 26, 1877,	No. 11, " (10 barrel well,)	265	18	888	42	930	955
June 2, 1877,	No. 12, " (sand good,)	274	10	898	42	940	966
	No. 1, Purtel farm, (abandoned,)	360	17	885	50	935	935
	No. 2, " (cased in slate,)	228	27	845	47	892	908
	No. 3, " (cased in slate,)	237	21	850	49	899	909
Nov. 8, 1876,	No. 3, Young farm, (cased in 1st SS.,)	280	12	728	36	764	784
May 29, 1877,	No. 4, " (12 barrel well,)	288	28	723	40	763	783
	No. 2, Jack farm, (15′ good sand, 19′ dark,)	221	98	603	34	637	655
Jan. 19, 1877,	No. 3, " (27′ good sand, salt water in hole, small well,)	260	118	593	32	625	644
Nov. 6, 1876,	No. 4, Noble farm, (cased in 1st SS.,)	393	12	698	38	736	757
	No. 1, Stanbridge farm, (3d SS., gray, but little oil,)	288	17	920	29	949	952
	No. 1, Sherman, (dry, cased in slate,)	235	38	775	35	810	846
Sept. 7, 1877,	No. 1, Wise, (6′ gray, 20′ white, close, dry,)	210	36	506	26	532	538
May 1, 1871,	Ætna Well, No. 1, { 1st SS. at 393′, 2d SS. top 580′, 2d SS. bottom 604′, }	251	27	629	31	660	705
	B. Mars Well, No. 2, top of 1st SS. at 465′; thickness, 40′; "Found all three sands at regular depth,"	216	7	743	7	750	800

Elevation of Wells in the Octave District near Titusville.

By Arthur Hale, 1876.

Stewart, No. 2, Robinson farm,		1528
" 3, "		1495
" 1, "		1484
Barnsdale, "		1504
Beecher well, opposite side of road,		1550
Stewart, No. 2, Thompson farm,		1496
Lady Gibson, "		1473
Strauss, N. of "		1543
Smith & Pettit, "		1568
McLaughlin, Curry farm, ?		1577
Fox, "		1591
King, No. 2, Symmes,		1566
Shamburg, No. 1, "		1558
" 2, "		1565
King, No. 1, "		1583
Burtis, No. 1, Lamb farm,		1605
Octave & Burtis, "		1626
Wood, Irvin & Co., "		1619
Imel & Hoffman, No. 2, "	?	1616
Imel & Hoffman, No. 1.		
Shamburg, No. 1, Hamilton farm,		1585
" 2, "	?	1516
Gilmore, No. 1, "	?	1573
" 2, "	?	1570
Pierce & Co.,		1577
Jonathan Watson, (south of do.,)		1597
Octave, No. 7, Hyde farm,		1672
" 6, "		1654
" 1, "		1624
" 2, "		1619
" 3, "		1613
" 4, Purtell,		1636
" 3,		1629
" 6,		1646
" 7,		1644
Toby, No. 1, Abbott & O'Hare farm,		1615
" 2,		1617
" 3,		1613
" 4,		1623
" 5,		1617
" 6,		1627
B. T., No. 1 well, near Toby, No. 1,		1620
Purtell, No. 1,		1648
" 2,		1649
" 3,		1654
Bannister,		1642
Gilmore, No. 4, Sloan farm,		1564
" 1,		1641
McGill, No. 2,		1575

Harsh Well, No. 1.

October, 1877.

On Minor & Schreiber tract, Allegheny township, Venango county, near Dawson Center on Pithole creek. Authority, record and specimens furnished to the survey by Samuel Harsh, owner of well.

Well mouth above ocean, in feet.		
Conductor,		9 to 9 =
Shale, yellowish,		46 to 55 =
Mud rock or soapstone,		55 to 110 =
SS., deep yellow; "Mountain sand,"		60 to 170 =
Slate and shale, dark,		138 to 303 =
SS., gray, "1st sand,"		15 to 323 =
Slate, dark,		211 to 534 =
SS., 8',	"2d sand,"	23 to 557 =
Slate and shells, 8',		
SS., 7',		
Slate,		57 to 614 =
SS., coarse, gray, pebbly, some lime, (Spec. No. 1 at 614,)	"3d sand, A,"	22 to 636 =
SS., greenish, gray, fine, soft, (Spec. No. 2 at 616,)		
SS., greenish, gray, fine, soft, (Spec. No. 3 at 620,)		
SS., gray, fine, hard, flaky, (Spec. No. 4 at 624,)		
SS., gray, fine, hard, flaky, (Spec. No. 5 at 635,)		
Slate and shale,		33 to 669 =
SS., fine, dark gray, (Spec. No. 6 at 669,)	"3d sand, B,"	4 to 673 =
SS., fine, hard, rusty, (Spec. No. 7 at 672,)		
SS., fine, greenish-gray, soft, (Spec. No. 8 at 673,)		
Slate, light color,		2 to 675 =
Red sandy shale, (Spec. No. 9 at 676,)		2 to 677 =
SS., fine, dark gray, (Spec No. 10 at 678,)	"3d Sand, C,"	18 to 695 =
SS., fine, yellowish, rusty, (Spec. No. 11 at 679,)		
SS, very fine, white, (Spec. No. 12 at 680,)		
SS., very fine, white, (Spec. No. 13 at 682,)		
SS., very fine, white, (Spec. No. 14 at 683,)		
SS., fine, yellow gray, soft, (Spec. No. 15, at 685,)		
SS., fine, yellow gray, soft, (Spec. No. 16, at 690,)		

Slate, dark,			63 to 758 =
SS., fine, greenish gray, soft, (Spec. No. 17 at 757,) SS., fine, bluish gray, soft, (Spec No. 18, 775,)			17 to 775 =
SS., pebbly, dark gray, (Spec. No. 19 at 778,) SS., yellow, rusty, medium, (Spec. No. 20 at 780,) SS., pebble, and slate, (Spec. No. 21 at 782,)	"4th Sand,		8 to 783 =
Slate, bluish, (Spec. No. 22 at 788.) " " " " 23 " 806,)			38 to 821 =
SS., dark, greenish-gray, hard, (Spec. No. 24 at 823,) SS., dark, greenish-gray, slaty, (Spec. No. 25 at 826.) SS., coarse and pebbly,	"5th Sand,"		10 to 831 =
Slate, dark and bluish, to bottom,			19 to 850 =

Drilled dry. Cased at 328′. Unproductive. Gas sufficient to ignite from the lamp in the derrick.

Linden Well, No. 1.

May, 1877.

On S. Q. Brown's "McKissock farm" tract, No. 166, Cornplanter township, Venango county, about $1\frac{1}{2}$ miles east south-east from Pithole City, commencing at the entrance of the old coal bank. Authority, records and specimens furnished by Samuel Harsh, owner of well.

Well mouth above ocean, in feet,		1589′
Conductor,	8 to 8 =	1581′
?,	153 to 161 =	1428′
Mountain sand,	92 to 253 =	1336′
?,	132 to 385 =	1204′
1st sand, gray and slaty, (Spec. No. 1 at 397′,)	20 to 405 =	1184′
Slate and gray sand shells, (Spec. No. 2 at 420′,) Sand shells, gray, (Spec. No. 3 at 424′,) Sandy slate, dark, (Spec. No. 4 at 446′,) Sandy slate, dark, (Spec. No. 5 at 532′,) Sand shells, gray, (Spec. No. 6 at 601′,)	215 to 620 =	969
2d sand, gray and slaty, (Spec. No. 7 at —,)	40 to 660 =	929
Slate, (Spec. No. 8 at 685′,)	43 to 703 =	886

SS., gray, very fine, (Spec. No. 9 at 703′,)			
SS., dark gray, *some lime*, (Spec. No. 10 at 707′,)			
SS., white, very fine, (Spec. No. 11 at 709′,)			
SS., white, very fine, (Spec. No. 12 at 711′,)	"3d SS., A,"	22 to 725 =	864′
SS., white, very fine, (Spec. No. 13 at 713′,)			
SS., white, very fine, (Spec. No. 14 at 721′,)			
Sandy shale,		29 to 754 =	835′
SS., yellow, medium grain, "3d SS., B," (Spec. No. 15 at 754′,)		10 to 764 =	825′
		4 to 768 =	821′
Slate, dark, (Spec. No. 16 at 764′,)			
SS., dark gray, (Spec. No. 17 at 768′,)			
SS., yellowish, very fine, (Spec. No. 18 at 772′,)	"3d SS., C,"	17 to 785 =	804′
SS., white, very fine, (Spec. No. 19 at 785′,)			
Slate, blue, (Spec. No. 20 at 798′,)			
Slate and shells, (Spec. No. 21 at 849′,)			
Shells, greenish-gray, (Spec. No. 22 at 853′,)			
Slaty shell, micaceous, (Spec. No. 23 at 860′,)		92 to 877 =	712′
Slate, (Spec. No 24 at 867′,)			
Sandy slate, (Spec. No. 25 at 870′,)			
Sandy slate, micaceous, (Spec. No. 26 at 873′,)			
Slate and shells, (Spec. No. 27 at 877′,)			
SS., yellow, rather fine, (Spec. No. 28 at 878′,)	"4th SS.,"	1 to 878 =	711′
Slate, gritty, (Spec. No. 29 at 882′,)			
State, gritty, (Spec. No. 30 at 889′,)			
Slate, (Spec. No. 31 at 892′,)			
Sand shells, dark, (Spec. No. 32 at 894′,)		36 to 914 =	675′
Sand shells, gray, (Spec. No. 33 at 897′,)			
Slate, gray, (Spec. No. 34 at 904′,)			
Slate, darker, (Spec. No. 35 at 909,)			
SS., pebbles and slate, (Spec. No. 36 at 916′,)	"5th SS.,"	2 to 916 =	673′
Slate, (Spec. No. 37 at 924′,)		8 to 924 =	665′

Drilled dry. Unproductive.

Hilton Bros. Well.

Spring of 1877.

Pithole creek, 1 mile from river. Nicholls & Krotzer, contractors. Authority, John Nicholls.

Casing, shutting off all water,	125 to 125
?,	69 to 194
1st SS., red in streaks,	38 to 232
?, (some chocolate rock,)	46 to 278
2d SS., gray, 15, White, 5, Best sand, 4,	24 to 302
?,	14 to 316

Show of oil in 1st SS. at 202 feet, six inch crevice and oil at 298 feet. Production small.

Buckhorn Well.

McCalmont farm, 1½ m. from Allegheny river and on Culbertson run. First well drilled on the farm. Authority, L. B. Dykins.

Well mouth above ocean, in feet.

?,	80 to 80
1st SS.,	60 to 140
?,	195 to 335
2d SS.,	13 to 348
?, some red rock here,	67 to 415
3d, (6′ of red sand in center,)	36 to 451

Natural production about 1 barrel per day.

Butternut Well.

On Culbertson run near its mouth and just above the new highway bridge. Authority, L. B. Dykins.

Well mouth above ocean, in feet,	1050
?,	187 to 187 = 863
1st SS.,	42 to 229 = 821
?,	44 to 273 = 777
2d SS., with red rock in center,	34 to 307 = 743
?.	30 to 337 = 713
SS., gray,	35 to 372 = 678
?,	96 to 468 = 582
Shell containing pebbles,	2 to 470 = 580
Slate to bottom,	81 to 551 = 499

"The horizon of the 2′ shell at 468′ is occupied in all other wells drilled deep enough to reach it, by the same kind of rock, but from 8′ to 10′ thick."

The Pithole Grit lies here with its base very near to the well mouth level.

Livzey Well, No. 3.

On west bank of Oil creek a short distance above railway tunnel at Oil City. Authority, J. V. W. Livzey.

Well mouth above ocean, in feet,	1010±

Shales and red rock,	200 to 200 = 810
1st SS., (estimated,)	10 to 210 = 800
?,	120 to 330 = 680
2d SS., top of 5′ pebbly, 30′ shelly,	35 to 365 = 645
?, (including "gray rock" 25′ thick,)	121 to 486 = 524
3d SS., white,	10 to 496 = 514
Soft slate, no red,	44 to 540 = 470

A productive well. Green oil.

Shamburg & Fink, No. 5.

March, 1874.

On Green lease, Mead farm, Cranberry township, Venango county, about two miles south of Oil City. Authority, J. J. B. Fink.

Well mouth above ocean, in feet,	1464
Conductor,	16 to 16 = 1448
Shale,	14 to 30 = 1434
?, cased at 275′,	987 to 1017 = 447
3d SS., "good sand,"	14 to 1031 = 433
?,	14 to 1045 = 419

Oil came in at 1022½′; color green; gravity 45°. Best production 25 barrels per day.

Fisher & Reeve, No. 1.

December 28, 1873.

Bly lease, Mead farm, Cranberry township, Venango county, about two miles south of Oil City. Authority, J. J. B. Fink, Supt.

Well mouth above ocean, in feet.	
Conductor,	8 to 8 =
?, (cased at 300′,)	972 to 980 =
Shell, top at,	— to 980 =
?,	20 to 1000 =
Gray sand,	16 to 1016 =
Slate,	2 to 1018 =
Light gray sand,	16 to 1034 =
Pebble shell,	4 to 1038 =
Slate, black,	2 to 1040 =
Slate, light,	2 to 1042 =
3d Sand, pebbly,	13 to 1055 =
?,	11 to 1066 =

SS. 1046′ to 1048′ oil came in and filled up the hole 500′. Torpedoed with best effect at 1045′. Best production per day 75 barrels. Green oil, gravity 46°.

Well levels, &c., South of Oil City, by H. M. Chance.

October, 1877.

Wilcox Well, No. —, (pumped with one boiler,) left of road, +1302

Wilcox Well, No. —, (pumped with one boiler,) left of road,	1238
Phillips Well,	1310
Turner & Thompson, No. 2,	1339
Turner & Thompson, No. 4, (at junction of two roads,)	1413
Halderman, No. 1, (960′ to sand ?)	1395

Near Salem.

Shamburg, No. 1, *Mead farm*,	1480
1037′′deep. Torpedoed at 1022 and 1025, about 2′ to 4′ in sand.	
" No. 2, 8 to 10 barrels,	1474
3d SS., 1007′ to 1024′—1040′ deep. Good sand.	
" No. 3, (about.)	1490
3d SS. at 1031; best sand 1040′, through 1045′; 1061′ deep.	
" No. 4,	1464
" No. 5, dry.	
" No. 6, little oil.	
Green, No. 3, (about,)	1484
3d SS., 1020′-1040′, (rope measure.)	

McGrew Bros. Well, No. 1.

Olmstead farm on State road, 1 mile west of Salem, Cranberry township, Venango county. Authority, Dorsey McGrew.

Well mouth above ocean, in feet.

?,	812 to 812 =
SS., 2d, estimated,	45 to 857 =
?,	93 to 950 =
SS., 3d, (4 or 5 bands, bottom pebbly,)	50 to 1000 =

Production four to five barrels per day.

Well No. 5.

On Olmstead farm and 300′ south-east of well No. 1. Authority, Dorsey McGrew.

Well mouth above ocean, in feet.

?,	470 to 470 =
SS., "mountain sand,"	20 to 490 =
?,	180 to 670 =
SS., 1st,	48 to 718 =
?,	65 to 783 =
SS., 2d, A,	8 to 791 =
?,	22 to 813 =
SS., 2d, B,	25 to 838 =

Oil at 815′. 40 barrels per day at first, but run down rapidly.

Perry Well, No. 1.

This well is located on the Perry farm, ½ mile north-east of Gas City, in Pine Grove township, Venango county. Authority, Peter Schreiber.

Well mouth above ocean, in feet.

Conductor clay,	8 to	8 =
Slate, blue,	82 to	90 =
SS., "surface sand,"	90 to	180 =
Slate,	100 to	280 =
SS., "mountain sand,"	96 to	376 =
Soapstone or mud rock,	156 to	532 =
Slate and shale,	133 to	665 =
Slate, black,	60 to	725 =
Red rock and shale,	40 to	765 =
SS., 1st, white and fine,	63 to	828 =
Slate,	9 to	837 =
Pebble,	4 to	841 =
SS.,	28 to	869 =
Red rock,	30 to	899 =
Soapstone,	29 to	928 =
SS., 2d, sand,	26 to	954 =
Slate, blue,	45 to	999 =
SS.,	12 to	1011 =
Slate,	15 to	1026 =
SS., pebble, large flow of gas,	12 to	1038 =
SS., dark,	20 to	1058 =
Slate, black,	12 to	1070 =

Unproductive. "All the rocks are regular except the third sand, which is here 10 to 12 feet less in thickness than in the producing wells."

Fertig & Milligan Well.

Near the old Pioneer Gas Well, in Pine Grove township, Venango county. Authority, Peter Schreiber.

Well mouth above ocean, in feet,			—
?,		633 to 633 =	
1st SS.,		91 to 724 =	
?,		57 to 781 =	
2d SS.,		29 to 810 =	
?,		62 to 872 =	
3d SS.,	Pebble rock, strong gas, 10′ SS., white, hard, fine, 26′ Pebble sand, 2′ SS., hard and close, 2′	40 to 912 =	

Lindsey Well.

1860.

In the borough of Franklin, Venango county; on the river flat, and about five rods from the celebrated Evans well. Authority Mr. Lindsey.

Well mouth above ocean, in feet, about		980′
Conductor,	10 to 10 =	970′
Slate,	30 to 40 =	940′
Mountain sand,	16 to 56 =	924′
Shale, including 80′ of *red rock*,	187 to 243 =	737′
Oil sand "1st sand," about	40 to 283 =	697′

A productive well. "Heavy oil."

Lindsey Well.

1877 ?

On high point between French creek and the Allegheny river, half a mile north-east of Franklin. Authority, Mr. Lindsey.

Well mouth above ocean, in feet,		1169′
?, including Mountain SS. and red rock,	450 to 450 =	719′
Oil sand, "1st sand,"	40 to 490 =	679′

A good well. "Heavy oil."

Bullion District, Venango county.

Levels and partial records of wells obtained by H. M. Chance and Arthur Hale, September, 1877.

Simcox, No. 3,	+1222.	2d SS., at 730′.
		3d SS., at 880′-32′ or 34′ to 914′.
Shorts, No. 1,	+1311.	1st SS., at 655′.
		3d SS., at 962½-26′ to 988½′.
Berringer, No. 2,	+1287.	3d SS., at 962-24′ to 986.
Berringer, No. 5,	+1374.	3d SS., at 1060′ or 1067′; probably 1067′ 1085′ deep.
Cornwall, No. 1, (Berringer,)	+1325.	3d SS., at 1010-30′-to 1040-1045′ deep.
Crawford, No. 1, "Gas well."	+1358.	1st SS., at 787′.
		2d SS., at 950′.
		3d SS., at 1103′-16′ to 1119′.
Crawford, No. 2,	+1371.	1st SS., at 783.
		3d SS., at 1108-16′ to 1124′.
Crawford, No. 4,	+1339.	3d SS., at 1075′.
Crawford, No. 5,	+1308.	1st SS., at 730′.
		3d SS., at 1047′-16′—1063′.
Crawford, No. 7.	+1262.	3d SS., at 1015′, about 15′ sand ±
Cross, No. 1,	+1236.	3d SS., 1011½-13′ to 1024½—1057 deep.
Cross, No. 2,	+1263.	1st SS., at 722′.
		3d SS., at 1027′.

Berringer, No. 8,	+1273.	1st SS., at 645'. 2d SS., at 785'. 3d SS., at 954–20' to 974'.
Berringer, No. 7,	+1259.	3d SS., 932'–20' to 952'.
Berringer, No. 6,	+1242.	1st SS., at 634'; 3d SS., 942' to 962'.
Berringer, No. 17,		No granite—only 4' shells, occupying 8' space. 3d SS., 1040' to 1078'; 1088' deep.
Davis, No. 2,	+1441.	1st SS., at 808. 3d SS., at 1121' to 1141'.
Davis, No. 3,		1st SS., 810'. 3d SS., 1123' to 1148'.
Baum (Furnace) well,	+1057.	1st SS., at 395'. 3d SS., 715' or 720' to 735'; 15' or 20' thick.
Gealy, No. 13,		1st SS., at 725'; 3d SS., 1040–1060.
Gealy, No. 14,		3d SS., 1040' to 1060'.
Gealy, No. 15,		2d SS, 874–914'; 3d SS., 1020–1037'.
Gealy, No. 17,		1st SS., 792'; 2d SS., 932'; 3d SS., 1092'–1110'.
Gealy, No. 18,		3d SS., 1004'–1019'.
Gealy, No. 19,		3d SS., 1117' to 1137'.
Gealy, No. 22,		3d SS., 1041'–1059'.
McKee well, Clintonville,		1st SS., 770'; 2d SS., 928'; pebbles and shells 1120' to 1145.

Nesbit,	No. 1, Sutton Farm,	1442.	3d SS., 1129' top.
McDonald,	No. 5, " "	1432.	
Criswell,	No. 1, " "	1408.	3d SS., at 1050'.
"	No. 3, " "	1454.	
Phillips,	No. 3, Berringer Farm,	1344½.	
"	No. 4, " "	1308.	
Galloway,	No. 1, Sutton Farm,	1328.	3d SS., 960' to 975'–15'.
"	No. 2, "	1288.	3d SS., 935' to 950'–15'.
"	No. 4, "	1271.	
Andrews,	No. 5, "	1284.	
Avery & McFarland,		1296.	
Bulger & Morrison,	Kennerdell Farm,	1324.	
Eagle Oil Co.,	No. 1, " "	1343.	
" "	No. 2, " "	1356.	
" "	No. 3, " "	1364.	
Nesbit,	No. 2, " "	1410.	
McKinney,	No. 1, Berringer Farm,	1413.	
Andrews,	No. 9, " "	1420.	
Phillips,	No. 10, " "	1420.	
McKinney,	No. 2, Kennerdell Farm,	1418.	
Lockhard & Archbold,	No. 2, Berringer Farm,	1422.	3d SS., top SS., between 1140' and 1145'.
Hovis, No. 1,	"Gas well,"	1461.	3d SS., 1136' to 1177' — 41', wire measurement.

McCalmont,	No. 14,	1402.		3d SS., 1113–1133, 1143 deep.
"	" 15,	1412.		" 1115–1135, 1147 "
"	" 16,	1403.	Dry hole.	" 1106–1124, 1164 "
"	" 17,	1363.		" 1068–1088, 1090 "

McCalmont,	No. 23,	1392.	
"	" 24,	1409.	
"	" 26,	1371.	
"	" 27,	1409.	3d SS. at 1122.
"	" 28,	1403.	" " 1123.
"	" 29,	1413.	
"	" 30,	1402.	
"	" 31,	1389.	
"	" 39,	1414.	Rig up.
"	" 1,		3d SS. at 1130.
"	" 2,		" " 1120 to 1141.
" "Big Medicine,"	" 4,		" " 1060.
"	" 5,		" " 1125.
"	" 38,		" " 1087.
"	" 32,		" " 1063.
Henderson Lease, No. 5,		1418.	(Dorsey, No. 2.)
" " 8,		1423.	
" " 9,		1462.	(Goodwin & Algeo,) 3d SS., 1151 to 1191′ — 40′.
" " 14,		1409.	(Gill.)
" " 15,		1434.	(Marks.)
" " 10,		1468.	(Pew's.)
" " —,		1413.	Jacobs, No. 2.

Markham, No. 2, 1329. (Now Thompson & Taber,) Plummer Tract.
Galena Lease, No. 6, 1342. Plummer Tract.
Plummer Lease, No. 25, 1455. (Pews'.) 3d SS., 975 to 995½, (wire.)
"Crawford Mill" well, 1182. "Gas Well," "Old Well."

Andrews' Wells.

No. 2, Sutton Farm,	+1222.	3d SS.,	916- 936;	948	deep.
" 3, " "	+1210.	"	904- 924;	940	"
" 4, Berringer Farm,	+1269.	"	941- 965;	980	"
" 5, Sutton "	+1284.	"	980-1000;	1012	"
" 6, " "		"	1013-1033;	1048	"
" 7, " "	+1269.	"	963- 985;	995	"
" 8, Berringer "		"	1040-1064;	1081	"
" 9, " "	+1420.	"	1122-1146;	1156	"
" 10, McCalmont Farm, (No. 7,)		"	1110-1130;	1138	"
" 12, Berringer Farm,	+1416.	"	1114-1138;	1148	"
" 13, " "	+1419.	"	1113-1137;	1148	"
" 14, McCalmont Farm, No. 14,	+1402.	"	1113-1133;	1143	"
" 15, " " " 15,	+1412.	"	1115-1135;	1147	"
" 16, " " " 16,	+1403.	"	1106-1124;	1164	"
" 17, " " " 17,	+1363.	"	1068-1088;	1090	"
Lockwood, No. 1,	+1179.	Sutton Farm.			
H. L. Taylor, No. 7,	1205.	Kennerdell Farm.			
" " 10,	1149.	" "			

Four Wells near Raymilton, Sandy Creek Township, Venango County.

Mason Well, No. 4, (formerly Reagle, No. 4.)

From Mr. Reagle, Jr., (note book.)

		+1182′
?, with red rock "a little piece" above 2d SS,,	525 to 525	= 657′
2d SS.,	12 to 537	= 645′
Slate,	18 to 555	= 627′
2d SS.,	12 to 567	= 615′
?, with 60′ of red rock,	257 to 824	= 358′
3d SS., (15′ "stray" SS. 15′ above 3d SS.,)	12 to 836	= 346′
Slate, (pocket,)	9 to 845	= 337′

Mason Well, No. 3, (formerly Reagle, No. 3.)

?,	570 to 570	=
2d SS., in two members,	42 to 612	=
?,	258 to 870	=
3d SS.,	10 to 880	=
?, with two red rocks 40′ and 80′ thick,	320 to 1200	=
?, with 15′ dark, grayish blue sand, (oil show,)	100 to 1300	=
?,	110 to 1410	=

Raymond, No. 2.

About 1870.

From Raymond Bros.

		+ 1123
?,	300 to 300	= + 823
1st SS., "say,"	20 to 320	= + 803
?,	157 to 477	= + 646
2d SS., "say,"	40 to 517	= + 606
?,	248 to 765	= + 358
3d SS., no oil, tested several months,	15 to 780	= + 343
Slate and red rock,	280 to 1060	= + 63
Black slate, gray SS. and sea shells,	105 to 1165	= — 42
Fine gray SS., mixed with red rock,	40 to 1205	= — 82
Hard gray SS.,	25 to 1230	= — 107
Slate,	12 to 1242	= — 119
Fine hard gray SS.,	8 to 1250	= — 127
Light colored SS., gas and oil,	20 to 1270	= — 147
Slate, "say,"	5 to 1275	= — 152
SS., gas and oil,	20 to 1295	= — 172
Slate and hard flag rock,	20 to 1315	= — 192
Hard gray SS. and quartz,	50 to 1365	= — 242
?,	35 to 1400	= — 277

From 1250′ to 1365′ strong of gas and oil, at 1365′ crevice, strong of gas and oil. No smell or show of oil or gas from

780′ to 1250′ and from 1365′ to 1400′. Dry in 3d SS., pumped several months.

Started after drilling deeper at 3 barrels, now doing 2 barrels. No heavy oil. Oil comes in between 1250′ and 1365′.

Raymond, No. 4.

About level of No. 2, ... = 1120 ±

Nearly dry in 3d SS., which was found about 775′± drilled to 1000′ with no improvement. Stood a year, then tubed and pumped to keep water out of rock as it was spoiling another well, when she began to flow and for some time did 10 barrels per day. Now pumping, rather small, (September, 1877.)

For *Raymond Well, No. 6*, see I[3], p. 419.

GROUP VII.

Wells in Harmony township, Forest county.

Carson Well.

1870.

On J. Carson farm, 1 m. S. E. of Neilltown, Harmony township, Forest county. Authority, Garvey Thompson.

Well mouth above ocean, in feet.

Conductor,	30 to 30 =
?,	340 to 370 =
1st SS.,	15 to 385 =
?,	190 to 575 =
2d SS.,	25 to 600 =
?,	105 to 705 =
3d SS.,	10 to 715 =
?,	15 to 730 =
4th SS.,	10 to 740 =
?,	35 to 775 =
Red rock to bottom,	220 to 995 =

Wet hole. No oil, no gas.

"Red rock is universally found in all this section below the regular oil sands, as in this well."

Griffin Well.

1870.

On J. Griffin farm, 1 mile south of Neilltown. Authority, Garvey Thompson.

Well mouth above ocean, in feet.

Conductor,	30 to 30 =
?,	430 to 460 =
1st SS.,	15 to 475 =
?,	43 to 518 =
2d SS.,	15 to 533 =
?,	77 to 610 =
3d SS.,	20 to 630 =
?,	5 to 635 =
4th SS.,	2 to 637 =
?,	13 to 650 =
5th SS.,	12 to 662 =
?,	30 to 692 =
Red rock,	158 to 850 =

Wet hole. No gas, no oil.

Shamburg & Thompson Well.

1872.

Madison farm, $1\frac{1}{2}$ miles south of Neilltown. Authority, Garvey Thompson.

Well mouth above ocean, in feet.

Conductor,		35 to 35 =
?,		237 to 272 =
1st SS.,		12 to 284 =
?,		226 to 510 =
2d SS.,		58 to 568 =
?,	166	35 to 603 =
3d SS.,		25 to 628 =
?,		77 to 705 =
4th SS.,		21 to 726 =
?,		8 to 734 =
5th SS.,		16 to 750 =
?,		100 to 850 =
6th SS., gray and hard, gas,		12 to 862 =
Red rock,		63 to 925 =

Dry cased. Production one barrel from 5th SS.

5th SS. 6′ top white and good, then dark and soft, then yellow and pebbly, then hard without pebbles. Some salt water in this SS.

Stufflebeam, No. 1.

1872.

On Stufflebeam farm, $1\frac{1}{2}$ m. S. S. E. of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.	
Drive pipe,	14 to 14 =
?,	316 to 330 =
1st SS.,	25 to 355 =
?,	215 to 570 =
2d SS.,	70 to 640 =
3d SS., 4th SS., } Same as in Shamburg & Thompson well,	170 to 810 =
5th SS.,	20 to 830 =
?,	12 to 842 =

Cased hole. Production 2 barrels, little salt water. First oil at top of gray SS. at 815′. Second near bottom at 823′.

5th SS., white and pebbly on top, then slate and sand mixed, then gray sand well filled with yellow pebbles.

Stufflebeam, No. 2.

1873?

On Stufflebeam farm, 2 m. south-east of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.	
Drive pipe, (same as Fogle, No. 1, down to 5th SS.,)	36 to 36 =
?,	790 to 826 =
5th,	12 to 838 =
?,	125 to 963 =

Cased hole. Production 1 barrel.

Poor 5th SS., close hard gray, little gas. Drilled by Jas. McCart.

Fogle Well, No. 1.

1872.

On Fogle farm, $2\frac{1}{4}$ miles S. E. of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.		
Conductor,		40 to 40 =
?,		310 to 350 =
1st SS.,		20 to 370 =
?,		210 to 580 =
2d SS.,		50 to 630 =
?,		48 to 678 =
3d SS., some gas,		25 to 703 =
?,		17 to 720 =
4th SS.,	4th SS.,	9 to 729 =
	Red, (very red, sandy clay,)	3 to 732 =
	4th SS.,	8 to 740 =
?,		90 to 830 =
5th SS.,		18 to 848 =
?,		27 to 875 =

Cased hole. Production, 8 bbls. No salt water. Well filled up 500 ft. while drilling. First oil at 833′, second at 835′. Torpedoed with good effect at 832′.

Fogle Well, No. 2.

1873.

Fogle farm, 300′ east of No. 1. Authority Mr. Garvey Thompson.

Well mouth above ocean, in feet,	
Drive pipe,	21 to 21 =
?,	340 to 361 =
1st SS.,	10 to 371 =
?,	220 to 591 =
2d SS.,	51 to 642 =
?,	47 to 689 =
3d SS.,	10 to 699 =
?,	32 to 731 =
4th SS.,	20 to 751 =
?,	91 to 842 =
5th SS.,	15 to 857 =
?,	12 to 869 =

Cased hole. Production, 2 bbls. 5th Sand soft, with white pebbles for 7′, then 3′ slate, then sand hard and close. Ten feet of slate and pebbles immediately on top of 5th SS. Some gas in 2d SS. Oil in 5th SS.

Holmden Well.

1872.

On the Widow Copeland farm, 2 miles S. E. of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet,	
Drive pipe,	7 to 7 =
?,	413 to 420 =
1st SS.,	10 to 430 =
?,	220 to 650 =
2d SS.,	30 to 680 =
?,	60 to 740 =
3d SS.,	15 to 755 =
?,	35 to 790 =
4th SS.,	18 to 808 =
?,	82 to 890 =
5th SS.,	20 to 910 =
?,	10 to 920 =

Cased hole. Production, one barrel. 5th SS. soft and gray, mixed with yellow pebbles. First show of oil near the bottom. Well filled up 100′ while drilling. No salt water. Drilled by Holmden & Merrill, who were the owners.

Hoadley Well.

1872.

Widow Copeland farm, 2 miles S. E. of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.

Drive pipe,	16 to 16 =
?,	364 to 380 =
1st SS.,	20 to 400 =
?,	210 to 610 =
2d SS.,	60 to 670 =
?,	38 to 708 =
3d SS.,	15 to 723 =
?,	97 to 820 =
4th SS.,	15 to 835 =
?,	41 to 876 =
5th SS.,	20 to 896 =
?,	1 to 897 =

Cased hole. Oil at 879′. Sand close and gray 10′; then 2′ slate then sand white and hard, (5th SS.)

Production ½ barrel. Some salt water.

Drilled by I. N. Hoadley.

Shamburg Petroleum Company Well.

August, 1873.

On McGarrel farm, or Campbell tract, 1¾ miles south-east of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.

Drive pipe,	10 to 10 =
?,	370 to 380 =
1st SS.,	10 to 390 =
?,	225 to 615 =
2d SS.,	50 to 665 =
?,	50 to 715 =
3d SS.,	18 to 733 =
?,	87 to 820 =
4th SS.,	30 to 850 =
?,	10 to 860 =
5th SS.,	25 to 885 =
?,	12 to 897 =

Cased hole. Production 6 barrels.

5th SS. gray with some pebbles on top, bottom hard. Oil at 871′.

Manross, Well, No. 1.

1876.

Manross farm, 2½ miles south-east of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet.	
?,	385 to 385 =
1st SS., estimated,	20 to 405 =
?, 2d SS., ?, 3d SS., ?, 4th SS., ?, — "Same as others."	450 to 855 =
Stray 5th, (gray,)	13 to 868 =
5th SS,,	20 to 888 =
?,	100 to 988 =

Cased hole. Production 1 barrel.

Gray sand from 855′ to 868′ then 4′ of coarse SS.

Drilled by Jas. McCart.

Manross Well, No. 3.

1876.

Like No. 1,	874 to 874
5th SS.,	13 to 887
?,	37 to 924

Cased hole. Production 3 barrels.

Poor 5th SS. close and hard ; at 874′ crevice and oil.

Drilled by Jas. McCart.

McNutt Well, No. 1.

1876.

On McNutt farm, 3¼ miles S. E. of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet,	
Drive pipe,	20 to 20 =
?,	195 to 215 =
1st SS.,	10 to 225 =
?,	265 to 490 =
2d SS.,	20 to 510 =
?,	20 to 530 =
3d SS.,	20 to 550 =
?,	115 to 665 =
Gray sandstone,	10 to 675 =

White,	12 to 687 =
?,	93 to 780 =

Cased hole. Dry. Show of heavy gravity oil at 687′. "No 4th or 5th sands. No regular oil sands. Sandstones gray."

Landers Well, No. 1.

1871.

On Landers farm, one mile north of Neilltown, in N. W. corner of Forest county. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet,	
Drive pipe,	27 to 27 =
?,	229 to 256 =
1st SS.,	25 to 281 =
?,	297 to 578 =
2d SS.,	15 to 593 =
?,	61 to 654 =
3d SS.,	25 to 679 =
?, including 4th SS., not noted,	96 to 775 =
5th SS.,	30 to 805 =
?,	3 to 808 =

Cased, but not tight. Production, three bbls. 5th SS. Close and hard. Amber oil.

Landers Well, No. 2.

1871.

Landers farm, one mile north of Neilltown. Authority, Mr. Garvey Thompson.

Well mouth above ocean, in feet,	
Drive pipe, &c., same as No. 1,	490 to 490 =
2d SS.,	15 to 505 =
?,	85 to 590 =
3d SS.,	25 to 615 =
?, including 4th, not noted,	138 to 753 =
5th SS ,	28 to 781 =
Depth,	— to 781 =

Cased hole. Production, one bbl. Oil at 753 ft. 8 in. Amber color.

Egypt Well.

1871.

On J. H. Neill or Thompson farm, 1¼ miles east of Neilltown. Owners, Sam Wood, Arnold, Stambaugh & Blake, of Petroleum Centre. Authority, Mr. Garvey Thompson, driller.

Well mouth above ocean, in feet,	
Drive pipe,	14 to 14 =
?,	239 to 253 =
1st SS.,	25 to 278 =
?,	300 to 578 =
2d SS.,	20 to 598 =
?,	52 to 650 =
3d SS.,	15 to 665 =
?,	40 to 705 =
4th SS.,	25 to 730 =
?,	52 to 782 =
5th SS.,	20 to 802 =
?,	105 to 907 =

Wet hole. Unproductive. 5th SS. Gray and loose, with six inches of white pebble on top. Very little gas in 4th SS. Well never tubed, the sand being so poor and show so slight that it would not warrant a test.

McLaughlin Well.

October, 1877.

On the Kepler farm, Harmony township, Forest county; about four miles south-east of Neilltown. Authority, T. McLaughlin.

Well mouth above ocean, in feet,			
?,			300 to 300 =
1st sand,			15 to 315 =
Shelly slate,			148 to 463 =
Red rock,			100 to 563 =
Shelly slate,			18 to 581 =
Red shale, very red,			4 to 585 =
SS.,	20′	"2d Sand,"	
Slate,	15′	"2d Sand,"	60 to 645 =
SS.,	25	"2d Sand,"	
Shale, good drilling,			30 to 675 =
3d SS.,			22 to 697 =
Slate,			81 to 778 =
4th Sand, (not through),			45 to 823 =

Production at first about 10 barrels per day.

Harmony Well.

1877.

Kepler farm, Harmony township, Forest county, fifty rods north-west of the McLaughlin well. Authority, one of the drillers.

Well mouth above ocean, in feet,	
?,	515 to 515 =
1st Sand,	40 to 555 =
?, (Red rock here,)	60 to 615 =

2d Sand, (red in center of sand,)	40 to 655 =
?,	45 to 700 =
3d Sand,	55 to 755 =
Slate,	30 to 785 =

Cased at 155′. Fresh water at 205′, and small casing had to be inserted to 210′. Production at first about 8 barrels per day.

GROUP VIII.

Wells in Tionesta, Howe, and Jenks Townships, Forest County.

Wood Well, No. 1.

November, 1877.

Wood estate, Tionesta township, Forest county. Warrant No. 3822. Authority, Mr. Baldwin, per J. W. Griswold.

Well mouth above ocean, in feet, (barometer,)	1530′
Conductor,	14 to 14 = 1516′
Surface rock,	76 to 90 = 1440′
Slate,	20 to 110 = 1420′
SS., "Mountain Sand,"	40 to 150 = 1380′
Slate,	72 to 222 = 1308′
Water rock,	4 to 226 = 1304′
Slate,	52 to 278 = 1252′
SS., (cased at 298′,)	80 to 358 = 1172′
Slate,	138 to 496 = 1034
SS. and hard stone,	20 to 516 = 1014′
Slate, blue and hard, with sand shells,	174 to 690 = 840′
SS., gray, with strata of hard slate, (gas at 760′,)	90 to 780 = 750′
Flint, hard,	10 to 790 = 740′
Slate and hard shells,	80 to 870 = 660′
Red rock,	15 to 885 = 645′
Slate and shells,	25 to 910 = 620′
SS.,	3 to 913 = 617′
Slate and shells,	47 to 960 = 570′
SS., coarse pebbles, "3d SS.,"	12 to 972 = 558′
Blue slate, shells, and *red rock* to bottom,	528 to 1500 = 30′

Unproductive.

Wood Well, No. 2.

1876?

Wood estate, Tionesta township, Forest county. Warrant No. 3822. Authority, Boon Magee, from note book.

Well mouth above ocean, in feet, (barometer,)		1300′
?,	100 to 100 =	1200′
SS., "Mountain Sand,"	50 to 150 =	1150′
?, (cased at 161′,)	90 to 240 =	1060′
SS., 1st sand,	27 to 267 =	1033′
?,	163 to 430 =	870′
Red rock,	15 to 445 =	855′
Slate,	87 to 532 =	768′
SS., 2d sand,	10 to 542 =	758′
Red rock,	15 to 557 =	743′
Shell,	1 to 558 =	742′
Red rock,	74 to 632 =	668′
?,	23 to 655 =	645′
SS., stray,	10 to 665 =	635′
?,	60 to 725 =	575′
SS., 3d sand, show of oil,	10 to 735 =	565′
?,	49 to 784 =	516′
Shell,	1 to 785 =	515′
Red rock,	10 to 795 =	505′
?,	5 to 800 =	500′
SS.,	10 to 810 =	490′
?,	190 to 1000 =	300′
Red rock,	15 to 1015 =	+285′
?,	385 to 1400 =	—100′
SS.,	10 to 1410 =	—110′
?,	32 to 1442 =	—142′
SS.,	40 to 1482 =	—182′
Slate,	178 to 1660 =	—360′
SS., blue,	15 to 1675 =	—375′
Slate and shells to bottom,	100 to 1775 =	—475′

Unproductive.

Wood Well, No. 3.

1877.

Wood estate, Tionesta township, Forest county. Warrant No. 3822. Authority, Boon Magee, from note book.

Well mouth above ocean, in feet, (barometer,)		1265
Conductor,	23 to 23 =	1242
Slate.	77 to 100 =	1165
SS., fine, "mountain sand,"	20 to 120 =	1145
Slate,	80 to 200 =	1065
SS.,	10 to 210 =	1055
?,	30 to 240 =	1025
SS.,	10 to 250 =	1015
?,	110 to 360 =	905
Red rock, (light red,)	50 to 410 =	855
?,	40 to 450 =	815
SS.,	10 to 460 =	805
?,	50 to 510 =	755
Red rock,	75 to 585 =	680
?,	103 to 688 =	577

SS., 3d sand,	14 to 702 =	563
?, to bottom,	248 to 950 =	315

Gas at 300′. Salt water at 320′.
Cased at 337′. Unproductive.

Wood Well, No. 4.

1876?

On Proper farm, at mouth of Peters' run, about 1 mile S. E. from Tionesta Village. Commencing at bottom of Pithole grit which is exposed along Tionesta creek a few rods above the well. Authority, Boon Magee, from note book.

Well mouth above ocean, in feet, (barometer,)		1105
Conductor,	16 to 16 =	1089
Slate and *red rock*, good drilling,	194 to 210 =	895
SS., 1st, (cased at 220′,)	10 to 220 =	885
Red rock,	10 to 230 =	875
Slate,	10 to 240 =	865
SS.,	8 to 248 =	857
Red rock,	15 to 263 =	842
Slate,	15 to 278 =	827
SS., (show of oil,)	5 to 283 =	822
Red rock,	15 to 298 =	807
Slate,	2 to 300 =	805
SS., 3d, (little oil,)	5 to 305 =	800
Slate,	249 to 554 =	551

Unproductive.

Berry Well, No. 1.

April, 1877.

Located on tract 4821 in Howe township, Forest county, east of Balltown and on north bank of Tionesta creek. Authority, Peter Berry, one of the owners.

Well mouth above ocean, in feet, (barometer,)		1250
Conductor 29′; stove pipe casing 55′	84 to 84 =	1166
Slate, very soft,	16 to 100 =	1150
SS., "mountain sand,"	18 to 118 =	1132
SS., hard and gray,	11 to 129 =	1121
Red rock, very red,	5 to 134 =	1116
Slate, (casing shut off fresh water at 135′,)	6 to 140 =	1110
SS., white, fine, some pebbles, ("lubricating oil SS.,")	28 to 168 =	1082
Red rock, very red,	6 to 174 =	1076
Slate and shells,	55 to 229 =	1021
SS., coarse, (gas,)	15 to 244 =	1006
Slate, very soft; some shells,	53 to 297 =	953
SS., "Edenburg oil sand,"	29 to 326 =	924
Slate, very soft, (recased at 334′,)	154 to 480 =	770
Shell with gas, and enough salt water for sand pump at,	— to 480 =	770
Shelly, very irregular drilling,	220 to 700 =	550
Slate, soft,	40 to 740 =	510

Slate, with a large mixture of red rock,	25 to 765 =		485
Shelly,	205 to 970 =		280
Shale, very soft drilling,	237 to 1207 =	+	43
SS. good; with pebbles, (amber oil,)	30 to 1237 =	+	13
Slate, with gray sand shells; no red,	188 to 1425 =	—	175

Salt water copious at 307′. Considerable gas at 315′. At 1210′ the hole filled up 150′ with amber oil.

Production small after being tubed.

Hulings Well.

1877.

Fox farm, or "Foxburg," Howe township, Forest county, 7 miles south of Sheffield. Well located at the bend of Tionesta creek, opposite the mouth of Blue Jay run. Record compiled from specimens of sands perserved by Mr. Horton at Sheffield.

Well mouth above ocean, in feet, (barometer,)			1270
Conductor,	about, 20 to 20 =		1250
?, (red at about 650′,)	965 to 985 =		285
1st SS., ashy gray, fine, "gas sand,"	20 to 1005 =		265
?,	245 to 1250 =	+	20
2d SS., gray, fine, muddy,	12 to 1262 =	+	8
?,	38 to 1300 =	—	30
3d SS., yellowish, medium grain,	8 to 1308 =	—	38
?,	142 to 1450 =	—	180
4th SS., yellowish, medium,	10 to 1460 =	—	190
?, to bottom of well,	190 to 1650 =	—	380

This well was tubed and tested producing two or three barrels per day of beautiful amber oil, but being isolated and difficult of access it was abandoned; and the territory remained undeveloped until it again came into notice by the opening of the "Blue Jay" district in November, 1880.

Blue Jay, No. 1.

November, 1880.

At Foxburg, Howe township, Forest county, about 30 rods N. N. E from the old Hulings well. Owned by Schultz, Morck & Co. Record obtained from Geo. Clark, chief driller, by A. B. Howland.

Well mouth above ocean, in feet, (barometer,)		1270′
Conductor, (drive pipe,)	36 to 36 =	1234′
?,	39 to 75 =	1195′
SS., gray, "bastard sand,"	15 to 90 =	1180′
SS., gray, fine, hard,	5 to 95 =	1175′
Slate,	30 to 125 =	1145′
Red rock, very red,	125 to 250 =	1020′
SS., gray, fine, hard,	10 to 260 =	1010′

Slate, (cased at 287′,)	35 to 295 =	975′
SS., gray, finest and hardest in well,	5 to 300 =	970′
Slate,	235 to 535 =	735′
SS., dark, shading on chocolate, fetid gas,	10 to 545 =	725′
Slate,	105 to 650 =	620′
Red slate, shelly-like,	50 to 700 =	570′
Slate,	280 to 980 =	290′
1st SS., gray,	25 to 1005 =	265′
Slate,	225 to 1230 =	+ 40′
2d SS., coarse, gray and white mixed,	25 to 1255 =	+ 15′
Slate,	135 to 1390 =	— 120′
3d SS., gray and pebbly,	55 to 1445 =	— 175′
3d SS., nearly white, pebbly, (oil sand,)	14 to 1459 =	— 189′
Slate, coarse, to bottom,	19 to 1478 =	— 208′

This well flowed several times before being torpedoed or tubed, and inaugurated a new oil development in the south-eastern part of Warren county; but it afterwards settled down to a production of only about five barrels.

Nicholl's Well.

1868.

Located on the north side of Millstone Creek, in Warrant No. 3170, Jenks township, Forest county, three fourths of a mile south-east of Marien Corners. Owners, Germantown Oil Company. Authority, copied from the driller's note book.

Well mouth above ocean, (by aneroid,) in feet,		1575*
Drive pipe,	40 to 40 =	1535′
SS., gray,	41 to 81 =	1494′
Slate, blue,	27 to 108 =	1467′
SS., white,	47 to 155 =	1420′
Slate, blue,	82 to 237 =	1338′
SS., gray,	30 to 267 =	1308′
Slate,	92 to 359 =	1216′
SS., gray, crevice and gas,	91 to 450 =	1125′
Slate, blue,	16 to 466 =	1109′
SS., pebble, gas, and mud vein,	18 to 484 =	1091′
Slate, blue,	204 to 688 =	887′
Red rock,	121 to 809 =	766′
SS., gray,	10 to 819 =	756′
Slate, *red,*	28 to 847 =	728′
SS., gray,	15 to 862 =	713′
Slate, blue and *red,*	141 to 1003 =	572′

Unproductive. Wet hole. Not cased. Information given by Dr. Towler, November 25, 1878, who got it from Col. Hunter, in the handwriting of the foreman in charge of the

*1550′ above tide, Chas. A. Ashburner.

well. Dr. Towler has also compared it with the driller's note book and found it to agree.

Towler & Hunt Well, No. 1.

September, 1877.

On Warrant No. 3170, 44 rods north-east of Nicholl's well. Authority, Dr. S. S. Towler.

Well mouth above ocean, in feet,	1585 ?
Conductor,	14 to 14 = 1571′
Bluff sand, white,	18 to 32 = 1553′
Slate, blue,	40 to 72 = 1513′
SS., (9 ft. shells 32 ft. gray sand,)	41 to 113 = 1472′
Slate, blue,	27 to 140 = 1445′
SS., white,	47 to 187 = 1398′
Slate, blue,	82 to 269 = 1316′
SS., white,	35 to 304 = 1281′
Slate, black,	92 to 396 = 1189′
SS., gray and full of pebbles,	91 to 487 = 1098′
Slate, blue,	16 to 503 = 1082′
SS. pebble,	20 to 523 = 1062′
Slate, blue,	20 to 543 = 1042′

Drilled dry. Cased at 312′. While drilling in the last sand the well was flooded with fresh water from the Nicholls well, and it could not be exhausted until the latter was cased, when there was quite a show of heavy oil and some gas. Unproductive.

Clark Well.

1866.

On Warrant No. 3170, Jenks township, 40 rods east of Nicholls' well. Drilled to about 400′, when the tools were stuck and well abandoned.

Jack James Well.

1875 ?

On Warrant 3170, Jenks township, sixty rods north-west from Nicholls' well. Drilled by Towler & Hunt to a depth of about 500′. "The record was very similar to Nicholls' well, except that there was less sandstone, and it was finer and harder in composition." Unproductive.

Towler & Hunt Well, No. 2.

February, 1878.

On the extreme north-west corner of Warrant No. 3168, Jenks township, west side of Millstone creek, and about a mile south-west of Nicholls' well. Dr. Towler says: "It was drilled to 550′ to catch the pebble sand of No. 1, which was then supposed to be our oil rock. The pebble sand was 4′ thick, with 10′ of close gray sand under it. Salt water, gas, and a show of green oil in the pebble sand." Unproductive.

Towler and Hunt Well, No. 3.

This well is located 66 rods east, and a little south, of Towler & Hunt well, No. 2, near Marien, Jenks township, Forest county. Authority, Dr. Towler.

	Well mouth above ocean, in feet,	1645′±
1.	Soil,	8′ to 8′
2.	Yellow sandstone,	30′ to 38′
3.	Blue slate,	24′ to 62′
4.	Pebble sandstone,	98′ to 160′
5.	Blue slate,	25′ to 185′
6.	Sandstone,	70′ to 255′
7.	Slate,	70′ to 325′
8.	White sandstone,	45′ to 370′
9.	Black slate,	85′ to 455′
10.	Sandstone,	100′ to 555′
11.	Blue gray slate,	20′ to 575′
12.	Close pebble sandstone,	13′ to 588′
13.	Slate,	204′ to 792′
14.	Red slate,	25′ to 817′
15.	Black slate shells,	18′ to 835′
16.	Red slate,	76′ to 911′
17.	Black slate,	12′ to 923′
18.	Slate and shells,	30′ to 953′
19.	Gray sand,	15′ to 968′
20.	Red rock,	10′ to 978′
21.	Black slate,	25′ to 1003′
22.	Gray sand,	20′ to 1023′
23.	Black slate,	25′ to 1048′
24.	Gray slate,	15′ to 1063′
25.	Red slate,	15′ to 1078′
26.	Black slate,	114′ to 1192′
27.	Sand-shells,	15′ to 1207′
28.	Chocolate slate,	20′ to 1227′
29.	Slate-sand-shells,	83′ to 1310′

Immediately above the "98 foot pebble sandstone," which is the representative of the OLEAN CONGLOMERATE of McKean county, was reported a bed of coal 3 feet thick.

Mr. Ashburner estimates the position of the *Ferriferous limestone* to be 125 feet above the top of the well. He also refers the strata for 275 feet above the "*25 feet of black slate*," at a depth of 1003 feet, to the Red Catskill formation, No. IX.

Towler & Hunt Well, No. 4.

March, 1880.

Located on Warrant No. 3171, Jenks township, Forest county, near Colonel Hunt's saw mill, on Salmon creek, and about a mile and a half W. N. W. of Nicholls' well. Authority, Dr. S. S. Towler, who carefully watched the drilling, and preserved specimens of sand-pumpings.

Well mouth above ocean, in feet, (barometer,)			1580±
Drive pipe,	36 to	36 =	1544
Clay, hard,	8 to	44 =	1536
SS., gray,	40 to	84 =	1496
Slate, blue; with sand-shells,	35 to	119 =	1461
SS., gray,	46 to	165 =	1415
Slate; thin sand-shells at 249′,	115 to	280 =	1300
SS., gray, 4′ SS., white, coarse pebbles, (Spec. No. 1,) 4′ SS., gray, (Spec. No. 2,) 47′	55 to	335 =	1245
Slate, black, (cased at 340′,)	64 to	399 =	1181
SS., gray, pebbles, (Spec. No. 3,)	11 to	410 =	1170
Slate, black, with thick sand-shells, (some salt water,)	80 to	490 =	1090
SS., white,	11 to	501 =	1079
Slate, black,	9 to	510 =	1070
SS., gray,	7 to	517 =	1063
Slate, black; sand shells at bottom,	93 to	610 =	970
Red rock; fine, gritty, red and green sand and red shale, (Spec. No. 4,)	20 to	630 =	950
Slate and shells,	7 to	637 =	943
SS., gray, (Spec. No. 5,)	25 to	662 =	918
Slate,	33 to	695 =	885
Red rock, pale; very fine, micaceous, flaky sandstone, (Spec. No. 6,)	85 to	780 =	800
SS., gray, (gas.) (Spec. No. 7,) 5′ SS., white, (Spec. No. 8,) 15′ SS., gray, dark and slaty, (Spec. No. 9,) 32′	52 to	832 =	748
Slate,	42 to	874 =	706
SS., white, (Spec. No. 10,)	12 to	886 =	694
Red shale, with mottled red and green, fine, micaceous sandstone, (Spec. No. 11,)	20 to	906 =	674
Slate,	3 to	909 =	671
SS., gray; very dark and fine, (Spec. No. 12,)	17 to	926 =	654
Slate,	30 to	956 =	624

Shells, gray; sandy slate, (Spec. No. 13,)	6 to 962 =	618
Slate, (mud vein,)	38 to 1000 =	580
Dark sand shells and slate,	100 to 1100 =	480
Slate and shells, some chocolate color,	100 to 1200 =	380
Slate and shells,	100 to 1300 =	280
Slate and shells, more muddy,	110 to 1410 =	170
SS., gray, fine-grained, (Spec. No. 14,)	10 to 1420 =	160
Slate,	70 to 1490 =	90
SS., gray, (Spec. No. 15,)	6 to 1496 = +	84
Slate,	139 to 1635 = —	55
SS., gray, fine, slaty, (Spec. No. 16,)	5 to 1640 = —	60
Slate,	9 to 1649 = —	69
SS., gray, (Spec. No. 17,)	6 to 1655 = —	75
Slate,	80 to 1735 = —	155
SS., slaty top; shelly middle; white bottom, (Spec. Nos. 18 to 27,)	72 to 1807 = —	227
Slate, (Spec Nos. 28 and 29,)	25 to 1832 = —	352
SS., white, fine; oil smell, (Spec. No. 30,)	12 to 1844 = —	264
Slate, (Spec. No. 31,)	41 to 1885 = —	305
SS., gray, (Spec. No. 32,)	30 to 1915 = —	335
Slate and white sand shells, (Spec. Nos. 33 and 34,)	9 to 1924 = —	344
SS., light gray; very fine, (Spec. Nos. 35 and 36,)	6 to 1930 = —	350
Slate and sand shells; grayish-brown, (Spec. No. 37,)	11 to 1941 = —	361
SS., grayish-brown, (Spec. Nos. 38 and 39,)	12 to 1953 = —	373
SS., Slate and shells (increase of gas,) (Spec. No. 40,)	12 to 1965 = —	385
SS., gray; with dark slate,	7 to 1972 = —	392
Slate, black,	28 to 2000 = —	420

"The 72′ sand (1735′ to 1807′) was gasy after the first 10′. The bottom, 7′, was white, but close and fine. Unproductive.

Towler & Hunt Well, No. 5.

March, 1882.

In south-east quarter of Warrant No. 3171, Jenks township, about 110 rods west and 60 rods north of Marienville center. Authority, Dr. S. S. Towler.

Well mouth above ocean, in feet, (barometer,)		1660±
Conductor,	17 to 17 =	1643
SS., yellow and blue,	53 to 70 =	1590
Slate,	10 to 80 =	1580
SS., pebbly,	40 to 120 =	1540
Slate, black,	25 to 145 =	1515
SS., white,	10 to 155 =	1505
Slate,	29 to 184 =	1476
SS.,	32 to 216 =	1444
Slate,	29 to 245 =	1415
SS., gray,	17 to 262 =	1398
Slate,	12 to 274 =	1386
SS.,	38 to 312 =	1348
Slate,	123 to 435 =	1225

SS., pebbly, (some gas,)	65 to 500 =		1160
Slate,	27 to 527 =		1133
SS., (salt water,)	10 to 537 =		1123
Slate, (cased at 550′,)	78 to 615 =		1045
SS., (gas,)	20 to 635 =		1025
Slate and shells,	105 to 740 =		920
Red rock,	160 to 900 =		760
SS., (heavy gas flow,)	19 to 919 =		741
Slate,	12 to 931 =		729
SS., gray,	16 to 947 =		713
Slate and shells,	38 to 985 =		675
SS., gray,	8 to 993 =		667
Red rock,	27 to 1020 =		640
Slate,	20 to 1040 =		620
SS.,	10 to 1050 =		610
Slate and hard sand shells,	325 to 1375 =		285
Slate and shells, some chocolate color,	25 to 1400 =		260
Slate and shells,	150 to 1550 =	+	110
Slate and mud,	247 to 1797 =	—	137
Sandy slate,	10 to 1807 =	—	147
Slate and mud,	43 to 1850 =	—	190
SS.,	15 to 1865 =	—	205
Slate, mud, and shells,	60 to 1925 =	—	265

No oil. A large gas flow from 900′.

GROUP IX.

Wells in Tuna Valley, in McKean county, Pa., and in Cattaraugus county, N. Y.

Foster Well, No. 1.

1871.

Hinchey farm. Authority, C. H. Foster.

Well mouth above ocean, in feet.

?,	442	to	442	=
1st SS.,	18	to	460	=
?,	290	to	750	=
2d SS.,	30	to	780	=
?,	320	to	1100	=
3d SS.,	30	to	1130	=
Slate,	6	to	1136	=
SS., hard,	70	to	1206	=
Slate with occasional shells,	389	to	1595	=

No oil or gas below 3d SS. Well deepened from 1136′ to 1595′ in 1873.

Olmstead Well, No. 1.

Fall of 1875.

Sanford farm, on Tuna flats, 3 m. S. of Limestone. Authority, Samuel Harsh.

Well mouth above ocean, in feet.

Drive pipe,	100	to	100	=
?,	260	to	360	=
1st SS.,	25	to	385	=
?,	275	to	660	=
2d SS.,	100	to	760	=
?,	140	to	900	=
Sand shell,	55	to	955	=
?,	115	to	1070	=
3d SS.,	40	to	1110	=
?,	20	to	1130	=

Shale oil flowed first at 905′ 25 barrels, increasing to bottom of shelly band to 120 barrels. Apparently not much increase of oil in 3d SS.

Crocker Well.

1875.

Tuna flats, near Olmstead, No. 1. Authority, one of the drillers.

Well mouth above ocean, in feet.		
Drive pipe,	240 to 240 =	
?,	160 to 400 =	
1st SS., shelly,	say, 30 to 430 =	
?,	315 to 745 =	
Band of sand shells and slate,	20 to 765 =	
Mud rock,	30 to 795 =	
Band of sand shells and slate,	20 to 815 =	
Mud rock,	30 to 845 =	
Band of sand shells and slate,	20 to 865 =	
Mud rock,	30 to 895 =	
Band of sand shells and slate,	20 to 915 =	
?, including 3d SS.,	125 to 1040 =	

Hole full of water down to 700′ by reason of imperfect casing, then cased with 3¼ casing, and 3⅛ hole continued to bottom of well.

No 2d SS. found. Top 3d SS. said to be 1030′. The above bands of sand shells commenced with a shell about 1 inch thick, then shale, then another shell of increased thickness, thus alternating to the center of the band where the shell was about 12 inches thick. They then decreased in the same way to the bottom of the band. Oil was found in the first band and an increase noticed in passing each one of the other groups. At 912′ gas and oil threw the water from the hole and the well flowed for two weeks. Deeper drilling did not materially increase the oil flow.

Lewis Well.

1875.

Seward farm, between Tarport and Bolivar run. Authority, Mr. Lewis.

Well mouth above ocean, in feet,		1496
?,	400 to 400 =	1096
1st SS., estimated,	20 to 420 =	1076
?,	280 to 700 =	796
2d SS.,	40 to 740 =	756
?,	330 to 1070 =	426
3d SS., not through,	48 to 1118 =	378

Specimens of SS. and oil from 1100′. Show of oil at 700′. Better show at 930′ in black slate.

Jackson & Walker, No. 2.

1875.

Kennedy farm, Bradford. Authority, Samuel Harsh.

Well mouth above ocean, in feet,	1512
Conductor,	45 to 45 = 1467
?,	1050 to 1095 = 417
3d SS.,	20 to 1115 = 397
Black slate,	5 to 1120 = 392

1st and 2d sands were not noticed in drilling. Cased 325′, show of oil above 3d SS. No red rock in well.

Mt. Raub Well.

1877.

Raub farm, Bradford; belonging to Producers' Consolidated Land and Petroleum Company, being the first well drilled on the mountain. Authority, Mr. L. C. Blakeslee, manager.

Well mouth above ocean, in feet,	2046
Conductor,	9 to 9 = 2037
Slate, gray,	50 to 59 = 1987
Red rock,	75 to 134 = 1912
SS., hard, (crooked hole here,)	20 to 154 = 1892
Red rock,	40 to 194 = 1852
Slate and shells, gray,	166 to 360 = 1686
SS., white and brown,	25 to 385 = 1661
Slate and shells, gray, fossils,	455 to 840 = 1206
?,	787 to 1627 = 419
3d SS., brown,	46 to 1637 = 373

Heeley & Boggs, No. 2.

December, 1877.

Rogers' farm, three-fourths of a mile south-west of Bradford, McKean county, Pa. Authority, O. P. Boggs.

Well mouth above ocean, in feet,	
Conductor,	14 to 14 =
?,	226 to 240 =
SS., gray and pebbly,	5 to 245 =
?,	655 to 900 =
SS.,	35 to 935 =
?,	235 to 1170 =
SS., brownish gray, mixed with slate,	5 to 1175 =
Slate,	7 to 1182 =
SS., gas,	30 to 1212 =
?,	288 to 1500 =
SS., oil,	43 to 1543 =
Pocket in slate,	12 to 1555 =

Well No. 1, Moody Farm.

October, 1876.

On RR. between Lewis Run Station and Prentice Mill Station, McKean county. Authority, C. L. Blakeslee, Supt. P. C. L. & P. Co.

Well mouth above ocean, in feet,	1599
?,	1030 to 1030 = 569
2d SS.,	20 to 1050 = 549
?,	328 to 1378 = 221
"Oil" SS.,	5 to 1383 = 216
?,	46 to 1429 = 170
SS., some oil,	15 to 1444 = 155

Produced 15 barrels per day for two days from 20′ below 2d SS., = 1070′. Slush oil. Producing 5 barrels per day, June, 1877, from horizon of 2d SS. 2d SS. was a good sand.

Haven Well, No. 1.

Near DeGolier, about 10′ above Tuna creek. Authority, L. C. Blakeslee, Supt. P. C. L. & P. Co.

Well mouth above ocean, in feet,	
Drive pipe,	37 to 37
?,	468 to 505
SS.,	63 to 568
?,	52 to 620
SS.,	97 to 717
?,	125 to 842
SS.,	82 to 924
?,	191 to 1115
Red SS. and gas,	31 to 1146
?,	149 to 1295
SS.,	9 to 1304
?, shells at 1325′,	100 to 1404

"Marshburgh Well."

H. L. Taylor & Co. C. L. Wheeler, Supt.

Well mouth above ocean, in feet,	
?,	1350 to 1350 =
SS., close and hard,	150 to 1500 =
?,	353 to 1853 =
SS., oil,	35 to 1888 =
Shale,	6 to 1894 =
SS., no oil,	25 to 1919 =

Bramley Well.

1881.

On Richardson farm, Sugar Run, Warrant 3714? Corydon twp., McKean county. Authority Thos. Chattle.

Well mouth above ocean, in feet,	
?,	450 to 450
1st SS., (15′ to 20′ thick,)	20 to 470
?,	280 to 750
2d SS.,	40 to 790
?,	90 to 880
3d SS., (stopped in good sand,)	90 to 970

Oil came in at 936′. Stopped in sand for fear of salt water. Promises to be a 15 barrel well, (Oct. 27, 1881.)

Records copied from books of Producers' Consolidated Land and Petroleum Company.

Mr. L. C. Blakeslee, Supt.

(Copied by Arthur Hale, January, 1878.)

Well No.	Farm.	Top SS.	Thickness.	Depth.	
1	Cookroft, 17 acre tract,	1034′	10′ in SS.,	1044′	175 barrels 1st day, D. P. 112′.
2	Tarport,	1056′	25′ fair,	1081′	60 barrels 1st day.
3	"	1039′	17′,	1056′	150 " "
5	"	1040′	11′ good,	1051′	90 " "
6	"	1034′	15′ good,	1049′	
7	"	1035′	19′,	1054′	50 " "
8	"	1036′	19′,	1055′	
10	R. R. lands,	1038′	27′,	1080′	
11	"	1037′	26′,	1063′	
12	"	1040′	25′,	1065′	2d SS. oil. Struck July 5, 1876.
14	"	1035′	25′,	1060′	236′ D. P.
15	"	1045′	30′,	1085′	
16	"	1032′	21′,	1053′	
17	"	1047′	30′ fair,	1077′	230 D. P.
18	Colby lot,	1044′	15′, poor,	1059′	227 D. P., June 2, 1876.
19	Baker "	1047′	34′,	1087′	237 D. P., August 30, 1876.
20	Holmes "	1050′	25′,	1075′	164 D. P., May 27, 1876.
21	Switzer,	1115′	33′,	1148′	19 cond., June 21, 1876.
22	"	1160′	18′,	1178′	18 cond.
23	Raub, No. 1,	1078′	16′,	1094′	
25	Gilbert, " 1,	1018′	12′, poor,	1035′	247 D. P., June 19, 1876
26	Glass, " 1,	1027′	18′,	1045′	248 D. P., oil 565, 890, 900.
27	Muller, " 1,	1068	19′,	1119′	40 bbl, June 20, 1876.
28	M. Garvis, Leonard Hollow, No. 1,	1300′	20′,	1665′	Fine white SS., 9′ hard, dry at 1650′.
29	Melvin, No. 1,	1005′	37′ fair,	1042′	237 D. P.
30	Tarport, " 2,	1005′	37′,	1042′	
31	" " 3,	1010′	25,	1035′	
32	" " 4,	1005′	30′,	1035′	
33	" " 5,	1008′	42,	1050′	
34	" " 6,	1036′	37′,	1073′	

35	"	" 7, .	1025′	53′, . .	1078′	
36	"	" 8, .	1011′	25′, . . .	1036′	223 D. P.
37	"	" 9, .	1012′	30′, . . .	1042′	225 D. P.
38	"	" 10, .	1002′	30′, .	1032′	224 D. P.
39	"	" 11, .	1005′	31′, . . .	1064′	720 feet of casing.
40	"	" 12, .	1008′	32′, . .	1040′	744′ of casing, (salt water at 700.)
41	"	" 13, .	1010′	52′, . . .	1062′	
42	"	" 14, .	1005′	37′, . . .	1042′	
43	"	" 15, .	1006′	49′, . . .	1055′	
44	"	" 16, .	1010′	45′, . . .	1055′	
45	"	" 17, .	1042′	66′, . . .	1108′	
46	"	" 18, .	1036′	28′, . . .	1076′	
47	"	" 19, .	1002′	57′, . . .	1159′	
48	"	" 20, .	1041′	52′, . . .	1093′	
49	"	" 21, .	1005′	32′, . . .	1037′	
50	"	" 22, .	1018′	82′, . . .	1091′	
51	"	" 23, .	1015′	88′, . .	1103′	
52	"	" 24, .	1197′	66′, . . .	1263′	
53	"	" 26, .	1107′	38′, . .	1150′	
54	"	" 26, .	1080′	44′, . . .	1126½′	
55	Melvin,	" 27, .	1147′	46′, . .	1193′	
56	"	" 28, .	1206′	50′, . . .	1281′	
57	"	" 29, .	1317′	71′, . .	1398′	
58	"	" 30, .	1333′	52′, . . .	1385′	
59	Raub,	" 2, .	1067′	30′, . . .	1097′	
60	"	" 3, .	1240′	32′, . . .	1272′	
61	"	" 4, .	1125′	27′, . . .	1157′	
62	"	" 5, .	1245′	45′, . . .	1300′	
63	Therry,	" 2, .	1047′	40′, . . .	1087′	
64	"	" 3, .	1047′	40′, . . .	1087′	
66	Nichols,	" 1, .	1125′	4′, . . .	1155′	
68	Gilbert,	" 2, .	1005′	30′, . .	1035′	
73	Muller,	" 5, .	1288′	12′, . .	1311′	
74	"	" 6,	1172′	14′, . . .	1195′	
75	"	" 7, .	1040′	10′, . . .	1060′	
76	"	" 8, .	1040′	16′, . . .	1067′	
77	"	" 9.				
78	"	" 10, .	1350′	13′, . . .	1371′	
79	Whitaker	" 1, .	1050′?	6′.?		
80	Carmody	" 1, .	1150′	6′, . .	1195′	
81	"	" 2, .	1376′	29′, .	1405′	
82	Garvis,	" 2, .	No 3d.		1510′	Dry.
86	Melvin,	" 31, .	1040′	60′, . . .	1100′	
87	"	" 32, .	1066′	54′, . . .	1120′	
88	"	" 33, .	1076′	88′, . . .	1164′	
89	"	" 34, .	1122′	64′, . . .	1186′	
90	"	" 35, .	1015′	91′, . . .	1106′	
92	"	" 37, .	1056′	61′, . . .	1117′	
94	"	" 39, .	1038′	62′, . . .	1100′	
96	"	" 41, .	1483′	. . . . .	1541′	
97	"	" 42, .	1515′	. . . .	1567′	
100	"	" 45, .	1039′	. . . .	1090′	
101	"	" 46, .	1064′	. . .	1120′	
123	Foster,	" 6, .	1175′	55′, . . .	1230′	
124	Raub,	" 6, .	1312′	40′, . . .	1352′	
125	Muller,	" 125, .	1410′	33′, . . .	1443′	Dry, drilled 35′ deeper.
126	Raub,	" 7, .	1627′	46′, . . .	1673′	
127	Havens,	" 2, .	1105′	30′, . . .	1166′	
128	D. E. Foster, No. 1		1195′	50′, . . .	1285′	Best SS., 1229′.
129	Moody, No. 4.*					

* "No SS., but shells, oil, and gas in small quantities at 1450′ ".

H. L. Taylor & Co. Wells.

1876.

On R. R. lands Tuna valley. Authority, C. L. Wheeler, superintendent.

			Top 3d.	Thick.	D. P.
	No. 14,	2060′ N. of State Line,	1038	18	250
	" 13,	1660′ " " "	1032	19	238
Dec. 8,	" 8,	660′ " " "	....	....	237
	" 12,	260′ " " "	1025	7	237
Oct. 7,	" 3,	500′ " Tarport,	1015	20	196
Aug. 23,	" 1,	500′ S. of "	1013	15	78
Aug. 30,	" 2,	700′ " "	1013	17	Dug.
Oct. 19,	" 20,	2980′ " Bradford,	1051	71	218
Oct. 31,	" 21,	3680′ " "	1054	68	218
	" 16,	4480′ " "	1064	46	215
	" 15,	5280′ " "	1072	39	207
Dec. 2,	" 22,	1320′ N. of DeGolia,	1131	69	185
Aug. 16,	" 17,	320′ " "	1128	46	155
Aug. 22,	" 18,	1200′ S. of "	1123	22	155
Aug. 5,	" 19,	2000′ " "	1128	50	88

Drive Pipe in the Tunangwant Valley.

Harsh & Schreiber Wells.

Little, No. 1, Little farm, ... 223′
" No. 2, " . . . . . 229′
" No. 3, " . . . . . 223′
" No. 4, " . . . . . 220′
Cole well, No. 1, ... 68′
" No. 2, ... 116′
Walcott, No. 1, ... 248′
" No. 2, ... 248′
" No. 5, ... 70′
" No. 6, ... 90′
" No. 7, ... 244′
" No. 8, ... 67′
Howe, No. 1, ... 214′
Beardsley, No. 1, ... 250′
" No. 2, ... 248′
" No. 3, ... 257′
" No. 4, ... 248′

Empire Transit Co.

Hooker farm, State line, ... 253′
Whitaker farm, State line, ... 252′

Haskill & Co., No. 2.

Welsh farm, Tarport, ... 239′

GROUP X.

Wells of the Enterprise Transit Company, in McKean Co., Pa., and Cattaraugus Co., N. Y.

Enterprise Transit Co.'s Well.

R. Whitaker Farm, Cattaraugus co., State line. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,	
Drive pipe,	252 to 252 =
?,	785 to 1037 =
3d SS.,	28 to 1065 =
Pocket,	22 to 1087 =

Cased 485′. Slush oil at 800′, flowed 8 barrels per day for a few days. At 970′ "large vein" of slush oil, flowed 20 barrels per day for some time. 3d SS. fine and hard at top, then grows coarser to 1050′, then mixed with slate.

Enterprise Transit Co.'s Well.

Hooker farm, McKean county, S. of State line. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,	
Drive pipe,	253 to 253 =
?,	789 to 1042 =
3d SS.,	18 to 1060 =
Pocket,	33 to 1093 =

Cased 410′. Slush oil at 800.′

Enterprise Transit Co.'s Well, No. 12.

Taylor tract, S. E. of Bradford, McKean Co. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,	
Drive pipe,	37 to 37 =
?, cased at 212′,	698 to 735 =
1st SS.,	42 to 777 =
?,	245 to 1022 =
2d SS., gas, but no oil,	20 to 1042 =
?,	307 to 1349 =
3d SS.,	30 to 1379 =
Pocket,	18 to 1397 =

Enterprise Transit Co.'s Well, No. 13.

Taylor tract, S. E. of Bradford, McKean Co. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,		
Conductor,	15 to 15	=
?, cased at 299′,	890 to 905	=
1st SS.,	75 to 980	=
?,	50 to 1030	=
SS., little oil,	5 to 1035	=
?,	170 to 1205	=
2d SS.,	55 to 1260	=
?,	275 to 1535	=
3d SS.,	77 to 1612	=
Pocket,	9 to 1621	=

Enterprise Transit Co.'s Well, No. 14.

October 25, 1877.

Taylor tract, on Rutherford Run, S. E. of Bradford, McKean Co. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,		
Conductor,	35 to 35	=
?,	742 to 777	=
1st SS.,	14 to 791	=
?,	369 to 1160	=
Stray SS.,	10 to 1170	=
?,	172 to 1342	=
3d SS.,	58 to 1400	=
Pocket,	24 to 1424	=

Started off at 20 barrels per day; now doing 16 barrels, (February 7, 1878.)

Enterprise Transit Co.'s Well, No. 15.

January 31, 1878.

Taylor tract, on Rutherford Run, S. E. Bradford, McKean Co. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,		
Drive pipe,	65 to 65	=
?, cased at 230′,	625 to 690	=
1st SS.,	18 to 708	=
?,	307 to 1015	=
2d SS.,	10 to 1025	=
?,	233 to 1258	=
3d SS.,	72 to 1330	=
Pocket,	15 to 1345	=

Started off at 30 barrels per day.

Enterprise Transit Co.'s Well, No. 69.

Schoonmaker farm, about 4 miles north-east of Bradford, McKean Co. Authority, J. Brown, Supt.

Well mouth above ocean, in feet,		
Drive pipe,	43 to 43	=
?,	487 to 530	=
Stray SS.,	6 to 536	=
?,	104 to 640	=
1st SS., very good,	15 to 655	=
?,	185 to 840	=
2d SS., some oil,	20 to 860	=
?,	335 to 1195	=
3d SS., very poor,	30 to 1225	=
Pocket,	116 to 1341	=

GROUP XI.

*Wells in the Bradford District, McKean County, Pa., and in New York.**

Jackson & Walker's Well, No. 7.

Kennedy lease, Bradford.

Well mouth above ocean, in feet,				1474±
?,	430	to	430 =	1044
1st SS.,	15	to	445 =	1029
?,	315	to	760 =	714
2d SS.,	15	to	775 =	699
?,	285	to	1960 =	414
3d SS.,	25	to	1085 =	389

Emery, Patterson & Co.'s Well, No. 1.

July 29, 1876.

Lewis Run, S. E. corner of Warrant 2277, in Miam Hollow. Authority, C. A. Ashburner

Well mouth above ocean,				1645
?,	3	to	3	=
SS., white,	15	to	18	=
Red shale, (Spec. No. 1,)	70	to	88	=
Black slate,	35	to	123	=
SS., white, compact, (Spec. No. 2,)	45	to	168	=
Gray slate, soapstone, and shells, (Spec. No. 3,)	65	to	233	=
Gray slate, "230 to 300,"	67	to	300	=
Shale, soft, clayey, sticky, mushy,	10	to	310	=
Slate and shells, (Spec. No. 4,)	390	to	700	=
"1st SS. at 700'," (Spec. No. 5,)	say 20	to	720	=
Shells and slate,	290	to	1010	=
"2d SS.," white, (Spec. No. 6,)	say 40	to	1050	=
Slate and shells, (Spec. No. 7 and 8.)	195	to	1245	=
SS., gray and dark, (Spec. No. 9 and 10,)	20	to	1265	=
Slate and shells, (Spec. No. 11,)	106	to	1371	=
3d SS.,	12?	to	1383?	=
Gray sandy shale,	7	to	1390	=

Shells and salt water at 230'. Pebbles at 700'. Gas at 1070'. Nice white SS. top at 1010'. Stopped drilling at 1265', July 29, 1876, afterwards drilled deeper. Unproductive.

*Communicated by Mr. C. A. Ashburner, January, 1878.

King and Big Shanty Well.

May, 1877.

Dent lands, Lafayette township. Authority, Tom King.

Well mouth above ocean, in feet,	1662
Drive pipe,	90 to 90 = 1572
?, "Red rock, near 320',"	690 to 780 = 882
SS., estimated,	20 to 800 = 862
?,	160 to 960 = 702
1st SS.,	40 to 1000 = 662
?,	160 to 1160 = 502
2d SS.,	120 to 1280 = 382
?,	265 to 1545 = 117
3d SS., (end of first drilling, 1610',)	40 to 1585 = 77
Gray shells and shale,	60 to 1645 = 17
SS., gas, no oil,	12 to 1657 = + 5
?,	6 to 1663 = — 1

Cased 307'. Production, May 31, 1877, 7 barrels. In August, 1877, was doing 5 barrels, when it was drilled deeper. SS., at 1645', was better than 3d SS.

Prentice Well, No. 8.

June 1, 1877.

On Foster brook, adjoining N. W. corner of Lafferty Farm. Authority, ———.

Well mouth above ocean, in feet,	1772
?,	700 to 700 = 1072
1st SS., estimated,	20 to 720 = 1052
?,	280 to 1000 = 772
2d SS.,	100 to 1100 = 672
?,	232 to 1332 = 440
3d SS., estimated,	20 to 1352 = 420

R. McMurray Well.

R. McMurray Farm, S. side of Foster brook, above Babcock R. R. station. Authority, ———.

Well mouth above ocean, in feet,	1574
?,	550 to 550 = 1024
1st SS.,	20 to 570 = 1004
?,	255 to 825 = 749
2d SS.,	40 to 865 = 709
?,	262 to 1127 = 447
3d SS., not through,	54 to 1181 = 393

McMullen & Hallock Gas Well.

May 23, 1877.

Loop Farm, on Indian creek. Authority, ————.

Well mouth above ocean, in feet,				1785
Conductor,	16	to	16	=1769
?, cased at 196′,	609	to	625	=1160
1st SS.,	50	to	675	=1110
Gray slate, with shells,	215	to	890	= 895
2d SS.,	70	to	960	= 825
?, (with SS.,)	195	to	1155	= 630
SS., gas,	25	to	1180	= 605
Slate,	7	to	1187	= 598
?,	33	to	1220	= 565
3d SS., estimated, slight oil show,	20	to	1240	= 545

Bennie, Trumbower Well.

May, 1877.

Loop Farm, on N. fork of S. branch of Indian creek. Authority, B. A. Packard.

Well mouth above ocean, in feet,				1785
Conductor,	34	to	34	=1751
?,	614	to	648	=1137
1st SS.,	60	to	708	=1077
?,	199	to	907	= 878
2d SS.,	70	to	977	= 808
?,	213	to	1190	= 595
Stray SS., gas,	15	to	1205	= 580
Dark gray slate, some shells,	10	to	1215	= 570
3d SS.,	85	to	1300	= 485
Slate and shells,	30	to	1330	= 455
Gray slate,	22	to	1352	= 433

Cased 233′. First oil show at 1225′. Most of the oil comes in here. Production, May 30, 1877, 5 barrels.

Follett Well.

June, 1877.

Loop Farm, N. branch of S. fork, Indian creek. Authority, D. Follett.

Well mouth above ocean, in feet,				2030
?,	850	to	850	=1180
1st SS., estimated,	20	to	870	=1160
?,	280	to	1150	= 880
2d SS., estimated,	20	to	1170	= 860
?,	270	to	1440	= 590
SS., gas in top,	32	to	1472	= 558
Gray slate,	9	to	1481	= 549
3d SS., estimated,	20	to	1501	= 529

Production, 2 barrels per day, in September, 1877.

Four Mile Run Well.

Johnson farm W. of Rock City, N. Y. Authority,

Well mouth above ocean, in feet,		1832
Conductor,	17 to 17	= 1815
?,	153 to 170	= 1662
Hard gray slate,	60 to 230	= 1602
?,	420 to 650	= 1182
1st SS.,	60 to 710	= 1122
?,	290 to 1000	= 832
2d SS., ("somewhere between 1000′ and 1100′",)	30 to 1030	= 802
?,	340 to 1370	= 462
3d SS.,	60 to 1430	= 402
Shells and shale,	41 to 1471	= 361

Cased 230′. Could have been cased at 170′.

Gas at 1340′. 3d SS., 4′ shell, 15′ good fine open sand and 41′ sand. Filled 35′ in an hour after striking the 15′ sand, and at a few bits in sand flowed over top of derrick. Doing 4 to 5 barrels May 23, 1877. Torpedoed and doing 10 barrels September, 1877.

James Well, No. 1.

Waters farm N. of Olean, Rock City, N. Y. Authority,

Well mouth above ocean, in feet,		1960
?,	700 to 700	= 1260
Red rock,	30 to 730	= 1230
?,	385 to 1115	= 845
2d SS.,	85 to 1200	= 760
?,	270 to 1470	= 490
3d SS.,	50 to 1520	= 440
?,	10 to 1530	= 430
SS.,	12 to 1542	= 418
?, pocket,	5 to 1547	= 413

Best sand 4′ to 5′ thick at 1535′. Oil came first from 1490′, now exhausted and coming from 1535′.

Production, 7 barrels per day in May, 1877.

NOTE.—Mr. Otto Germer says he watched this well closely. Top 3d SS. 1470′. Oil came in at 1476′, sand 50′ or more in thickness. Depth of well 1546′. This agrees with the stratification in his "Flat Iron" well, which is on ground 33′ above the James well.

Knox Well.

1877 ?

Conover tract, Sugar run. Authority, Henry Bradley.

Well mouth above ocean, in feet.		
Drive pipe,	86 to 86	=
?, cased at 400′,	384 to 470	=

1st SS., oil show, gas,	40 to 510 =
?,	260 to 770 =
2d SS., oil show, gas,	114 to 884 =
?, red rock near bottom,	201 to 1085 =
3d SS., oil show, gas,	40 to 1125 =
?,	375 to 1500 =

Struck red rock 6′ from top of 3d SS. 1091′. Oil show in shells from 1st to 3d sands. Best oil show in 1st SS. similar to refined oil. Shell in gray rock below 3d SS. gave an oil show. Unremunerative.

Salamanca Centennial Well, No. 2.

Oct. 28, 1876.

Authority, H. A. Darrow.

Well mouth above ocean, in feet,	1554
Conductor,	9 to 9 = 1545
Gray slate (red?) and shells,	441 to 450 = 1104
1st SS.,	5 to 455 = 1099
Gray slate,	295 to 750 = 804
?,	30 to 780 = 774
2d SS.,	4 to 784 = 770
Gray slate with shells,	336 to 1120 = 434
3d SS.,	18 to 1138 = 416
Gray slate with hard shells,	187 to 1325 = 229

Cased 241′. Gas at 900′. No production.

Keown & Vaughan Well.

June, 1877.

Cutting farm, DeGolier Station.

Well mouth above ocean in feet,	1501
3d sand, at	1124 = 377

Started at 12 barrels, increased by torpedo.

C. S. Whitney Well.

James DeGolier farm.

Well mouth above ocean in feet,	1514
3d sand, at	1137 = 377

Started at from 5 to 10 barrels.

Emery Patterson & Co.'s Well.

Morris Estate, Toad Hollow.

Well mouth above ocean in feet,	1582
3d sand (42′) top,	1196 = 386

Kennedy Well, No. 1.

Smith farm, Shepard Run.

Well mouth above ocean in feet,		1575
3d sand, at	1235 =	340

Doing 8 barrels, June 22, 1877; about one month old.

Echart Well.

D. Foster farm, Shepard Run.

Well mouth above ocean in feet,		1565
3d sand, at	1210? =	355?

Emery Patterson & Co.'s Well, No. 2.

November 1, 1876.

Lewis Run. In Miam Hollow, near north line of Warrant, 2276.

Well mouth above ocean in feet,		1908
?,	1050 to 1050 =	858
1st SS., at	1050	
?, including 1st SS.,	250 to 1300 =	608
2d SS., at	1300	
?, including 2d SS.,	336 to 1636 =	272
3d SS., at	1636	
?, including 3d SS.,	71 to 1707 =	201

Unproductive.

Prentice R. R. Well.

Big Shanty.

Well mouth above ocean in feet,		1633
3d sand, at	1497 =	136

Prentice Well, No. 3.

Melvin farm, Tarport.

Well mouth above ocean in feet,		1440
3d SS., at	1010 =	430

H. L. Taylor & Co.'s Well, No. 2.

Dikeman (?) farm, Bradford.

Well mouth above ocean in feet,		1552
3d SS., at	1156 =	396

Clark, Babcock & Hulings' Well, No. 1.

Foster Brook, near saw mill.

Well mouth above ocean in feet,		1474
3d SS., (25' thick,) at	1024 =	450
?, to bottom of well,	90 to 1114 =	360

Considerable salt water. Doing 2 barrels, June 2, 1877.

Clark, Babcock & Hulings' Well, No. 2.

Well mouth above ocean in feet,		1680
No. 3d SS. reported, depth of well,	1250 =	430

Unproductive.

Clark, Babcock & Hulings' Well, No. 3.

Well mouth above ocean in feet,		1500
?,	490 to 490 =	1010
1st SS.,	35 to 525 =	975
?, including 100′ of 2d sand,	537 to 1062 =	438
3d SS., not through,	51 to 1113 =	387

Doing 8 barrels, June 2, 1877. Cased at 542′.

O. Neil Well.

Snyder farm, Foster Brook. The extreme eastern well on Foster Brook, June 2, 1877.

Well mouth above ocean in feet,		1650
?,	1220 to 1220 =	430
3d SS., (best sand at 1245′,)	43 to 1263 =	387
?,	2 to 1265 =	385

Germer & Carey's Well.

J. McMurray farm, Foster Brook, west of Derrick City.

Well mouth above ocean in feet,		1530
?,	1072 to 1072 =	458
3d SS.,	100 to 1172 =	358
?,	3 to 1175 =	355

Van Vleck Well, No. 1.

Lafferty farm; branch of Kendall creek.

Well mouth above ocean in feet,		1577
?,	1130 to 1130 =	447
3d SS., (not through,)	45 to 1175 =	402

Doing 10 barrels, June, 1877. One month old.

Van Vleck Well, No. 2.

Well mouth above ocean in feet,		1632
?,	1176 to 1176 =	456
3d SS.,	82 to 1258 =	374

Doing 10 barrels, June, 1877.

GROUP XII.

Wells in McKean county, repeated from Report R.

Wilcox Well, No. 1.

(Adams Well.)

Owned by M. M. Schultz & Co., situated on the west branch Clarion river, in warrant 2676, 1 mile north of the McKean-Elk county line. This well was drilled by Adams & Babcock * in 1864 (?). According to M. M. Schultz the well was only drilled to the depth of 1600′± in 1864; afterwards drilling was continued to a depth of 1700′ and it was finally abandoned at a debth of 1785′, where the tools were lost.

	Well mouth above ocean, in feet,		1646
1.	Conductor,	41 to 41 =	1605
2.	Slate,	30 to 71 =	1575
3.	Red shale,	137 to 208 =	1438
4.	Blue sand,	8 to 216 =	1430
5.	Slate,	26 to 242 =	1404
6.	Red shale,	64 to 306 =	1340
7.	Micaceous sand,	21 to 327 =	1319
8.	Blue sand,	5 to 332 =	1314
9.	Red shale,	31 to 363 =	1283
10.	Slate,	13 to 376 =	1270
11.	Blue sand,	8 to 384 =	1262
12.	Red shale,	31 to 415 =	1231
13.	Blue sand,	14 to 429 =	1217
14.	Slate,	84 to 513 =	1133
15.	Micaceous sand,	47 to 560 =	1086
16.	Slate,	77 to 637 =	1009
17.	Blue sand,	20 to 657 =	989
18.	Slate,	43 to 700 =	946
19.	Micaceous sand,	48 to 748 =	898
20.	Olive shales,	65 to 813 =	833
21.	Micaceous sand,	21 to 834 =	812
22.	Olive shales,	11 to 845 =	801
23.	Micaceous sand,	18 to 863 =	783
24.	Olive shales,	7 to 870 =	776
25.	Micaceous sand,	5 to 875 =	771

* That portion of the record to a depth of 1302′ was originally communicated by Mr. O. N. Adams, formerly of Wilcox, to Prof. Lesley and published by him in the Proceedings of the American Philosophical Society, Vol. X, page 238. The record of the well to a depth of 1609′ was afterwards published in the Petroleum Monthly. The undescribed interval of 176′ (stratum 67) has been added on the authority of Mr. Schultz. The record as it appears below is copied from that published in the Petroleum Monthly.

26. Olive shales,	5 to 880 =	766
27. Chocolate colored mica sand,	9 to 889 =	757
28. Olive shales,	23 to 912 =	734
29. Micaceous sand,	6 to 918 =	728
30. Olive shales,	6 to 924 =	722
31. Red shale,	6 to 930 =	716
32. Micaceous sands,	5 to 935 =	711
33. Olive shales,	2 to 937 =	709
34. Micaceous sand,	10 to 947 =	699
35. Olive shales,	6 to 953 =	693
36. Mixed shales, (red and olive,)	2 to 955 =	691
37. Olive shales,	38 to 993 =	653
38. Gray sand, light,	3 to 996 =	650
39. Shale very soft,	6 to 1002 =	644
40. Blue clay,	6 to 1008 =	638
41. Olive shales,	65 to 1073 =	573
42. Dark micaceous sand,	36 to 1109 =	537
43. Soapstone, soft mud vein,	2 to 1111 =	535
44. Gray sandstone,	28 to 1139 =	507
45. Slate rock,	25 to 1164 =	482
46. Very hard sandrock,	11 to 1175 =	471
47. Sandstone,	26 to 1201 =	445
48. Slaty rock,	21 to 1222 =	424
49. Hard sandstone and soft slate,	21 to 1243 =	403
50. Slaty rock with sand,	25 to 1268 =	378
51. Mud vein,	1 to 1269 =	377
52. Slate,	4 to 1273 =	373
53. Sandrock,	48 to 1321 =	325
54. "Chalk rock,"	6 to 1327 =	319
55. Mud vein,	17 to 1344 =	302
56. Light sandrock,	18 to 1362 =	284
57. Sandrock,	17 to 1379 =	267
58. Lime (?) and hard shale,	8 to 1387 =	259
59. Soft shale,	25 to 1412 =	234
60. Hard shale, lime and sand,	10 to 1422 =	224
61. Soft blue shale,	15 to 1437 =	209
62. Hard sandrock,	60 to 1497 =	149
63. Sandrock, (?)	8 to 1505 =	141
64. Shale and sand mixed,	14 to 1519 =	127
65. Hard shelly sandrock,	38 to 1557 =	89
66. Rock and shales, alternating,	52 to 1609 =	37
67. Interval,	176 to 1785 =	— 139

Drilled wet. Afterwards cased at . . . . 400′
Size of hole, ... 5 inches.
Inside diameter of casing, $3\frac{3}{4}''$; outside, $4''$; weight per foot, 5.320 pounds.
Conductor, ... 41′
Heavy fresh water course, ... 60′
Salt water, ... 400′
Mica and iron pyrites abound at . . . . 520′+
Gas and "soot," . . . . 726′ to 820′±

Very soft olive shales, "putty rock,"	840′
"Black gas" downward from,	900′
Red shale at	940′
Silica abounds, hard and compact,	950′
Iron pyrites,	1000′
Strong smell in derrick when raising tools, at	1100′
Gas vein very strong, shooting sometimes 20′ high from top of 26′ sandstone, (stratum No. 47.) Gas vein not so strong at bottom of same sandstone.	
Gas and soot, with strong odor,	1240′
Very small red and white pebbles on tools in 25′ sand (stratum 50,) at	1250′
Gas quite strong at	1280′
Oil and oil smell in air,	1335′±
Plenty of soot at	1480
Increasing gas at	1560′
Strong gas and strong smell at	1600′

Wilcox Well, No. 2.

Owned by M. M. Schultz & Co. Situated 855 feet S. 17½° W. of Wilcox well, No. 1, above.

	Well mouth above ocean, in feet,					1642*
1.	Loam and gravel,	30	to	30	=	1612
2.	Gray slate,	50	to	80	=	1562
3.	Gray slate,	2½	to	82½	=	1559½
4.	Gray sand,	42½	to	125	=	1517
5.	Red shale,	20	to	145	=	1497
6.	Gray sand,	5	to	150	=	1492
7.	Red shale,	25	to	175	=	1467
8.	Gray soapstone, (shale and clay,)	10	to	185	=	1457
9.	Red shale, mixed with gray slate,	155	to	340	=	1302
10.	Streak of soft red shale,	15	to	355	=	1287
11.	Gray slate,	62	to	417	=	1225
12.	White sand pebble rock, containing gas and salt water,	5	to	422	=	1220
13.	Gray slate,	228	to	650	=	992
14.	Dark gray slate,	30	to	680	=	962
15.	Gray slate and sand,	75	to	755	=	887
16.	Gray and red slate mixed,	40	to	795	=	847
17.	Gray slate,	60	to	855	=	787
18.	Gray slate and hard shell,	5	to	860	=	782
19.	Gray slate,	5	to	865	=	777

* Based on the 1879 profile of the P. and E. RR., which makes Wilcox 1526.36, (see R., p. 12.) In Vol. XVIII, page 14, proceedings of the American Philosophical Society, I state that the elevation of the well mouth above ocean is 1642′, based on the then (1878) corrected datum of P. and E. RR., which makes Wilcox station 1527′. The difference between the two elevations of Wilcox station is possibly less than the probable error in the elevation of the well, so that I deem it advisable not to change the elevation of the well, which has already been published.

20. Gray and red slate,	20	to 885 =	757
21. Gray slate,	25	to 910 =	732
22. Red and gray slate,	5	to 915 =	727
23. Gray slate,	30	to 945 =	697
24. Gray sand,	5	to 950 =	692
25. Gray and red sand,	5	to 955 =	687
26. Gray and red slate,	15	to 970 =	672
27. Gray slate,	15	to 985 =	657
28. Gray slate and sand,	5	to 990 =	652
29. Gray slate,	60	to 1050 =	592
30. Gray slate and sand,	5	to 1055 =	587
31. Gray slate and sand,	25	to 1080 =	562
32. Dark gray sand,	15	to 1095 =	547
33. Very hard light gray sand,	5	to 1100 =	542
34. Gray slate and sand, containing small bivalve shells,	20	to 1120 =	522
35. Gray slate and hard gray sand,	5	to 1125 =	517
36. Gray slate and soft sand,	10	to 1135 =	507
37. Hard gray sand,	10	to 1145 =	497
38. Soft gray slate,	27	to 1172 =	470
39. Gray sand,	8	to 1180 =	462
40. Gray sand and slate,	5	to 1185 =	457
41. Gray slate containing shell,	15	to 1200 =	442
42. Gray sand, containing first strong smell of oil 1205 to 1210,	20	to 1220 =	422
43. Gray slate and hard shell,	15	to 1235 =	407
44. Gray slate,	15	to 1250 =	392
45. Gray slate containing shells,	15	to 1265 =	377
46. Gray slate and clover seed sand,	5	to 1270 =	372
47. Gray slate, with hard shell,	10	to 1280 =	362
48. Gray slate,	10	to 1290 =	352
49. Gray slate and hard shell,	25	to 1315 =	327
50. Light gray sand,	10	to 1325 =	317
51. Coarse gray sand,	5	to 1330 =	312
52. Slate,	5	to 1335 =	307
53. Hard gray sand,	5	to 1340 =	302
54. White sand,	10	to 1350 =	292
55. Coarse gray sand,	5	to 1355 =	287
56. Gray slate and shell,	5	to 1360 =	282
57. Gray slate,	30	to 1390 =	252
58. Gray sand,	10	to 1400 =	242
59. Gray slate,	20	to 1420 =	222
60. Gray slate containing shell,	25	to 1445 =	197
61. Gray slate,	15	to 1460 =	182
62. Gray slate containing shell,	105	to 1565 =	77
63. Hard gray sand,	15	to 1580 =	62
64. Slate and shell,	55	to 1635 =	7
65. Gray sand,	35	to 1670 = —	28
66. Coarse gray slate,	9	to 1679 = —	37
67. Dark brown sand, containing amber oil, greatest amount near top of sand,*	16	to 1695 = —	53

* Probable representative of Bradford "3d" or oil producing sand.

68. Gray slate,	40	to 1735	= — 93
69. Gray slate and sand,	10	to 1745	= — 103
70. Gray slate and shell,	25	to 1770	= — 128
71. Gray slate and sand,	6	to 1776	= — 134
72. Hard gray sand rock, containing a great quantity of gas,	4	to 1780	= — 138
73. Gray slate,	10	to 1790	= — 148
74. Fine sand and slate,	5	to 1795	= — 153
75. Gray sand, upper part containing heavy green oil,	20	to 1815	= — 173
76. Gray and red micaceous sand and pebbles,	20	to 1835	= — 193
77. Gray slate,	55	to 1890	= — 248
78. Gray slate and red sand,	5	to 1895	= — 253
79. Red sand and pebbles,	5	to 1900	= — 258
80. White sand containing oil,	10	to 1910	= — 268
81. White and gray sand containing oil,	20	to 1930	= — 288
82. Gray slate,	74	to 2004	= — 362

Drilled dry. Cased,	541′
Fresh water course,	42½′
Gas and salt water,	422′
Gas increases, salt water,	538′
Gas vein,	1172′
First show of oil,	1205′ to 1210′
Sand containing greatest amount of oil, particularly at top of sand. Oil, amber color,	1679′ to 1695′
Great gas vein,	1776′
Heavy green oil,	1800′
White and gray sand containing oil,	1900′ to 1930′

Wilcox Well, No. 3.

(*John's Well.*)

Owned by same. Situated 1782 feet N. 73½° W. of Well No. 2, above.

Well mouth above ocean, in feet,			1666
1. Drift, as follows:	43 to	43	
Loam and sand, 5′			
Loam and gravel, 5′			
Gravel and pebble, 10′			
Gravel and sand, 5′			
Gravel and pebble, 5′			
Gravel and sandrock, 5′			
Quicksand and coarse pebble, 5′			
Fine sand, 3′			
2. { Gray slate,	2 to	45 =	1621
{ Gray slate,	35 to	80 =	1586
3. Gray sand,	37 to	117 =	1549
4. Red slate or shale,	18 to	135 =	1531
5. Red shale, (rock hard,)	10 to	145 =	1521
6. Gray sand rock,	10 to	155 =	1511
7. Red shale,	5 to	160 =	1506
8. Red slate,	20 to	180 =	1486
9. Gray slate,	25 to	205 =	1461

10.	Red slate,	105 to	310 =	1356
11.	Red shale,	15 to	325 =	1341
12.	Gray slate and sand,	15 to	340 =	1326
13.	Gray slate and shell,	15 to	355 =	1311
14.	Red slate,	25 to	380 =	1286
15.	Gray slate,	15 to	395 =	1271
16.	Gray slate and shell,	20 to	415 =	1251
17.	Gray sand,	15 to	430 =	1236
18.	Gray slate,	5 to	435 =	1231
19.	Gray sand rock,	7 to	442 =	1224
20.	Clover seed rock,	8 to	450 =	1216
21.	Gray shale,	15 to	465 =	1201
22.	Dark gray slate and shell,	75 to	540 =	1126
23.	Gray slate and shell,	7 to	547 =	1119
24.	Gray slate,	43 to	590 =	1076
25.	Hard gray slate,	75 to	665 =	1001
26.	Hard dark gray shale,	30 to	695 =	971
27.	Gray slate and sand,	5 to	700 =	966
28.	Hard gray sand,	15 to	715 =	951
29.	Light sand with shale,	5 to	720 =	946
30.	White and gray sand,	55 to	775 =	891
31.	Hard and fine gray sand,	25 to	800 =	866
32.	Fine dark gray sand,	5 to	805 =	861
33.	Gray sla e,	5 to	810 =	856
	Gray slate and shale,	5 to	815 =	851
34.	Fine gray sand,	23 to	838 =	828
35.	Red slate,	7 to	845 =	821
36.	Gray sand,	25 to	870 =	796
37.	Red slate,	10 to	880 =	786
38.	Gray slate,	35 to	915 =	751
39.	Red slate,	5 to	920 =	746
40.	Gray slate,	15 to	935 =	731
41.	Soft gray sand,	5 to	940 =	726
42.	Soft gray and white sand,	15 to	955 =	711
43.	Dark gray sand,	5 to	960 =	706
	Hard gray sand,	5 to	965 =	701
44.	Gray sand and slate,	5 to	970 =	696
45.	Fine hard dark gray sand,	5 to	975 =	691
46.	Red slate,	5 to	980 =	686
47.	Gray slate,	35 to	1015 =	651
48.	Hard gray sand,	20 to	1035 =	631
49.	Gray slate,	35 to	1070 =	596
50.	Dark gray sand,	5 to	1075 =	591
51.	Gray sand,	5 to	1080 =	586
52.	Gray shale,	15 to	1095 =	571
53.	Gray sand and very hard shells,	5 to	1100 =	566
54.	Soft gray sand,	15 to	1115 =	551
55.	Gray and white shell,	10 to	1125 =	541
56.	Close soft white sand,	20 to	1145 =	521
57.	Hard gray shells,	20 to	1165 =	501
58.	Gray slate,	15 to	1180 =	486
59.	White and gray sand and pebbles,	10 to	1190 =	476

60.	Close white sand,	5 to 1195 =	471
61.	Gray sandstone and white pebbles,	20 to 1215 =	451
62.	Coarse white sand,	5 to 1220 =	446
63.	Silver gray sand,	10 to 1230 =	436
64.	Fine white sand,	5 to 1235 =	431
65.	Gray slate and shell,	10 to 1245 =	421
66.	Gray slate,	40 to 1285 =	381
67.	Gray slate and shell,	25 to 1310 =	356
68.	Gray sand,	20 to 1330 =	336
69.	White sand,	10 to 1340 =	326
70.	Slate,	5 to 1345 =	321
71.	Coarse gray sand,	10 to 1355 =	311
72.	Soft white sand,	5 to 1360 =	306
73.	Soft gray sand,	5 to 1365 =	301
74.	Fine white sand.	5 to 1370 =	296
75.	Slate and hard shell,	15 to 1385 =	281
76.	Gray and hard shell,	30 to 1415 =	251
77.	Gray slate,	20 to 1435 =	231
78.	Slate and shell,	5 to 1440 =	226
79.	Hard gray sandstone,	10 to 1450 =	216
80.	White sand,	5 to 1455 =	211
81.	Gray slate,	35 to 1490 =	176
82.	Hard gray shale,	5 to 1495 =	171
83.	Gray sand,	5 to 1500 =	166
84.	Close white sand,	5 to 1505 =	161
85.	Hard white sand,	5 to 1510 =	156
86.	Gray slate,	20 to 1530 =	136
87.	Gray slate and shell,	5 to 1535 =	131
88.	Hard white sand,	10 to 1545 =	121
89.	Gray shell,	5 to 1550 =	116
90.	Gray slate,	25 to 1575 =	91
91.	Gray sand and shell,	15 to 1590 =	76
92.	Gray slate,	15 to 1605 =	61
93.	Gray sand,	20 to 1625 =	41
94.	Gray slate,	10 to 1635 =	31
95.	Gray slate and shell,	30 to 1665 =	1
96.	Gray slate,	10 to 1675 =—	9
97.	Gray slate and shell,	10 to 1685 =—	19
98.	Crevice full of quicksand,	2 to 1687 =—	21
99.	Dark sand containing oil,	3 to 1690 =—	24
100.	Crevice containing loose stones and oil,	5 to 1695 =—	29
101.	Dark sand and oil,	5 to 1700 =—	34
102.	Coarse sand and oil,	5 to 1705 =—	39
103.	Loose slate,	10 to 1715 =—	49
104.	Light-colored slate,	65 to 1780 =—	114
105.	"Gas crevice," full of stone and sand,	5 to 1785 =—	119
106.	Dark sand,	7 to 1792 =—	126
107.	Light-colored slate,	16 to 1808 =—	142
108.	Hard fine sand,	15 to 1823 =—	157
109	White and red sand mixed, red sand-like quicksand,	9 to 1832 =—	166
110.	Fine red and white sand,	11 to 1843 =—	177
111.	Sandy slate (?),	7 to 1850 =—	184

Drilled dry. Cased,	547′
Drive pipe,	43′
Heavy water course,	52½′
Gas vein,	593′
First strong smell of oil,	1132′
Gas and strong smell of oil,	1182′
Oil in gray shale,	1685′
Crevice full of quicksand,	1687′±
Oil,	1690′
Crevice containing loose stones and oil,	1695′
Oil,	1700′
Oil,	1705′
Pumped,	1720′ (?)
Oil,	1780′
Gas crevice full of stone and sand,	1784′
Gas crevice,	1808′

Huling's Well, No. 1.

(Old Owl Well.)

South Bank of Kinzua creek; northern part of Warrant 3084, Hamlin township. Drilled 1878. Authority, Mr. Seth Hulings.

Well mouth above ocean in feet,				+ 1625
1. Conductor,	50	to	50	= + 1575
2. Red rock,	100	to	150	= + 1475
3. ?,	600	to	750	= + 875
4. Red rock,	50	to	800	= + 825
5. ?,	175	to	975	= + 650
6. Shells and sand,	100	to	1075	= + 550
7. ?,	200	to	1275	= + 350
8. Sand, slate and shells,	270	to	1545	= + 80
9. Bradford oil sand,	68	to	1613	= + 12

Huling's Well, No. 3.

North of Kinzua creek in western part of warrant 3076, Hamlin township. Drilled winter 1878 and 1879. Finished March, 1879. Authority drillers.

Well mouth above ocean in feet,				+ 1715
1. ?,	150	to	150	= + 1565
2. Red shale,	50	to	200	= 1515
3. Gray shale,	25	to	225	= 1490
4. Red rock,	85	to	310	= 1405
5. Pebble rock,	20	to	330	= 1385
6. Red rock,	20	to	350	= 1365
7. Sand shale,	20	to	370	= 1345
8. Red rock,	30	to	400	= 1315
9. Sandy shale,	20	to	420	= 1295
Streak of red rock,			420	=
10. ?,	55	to	475	= 1240
11. Blue slate,	315	to	790	= 925

12. Slate and shale,	5 to	795 =	920
Light red rock,		795 =	
13. ?,	100 to	895 =	820
14. Slate and shale,	20 to	915 =	800
15. Red rock,	15 to	930 =	785
16. Slate,	20 to	950 =	765
Red rock,		950 =	
17. ?,	45 to	995 =	720
18. Slate,	5 to	1000 =	715
Dark red rock,		1000 =	
19. ?,	100 to	1100 =	615
20. Slate and shell,	10 to	1110 =	605
21. Pebble sand,	15 to	1125 =	590
22. Slate and shell,	175 to	1300 =	415
23. Shale,	60 to	1360 =	355
24. Slate and shell,	15 to	1375 =	340
Sand, "2d sand,"		1375 =	
25. ?,	75 to	1450 =	265
26. Pebble sand,	15 to	1465 =	250
27. Slate and hard shells,	200 to	1665 = +	50
28. Sand, "3d sand,"	65 to	1730 = —	15

Drilled dry. A show of oil was found at a depth 1695′. A salt water vein was encountered at 1700′. The well was reported to be "dry," and at the time the record was obtained, July 2, 1879, the derrick had been pulled down and the well abandoned.

Glad Run "Dry Hole."

(*Kinzua Well.*)

Owned by the Producers Consolidated Land and Petroleum Company of Bradford, situated on Kinzua creek, near the mouth of Glad run, in warrant 3123, Hamlin township, McKean county, and about five miles northeast of Kane. The land upon which this well is located together with the adjoining tracts are part of those originally belonging to the "McKean Elk Land and Improvement Co.," General Thomas L. Kane, Supt.

The well was drilled in the spring of 1877, and the record was furnished by Mr. L. C. Blakeslee, Superintendent P. C. L. and P. Co.

The elevation of the top of the well as determined Mr. J. W. Murphy of Wilcox, is 52 feet higher than Wilcox Well, No. 3, or 1718 feet above ocean.

Well mouth above ocean in feet,			1718
1. Surface clays, &c.,	32 to	32 =	1686
2. Soft slate,	78 to	110 =	1608
3. Mud slate,	95 to	205 =	1513
4. Red rock,	50 to	255 =	1463
5. Slate rock,	38 to	293 =	1425
6. Red rock,	57 to	350 =	1368
7. Sand "shells" and red rock mixed,	15 to	365 =	1353
8. Slate,	35 to	400 =	1318

9.	Sand "shell,"	10 to 410 =	1308
10.	Slate,	346 to 756 =	962
11.	Mixed slate and hard slate rock,	261 to 1017 =	701
12.	Mixed slate and sand "shells,"	358 to 1375 =	343
13.	Hard slate mixed with sand and "pebble shell,"	370 to 1745 = —	27
14.	Slate and sand alternating,	40 to 1785 = —	67

Drilled dry. Cased at	370′
Heavy sand "shell" at	1017′
Sand at	1745′
Slate at	1760′
Sand at	1768′
Slate at	1780′
Salt water found in sands at	1745′ and 1768′

Mr. Blakeslee reports that no "good show" of oil was found. A small gas vein was struck, position not stated. Elevation of the bottom of the Olean Conglomerate on the P. & E. RR. four miles due southwest from the Kinzua Well is 1868 feet. The calculated elevation of the same horizon at the well is 1900 feet.

Coburn Well.

(*Warrant 3212 Wetmore.*)

This well is located on an east branch of Dalson run, and a little over 1½ miles due north of Sergeant station, on the P. and E. R. R.

	Well mouth above ocean in feet,		= 1900
1.	Conductor,	20 to 20 =	1880
2.	White pebbly sand,	50 to 70 =	1830
3.	Gray slate,	32 to 102 =	1798
4.	Sand, (show of oil,)	46 to 148 =	1752
5.	Slate,	30 to 178 =	1722
6.	Sand, (show of oil,)	34 to 212 =	1688
7.	Hard shell and sand,	183 to 395 =	1505
8.	Red rock,	200 to 595 =	1305
9.	Gray sand containing gas,	15 to 610 =	1290
10.	Red rock,	100 to 710 =	1190
11.	Gray slate and shell,	530 to 1240 =	660
12.	Hard sand,	16 to 1256 =	644
13.	Gray slate,	124 to 1380 =	520
14.	Sand,	35 to 1415 =	485
15.	Gray slate,	63 to 1478 =	422
16.	Sand,	15 to 1493 =	407
17.	Gray slate,	44 to 1537 =	363
18.	Sand, (smell of oil,)	20 to 1557 =	343
19.	Sand, (nearly solid,)	200 to 1757 =	143
20.	Gray slate,	38 to 1795 =	105
21.	Sand,	15 to 1810 =	90
22.	Gray slate,	30 to 1840 =	60

23.	Sand,	40 to 1880 =	+ 20
24.	Gray slate and shells,	64 to 1944 =	— 44
25.	Brown sand containing oil,	9 to 1953 =	— 53
26.	Gray slate and shell,	15 to 1968 =	— 68
27.	Sand, (BRADFORD OIL PRODUCING SAND,)	70 to 2038 =	— 138
28.	Slate,	55 to 2093 =	— 193
29.	Slate and sand,	170 to 2263 =	— 363

Smethport Well, No. 1.

L. Taylor farm, on the first north branch of Blacksmith run west of Smethport. Drilled by Lytle and Vezie, 1875, for Smethport Oil Co. Specimens lost. Record imperfect but reliable.

	Well mouth above ocean in feet,		1590
1.	Red soil, (conductor,)	8 to 8 =	1582
2.	Red sandstone,	2 to 10 =	1580
3.	Red and gray sand,	10 to 20 =	1570
4 & 5.	Sand very hard,	18 to 38 =	1552

UPPER CHEMUNG, No. VIII.

6.	Black slate,	22 to 60 =	1530
7.	Slate,	10 to 70 =	1520
8.	Dark and very hard,	34 to 104 =	1486
9.	Dark slate,	16 to 120 =	1470
10.	Dark sand,	50 to 170 =	1420
11.	Slate,	10 to 180 =	1410
12.	Light slate,	20 to 200 =	1390
13.	Slate,	10 to 210 =	1380
14.	Light gray sand,	14 to 224 =	1366
15.	Slate,	6 to 230 =	1360
16.	Slate and shell,	100 to 330 =	1260
17.	Shells very hard,	48 to 378 =	1212
18.	Dark gray sand,	12 to 390 =	1200
19.	White pebbles,	10 to 400 =	1190
20.	Slate,	20 to 420 =	1170
21.	Slate,	20 to 440 =	1150
22.	Very muddy,	20 to 460 =	1130
23.	Sand shells,	110 to 570 =	1020
24.	Slate,	10 to 580 =	1010
25.	Slate and sand shells,	547 to 1127 =	463
26.	Coarse gray sand,	13 to 1140 =	450
27.	Pebbles,	10 to 1150 =	440
28.	Slate	20 to 1170 =	420
29.	Coarse sand,	10 to 1180 =	410
30.	Hard fine white sand,	13 to 1193 =	397
31.	Slate,	17 to 1210 =	380
32.	Dark gray slate,	10 to 1220 =	370
33.	Slate and shell,	120 to 1340 =	250

BRADFORD OIL SAND.

34 & 35.	White sand,	20 to 1360 =	230

LOWER CHEMUNG, No. VIII.

36. Slate,	148 to 1508 =	82
37. Blue shell,	22 to 1530 =	60
38. Gray slate,	40 to 1570 = +	20
39. Slate and shells,	124 to 1694 = —	104
40. Dark brown sand, (SMETHPORT OIL SAND,)	26 to 1720 = —	130
41. Light gray slate,	60 to 1780 = —	190
42. Slate and shell,	120 to 1900 = —	310
43. Slate and shell,	104 to 2004 = —	414

Drilled dry. Cased at 237′. At 1127′ in stratum number 26 a considerable showing of oil was obtained.

At about 1400 and 1500 feet a considerable quantity of gas was obtained, about half as much as was obtained in the Haskill. There was not a sufficient quantity to run the boiler.

Haskill Well.

East side of Marvin creek, 1½ miles S. W. of Smethport. Begun December 1, 1876. Continued to 1581′, April, 1877. Record by W. Haskill.

Well mouth above ocean, in feet,		1552
1. Conductor,	30 to 30 =	1522
2. Flagstone,	25 to 55 =	1497
3. Blue slate,	165 to 220 =	1332
4. Hard sand shells,	25 to 245 =	1307
5. Blue slate,	175 to 420 =	1132
6. Red shales,	25 to 445 =	1107
7. Blue slate,	22 to 467 =	1085
8. Red shale,	12 to 479 =	1073
9. Hard shells and blue slate,	21 to 500 =	1052
10. Hard blue rock,	2 to 502 =	1050
11. Soapstone and shells,	103 to 605 =	947
12. Very hard blue shales,	10 to 615 =	937
13. Soapstone and hard shells,	45 to 660 =	892
14. Sand, open and porous,	20 to 680 =	872
15. Soapstone and hard shells,	36 to 716 =	836
16. Pebble sand and gas,	3 to 719 =	833
17. Soapstone and shells,	61 to 780 =	772
18. Hard gray sand,	5 to 785 =	767
19. Soapstone and shells,	100 to 885 =	667
20. Soft white slate,	35 to 920 =	632
21. Slate and shells,	40 to 960 =	592
22. Very hard shell,	5 to 965 =	587
23. Very soft soapstone,	7 to 972 =	580
24. Very hard sand shells,	3 to 975 =	577
25. Slate and shell,	55 to 1030 =	522
26. Stray sand,	15 to 1045 =	507
27. Slate and shell,	40 to 1085 =	467
28. Hard sand shell,	4 to 1089 =	463

29.	Good stray sand,	4 to 1093 =	459
30.	Slate and shell,	77 to 1170 =	382
31.	Second sand,	45 to 1215 =	337
32.	Slate and shell,	30 to 1245 =	307
33.	Stray sand,	18 to 1263 =	289
34.	Soapstone and shell,	82 to 1345 =	207
35.	Sand, (show of oil, BRADFORD OIL SAND,)	12 to 1357 =	195
36.	Soapstone shells,	93 to 1450 =	102
37.	Shelly sand,	7 to 1457 =	95
38.	Soapstone and shells,	23 to 1480 =	72
39.	Shell, strong gas,	2 to 1482 =	70
40, 41, & 42.	Soapstone shells,	138 to 1620 = —	68
43.	Sand, (good show of oil,)	30 to 1650 = —	98
44.	Hard shells and sandy slate,	63 to 1713 = —	161
45.	Soapstone,	5 to 1718 = —	166
46.	Oil sand, (SMETHPORT OIL SAND,)	18 to 1736 = —	184
47.	Shells and sandy slate,	125 to 1861 = —	309

Drilled dry. Cased at 250′. Gas at 719. Strong gas at 1482′ and 1620′. Smell of oil at 1263′. Show of oil at 1357′, 1482′ and 1620′.

It has been variously reported that the oil found in this well in small quantities came from the Bradford sand (stratum 35) and the Smethport sand (stratum 46.) At different times positive assertions have been made in regard to each horizon; from the latest reports it seems now quite certain that the bulk of the petroleum comes from the lower sand.

Brant & Co.'s Well, No. 2.

Located 495 feet south of Haskill well.

Top of well,	1603
To Bradford sand,	1360
To Smethport sand,	1754
Thickness of sand,	24
Gas at	1630
Torpedoed at	1778
Total depth of well,	1805

Produced 1 barrel a day six months after drilling.

Brant & Co.'s Well, No. 3.

1320′ E. and 165′ S. of No. 2.

Top of well,	1775
Fossil shell bed, (8′ to 10′ thick,) at	1450
To top of Bradford sand, (20′ thick,)	1510
Total depth of well, (?)	1900

Brant & Co.'s Well.

(Wilcox Tract.)

On Marvin creek.

Top of well A. T.,	1517
To Bradford sand, (35' thick,)	1293

Hamar & Ernhout's Well.

(Fletcher tract.)

Marvin creek valley, mouth of Head brook, Sergeant township.

Top of well above tide,	1715
To Smethport sand, (25' thick,)	1975
Chocolate sand, (30' thick, show of oil,)	2200
Total depth of well,	2230

Hamar's Well.

On Wild Cat run, Sergeant township.

Top of well A. T.,	1671
Total depth,	2000

Show of oil in Bradford and Smethport sands.

Lucius Rogers' Well.

On Warrant 2058, near Smethport, between county road and railroad.

Top, A. T.,	1531
To Bradford sand, (30' to 35' and strong gas,)	1300
To Smethport sand, (with oil show,)	1723

Sherman, Hatch & Co.'s Well.

On Caspar Smith's farm, Warrant 2091, near school-house No. 6, Farmers' Valley, Keating township.

To top of Smethport sand, (20,)	1780
Drilling stopped at	1811

GROUP XIII.

Wells in Crawford County. Five Wells near Titusville, (one in Venango County.) Four Wells repeated from Report Q[4]. Wells in Erie County. Wells in Mercer County.

Logan Well, No. 1.

May, 1869.

Parker farm, Titusville, Crawford county. Authority, S. B. Logan.

Well mouth above ocean, in feet,	
Conductor,	14 to 14 =
?,	466 to 480 =
1st sand,	18 to 498 =
?,	202 to 700 =
2d sand, (Oil creek "stray,")	20 to 720 =
?,	16 to 736 =
3d sand, (coarse and pebbly,)	62 to 798 =

A good paying well.

Logan Well, No. 2.

Located on the same farm, and 200 feet west of Well No. 1.

Well mouth above ocean, in feet,	
Conductor,	18 to 18 =
?,	455 to 473 =
1st sand,	24 to 497 =
?,	193 to 690 =
2d sand, (Oil creek "stray,")	20 to 710 =
?,	18 to 728 =
3d sand, (finer than in No. 1,)	61 to 789 =

Not so good a producer as Well No. 1.

Logan Well, No. 3.

On Parker farm, 200 feet north of east from Well No. 1.

Well mouth above ocean, in feet,	
Conductor,	18 to 18 =
?,	468 to 486 =
1st sand,	20 to 506 =
?,	204 to 710 =
2d sand, (Oil creek "stray,")	30 to 740 =
?,	4 to 744 =
3d sand, fine, (coarse at 768',)	62 to 806 =

Production small.

Logan Well, No. 4.

August, 1870.

On Parker farm, 300 feet south-east of Well No. 1.

Well mouth above ocean, in feet,	
?,	470 to 470 =
1st sand, estimated,	20 to 490 =
?,	202 to 692 =
2d sand, (Oil creek "stray,")	30 to 722 =
?,	8 to 730 =
3d sand, (good,)	60 to 790 =

Production small.

Logan Well, No. 5.

On Watson farm (?) below the Refinery on the plank road between Titusville and Pleasantville; about one mile south-westerly from Well No. 1.

Well mouth above ocean in feet,	
Drive pipe,	100 to 100 =
?,	35 to 135 =
1st sand,	23 to 158 =
?,	214 to 372 =
2d sand, (Oil creek, "stray,")	8 to 380 =
?,	11 to 391 =
3d sand, (good sand,)	50 to 441 =

Production small.

Dobbin's Well.

Near Oil Creek Lake, Bloomfield township, Crawford county.

Mouth of well,	0′ = 1420′ A. T.
"Conductor hole,"	14′ to 14′ = 1406′
"Very hard sandstone,"	30′ to 44′ = 1376′
"Slate (red rock at 209′ from top),"	331′ to 375′ = 1045′
"Sand, good, pebbly, some oil," (*Third oil sand.*—I. C. White,)	9′ to 384′
"Slate,"	146′ to 530′
"Sand shells, fragments in this interval, one containing pebbles at 594′,"	120′ to 650
"Soft slate,"	262′ to 912′
"Sand shells, very hard,"	20′ to 932′
"Soft slate, to bottom of hole,"	68′ to 1000′

Rightly to understand this record, it is necessary to connect it with an outcrop of the *Corry sandstone* in the ravine next west of the hole; the *base* of the rock lying 85′ above R. R. Grade, or 1496′ A. T.

Lilly Well.

One mile south of Concord, Concord township, Crawford county.

1.	"Drive-pipe" *through Drift,*	119′ to 119′
2.	"Black slate (Big water vein at 123′),"	16′ to 135′
3.	"Blue sandrock, very hard,"	20′ to 155′
4.	"Red rock, blood red,"	18′ to 173′
5.	"Slate, gritty, soft,"	20′ to 193′
6.	"Sharp grit and pebble rock, pebbles thin and flat, some red, dark, and white, pebbly at top, blue grit below," *some oil;* (3rd oil sand—I. C. W.),	25′ to 218′
7.	"Loadstone rock; magnetized the drill; soft like rubber," (!),	90′ to 308′
8.	"Red rock,"	40′ to 348′
9.	"Sand, white, very hard, and filled with pebbles,"	30′ to 378′
10.	"Shells,"	30′ to 408′
11.	"Fine slate,"	100′ to 508′
12.	"Shells,"	35′ to 543′
13.	"Sand, white, very hard, some pebbles, *big gas vein* near center,	25′ to 568′
14.	"Gritty slate,"	60 to 628′
15.	"Red rock,"	5′ to 633′
16.	"Shells,"	67′ to 700′
17.	"Slate, with no grit,"	90′ to 790′
18.	"Shells, very hard to bottom of hole,"	55′ to 845′

Wentworth Well.

Two and a half miles south of Sugar Lake, Wayne township, Crawford county.

1.	"Clay and Gravel,"	46′ to 46′
2.	"Slate,"	8′ to 54′
3.	"Coal, { 1. Coal, 1′ 2. Slate, 5′ 3. Coal, 2′ }"	8′ to 62′
4.	"Slate,"	6′ to 68′
5.	"Sandstone,"	32′ to 100′
6.	"Bluff SS.,"	100′ to 200′
7.	" ? ,"	100′ to 300′
8.	"Mt. Sand,"	100′ to 400′
9.	" ? ,"	306′ to 706′
10.	"1st S. S.,"	15′ to 721′
11.	" ? ,"	231′ to 952′
12.	"2d Sand, (some oil),"	10′ to 962′
13.	"Slate,"	15′ to 977′
14.	"3d Sand, (better oil show),"	2′ to 979′
15.	Slate, soapstone, &c., nothing hard to drill through to bottom of hole, (at 1100),"	121′ to 1100′

Stimpson Wells.

Cornell Well.

In Beaver township, Crawford county. (See Report Q[4], pages 212+.)

Union City Well.

July, 1878.

Located on French Creek flats, Union township, Erie county, about 80 rods west of the P. & E. R. R. depot, at Union City. Authority, Mr. G. Smith, who preserved, and kindly presented to the Survey, 21 specimens of the sand pumpings, as noted below.

Well mouth above ocean, in feet,		1265
Conductor,	12 to 12 =	1253
Slate and shale,	148 to 160 =	1105
Mountain sand,	2 to 162 =	1103
Slate and shale, (cased at 175',)	613 to 775 =	490
Slate, sandy, little gas at 800', (Spec. No. 1 at 775',)	25 to 800 =	465
Sand shells, fine, gray, (Spec. No. 2 at 800',)	25 to 825 =	440
Slate, (Spec. No. 3 at 840',)	25 to 850 =	415
Slate and shells, (Spec. No. 4 at 875',)	30 to 880 =	385
Slate, (Spec. No. 5 at 900',)	30 to 910 =	355
Slate, a little sand, (Spec. No. 6 at 925',)	40 to 950 =	315
Slate and shells, (Spec. No. 7 at 975')	25 to 975 =	290
Sandy slate, (Spec. No. 8 at 980',)	5 to 980 =	285
" " (Spec. No. 9 at 985',)	5 to 985 =	280
" " (Spec. No. 10 at 987',)	2 to 987 =	278
" " less sand, (Spec. No. 11 at 1000',)	13 to 1000 =	265
" " (Spec. No. 12 at 1020',)	20 to 1020 =	245
" " (Spec. No. 13 at 1040',)	20 to 1040 =	225
Sand shells, (Spec. No. 14 at 1050 ,)	10 to 1050 =	215
Sand shells, (Spec. No. 15 at 1053',)	3 to 1053 =	212
SS., fine-grained, gray, (Spec. No. 16 at 1055,)	2 to 1055 =	210
Sand shells (Spec. No. 17 at 1060',)	5 to 1060 =	205
Slate, black, and sand shells, gray, (Spec. No. 18 at 1075,)	15 to 1075 =	190
Slate, dark, some sand shells, (Spec. No 19 at 1100',)	25 to 1100 =	165
SS., very fine, gray, micaceous, flaky, (Spec. No. 20 at 1105',)	10 to 1110 =	155
Sandy slate, (Spec. No. 21 at 1225',)	15 to 1125 = +	140
" " to bottom,	398 to 1523 = —	258

No specimens of the last 398 feet were kept, but they are said to have been very similar to those from the last 15' sampled. The measures were soft. No sands, no gas, no salt water below the casing, and not a "show" of oil.

City of Erie Gas Wells.

(See Report L, page 168, &c. See Report Q[4], page 288, &c. Report Q[4] also contains fragmentary records of many experimental wells in Crawford and Erie counties.)

Cawthro Well Record.

Mouth of well	about, 670' A. T.	
1. Conductor,	12 to 12 =	

2.	Gray slate,	230 to 242 =
3.	1st gas at bottom of last.	
4.	Gray slate, (2nd gas at bottom,)	29 to 271 =
5.	" (3rd " ")	33 to 304 =
6.	" (4th " ")	64 to 368 =
7.	" (5th gas 397′, oil 392′,)	29 to 397 =
8.	" (6th gas at bottom,)	6 to 403 =
9.	" (7th " ")	17 to 420 =
10.	" (8th " ")	24 to 444 =
11.	" (9th " ")	2 to 446 =
12.	" (10th " ")	3 to 449 =
13.	" (gas and oil,)	19 to 468 =
14.	" (gas and oil at bottom,)	125 to 593 =
15.	" (more oil at bottom,)	53 to 646 =
16.	" to bottom of hole,	49 to 695 =

"First oil at 392′."

Stearne Manufacturing Co. Well.

1.	"Conductor,"	8′ to 8′
2.	"Gray flags,"	450′ to 458′
3.	"Reddish-brown shale,"	? to ——
4.	Soapstone and shales to bottom,	? to 1418′

The heaviest gas vein came in No. 3 which Mr. Flannigan thinks was about 50′ thick, but is not certain, and the gas came near its base.

He also states that No. 4 seemed to have almost the same composition throughout, being a mass of gray "soapstone" shales with occasional thin "shells," or sandy layers 1′ to 2′ thick. No black slates of any importance were penetrated, except thin streaks which alternated with the "gray" material, hence the *Portage formation* was not passed through in this boring. The well commences at 655′ above tide or about 120′ below the top of the *Portage system*, and this would give us as the thickness of these rocks at Erie, 1418′ +120′ = 1538′ plus an undetermined amount not penetrated by the drill hole.

In and around the city of Erie there are some fifty gas wells.

The first well of which the gas was utilized was put down about one hundred and fifty yards from the Jarecki Manufacturing Company's Work, where the gas was used. It yielded largely at first, but the amount steadily decreased. This well was six hundred feet deep.

A second well, put down by the company on their own ground, yielded largely. It was put down seven years ago; found gas at 200, 250, 400, and 600 feet deep, and is in all 700 feet deep. It at first supplied gas enough to take the place of four tons of coal daily, and to light the works. It now only partially lights the works.

These two wells are in the valley of a small creek. When other wells were put down in the same valley to the north of the works, the effect upon the yield of gas from the company's well was immediate and decided.

At Stearn's Works there are two wells, one 700 and one 1400 feet deep. The supply of gas was originally large, but is now fallen off to a small quantity.

The Erie Gas Company have put down two wells, and use the gas in supplying the city.

Gas Well No. 1, is down to a depth of 750 feet. Gas was struck at 300 feet and at 360 feet.

The pressure at first was fifty pounds to the square inch, but this fell off, and the pressure is now extremely irregular, never very great, and sometimes ceasing entirely and then coming back with temporarily much increased pressure.

Mr. Caughey, the president of the company, who furnished the above facts, states that the natural gas is much heavier than the illuminating gas manufactured by them. He says that the natural gas is an 8-candle gas; their manufactured gas, made from one half Sharon and one half Beaver coal, being a 16-candle gas.

Gas Well No. 2, which was put down close to No. 1, yielded nothing.

In Mr. Evans' well, also, the gas occasionally stops flowing entirely, and then, after a few days, begins flowing again with as much as double the normal pressure.

Messrs. Oliver and Bacon have two wells. No. 1, down 470 feet, and No. 2, down 600 feet. No. 2 never yielded anything. In well No. 1 gas was found all the way down, and at 450 feet deep the pressure was very heavy.

The pressure of the well at first is estimated at 60 to 80 pounds. This pressure lasted for six months. The well is five inches in diameter, and the gas originally ran all the power, (100 horse,) taking the place of three tons of coal daily. Now 2,200 pounds of coal daily are used, and the gas does the remainder of the work. The pressure is reported to be now even and regular, and no falling off is noticed.

The Erie Water Works have two gas wells. In No. 1 there was gas at 550 feet, but the amount was small, and the well was abandoned.

No. 2, is 1,200 feet deep, but no gas apparently deeper than 800 feet. The pressure at first was very heavy, but soon settled down to a normal rate, which now keeps very even. The gas yielded takes the place of two tons of coal daily. The well hole is six inches in diameter.

The Swalley well, which is down in the valley of the small run on which the Jarecki wells were put down, is yielding gas, but in the absence of accurate figures, can only be said to have lost three fourths of its pressure in ten years.

The well at the mouth of this small run, where it empties into Lake Erie, continues to yield gas with a very regular pressure. Messrs. Rawle, Noble & Co., have carried it with pipe from the well to their furnace, one mile to the eastward. The well is 800 feet deep, and shows a pressure of gas of 25 pounds. This pressure is variable, but Mr. Noble thinks, shows no regular falling off.

At the Erie Car Works, (Messrs. Davenport, Fairburn & Co.,) 1½ miles southwest of Erie, there are two gas wells.

Well, No. 1, is down 705 feet, and was put down in December, 1870. Some gas was found near the surface, within the first 60 feet; fresh water at 147 feet; gas at 213 feet; much gas at 580 feet, and again gas in the bottom of the well. The water now pumped is salt; the original pressure was 70 pounds to the square inch, it is now only 17 pounds.

The well is six inches in diameter. The pressure is reported as not now falling off, but on the contrary, that it seems rather greater now than in 1874.

Well, No. 2, is down 700 feet. The pressure of the gas was very heavy at first, but is now about 17 pounds to the square inch.

Mr. F. F. Adams has a gas well one third of a mile east of the Erie Car Works. The well is down 750 feet. The first gas was struck at about 300 feet deep, and from that on down at various depths to the bottom. The water in the well is slightly salt, and a little heavy oil comes with it.

The pressure at first was heavy, but soon came down to the present moderate flow, which it keeps now apparently with no regular falling off.

The Tracy Gas Well, two miles from Erie, is down 750 feet. Gas found at 400 feet; much gas at 610 feet, and again gas at 675 feet. The pressure kept evenly at about 25 pounds for the first 17 months, when it suddenly fell off to about one eighth of that pressure, and at that point, it has since remained constant.

At Fredonia, New York, natural gas from an horizon far below that of the oil sands of Pennsylvania, has been utilized for many years.

The gas was first found coming up in the bed of the creek in 1821, and was then used, though in a small way, for lighting some houses in the village.

In 1858 a gas well was put down on the creek, one half mile north of this old well. Of this depth thirty feet were shafted, and one hundred and twenty feet of a four-inch bore hole. The gas supply from this well has been and is regular in its average amount.

A second well, four hundred and seventy-five feet deep, just along side of this well, failed to add anything to the gas yielded, the amount coming from the two wells being just what had been coming from the first one. The second was therefore abandoned.

A gas well put down at the gas works, one half mile away, was eight hundred feet deep and yielding nothing.

Mr. Coburn put down a well in the town, at his mill, 1,250 feet deep, which yields a regular supply of gas. The total yield, however, of these wells is only about 6,000 cubic feet daily.

Jamestown Well.

1876.

Situated on hillside, nearly opposite depot at Jamestown, Chautauqua county, N. Y. From Mr. Prather, of Jamestown

Well mouth above ocean, in feet, about			+1325
Conductor dug	say, 8 to	8 =	1317
Slate and shale,	402 to	410 =	915
SS., fine gray, little gas,	8 to	418 = +	907
Dark slate, no sand,	1389 to	1807 = −	482

Sulphur water at 68′. Salt water at 270′±. Cased at 250′. No red rock in well, no oil, and but little gas.

Wild Cat Hollow Well.

1877.

On land of Mr. T. H. Bromley, about one mile west of Stoneboro', Mercer county. Authority, T. H. Bromley. The upper part, down to 172′, was given to Mr. Chance before the well was completed. The lower part, to Prof. White, in the following year: *

Well mouth above ocean, in feet,			1227
Conductor,	10 to	10 =	1217
SS., "surface sand,"	20 to	30 =	1197
Slate, black,	20 to	50 =	1177
Red rock,	8 to	58 =	1169
Slate, black,	34 to	92 =	1135
SS., "Mountain Sand,"	80 to	172 =	1055
?, (Red rock above First sand,)	463 to	635 =	592
1st SS., (thickness not given,) at		635	
?, (including 140′ of 2d SS.,)	315 to	950 =	277
3d SS., (thickness not given,) at		950	
Black slate below 3d sand.			

The Second sand contained a show of heavy oil. The Third sand yields a light yellow oil. Probably a ten barrel well.

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* See Q^3. page 174.

GROUP XIV.

Wells in Elk, Cameron, Clinton, and Potter Counties.

Ernhout and Taylor Well, No. 1.

North side of Wilson run, near south-east corner of Warrant 3218, Jones township, Elk county, and about 3¾ miles north-west of Wilcox, and several hundred feet north of the P. & E. R. R. Owned by Capt. John Ernhout and Frank Taylor, Esq.

Drilling was commenced Jan. 15, 1878, and abandoned March 13, when the tools were lost.

Record reported by Mr. M. M. Schultz. Elevation of well, determined by Mr. A. W. Sheafer.

Mouth of well, by barometer, above ocean level,			1645
Loam and sand,	40 to	40 =	1605
Blue sand shale,	160 to	200 =	1445
Blue slate,	40 to	240 =	1405
Red rock,	95 to	335 =	1310
Red rock, very hard,	15 to	350 =	1295
Red rock, softer,	45 to	395 =	1250
Red rock,	45 to	440 =	1205
Sand and shells,	15 to	455 =	1190
Slate,	15 to	470 =	1175
Red rock,	10 to	480 =	1165
Red sand, (cased at 481½',)	15 to	495 =	1150
Blue sand shells,	35 to	530 =	1115
Brown sand and white pebble,	20 to	550 =	1095
Slate and shells,	95 to	645 =	1000
Hard blue sand,	10 to	655 =	990
Slate and shells,	20 to	675 =	970
Brown sand and white shells,	5 to	680 =	965
Slate and shells,	75 to	755 =	890
Blue sand,	25 to	780 =	865
Slate and shells,	210 to	990 =	655
Red rock,	20 to	1010 =	635
Slate,	50 to	1060 =	585
White sand,	35 to	1095 =	550
Red sand,	20 to	1115 =	530
Slate and shells,	135 to	1250 =	395
Gray sand,	25 to	1275 =	370
Gray slate and shells,	10 to	1285 =	360
Gray sand,	20 to	1305 =	340
Slate and shells,	10 to	1315 =	330
White sand,	5 to	1320 =	325
White sand, containing gas and strong smell of oil,	15 to	1335 =	310

Gas and smell of oil, ... 1320'

Lost tools, ... 1335'

Bear Creek Well.

On Bear Creek, east side of county road, between Wilcox and Ridgway, in Warrant 3257, Jones township, Elk county.

Owned by the Producers' Consolidated Land and Petroleum Company, of Bradford. Land leased from Wilcox Tanning Company.

Drilling was commenced about April 1, 1878, and was completed in from 50 to 60 days.

The record was reported by Mr. M. M. Schultz. No show of oil was found.

The elevation of the top of the well is, (bar.,) above ocean,			1595
Drive pipe,	25 to	25 =	1570
Blue slate rock,	25 to	50 =	1545
Red rock,	15 to	65 =	1530
Blue slate,	10 to	75 =	1520
Red rock,	20 to	95 =	1500
Sandy or "putty" slate rock,	25 to	120 =	1475
Sand rock,	25 to	145 =	1450
Soft slate,	12 to	157 =	1438
Hard shells,	5 to	162 =	1433
Very muddy slate,	20 to	182 =	1413
Hard slate,	10 to	192 =	1403
Hard sand,	8 to	200 =	1395
Hard slate,	30 to	230 =	1365
Very white loose sand,	35 to	265 =	1330
Hard shells and slate,	5 to	270 =	1325
Very hard sand,	20 to	290 =	1305
Tough slate rock,	10 to	300 =	1295
Very hard shells,	10 to	310 =	1285
Hard fine sand,	10 to	320 =	1275
Soft slate,	30 to	350 =	1245
Hard fine sand, (cased at 380',)	69 to	419 =	1176
Soft slate,	10 to	429 =	1166
Hard fine sand,	10 to	439 =	1156
Shells,	30 to	469 =	1126
Very red rock,	5 to	474 =	1121
Soft slate or "putty" rock,	80 to	554 =	1041
Shells and slate,	55 to	609 =	986
Blue slate,	15 to	624 =	971
Red rock,	10 to	634 =	961
Blue slate,	22 to	656 =	939
Hard sand,	9 to	665 =	930
Red rock,	26 to	691 =	904
Blue slate,	12 to	703 =	892
Hard shell,	4 to	707 =	888
Red rock,	86 to	793 =	802
Blue slate,	22 to	815 =	780
Red rock,	48 to	863 =	732
Slate and shells,	30 to	893 =	702
Red rock,	26 to	919 =	676
Hard gray sand,	10 to	929 =	666
Soft slate and shell,	167 to	1096 =	499

Gray slate,	159 to 1255 =	340
Sand,	10 to 1265 =	330
Slate and shells,	30 to 1295 =	300
Fine red sand,	10 to 1305 =	290
Slate and shells,	203 to 1508 =	87
Sandy shells,	25 to 1533 =	62
Slate and shells,	34 to 1567 =	28
Close light sand,	12 to 1579 = +	16
Soft slate,	25 to 1604 = —	9
Close white sand,	10 to 1614 = —	19
Slate and shells,	52 to 1666 = —	71
Pebble sand,	5 to 1671 = —	76
Slate and shells,	15 to 1686 = —	91
White sand shells,	10 to 1696 = —	101
Hard slate,	10 to 1706 = —	111
Loose white sand,	50 to 1756 = —	161
Slate and shells,	65 to 1821 = —	226
Muddy slate,	15 to 1836 = —	241
Slate and shells,	12 to 1848 = —	253
Muddy slate,	20 to 1868 = —	273
Slate and sand shells,	30 to 1898 = —	303
Sand,	22 to 1920 = —	325
Slate and shells,	8 to 1928 = —	333
Slate,	60 to 1988 = —	393
Slate and shells,	10 to 1998 = —	403

Crevice drained off water, ... 120′
" " " . . . . 230′
Salt water, ... 270′
Drillers reported "oil smell" in sand from . . 1706 to 1756′

Silver Creek Well.

On Silver Creek, west side of county road, between Wilcox and Ridgway, in warrant 3261, Ridgway township, Elk county.

Owned by Messrs. Burton and Wallace, of Rynd farm. Land leased from Wilcox Tanning Company.

Drilling was commenced about the same time as at the Bear Creek Well, and was completed June 26, 1878.

The record was reported by Mr. M. M. Schultz. No show of oil was found.

The elevation of the top of the well is (Bar.) above ocean,		1615
Conductor,	15 to 15 =	1600
Slate,	15 to 30 =	1585
Gray sand,	25 to 55 =	1560
Pebble sand,	30 to 85 =	1530
Red slate,	5 to 90 =	1525
Black sand,	60 to 150 =	1465
Fine blue sand,	70 to 220 =	1395
Red slate,	10 to 230 =	1385
Fine pebble rock,	30 to 260 =	1355
Dark fine sand,	40 to 300 =	1315
Slate and hard shells,	10 to 310 =	1305

Fine blue sand,	70 to 380 =	1235
White slate,	10 to 390 =	1225
Hard fine sand,	55 to 445 =	1170
White slate and hard shells, (cased at 450′,)	95 to 540 =	1075
Red rock,	5 to 545 =	1070
Soft white slate,	55 to 600 =	1015
Hard shells and slate,	10 to 610 =	1005
Soft white rock,	40 to 650 =	965
Red rock,	100 to 750 =	865
White slate,	15 to 765 =	850
Red rock,	85 to 850 =	765
White slate,	22 to 872 =	743
Red rock,	25 to 897 =	718
White shells and slate,	26 to 923 =	692
Red rock,	40 to 963 =	652
White slate,	42 to 1005 =	610
Hard shells and slate,	20 to 1025 =	590
White slate with shells,	50 to 1075 =	540
Hard black sand,	25 to 1100 =	515
Hard slate,	75 to 1175 =	440
Black slate and shells,	45 to 1220 =	395
Hard white sand,	15 to 1235 =	380
Slate,	10 to 1245 =	370
Sand and shells,	10 to 1255 =	360
Hard shelly rock,	45 to 1300 =	315
Pale red rock and slate,	10 to 1310 =	305
White slate and shells,	10 to 1320 =	295
Red sand,	12 to 1332 =	283
Soft slate,	13 to 1345 =	270
Hard shells,	20 to 1365 =	250
Light red sand,	10 to 1375 =	240
Hard shelly rock,	20 to 1395 =	220
Fine gray sand,	10 to 1405 =	210
Hard red rock,	10 to 1415 =	200
Slate and shells,	20 to 1435 =	180
Red sand and pebbles,	25 to 1460 =	155
Hard shells,	15 to 1475 =	140
Slate and shells,	35 to 1510 =	105
White slate,	10 to 1520 =	95
Gray sand,	8 to 1528 =	87
Red rock,	7 to 1535 =	80
Slate and hard shells,	45 to 1580 =	35
Hard fine white sand,	25 to 1605 = +	10
Hard slate and shells,	20 to 1625 = —	10
Fine white sand,	8 to 1633 = —	18
Hard shells,	7 to 1640 = —	25
Fine gray sand,	10 to 1650 = —	35
Hard shells and slate,	15 to 1665 = —	50
Hard shells,	5 to 1670 = —	55
Sand and pebbles,	8 to 1678 = —	63
Slate and shells,	82 to 1760 = —	145

Salt water in slate,	445 to 540′
Salt water in red rock,	1528 to 1535′
Smell of oil reported in sand,	1670 to 1678′

St. Mary's Well.

West of St. Mary's in Benzinger township, Elk county.

The record of this well was published in a paper read before the American Philosophical Society, March 18, 1881, by Mr. Charles A. Ashburner. A section of the coal measure above the well mouth was constructed and joined to the well record for convenience of reference.

The section and record as reported, are as follows:

1. Gray sandstone, shale and slate,	67′		
2. Coal, *Kittanning Upper*,	3′		
3. Sandy shale and slate,	33′		
4. Coal, *Kittaning Middle*,	1′ 6″		
5. Sandstone and shale,	55′		
6. Coal, *Dagus, Kittanning Lower*,	3′		
7. Fireclay,	3′		
8. Shale,	17′		
9. Coal,	1′ 4″		
10. Sandstone and shale,	10′		
11. Limestone and shale, *Clermont Ferriferous*,	10′		
12. Shale,	13′		
13. Coal,	5″		
14. Shale,	16′		
15. Coal, *Clermont, Clarion*,	2′		
16. Sandstone and shale, JOHNSON RUN SS.,	32′		
17. Coal, *Alton Upper*,	2′ 7″		
18. Shale,	18′		
19. Coal, *Alton Lower*,	3′		
20. Sandstone, KINZUA CREEK SS.,	45′		
21. Shale and coal,	10′		
22. Sandstone and conglomerate, OLEAN CONGLOMERATE,	50′		
23. Slate, sometimes containing a coal bed 2′ thick,	10′		
Total,	406′		
24. Grit, clay and gravel (top of St. Mary's drill hole,)	18	to	18
25. Sand,	18	to	50
26. Interval,	45	to	95
27. Sand,	25	to	120
28. Interval,	140	to	260
29. Sand,	16	to	276
30. Interval,	124	to	400
31. Sand,	20	to	420
32. Interval,	205	to	625
33. Red shale, sandstone and slate,	335	to	960
34. Interval,	12	to	972
35. Sand,	49	to	1021
36. Interval,	369	to	1390
37. Red sandstone,	25	to	1415

38. Interval,	35	to 1450
39. Reddish rock,	5 ±	to 1455
40. Interval,	215	to 1670
41. Sand,	44	to 1714
42. Gray and black slate, containing shells and streaks of red,	286	to 2000
43. Fine bluish-white sand,	10	to 2010

The record of the well is given just as it was reported by Mr. W. W. Ames, who had copied it from the driller's book. The underscribed intervals contained generally gray slate.

A small *gas vein* was struck at a depth of 550 feet; at 972 feet a very much larger one was found. At a depth of 450 feet and 1020 feet salt water was encountered. The geological horizon of the *Bradford Oil sand* is at least 250 feet below the bottom of the St. Mary's test well.

The section may be grouped into formations as follows:

CARBONIFEROUS AGE.

XIII.	Lower productive Coal Measures, (1 to 15 incl.,)	235
XII.	Pottsville conglomerate, (16 to 22 incl.,)	161
XI.	Mauch Chunk shale, (23,)	10
X.	Pocono shales and sandstones, (24 to 32 incl.,)	625
	Total,	1031

DEVONIAN AGE.

IX.	Catskill sandstone and shale, (33,)	335
VIII.	Chemung shale and sandstone, (34 to 43 incl.,)	1050 +
	Total,	1385
	Total of known rocks,	2416

Spring Creek Well.

Near the mouth of Spring creek, Spring Creek township, Elk county. Record reported by Prof. J. P. Lesley.

Well mouth above ocean, in feet,	1268
1. Hard sandstone,	0 to 150 =
2. Gray slate and flaggy sandstone,	250 to 400 =
3. Red sandstone,	215 to 615 =
4. Hard, white sandstone,	35 to 650 =
5. Soft slate,	25 to 675 =
6. Red sandstone,	60 to 735 =
7. Sandstone and slate,	115 to 850 =
8. Hard white sandstone,	30 to 880 =

According to Mr. Chas. A. Ashburner, strata Nos. 3, 4, 5, and 6 of this well, having a total thickness of 335 feet, represent the Red Catskill formation, No. IX. The following section, from the hilltop down to the top of the well, was reported by Mr. Ashburner:

Top of hill above tide,	1830
Concealed,	45
JOHNSON RUN SANDSTONE,	55
Alton Upper coal bed,	5
Slate and shale,	33
Crop Alton Lower coal bed,	—
Kinzua Creek sandstone and shale,	104
Crop Marshburg Upper coal bed,	—
OLEAN CONGLOMERATE, and concealed strata,	265
Sandstone and shale,	20
Conglomerate,	20
Sandstone and shales,	15
Total,	—

The Spring Creek well was drilled about 1866 (?), in search for the Oil Creek sands. No show of oil was reported.

Mr. Ashburner estimates that the Bradford oil sand is at least 1200 feet below where the drill stopped in this well.

Benezette Oil Company's Well.

At Benezette, Benezette township, Elk county.

Drilling was commenced at this well by water power May 1877, abandoned February, 1878.

Well mouth above ocean in feet,			1005
1. Soil,	7	to 7	
2. Red and gray rock,	10	to 17	
3. Gray shale,	40	to 57	
4. Red rock,	4	to 61	
5. Gray slate,	12	to 73	
6. Red rock,	18	to 91	
7. Blue slate,	8	to 99	
8. Blue sandy rock,	4	to 103	
9. Blue slate,	20	to 123	
10. HARD BLUE LIMESTONE,	7	to 130	
11. Light slate,	4	to 134	
12. Dark slate,	18	to 152	
13. Sandy slate,	26	to 178	
14. Slate,	22	to 200	
15. Red rock,	4	to 204	
16. Hard gray rock,	3	to 207	
17. Sandstone, "*1st sand,*"	10	to 217	
18. White clay,	8	to 225	
19. Red rock mixed with green slate and gray rock,	400	to 625	
20. Gray sandstone,	8	to 633	
21. Red rock,	24	to 657	

22. Hard gray and blue rock,	42	to 699
23. Red rock,	8	to 707
24. Gray rock,	6	to 713
25. Sandstone "*second sand*" not through,	8 +	to 721
Size of hole,	0.8	
Casing $5\frac{5}{8}''$ diameter,	398	
Size of hole below casing,	$0.5\frac{1}{2}$	
Gas vein struck at	376	

This well was originally drilled for salt to a depth of 600 feet about 1863, (?) The salt water came from a depth of 300 feet. The size of the original well was 3 inches.

When this well was drilled it was expected to find the Oil creek "oil sands."

The red rock found below a depth of 225′ is the representative of the Red Catskill formation No. IX.

The upper Benezette limestone occurs about 40 feet above the top of the well, and the top of the OLEAN CONGLOMERATE, about 225 feet above the well mouth.

Record reported by Mr. Charles A. Ashburner.

Houghston and Ernst Well. (*Emporium Well.*)

Bond farm, Shippen township, Cameron county.

On the Bond farm north of the junction of North Creek with the Driftwood branch. Messrs. Houghston and Ernst drilled a well for oil, but no indications of oil were found.

The following is the record:

1. Conductor,	25 to	25
2. Shells, mostly fine sand,	200 to	225
3. Red rock,	12 to	237
4. Hard shells,	108 to	345
5. Red rock,	5 to	350
6. Shell,	75 to	425
7. Soft slate,	175 to	600
8. Sand,	55 to	655
9. Slate and shells,	295 to	950
10. Sand,	70 to	1020
11. Hard shells,	55 to	1075
12. Pebbly sand,	4 to	1079
13. Soft slate,	250 to	1329
14. Sand shells and slate,	278 to	1607

Elevation of well 1100′ above tide.

The top of the Chemung is probably 100′ above the mouth of the well, so that the section shows about 1600′ of these measures. There is no stratum in this record which can be identified with the *Bradford oil sand;* this horizon is at least 1300′ below the bottom of the Catskill rocks.

Cameron Well and Section.

This well, situated on the east bank of the Sinnemahoning, one half a mile north-east of Cameron station, was drilled to a depth of 971′, but although one "sand" was pierced, it failed to produce oil.

The section was constructed in the deep hill immediately above the well. The elevation of the bottom of the Oleau Conglomerate is 1440′ above tide, and of the well mouth 955′.

	Massive sandstone and conglomerate. Lower portion of Olean, No. XII,	25
	Concealed, (upper 50′±, No. XI,)	75
	Sandstone, green-gray, micaceous, thin bedded,	10
	Sandstone as above; grains a little coarse,	20
	Concealed,	70
	Sandstone, green-gray flaggy, thin bedded,	5
	Concealed to top of well,	305
1.	Gray flags,	113 to 113
	Catskill, No. IX.	
2.	Chocolate,	8 to 121
3.	Blue shale,	59 to 180
4.	Chocolate,	41 to 221
5.	Blue,	14 to 235
6.	Chocolate,	24 to 259
7.	Blue,	28 to 287
8.	Chocolate,	104 to 391
9.	Gray,	34 to 425
10.	Chocolate,	35 to 460
	Chemung No. VIII.	
11.	Gray,	120 to 580
12.	Dark iron gray,	9 to 589
13.	Light Gray,	37 to 626
14.	Iron gray,	37 to 663
15.	Light gray, hard rock, gas increasing,	84 to 747
16.	Sandstone, yellowish, very sharp grit,	42 to 789
17.	Light gray rock, large quantities of gas,	21 to 810
18.	Blue, soft, shelly, growing harder and whiter, then changing to brown rock, thence to blue,	64 to 874
19.	White,	20 to 894
20.	Red,	4 to 898
21.	Very hard blue rock,	73 to 971

The *Bradford oil sand*, in McKean and Elk counties, lies 1300′ below the bottom of the Catskill formation. To reach the horizon of this sand, provided the Chemung does not thicken to the east as the formations above it do, this well would have to be drilled 800′ deeper.

Judging from the record of the Bond farm well, it seems improbable that this sand would be found at this depth.

Stratum No. 20 is one of a series of red bands which are very persistent in McKean and Elk counties. They show in the wells about Bradford, Kinzua creek, Wilcox, Ridgway, St. Mary's, and other places in these counties.

Hyner Well.

Three quarters of a mile below Hyner's Station, P. & E. RR., Clinton county. Drilled by Clinton County Oil and Mining Co.; commenced Sept. 1, 1877; finished Dec. 10, 1877. See report G[4], page 133.

Drive pipe in well "stone and wash," local drift,	50
Red rock, with iron,	30
Gray rock, hard and dark,	15
Red rock, partly shales,	22
Gray rock, with mica,	16
Red rock, hard,	5
Red rock, salt water,	32
"Copper" (?) rock,	4
Red rock, salt water,	10
Gray rock, salt water,	16
Red sandstone; gas,	46
Red rock; with shales; gas,	52
Gray rock; very hard,	11
Red rock; with gray shales,	115
Sandstone,	4
Red sandstone,	111
Gray rock,	8
Sandy red shale, gas,	37
Gray rock; dark, some sandy bands,	95
Red rock; some oil,	35
Shale; sandy and gray, "partially hard,"	35
Red shale; some ore,	10
Gray rock; with sand,	30
Red shale,	7
Shale and sandstone alternating, blue,	67
Sandstone fine and white,	25
Slate, blue,	38
Sandstone and blue slate, alternating,	96
Sandstone white,	6
Sandstone blue, very hard,	55
Sandstone and shale, blue and very hard,	92
Sandstone and shale, blue,	30
Sandstone brown and white; oil and gas,	5
Sandstone dark blue, with shale,	165
Sandstone dark blue, with white sand shells,	10
Sand shale; soft and blue,	33
Shale; blue, with brown and black sand shells,	125

Shale; soft blue,	150
Sandstone, white with oil,	46
Shale; sandy, blue,	25
Sandy shelly rock, blue,	219
Total to bottom of well,	1187

Hebron Well.

At Hebron in Potter county. (See G^3, p. 79.)

Surface,		
Interval,	430 =	430
Sand ?, (impure limestone,)	20 =	450
Interval,	310 =	760
Stray sand,	15 =	775
Interval,	35 =	810
Sand, ?	120 =	930
Interval,	130 =	1060
Sand, ?	10 =	1070
Interval,	32 =	1102
Sand,	16 =	1118
Interval,	105 =	1223
Sand,	15 =	1238
Interval,	42 =	1280
Sand,	3 to 6 =	1286

Borehole in Harrison township, Potter county.

(See G^3, p. 80:)

Surface,		0
Interval, end of casing, *gas*,	392 to	392 =
Interval, *salt water at bottom*,	51 to	443 =
Interval,	292 to	735 =
Streaks of sand and shell,	70 to	805 =
Interval,	35 to	840 =
Sand,	55 to	895 =
Interval,	105 to	1000 =
Streaks of sand and shell,	185 to	1185 =
Interval,	45 to	1230 =
Sand,	50 to	1280 =
Interval,	170 to	1450 =
Sand,	10 to	1460 =
Interval,	143 to	1603 =
Sand and shell,	7 to	1610 =
Interval,	65 to	1675 =
Sand and shell,	70 to	1745 =
Interval,	185 to	1930 =
Sand,	4 to	1934 =
Interval to bottom of well,	61 to	1995 =

Neah Well.

Butler county, Neah farm, three miles S. W. of St. Joe. From the driller, and "good," per Mr. James Stevenson.

Well mouth above ocean, in feet,	
?,	160 to 160 =
Limestone, (estimated,)	12 to 172 =
Shells, gray; strong gas,	828 to 1000 =
?,	133 to 1133 =
2d SS., (estimated,)	20 to 1153 =
?,	200 to 1353 =
Stray sand, (estimated,)	15 to 1368 =
?,	21 to 1389 =
3d SS.,	12 to 1401 =
Gray rock, with gas,	44 to 1445 =

Blair Well.

Butler county, Staley farm; not far from Great Belt city, 1874(?). From Mr. Blair to James Stevenson, and believed to be correct.

?,	177 to 177 =
Coal,	— to 177 =
?,	273 to 450 =
Limestone,	13 to 463 =
?,	988 to 1451 =
2d SS., (estimated,)	20 to 1471 =
?,	231 to 1702 =
3d SS., oil show,	27 to 1729 =
?,	29 to 1758 =
SS., good,	1 to 1759 =
Shale, red at bottom,	66 to 1825 =
Slate,	50 to 1875 =

Mr. Blair thinks the one foot sand at 1758′ is Butler 3d sand.

Spang & Chalfant Well.

1875.

Allegheny county, Shaler township, on Pine creek, near Sharpsburg. Authority, Mr. Chalfant.

		750±?
?,	200 to 200 =	
Coal,	1 to 201 =	
?, mostly sandstone,	1249 to 1450 =	
?,	350 to 1800 =	
"2d sand,"	30 to 1830 =	
?,	170 to 2000 =	•
"3d sand," (not through,)	10 to 2010 =	1260?

The well was cased with $5\frac{5}{8}''$ casing to the depth of 450′, and drilled on down to 1450 feet, where a very heavy vein of salt water was encountered, which filled the well and flowed over at the top. Smaller casing was then inserted, and the salt water passing up between the two casings poured out daily, it is estimated, about 2000 barrels. Some more salt water was struck at 1800′, but this did not interfere so much with the drill, and it was urged on down to 2010′, where a bit or reamer was lost, and the hole being too small to allow the introduction of effective fishing tools, the well was finally abandoned.

GROUP XV.

Wells in Jefferson, Clarion, Butler, Allegheny, Beaver, Greene, Cambria and Somerset Counties.

Brookville Well.

Jefferson county, on R. D. Taylor's land. Drilled in 1875. Authority, R. J. Nicholson. (See p. 116, VV.)

Conductor,	23 to 23
Mountain sandstone,	120 to 143
"Red sand;" "Red rock,"	15 to 158
Soapstone and shale,	20 to 178
White slate,	6 to 184
Coarse sand,	30 to 214
Slate, sand, and red rock,	161 to 375
Interval,	5 to 380
First sand, (gas show,)	29 to 409
Soft rock,	121 to 530
Sand, (with oil show)	18 to 548
Slate and shells, (gas,)	92 to 640
Red rock and shale,	123 to 763
Sand, (gas, no oil,)	20 to 783
Alternate slate, shale, red rock, with shells,	347 to 1130
Sand, fine and close, / Shale, slate, and red rock,	270 to 1400
Shale and slate,	300 to 1700

Cased at 455′.

Chambers' Well, No. 4.

November, 1875.

Clarion county, J. Mendenhall farm, Edenburg, near Goss Bros., No. 1. Authority, H. McCormick, driller.

Well mouth above ocean, in feet,		1560
?,	100 to 100 =	1460
Coal,	2 to 102 =	1458
?,	58 to 160 =	1400
Limestone, *ferriferous*,	12 to 172 =	1388
?,	108 to 280 =	1280
SS., "Mountain sand," hard,	100 to 380 =	1180
Slate,	200 to 580 =	980
?,	74 to 654 =	906
Cased, (salt water,) 654′.		
?,	320 to 974 =	586
SS., 1st,	8 to 982 =	578
Slate,	40 to 1022 =	538
Shells,	60 to 1082 =	478
SS., 2d,	14 to 1096 =	464
?, including 50′ of *red rock*,	146 to 1242 =	318
SS., 3d, (oil at 1245′,)	26 to 1268 =	292

A good average well.

Snydersburg Well.

Clarion county, Farmington township, 4 m. S. of Tylersburg and 1 m. E. of Snydersburg. Drilled in 1878. Authority, Dr. Towler. (See p. 180, VV.)

Well mouth, A. T., (barometer,)	1470′
Conductor,	14 to 14
Bluff sand,	156 to 170
Mountain sand,	70 to 240
Slate and shells,	60 to 300
Red rock,	7 to 307
Slate and shells,	282 to 589
Soft slate,	2 to 591
Pebble sand,	5 to 596
Shell, slate, and sand,	138 to 734
First sand,	30 to 764
Slate,	110 to 874
Red rock, "little,"	27 to 901
Second sand,	20 to 921
White sand,	5 to 926
Red rock, "big,"	40 to 966
Black slate,	50 to 1016
Stray sand,	17 to 1033
Third sand,	12 to 1045
Slate,	9 to 1054
Third sand,	11 to 1065
Slats,	35 to 1100
Fourth sand,	11 to 1111
Slate,	96 to 1207

Cook Well, No. 2.

Clarion county, Farmington township, Tom's run, 2 m. N. W. of Cooksburg, 1878. (See p. 184, VV.)

Well mouth, A. T.,	1260±
Conductor,	22 to 22
Interval,	21 to 43
Mountain sandstone,	121 to 164
Slate,	56 to 220
Sandstone, yellow,	5 to 225
Slate,	27 to 252
Sandstone, close,	20 to 272
Slate and shells,	8 to 280
Sandstone, close,	39 to 319
Slate,	10 to 329
Sandstone, pebbly,	31 to 360
Slate,	110 to 470
Interval,	29 to 499
Red rock,	11 to 510
Slate,	40 to 550
Red rock,	18 to 568
Slate,	22 to 590
Red rock, (shells at 635′, 650′, 675′,)	135′ to 725
Slate,	43 to 768
Sandstone,	16 to 784
Slate,	42 to 826
Red rock,	17 to 843

Thompson Well, No. –.

Butler county, Concord township. Moses Thompson farm 3 miles west of Greece City.

Well mouth above ocean, in feet.		
Conductor,	20 to 20	=
Slate,	50 to 70	=
SS.,	20 to 90	=
?,	85 to 175	=
Limestone,	25 to 200	=
?,	100 to 300	=
SS., ("60 feet,")	60 to 360	=
Slate,	12 to 372	=
SS.,	15 to 387	=
?,	15 to 402	=
SS , mountain sand, cased 405,	25 to 427	=
Slate,	15 to 442	=
SS., estimated,	20 to 462	=
?,	613 to 1075	=
SS., 2d, streaked with red, estimated,	20 to 1095	=
?,	285 to 1380	=
SS., 3d, "poor,"	30 to 1410	=
Slate,	40 to 1450	=
SS., 4th, (good, no oil,)	20 to 1470	=
Slate and shells,	30 to 1500	=

Unproductive.

Fetterman Well.

1862.?

Beaver county, on Fetterman farm 2½ miles above Beaver Falls.

This well was originally drilled a four inch hole, to the depth of about 1000 feet. Much salt water was encountered before reaching 650 feet, and at 900 feet or deeper a heavy gas vein was tapped, which threw out the salt water with so much force that drilling had to be finally abandoned.

The gas continued to flow apparently with unabated volume until 1876 when the Economy Company leased the well for the purpose of utilizing the gas in their cutlery works at Beaver Falls.

A new rig was built (the old one having been destroyed by the burning gas) and the hole was reamed out 6½ inches in diameter, to the depth of 657′. Three and a quarter inch casing was then inserted which so effectually excluded the water that not a barrel per day came in afterwards.

The gas was conveyed in pipes to the cutlery works and sufficed to fire six boilers for several years.

A slight show of oil can be seen on the salt water in this well and also in Economy No 1, but it comes in at some point above the bottom of the casing, for none appears after the water is excluded.

The reaming of the well was done under the direction of Mr. J. W. Ramsey, who preserved and kindly presented to the Survey, fifteen specimens of the rock-chippings, from which the following record is made.

The well commences at the base of the Homewood sandstone at an elevation of about 25′ above the Beaver river. Before reaming commenced, the old conductor of 12′ had to be removed and an iron pipe inserted to the depth of 25′ to sustain the crumbling iron-shales found at this horizon.

Conductor,	25 to 25
Slaty shale, dark, (Spec. No. 1,)	39 to 64
SS. fine, hard, gray, (Spec. No. 2,)	2 to 66
Slate dark, (Spec. No. 3,)	50 to 116
Shale, micaceous, dark, (Spec. No. 4,)	14 to 130
SS. fine, hard, white, (Spec. No. 5,)	46 to 176
Slaty shale, dark, (Spec. No. 6,)	44 to 220

SS. fine, hard, gray, (Spec. No, 7,)	24 to 244
Slaty shale, dark, (Spec. No. 8,)	8 to 252
Shale, with fine, micaceous sand shells, dark, (Spec. No. 9,)	40 to 292
Slaty-shale, micaceous, dark, (Spec. No. 10,)	78 to 370
SS. fine, hard, flaky, dark greenish-gray, (Spec. No. 11,)	6 to 376
SS. fine, hard, greenish-gray, mixed with dark sandy shale, (Spec. No. 12,)	12 to 388
Slaty shale, bluish, (Spec. No. 13,)	142 to 530
SS. coarse, with white, red and slate colored pebbles, (Spec. No. 14,)	102 to 632
Large pebbles from the above, (Spec. No. 14, bis.)	
Slaty shale, micaceous, blueish, (Spec. No. 15,)	25 to 657

The bottom of the well was not reamed and consequently no record can be made. The total depth is 982 feet. The gas is supposed to come from a depth of about 900 feet.

Comparison of Specimens.

These specimens evidently do not correctly represent the whole section in detail. Many more ought to have been taken, to show the structure satisfactorily. Compare, as follows, with Economy Well, No. 2:

Fetterman.		*Economy, No. 2.*	
Nos. 1,	with	Nos. 3,4,5,	
2,	"	6,	
3 and 4,	"	7, and 8,	
5,	"	9,	agree well,
6,	"	10,11,12,13,14,	
7,	"	15,	agree well,
8 and 9,	"	16,	
10,	"	17,18,19,	
11 and 12,	"	20,	agree well,
13,	"	21 to 32,	
(No. 13 probably taken near horizon of No. 22.)			
14,	with	33,	agree well,
15,	"	34,	" "

Wolf Creek Well.

1870.

Butler county, Slippery Rock township, farm of Edward Smith, on Wolf creek, near the junction of Butler, Lawrence, and Mercer counties. Drilled by the Wolf Creek Oil Company. Authority, C. O. Kingsbury, treasurer of company.

Slate and shale,	108 to 108	=
SS.,	35 to 143	=
Slate,	20 to 163	=
SS.,	157 to 320	=

Slate,	105 to 425 =
SS.,	35 to 460 =
"Soapstone,"	200 to 660 =
SS.,	20 to 680 =
SS.,	75 to 755 =
Red rock,	80 to 835 =
SS.,	11 to 846 =
Slate,	231 to 1077 =
Shells, (oil show at 1080',)	5 to 1082 =
"Soapstone,"	50 to 1132 =
SS., gray,	20 to 1152 =
Slate,	90 to 1242 =
Red rock,	80 to 1322 =
Slate, black,	78 to 1400 =

Unproductive.

Nesbitt Well.

Butler county, Franklin township, Hindman farm, 1877, (for description, see p. 47, V.)

Limestone, at	215
Mountain sand, at	375
First sand, at	1090
Second sand, at	1275
Third sand, at	1375
Cased at 510'. Total depth,	1492

McCandless Well.

Butler county, Franklin township, 1877.

Limestone, at	235 to 250 =
Mt. sand, at	470 to 630 =
First sand, at (heavy vein of salt water,)	1130 to 1180 =
Second sand, at	1370
Depth of well,	1500 ±

Davis Well.

1879.

Ohio, Loraine county, Grafton township, near Belden and about 27 miles south-west of Cleveland. Authority, James Davis, Pleasantville.

1. Surface clay,	7 to 7
2. Soapstone, blue,	20 to 27
3. Slate or shale, black and very hard,	70 to 97
4. SS., bluish gray, fine; fair drilling,	58 to 155

No. 3 varies in thickness in different localities from 50' to 100', and it has been known to reach 130'.

No. 4 is sometimes white and it may have a thickness of 10' in one well and of 130' in another. It is in layers and the oil appears to come from the horizontal seams between them.

Under No. 4 is found a layer of white mud or clay, from 2′ to 30′ thick, and under this mud comes 45 feet or more of *red shale.*

About 40 wells are now producing in this district, (Oct., 1879.) A well pumps from 100 to 800 barrels of *salt water* per day, bringing with it from half a barrel to 10 barrels of oil, which varies in gravity from 26° to 29°.

The total production of a good well during its life ranges from 300 to 500 barrels, but the best well in the district is said to have produced about 4,000 barrels.

Well, No. 10.

(Widow Garrison's farm.) Greene county, 4½ miles a little N.W. of Greensburg and 2½ E. of Dunkard creek, Greene county.

Well drilled by Tanner & Co., of Millerstown. Record obtained from Dr. Koamer, of Greensburg, through H. L. Taylor & Co., of Petrolia.

Stratum, No.	1,	3 to 30, L. S.
"	2,	to 55, dark gray sand.
"	3,	to 60, " "
"	4,	to 70, " " lime mixed.
"	5,	to 80, light "
"	6,	to 100, hard "
"	7,	to 130, fine blue sand.
"	8,	to 190, bottom of coal, (6′ vein.)
"	9,	to 243, more lime.
"	10,	to 255, mountain sand.
"	11,	to 273, gray sand.
"	12,	to 319, 9′ vein coal.
"	13,	to 373, lime, got gas and cased at 350′.
"	14,	to 397, gray sand.
"	15,	to 420, bl. sand and gas.
"	16,	to 466, salt water top of sand 456′.
"	17,	to 518, 1st sand.
"	18,	to —, (out.)
"	19,	to 616, red slate. This is the stuff that caves.
"	20,	to 739, top of 2d sand, got gas.
"	21,	to 744, in sand 5′.
"	22,	to 748, got oil 4′ in sand, little.
"	23,	to 769, top of oil sand.
"	24,	to —, bottom of oil sand 5′.
"	25,	to —, hard.

Produced 40 barrels a day for 30 days.

Cherry Tree Gas Well.

Cambria county, Susquehanna township, east bank of Susquehanna river, in the borough of Cherry Tree. Authority, Mr. Grummun. 1867? (See p. 179, HH.)

Mouth a few feet above the river.		
Soil and river gravel,	33	to 33
Coal,	2	to 35
Fire clay,	10	to 45
Sandstone, pebbly,	40	to 85
Coal,	5	to 90
Fire clay,	8	to 98
Slate, becoming black downward,	21	to 119
Coal,	5	to 124
Fire clay,	4	to 128
Sandstone,	19	to 147
Coal,	*thin.*	
Slate, becoming black downward,	20	to 167
Coal,	5	to 172
Fire clay,	7	to 179
Sandstone, massive, hard, (Top of XII,)	75	to 254
(*Heavy flow of gas.*)		
Shale,	20	to 274
Sandstone,	40	to 314
Sandstone ?, (hard boring,)	68	to 382
Sandstone, (flint rock, very hard)	1½	to 383½
Sandstone, (massive,)	20	to 403½
Black slates,	15	to 418½
Coal,	4½	to 423
Fire clay,	5	to 428
Sandstone, massive,	35	to 463
Shale,	5	to 468
Sandstone (?), massive,	165	to 633
Shale,	2	to 635
Sandstone,	18	to 653

Accuracy is not claimed for this record.

Salisbury Well.

Somerset county, Salisbury basin, Piney run. Authority, Joel Miller, Esq., President.

Coal,	at 96
Coal,	at 136
Coal,	at 266
Black slate, streaks of coal, 2′,	at 320
Layers of slate, and iron ore above both,	at 350
Iron balls,	at 375
Sandstone,	375 to 400
Sandstone 20′, with some shales,	at 420
Sandstone 40′,	at 440

Brown slates and coal streaks, ...	at 480
Sandstone 60′, very hard, slate at bottom, ...	at 500
Soapstone, ...	at 560
Gray shale, ...	at 590
Shale, ...	at 605
Sand rock, white, ...	at 620
Shale, *red*, ...	at 640
Shale, gray, and thin SS. to bottom of well, ...	at 678

GEOLOGICAL REPORT

ON

WARREN COUNTY.

By J. F. Carll.

Chapter I.

Geography and history of the county.

Warren county, in north-western Pennsylvania, at the western end of the New York State line, has Erie and Crawford on the west, Venango and Forest on the south, McKean on the east, and Cattaraugus and Chautauqua counties of New York on the north.

Its northern border along the State line measures about 35½ miles, Cattaraugus county aligning with the two easternmost townships, and Chautauqua county with the remaining five.

Its eastern border (not a continuous north and south line) is 26 miles long.

Its southern border, a continuous east and west line, is in common with Forest county for 28½ miles, and with Venango county for the remaining 5 miles.

Its western border, a continuous north and south line, is in common with Crawford county for 16 miles, and with Erie for the remaining 10 miles to the State line.

The area of Warren county is therefore almost an exact rectangle, about 33½ miles long, east and west, by 25½ broad; containing 910 square miles, or 582,400 acres, according to the U. S. census of 1880.

Its 23 townships (15 to the north-west, and 8 to the south-east of the Allegheny river) are arranged in the following order:

Columbus,	Freehold,	Sugar Grove,	Farmington,	Pine Grove,	Elk,	Corydon.
			Conewango.		Glade.	
Spring Creek,	Pittsfield,	Brokenstraw,	Pleasant,	Mead,	Kinzua,	
Eldred,	Deerfield,		Watson.			
Southwest,	Triumph,		Limestone,	Cherry Grove,	Sheffield.	

History.—Under an act of the General Assembly of the State of Pennsylvania, passed March 11, A. D. 1800, the counties of Beaver, Mercer, Crawford, Erie, Armstrong, Butler, Venango and *Warren* were created by sub-dividing the territory previously included within the limits of the old counties of Allegheny and Lycoming.

The north-westerly part of Warren county came from Allegheny county; the south-easterly part from Lycoming—the Allegheny river having been the boundary between the two large old counties in this region.

In 1846 the narrow township of Corydon, embracing the settlements and improvements skirting the east side of the Allegheny river, was set off from McKean county to Warren, to which by geographical position it seems naturally to belong.

The town of Warren, with its adjoining reserved tracts, was surveyed and staked out in the year 1795, when the first block-house was built there by the Holland Land Company and used as a depot for supplies brought up the river in canoes from Pittsburgh, for their surveyors and a few settlers who about that time began to come into the country.

Previous to this, however, a few families had settled on Conewango creek, in Pine Grove township. This is said to have been about the year 1790. A settlement was also commenced at Columbus on Big Brokenstraw creek in 1793.

Warren was incorporated as a borough in 1832, and at that time had a population of 358 souls.

In 1801 the first lumber was rafted from the Big Brokenstraw to Pittsburgh, and in 1805 water mills with single upright saws had been erected, and seasoned lumber was shipped by barges from the Brokenstraw Valley to New Orleans, where the cargoes and boats were disposed of—the crews returning by sailing vessels to Baltimore and thence walking home. It is said that some of the men employed in these lumbering operations, not relishing the sea voyage to Baltimore, made several journeys on foot all the way from New Orleans to Warren.

In 1830 the steamboat "Allegheny," built to ply between Warren and Pittsburgh, made an experimental excursion from Warren to Olean, New York, about 67 miles as the river runs. No other steamboat has traversed these waters; but that one trip demonstrated that the Allegheny river at certain stages was navigable for steamboats to a distance of 255 miles above Pittsburgh.

Warren county was not organized for judicial and municipal purposes until March 16, 1819, the first court being held at Warren in November of that year.

In 1827 the first court-house was built, and this was followed by the erection of the first jail in 1829. The latter was superseded in 1874 by the present substantial structure.

The corner-stone of the new court-house, one of the finest edifices of that class in the State, was laid on the 4th of July, 1876--the centennial anniversary—and the completed building was dedicated December 3, 1877. It was erected at a cost of $103,434 59.

Bridges.—Within the county limits there are three highway bridges and three railway bridges across the Allegheny river. They were built in the following order:

The first bridge at Warren, in 1839, and this was re-placed by the present elegant suspension bridge in 1872.

Philadelphia and Erie railroad bridge at the west end of Warren, in 1859.

Suspension bridge at Tidioute, in 1873.

Warren and Clarendon highway bridge at the mouth of Dutchman's run, about a mile and a half south-east of Warren, in 1880-81.

Buffalo, Pittsburgh and Western railroad bridges at Great Bend, and from Glade to South Warren, in 1882.

Ferries.—The river may be crossed by ferry boats near Corydon, at Great Bend, Hook's ferry, Hertzell's ferry, (now superseded by the Clarendon bridge,) Irvineton, and Cobham. At low water it is fordable in a number of places.

Railroads.—The Sunbury and Erie railroad, chartered and organized in 1837, was located through Warren county in 1838, but owing to the financial embarrassments of that period, the work was suspended until 1857, when it was revived and the western division, extending from Warren to Erie, was then put under contract and completed in the fall of 1859.

In 1863 the eastern division was opened to Sunbury, which already had connections at the east, and thus the town of Warren became an important station on a through line, (now known as the Philadelphia and Erie railroad) from the seaboard to Lake Erie.

The Atlantic and Great Western railway, crossing the north-western corner of the county, and intersecting the P. & E. at Corry, just west of the county line, was opened for traffic in June, 1861.

The Warren and Franklin railroad (now the Buffalo, Pittsburgh and Western) was next built from Irvineton to Oil City, in 1867.

In 1871 the completion of the Dunkirk and Warren railway furnished another outlet to Lake Erie, and in 1872 the Warren and Venango railroad was opened to Titusville. These two roads were consolidated in 1873 under the present title of Dunkirk, Allegheny Valley and Pittsburgh railroad.

The Olean, Bradford and Warren extension (narrow gauge) was completed from Bradford to Kinzua village in the fall of 1881, and on May 17, 1882, that part of the Salamanca, or river division of the Buffalo, Pittsburgh and Western RR., extending from Kinzua to Warren, was opened to the public, thus making a short and direct line (but with a change of cars at Kinzua) between Warren and Bradford.

Along the Allegheny valley, north of Kinzua, the road is being rapidly graded, and trains on the B., P. & W. will soon be running regularly from Warren to Salamanca.

The Tionesta Valley narrow gauge railroad, from Sheffield to Brookston, was built in 1881.

The Warren and Farnsworth (narrow gauge) railroad extending from Clarendon summit on the P. & E. RR. to the new oil town of Garfield, in Cherry Grove township, and ultimately to be continued on into Forest county, is now under contract, and is expected to be ready for business in August. [Opened to Garfield August 3, 1882.]

Public buildings.—The Western Insane Asylum of Pennsylvania was located in the Conewango valley, at North Warren, in 1873, and in the following year the corner stone of the present imposing edifice was laid. The main building is 1200′ long, and capable of accommodating about six hundred patients. Its location and surroundings are all that could be desired for an institution of this kind.

To the late Henry D. Rouse, a former resident of Enterprise, the county is indebted for the "Rouse Home" and a farm for the poor, containing about 400 acres and beautifully situated on the Brokenstraw flats, between Youngsville and Irvineton. Mr. Rouse was one of the pioneers in developing the petroleum industry, being among the first to grasp the situation and comprehend the importance of Drake's discovery of rock oil at Titusville, in 1859. Acting promptly on his convictions, he early secured large leases of oil territory on Oil creek and elsewhere, and commenced operations. In 1861, while witnessing the opening of the first flowing well at Rouseville, in which he was largely interested, the gas and oil accidentally ignited and an appalling fire occurred, in which he and about twenty others were fatally burned, and as many more seriously injured. He lived a few hours after the accident, bearing his sufferings with great fortitude, and dictated a will in which Warren county was made his residuary legatee. He directed that the funds thus realized by the county from his estate should be securely invested, the interest from one half of it to be expended for the benefit of the poor, and the interest from the other half to be appropriated to the improvement of public roads. This legacy amounted to nearly $200,000, and the money having been loaned to the county, it has given to this division of the Commonwealth a model home and farm for the poor, and a commodious and elegant court-house. Of course the interest on the loan must be paid, but this, when applied as directed by the will, one half to the poor fund and one half to the road fund, returns again to the people.

Population.—According to the statistics of the U. S. Census Bureau, the total number of inhabitants in the county was increased by 4,084 during the decade from 1870 to 1880, as will be seen in detail by the tables below. At present, owing to the rush of people of all classes into the newly discovered oil fields, the population is increasing with great rapidity.

Population of Warren county by Townships.

	1880.	1870.
Brokenstraw,	1,212	1,048
Cherry Grove,	158	61
Columbus,	1,242	1,257
Conewango,	1,478	1,212
Corydon,	335	411
Deerfield, (part to Triumph in 1878,)	657	2,324
Eldred,	797	557
Elk,	637	469
Farmington,	1,149	1,101
Freehold,	1,574	1,316
Glade,	1,622	899
Kinzua,	348	318
Limestone, (part to Watson in 1880,)	446	848
Mead,	1,155	463
Pine Grove,	1,332	1,206
Pittsfield,	1,740	1,260
Pleasant,	395	385
Sheffield,	1,424	660
South West,	660	677
Spring Creek,	1,309	1,116
Sugar Grove,	1,861	1,729
Triumph, (from Deerfield in 1878,)	1,100	—
Watson, (from Limestone in 1880,)	258	—
Columbus borough,	421	466

Tidioute borough,	1,255	1,638
Warren borough,	2,810	2,014
Youngsville borough,	606	462
Totals,	27,981	23,897

Total Population of Warren county.

Census of 1800,	233
" " 1810,	827
" " 1820,	1,976
" " 1830,	4,697
" " 1840,	9,278
" " 1850,	13,671
" " 1860,	19,190
" " 1870,	23,897
" " 1880,	27,981

Agriculture.—The census of 1870 showed a production of 2,660 bushels of barley; 25,763 bushels of buckwheat; 98,850 bushels of Indian corn; 253,380 bushels of oats; 13,749 bushels of rye, and 26,759 bushels of wheat.

In 1880 the census bureau reported as follows:

Barley,	174	acres.	3,373	bushels.
Buckwheat,	2,307	"	38,856	"
Indian corn,	5,061	"	158,090	"
Oats,	9,615	"	304,653	"
Rye,	421	"	5,006	"
Wheat,	3,382	"	50,042	"
Totals,	20,960	"	560,020	"

Altitudes above tide.—The following are the accepted elevations above ocean level of stations on the principal railroads traversing the county:

New York, Pennsylvania and Ohio railroad.

(Formerly Atlantic and Great Western.)

	Miles.	*Above ocean.*
Salamanca, (center of Hemlock St.,)		1393
Bucktooth,	2	1376
Red House,	7	1353
Steamburg,	12	1404
Randolph,	18	1318
Waterboro',		1276
Kennedy,	25	1264
Poland,		1269

D. A. V. & P. RR. crossing, (near Falconer's,)	31	1267
Jamestown,*	24	1321
Chautauqua lake, (surface of water,)		1299
Ashville,	41	1356
Watts Flats,	45	1456
Grant,	48	1437
N. Y. & Penn'a State line,		1468
Bear Lake,	51	1550
Columbus,	58	1427
P. & E. RR. crossing, (at Corry,)		1427
Corry,	61	1429

Philadelphia and Erie railroad. †

	Above ocean.
Kane,	2021
Cumming's siding,	1880
Wetmore,	1810
May's siding,	1741
Ludlow,	1607
Roystone,	1422
Sheffield,	1344
Tiona,	1367
Clarendon,	1395
Stoneham,	1361
Warren,	1200
Irvineton depot,	1170
Youngsville,	1214
Pittsfield,	1247
Garland,	1309
Garland quarry,	1330
Horn's siding,	1370
Spring Creek,	1392
Columbus,	1407
A. & G. W. crossing,	1427
Corry depot,	1429
B., P. & W. crossing (Corry summit,)	1440

*If the accepted elevation of Chautauqua lake (1299') be correct, this elevation would seem to be too high, for the depot at Jamestown certainly cannot be more than 15' above lake level.

† These elevations differ slightly from those published in reports N and R, but believing them to be as nearly correct as any, and having used them as bases to work from, they are here inserted as a matter of record. It is quite probable that Warren depot is put about five feet too high, but as we had accepted 1200' above tide before the recent re-survey of the P. & E. RR., and all our levels in the vicinity of Warren were based upon that, it is inexpedient to make any alterations now.

*Dunkirk and Allegheny Valley Railroad.**

	Miles.	Above ocean.
Titusville, (5′ below Oil Creek depot,)	0	1189
E. Titusville,	1	1185
Grand Valley,	9	1348
Star,		1383
Newton,	11	1419
Summit,		1476
Garland, (2′ below P. & E. depot,)	19	1307
Pittsfield,	23	1250
Youngsville,	27	1215
Irvineton, (same as P. & E. depot,)	29	1170
Jackson,	32	1187
Warren, (11′ above P. & E. depot,)	35	1211
North Warren,	37	1221
Russellburg,	43	1238
Ackley's,		1241
Fentonville,	48	1248
Frewsburg,	52	1266
A. & G. W. Crossing,	57	1267
Falconer,	58	1263
Ross Mill,		1266
Vermont,	63	1298
Sinclearville,	68	1332
Moore's,	72	1304
Cassadaga,	76	1309
Cassadaga Lake, surface of water 732′ above Lake Erie,	76	1305
Skidmore,		1317
Nortons,	81	991
Laona,	85	810
Fredonia,	87	765
Dunkirk,	90	598
Lake Erie,		573

Buffalo, Pittsburgh and Western R. R.†

(River Division.)

	Miles.	Above ocean.
Irvineton, (P. and E depot,)	.0	1170′
Dunn's Eddy,	2.6	1156

* I am not aware that this road has been re-leveled to insure an accurate profile. The figures heretofore given were from the preliminary and construction surveys, and it is very evident by checks on other railroads—at the A. &. G. W. crossing, Warren, Irvineton, Youngsville, Garland and Titusville that errors had crept into the work. I have adjusted the elevations above given as best I could, so that they now conform, relatively, to known points on the other roads at the places named. While they cannot be said to be absolutely correct, they are without doubt reliable enough for all practical purposes.

† Copied from Report II, page 345.

Pennsylvania House,	4.1	1151
Thompsons,	6.6	1143
Cobham,	8.9	1137
Magee,	11.1	1131
Tidioute,	14.8	1113
Trunkeyville,	20.1	1099
Hickory,	23.3	1092
Dawsons,	26.2	1076
Jamiesons,	28.1	1074
Tionesta,	29.6	1060
Hunter's,	32.5	1061
Stewart's Run,	34.9	1047
President,	36.8	1048
Eagle Rock,	38.0	1046
Henry's Bend,	39.3	1035
Oleopolis,	41.3	1032
Walnut Bend,	43.2	1023
Rockwood,	46.5	1016
Oil City,	50.2	1008

Relative Levels at Irvineton.

	Above ocean.
P. & E. bridge over Brokenstraw creek,	1173.00′
P. & E. depot,	1169.99
D. A. V. & P. depot,	1170.33
B. P. & W. depot,	1168.08
P. & E. and B. P. & W. junction, (upper,)	1172.61
" " " (lower,)	1169.96

*Relative Levels in Warren.**

	Above ocean.
P. & E. passenger depot, (accepted elevation,)	1200.00′
" freight station, (center, river rail,)	1192.72
" bridge, (top of rail, north end,)	1199.34
D. A. V. & P. passenger depot,	1211.42
Randall's, B. M., on retaining logs, near landing,	1179.62
Extreme low water 3.50′ below this,	1176.12
B. M. north side of triangular grove,	1208.96
B. M. N. E. corner of Third and Hickory streets,	1213.51
B. M. S. W. corner of Third and East streets,	1202.56
Center of RR. curve in East street,	1208.95
B. M. N.W. corner Conewango bridge, (1′ below roadway,)	1200.25
B. M. on Walnut tree, Beatty's corner, Glade,	1200.70
B. M. corners in Glade at E. end of covered bridge,	1201.01

*Taken by Mr. H. M. Chance in 1877.

*Warren and Quaker hill high road.**

	Above ocean.
P. & E. depot at Warren,	1200.0
B. M. on tree—Beatty's corners, Glade,	1200.7
B. M. on stone near pipe line crossing road,	1271.9
Magee well No. 1, (No. 2=1339.4,)	1313.6
B. M. on lowest step of stone steps leading to Magee's house,	1333.5
B. M. on flat stone, left of road, near pipe line crossing,	1371.8
Verback's deep well, Sweeting farm,	1433.1
B. M. on flat stone over culvert near above well,	1438.3
Smith Bros. well No. 2, Sutter farm,	1464.4
B. M. on walnut in field to right, at turn in road,	1551.6
Magee & Co.'s new rig,	1566.8
B. M. on root of oak 8 inches in diameter, left side at turn in road and foot of steep rise,	1811.1
Spirifer band 2½′ thick at	1820.0
B. M. on loose piece of spirifer band at gate of house left of road, (L. S. Morse,)	1841.7
B. M. on root of oak (inside) on summit and near barn on left,	1854.3
B. M. on stone in center of road leading to Brazington's,	1871.9
Bell well, Snyder farm (left of road,)	1795.8
B. M. on stone, right of road, by hen-house, (N. Snyder's,)	1863.3
Summit west of G. Gebhart's	1909.0
B. M. on root of hollow oak 2 feet in diameter, 40 feet left of road; Honicker's barn in hollow north,	1942.3
B. M. on small chestnut on summit, right of road. Grave-yard on left, conglomerate knob,	2017.6
Opposite P. M Smith's house (road level,)	1968.0
B. M. on large stone, junction of Glade Run road 100′ N. of school-house,	1924.5
B. M. on large conglomerate block left of road, 2′ above the track and 50′ S. W. of "The Pass,"	1996.0
Approximate base of "Singular Rocks,"	1995.0
B. M. on SS. block 3′×2′ on the summit of "Singular Rocks" south of the road at the "Pass,"	2079.0
B. M. on large stone opposite watering trough,	2018.4
Summit in road north of water trough,	2090.0
B. M. on chestnut at corners, 200′ N. E. of school-house,	2042.7
B. M. on conglomerate block under the fence right of road, near stump in center of road, summit,	2129.1
Road covered with flat pebbles, top of conglomerate,	2055.0
B. M. N. W. corner of coal scales in front of Dinsmoor's house,	2028.0
Base of coal—North Bank,	2000.2
Base of coal—South Bank (about 1600′ apart,)	2011.3
Sill of old barn at South Bank,	2014.8

The Bench Marks when on stone are cut thus +.

* From a line of levels run by Messrs. H. M. Chance and Arthur Hale in June, 1877.

*Warren and Corydon river road.**

	Above ocean.
P. & E. depot, Warren,	1200.0
B. M. on corners in Glade, E. end of covered bridge,	1201.0
Road in front of brick house, (Allen's,)	1214.4
B. M. on stone step of burnt house. (Glade hotel,)	1206.7
Cobham oil well, (top conductor,)	1221.2
River at Hook's ferry,	1194.0
B. M. on flat stone 450′ W. of Hemlock run,	1218.6
B. M. on N. E. corner of bridge, stream E. of Dixon's,	1227.9
B. M. on top step of porch to Geer's house,	1225.5
B. M. on tree on river bank 50′ E. of ferry,	1211.7
Extreme low water at Great Bend ferry,	1201.0
B. M. on large rock W. of road, ⅓ mile N. of Tuttle's house,	1254.4
Spirifer band exposed in road cutting,	1233.1
B. M. on 2d maple E. of Kinzua hotel and corners,	1231.0
B. M. on root of walnut W. of road and N. of school-H.,	1228.6
B. M. on large chestnut W. of road ½ mile S. of Sugar run,	1241.6
B. M. on root large tree S. E. cor. Sugar Run bridge,	1237.3
Surface of water in Sugar run,	1229.0
B. M. on root of butternut W. of road and N. of Harris' saw-mill,	1250.0
B. M. on chestnut in front of J. Williams' house,	1273.0
B. M. on root of large oak at the river bank and opposite the south end of Corydon hotel,	1280.0

* By Messrs. Chance and Hale, August, 1877.

CHAPTER II.

Resources of Warren County.

In its capabilities for supporting and enriching its inhabitants, Warren county possesses rather unusual resources. Not only does it offer competence and wealth to those who judiciously avail themselves solely of its surface products and privileges—the lumberman, the farmer and the manufacturer—but, in some sections, it has yielded and is still yielding immensely profitable returns to the oil miner who sinks the drill fifteen hundred feet or more into the rocks below the surface.

Timber.—A large proportion of the south-eastern half of the county is still in a wooded state, and many extensive tracts of hemlock and considerable pine timber remain to be marketed. But the increasing demand for hemlock bark to supply the immense tanneries at Sheffield, Brookston, Clarendon, Stoneham, and numerous smaller ones in other places, is causing a wholesale destruction of the native forests, hundreds of acres of fine hemlock being felled for the bark alone, while much excellent milling timber is left to rot upon the ground.

This waste, however, will be somewhat checked and remedied in the future. The advance of oil developments in this section causes new home demands for lumber at good prices. Railroads and plank roads are being built, and common roads are being extended and improved. Thus timber tracts that were formerly almost inaccessible, are rendered available, and saw-logs that a few years ago could not be hauled out and worked up except at a loss, can now be profitably handled. Through these means, also, some valuable pine groves that have been preserved by reason of their remoteness from convenient avenues to market, will become disencumbered and bring rich harvests to their owners.

Coal.—This portion of the county also holds quite extensive areas of carboniferous rocks, as may be seen on the geological map. Coal beds have been opened in several places in Kinzua, Cherry Grove, and Pleasant townships, but no commercially valuable article has thus far been obtained. Some of the beds are of sufficient thickness to mine, but the coal is so impure and unreliable, that but little profit can be anticipated from this source.

On the line between Elk and Glade townships, the Quaker Hill coal has been profitably mined on a small scale for 30 or 40 years. But this appears to be a sporadic bed, occupying, as far as known, only about 50 acres, and it has been found no where else in the county. For its geological position, &c., see Elk and Glade townships.

Soil.—The broad valleys north-west of the Allegheny river, originally largely covered with superb pine groves, and the ready facilities for rafting offered by the numerous streams of that region, early attracted the attention of lumbermen. Here, on the big Brokenstraw and Conewango creeks, the first settlements in the county were made about 90 years ago. While the pines were disappearing beneath the woodman's ax, the adaptability of the easily-worked, fertile soils of these creek bottoms and the smoothly contoured hills between them at the north, to the wants of the agriculturist, the dairyman, and the fruit grower, became apparent, and soon many clearings for cultivation were made, not only in the valleys, but also upon the beech and maple table lands and slopes between them. Since then farming interests have taken precedence of all others in this section, and now this is the most densely populated and the best agricultural portion of the county. Some of the farms from long cultivation and injudicious cropping have a worn-out appearance, but these soils (particularly on some of the higher ground) possess considerable recuperative energy and can be reclaimed by rest and the application of proper fertilizers.

Limestone.—It would be a great acquisition to the farmers of the county if they had a good limestone within reach, that could be utilized for agricultural purposes. But there is little or no hope of finding one; for although several thin irregular layers of rocks made limy by holding aggregated masses of fossil shells are exposed in many places in the county, they are all too siliceous and require too much labor in their quarrying to be of any commercial value in lime making. So great is their power of resistance to the action of heat that they are popularly called "fire stones," and sought after for lining fire places, furnaces, &c. in preference to all other stones that can be obtained here.

Building stone.—Good building stones are abundant throughout the county, except in the region bordering the State line west of Conewango creek. For all local demands an ample supply of loose sandstone blocks can be found upon the surface. For commercial purposes three quarries have been opened and systematically worked. Two of these lie close together on the ridge between Big Brokenstraw creek and Blue Eye, about a mile north-west of Garland, in Pittsfield township. The other is on Follett run about a mile north of Warren.

The Garland quarries are in the Garland (Olean) conglomerate, which here caps the ridge and along the escarpment facing the Brokenstraw throws off large blocks easily worked up and delivered by short inclined tramways to the cars of the P. & E. railroad, and cheaply shipped either east or west. The portion of the rock which is used is a massive coarse-grained sandstone, yellow and white, but sometimes stained with streaks of iron. It dresses easily when fresh from the ledge, but hardens on exposure, and makes a very desirable article if carefully selected as to color and composition. Its proximity to the railroad and the ease with which the blocks can be quarried and placed upon the cars ought to make this ledge quite valuable.

The Follett run quarry was opened in 1874 to furnish material for the construction of the Western Insane asylum at North Warren. It is a finer-grained and more compact stone than that at Garland and lies at a lower geological horizon. For further reference to it see Conewango township.

No good beds of flagstone for commercial purposes are known in the county. Some thin layers from two to six inches thick may be found in many places, but they are irregularly bedded, uneven in composition and often defaced by fucoidal casts, wave-marks and sun cracks, so that they can hardly be esteemed of much importance.

Brick clay can be obtained in every part of the county. Wherever bricks are needed a little judicious exploration and experiment will disclose the materials for their manufacture near at hand. Those used in building the Insane Asylum at North Warren were made upon the grounds belonging to the institution. It is quite probable that beds of clay suitable for pottery might also be found, but I am not aware that any industry of this kind has ever been attempted in the county. The great thickness of the clay beds in the old filled-in valleys is shown by the records of wells at Fentonville, Lottsville and Clarendon.

Mineral Springs.—But one of note was heard of. It is near the center of the county. For description and analysis of water, see Brokenstraw township. There are several other springs more or less impregnated with minerals, but none of them deserve special notice here.

Petroleum.—As far as our present knowledge reaches no county in the State possesses such a total thickness of oil bearing strata as Warren.

In Venango, Butler, and Clarion a group of sandstones and shales about 350 feet in thickness has furnished all the oil there obtained.

In McKean the Bradford oil sand, from 40′ to 70′ thick, is the great fountain of supplies ; but some "Second sand oil" and "Slush oil" has been obtained above it, so that we may assign a thickness of about 400′ to the oil bearing horizon in that county.*

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* The "Smethport oil sand" which Mr. Ashburner puts 360′ *below* the Bradford sand, but which has never been remunerative, is, of course, not included in this calculation.

The two oil producing sands in Allegany county, New York (the Richburg sand, in northern Bolivar township, and the sand found at Waugh & Porter's well in southern Bolivar) may be included in a band of rocks not over 300′ in thickness.

But from the top of the highest oil producing rock in Warren county down to the bottom of the lowest yet discovered we have a vertical distance of about 1400 feet!

The geological positions of these several horizons with reference to the Olean conglomerate may be stated *approximately* thus:

From the base of the Conglomerate down to the top of the Venango group (the oil rocks of Venango, Butler, Armstrong, Clarion and a part of Warren) 450′; to the bottom of the same, 800′.

From Conglomerate to Upper Oil horizon in McKean county, 1450′; to bottom of Bradford oil sand 1850′.

From Conglomerate to top of Richburgh sand in Allegany county, New York, 1600′; to bottom of Waugh & Porter sand as above mentioned 1900′.

From Conglomerate to top of Venango group in Warren county (oil in Spring Creek, Pittsfield, Eldred, Deerfield, South West, Triumph and Limestone townships) 450′; to bottom of same 800′; to the "Slush oil" at North Warren 1100′; to the "Warren Third sand" 1300′; to the "Clarendon sand" 1450; to the "Cherry Grove sand" 1625′; to the "Sheffield or Blue Jay sand" 1850′.

With such a wide vertical range of oil-bearing rocks, and a large area in the south-eastern part of the county still but partially tested, the possibilities of the future can only be conjectured.

As early as 1860 Tidioute entered the list as an oil-producing center, and ever since that time Warren county has been yielding oil from the sands of the Venango group. On Hosmer run there are old oil pits and surface springs presumably delivering oil from the Venango *First sand*. At Triumph the *Third sand* was of the remarkable thickness of 120′ and stored an immense amount of petroleum. Enterprise, Colorado, New London, Fagundus, and West Hickory have been reliable oil fields for years.

In 1875–6 a new oil horizon was developed at Warren, followed later by Clarendon and Sheffield, and now, in June, 1882, by Cherry Grove, which fairly eclipses them all, the first ten wells drilled having flowed an average of about 2,000 barrels each, during the first 24 hours after they were opened, and this, too, apparently from a rock not as yet found productive in any other part of the county. What ever new developments may follow, the inhabitants of Warren county have been favored with a rich inheritance.

Water Power.—The numerous water-power privileges found along Conewango creek, the Brokenstraw, Spring Creek, Tionesta, and many other smaller streams were utilized by the early settlers, and have aided very materially in developing the resources of the county by furnishing the means for propelling saw-mills, grist-mills, carding-machines, &c. Although steam has now largely superseded water power as a motor, some of these mill-sites are still very valuable. None of the streams have a very rapid descent, but the larger ones, particularly the Conewango, have a continuous and never-failing supply of water, which makes them competent to drive almost any kind of manufacturing machinery. Here is a source of wealth which should not be neglected when the scarcity of timber consigns the old-time saw-mill to decay.

Natural Railway Routes.—Owing to its geographical position and its remarkable topographical peculiarities, Warren county has been favored with more than the usual allotment of railroad facilities. It holds several of the natural railroad gateways between the east and west and between the north and south. Its north-west corner covers one section of the remarkable east and west valley through which passes one of the great railroad arteries between New York and the western country. The through line from Philadelphia to Lake Erie was forced to follow the valleys of the Tionesta, Allegheny, and Brokenstraw. In seeking a route from Buffalo to Pittsburgh the valleys of the Allegheny and Conewango creek could not be overlooked. These valleys are all now occupied by important railroads, and others yet remain to be appropriated as local demands increase or connecting links become desirable. Along the Little Brokenstraw from Grant station on the A. & G. W. RR. to Pittsfield on the P. & E. RR. a good natural grade may be found. Another up Stillwater creek to Sugar Grove and Chandler's valley and thence down Matthew's run to Youngsville, or down Jackson run to North Warren. In fact, although the surface of the county is so uneven and varying in altitudes, a number of good routes with moderate grades can be selected even across the ridges, by following those streams through which the principal ice flows of the Glacial age passed.

Highways.—I cannot close this chapter without referring to the county roads and pressing the importance of their improvement. It cannot be denied that many of them are not in the condition they should be. In some places, to be sure, the topography of the country and the nature of the soil are such that good roads can only be maintained by a considerable outlay of labor upon them; but in others there is no reason why they should not easily be put in proper shape and kept in good condition. With the interest from the "Rouse fund," and a moderate road tax, Warren county ought to have the best of country roads. But to accomplish this systematic work must be done. It will not do for the farmers to put in odd time on the roads whenever it suits their convenience, and at all seasons of the year, filling up a mud hole here or opening a side drain there, the same thing to be repeated year after year without any permanent benefit. Many of the roads need shaping up from beginning to end before they can be economically kept in order. They want a rounded surface and good side ditches, not dug so as to receive and retain the drainage, but ditches having ample slopes and free outlets so that there shall be no standing water in them to saturate and soften the road bed, and the work should be done at the proper season of the year, or not at all. If each path-master would make it a rule to properly grade a mile or two each year, and do it thoroughly, the beneficial results would soon be seen and appreciated. Mud holes may be filled with stone, and worn down wagon tracks may be covered with gravel; but so long as the road-bed is not properly graded and drained, it is labor thrown away. A great deal of money is wasted every year in hauling gravel from the creek bottoms and injudiciously applying it to the roads. Gravel is undoubtedly a good material when applied on a bed properly prepared for it, but it can never make a good road where the drainage is neglected. Neither will it make a pleasant road to ride upon, or an even durable surface, unless it is carefully selected. Most of the creek pebbles are flattish, and when large and small are indiscriminately mixed, they cannot pack into a solid surface, for the larger ones act as levers to loosen those around them, and finally come to the surface where they are knocked around to the great damage of the road-bed itself and of every passing vehicle, and to the discomfort of every traveler. When unassorted gravel must be used the large stones should be broken up by the hammer. This would greatly facilitate the consolidation of the road-bed and render it more lasting. A loose rolling stone in the road is not only an annoyance to man and horse, but it damages the road-bed by causing an uneven wear upon it and strains or breaks the wagon. In traveling through the county during the dry weather of 1881 I often passed along long stretches of roads covered with rolling stones, which made the riding almost intolerable, and where, if a few hours had been spent in removing the stones, the traveling would have been smooth and pleasant; and I could not but wonder how communities who had any regard for economy and comfort could suffer such a state of things to exist. The extra wear and tear (to say nothing of the traveler's discomfort) occasioned by these unnecessary obstructions, cost a much larger amount of money in the long run than would be required to keep the roads free from the nuisance.

Chapter III.

*River valleys and highlands.**

The greater part of the surface of Warren county is very rugged and uneven, producing a diversity of soils and as a natural sequence inducing an indigenous growth of many varieties of trees and shrubs. These characteristics result from variations in the geological constitution of the surface rocks and the peculiar manner in which they have been wrought upon by erosive agents, water and ice.

The *newest* rocks of the county lie in Kinzua township near Great Bend, where "coal knob," one of the most elevated points in the county, reaches an altitude of 2154′ A. T. and attains a height of 316′ above the base of the Olean conglomerate.

The *oldest* are Chemung, (No. VIII,) lying at water level at Corydon, where the Allegheny river enters the county near its north-east corner. This last horizon is about 875′ below the base of Olean conglomerate.

Total thickness of rocks exposed to surface examination in the county, 316′+875′=1191′.

Two other thick masses of carboniferous rocks are seen in the county; one in Pleasant township about 150′ thick; and one in Cherry Grove about 200′ thick. Additional ex-

* The elevations used in this report were taken with a Hicks' Aneroid Barometer, (except when otherwise noted,) an excellent instrument and as reliable as any barometer can be. But every one who has used barometers knows that there are some days of varying pressures when it is impossible to do close work with them in the hurried manner in which geologists are obliged to proceed. Some of the points were checked a number of times from known railroad levels, and from these the main lines were carried forward. Others depend solely upon the accuracy of one observation. In the main, however, it is believed that they are sufficiently accurate for all ordinary practical purposes.

posures of Chemung, possibly as low geologically as that mentioned above should occur along the State line where it is crossed by Conewango creek and again by Little Brokenstraw creek.

If we bisect the geological map of the county by a line drawn from its south-west corner to its north-east corner, it will be noticed that the surface rocks of the south-eastern half are nearly all of carboniferous age, while those of the north-western half are older. Now as the carboniferous formation contains thick beds of massive conglomerates and sandstones, and the underlying measures are more shaly, with fewer purely arenaceous beds—and these seldom more than from 15′ to 20′ thick—one would expect to find a marked difference between the topography on the one side of the line and that on the other. Comparing the extreme north-west with the extreme south-east the contrast in surface features is apparent to the most careless observer. For instance, in Columbus and Freehold townships the valleys are broad and smooth, the hillsides rise by gentle slopes up to broad-topped undulating summits; but few steep declivities and no colonies of broken sand-rock obstruct cultivation, nearly every acre may be classed as arable land. But in Sheffield and Cherry Grove townships the valleys are narrower, the hillsides steep and frequently broken by escarpments of naked rock, and the terraces and summits are in many instances clayey swamps or rock-covered wastes which never can be reclaimed.

Along our diagonal line and for several miles on each side of it, may be seen a combination of both characters, with only a partial removal of all the carboniferous rocks.

Here the Sub-olean conglomerate—a massive pebbly sand-rock, 40′ or more in thickness and lying from 30′ to 60′ below the Olean conglomerate, plays an important part in fashioning the topography. It is barely removed, perhaps, from one range of hills, and the contours there are just beginning to assume graceful outlines. On another it forms the cap-rock and, protecting the softer measures below it, makes flat-topped ranges with steep hillsides and rapidly descending streams. The next ridge may be topped by the

Olean conglomerate, lying on narrow "hog-backs," cliffing out occasionally in vertical walls from 30′ to 50′ high and throwing off huge blocks of conglomerate and sandstone into the valleys below.

In passing across the county from south-east to north-west three phases of erosion are well exhibited by the topography. (1.) Erosion in carboniferous rocks where considerable thicknesses of them still remain upon the surface. (2.) Intermediate erosion leaving the hilltops partly in carboniferous and partly in sub-carboniferous strata. (3.) Erosion entirely in the softer and more homogenous measures lying below the Sub-olean conglomerate.

We must seek for an explanation of these various stages of erosion in the gentle and gradual rise of all the strata towards the north.

Anterior to the ice age conglomerate-capped hills were to be found, no doubt, some distance to the north-west of their present range. Atmospheric erosion had already deeply trenched the surface there, and pre-glacial streams had transported the excavated materials to the ocean. The whole face of the country had been denuded of its upper rocks, and outliers of conglomerate-capped knobs and ridges stretched all along the north-western front of outcropping carboniferous sandrocks. When the ice flow came these isolated, unguarded peaks were the first to be attacked and denuded. One after another the outposts were destroyed, while the flanking masses in the more continuous ranges to the south-east were steadily cut into and weakened, so that eventually a considerable recession of the line of outcrop took place along its entire north-western front.

With these facts in mind the topographical features of the county as generally shown on our geological map will be more readily understood.

North of Big Brokenstraw creek and west of the Conewango but a few small patches of conglomerate remain. The great ice sheet, guided by the broad valley in New York which extends south-westwardly from Chautauqua Lake, expended its full force over this area. It was somewhat held in check, however, by the bold highlands extending west north-west from Warren to the north-west corner of the county, where it also met other streams coming down more directly from the north and all gravitating toward the Allegheny outlet. Near Chandlers valley, in Sugar Grove township, the old summit between Stillwater creek and Jackson run was leveled down and a clean new cut was also made through the ridge toward the south, by which the waters of a former branch of Jackson run are now diverted into Matthew's run and thence to the Big Brokenstraw. This ridge rises at present from 400′ to 700′ above the level of Jackson run, but the ice swept over it, and wherever two streams head in proximity upon or near its summit—or rather, wherever the upper parts of their valleys approach each other—depressions from 50′ to 80′ deep are cut in the crest of the ridge. On each side of these depressions will generally be seen broad bowl-shaped basins, steep and dry for some distance, with the streams first appearing at some springs in the valley below. This is but one group of examples of many that might be given to illustrate the manner in which the topography in every part of the county has been fashioned by the combined action of ice and water. Every feature indicates an ice-filled basin supplied from the north and urgently impelled to seek for outlets through every possible passage southward.

I have said in Report I[3] that no open drainage channel toward the south existed in this latitude prior to the ice-age. My special work in Warren county since that report was written confirms me in that opinion; not a valley, ridge, or hilltop has failed to furnish affirmative evidences of its correctness.

During the ice-age, four principal deliveries leading out of the county toward the south seem to have been established, but they were not all maintained in operation until its close.

One was near Columbus, in the north-western corner of the county—opening communication between the upper reaches of the Big Brokenstraw and French creek.

One in the north-west corner of Deerfield township, connecting Crouse's run with Caldwell creek, and leaving the county at its south-western corner.

One south of Irvineton—the Allegheny river outlet—as explained in Report I[3].

Another at Lower Sheffield, or Barnesville, connecting an old northerly flowing stream with Tionesta creek, and leaving the county near the center of the south line of Sheffield township.

The last two named are open deliveries to-day for the passage of southerly flowing waters. The other two are low divides in abandoned glacial valleys, with streams falling from them in opposite directions. How could it have been otherwise? The Columbus breach was made near the old summit, on one side of which the Big Brokenstraw took its rise, on the other French creek. The old stream level here must have been at least 200′ higher than at Irvineton, and all the tendencies of drainage were strongly in that direction. The breach opened into the Conneaut basin, already a *mer-de-glace* full to overflowing and preparing to make for itself an outlet to the south through French creek.

The Deerfield township gap delivered into Oil creek basin, in like manner full, and held in check by the rocky weir in Oil creek, which had to be removed to establish free communication with the Allegheny river. But not so with the Allegheny river cut near Thompson's. It had a direct and almost unobstructed drainage south; and during the early periods of overflow comparatively little northern ice could find its way laterally into the channel below it; for the Oil creek cut and the French creek cut could not yet have been delivering freely. Hence everything favored more rapid erosion at the Allegheny breach than at any of the others: the drainage of Chautauqua basin,* if checked in its single pre-glacial outlet to the north, would naturally center there; the remains of the carboniferous rocks as they now lie are lower at this point than they are either to the east or to the west of it; the Olean conglomerate is mostly a coarse pebbly rock which disintegrates readily under the action of frost and moisture; the sub-Olean is more shaly, thinner,

*See pre-glacial drainage map, report I[3].

and less massive than at many other places; and beneath it for several hundred feet the measures are shales and thin shaly sandstones. This gap is an illustration even in inorganic nature of the "survival of the fittest." From its first inception it possessed more of the elements of endurance than any of its rivals, and consequently it has outlived them all. While many other outlets served a purpose for a while and then were abandoned, this one gradually cut deeper and deeper until it has become the grand channel through which an area of over 4,000 square miles of water-shed, which formerly drained into the Lake Erie basin, now sends down its accumulated washings toward the Gulf of Mexico.

About two thirds of the drainage of Warren county enters into the Allegheny river within the county limits, and the remaining one third enters it a little lower down through East Hickory and Tionesta creeks on the east, and West Hickory and Oil creek on the west; the first named streams draining about 210 square miles in the south-east corner, and the last two about 80 square miles in the south-west corner.

The Allegheny enters the county at its north-east corner, flows nearly south to Great Bend (about 11 miles,) where it turns sharply west and then wanders in a somewhat devious but average westerly course for 14 miles to Irvineton, about two miles north of the geographical center of the county. Here it turns abruptly towards the south and flows on 13 miles to Tidioute bend, where it sweeps to the west for about two miles and a half, and then again to the east and south for four miles, and leaves the county at its southern line, about 11 miles east of its south-west corner.

Above Great Bend it is reinforced from the east by the drainage of large areas in McKean county, sent down Willow creek at Corydon, Sugar creek 3 miles above Kinzua village, and Kinzua creek; at Warren by the Conewango from the north—the outlet from Chautauqua and Cassadaga lakes and the drainage channel for extensive areas in that region; at Irvineton, by the Big Brokenstraw from the west, whose tributaries collect from all the north-western part of the county and reach far out above the State line into New

York. Many other smaller streams deliver into it, which will be mentioned particularly in the township report.

An uncolored wall map of the county, with the Allegheny and its branches drawn boldly so as to overshadow the other details, would at first sight strike the spectator as a representation of a grape vine upon a trellis, instead of a county map; for the river, bifurcating at Irvineton and then sending up its lateral branches at quite regular intervals and in a systematic manner, has very much the appearance of a trained vine.

The approximately east and west valley occupied by the Allegheny east of Irvineton, and by the Big Brokenstraw west of it, forms an interesting feature of this water tree. Running in a general direction almost at right angles to the in-flowing streams from the north and south, and being connected near its center with the only southern outlet, its influence in controlling and directing the ice-currents is plainly shown in the topography of this section of the county, as may be seen by reference to the geological map.

Chapter IV.

*Geological Structure and Map.**

In attempting to systematize the geology of Warren county from my notes and observations, I have been beset with some rather formidable and perplexing difficulties, which may

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*The black letter base of this map is a reproduction on an enlarged scale of the county map given in Howden & Co's atlas of Warren county. It was prepared in proof in 1879 for report I^3, and afterwards laid aside with other matter for this report. Like all of our county maps it is quite faulty in detail, and in many places I have found it difficult to represent the geology satisfactorily upon it. Warren is unquestionably a county of crooked roads, but the traveler is not compelled to stop and back his team to turn the corners as he evidently would have to do sometimes, if they were as sharp as they appear to be on the map.

Four new railroads have been projected since this map was lithographed, very properly be referred to here to prepare the way for the details and conclusions to be given further on.

Since the Second Geological Survey commenced its work the surveys of Western Pennsylvania have been pushed forward in all directions and closed in upon the lines of Warren county. McKean county on the east, Forest and Venango on the south, and Crawford and Erie on the west have been surveyed and reported upon. The geology of New York, on the north had been published years before. Thus the geological formations on all sides have been designated on colored maps; and now Warren county, like the last block in a mosaic, remains to be inserted. To make its systematic geology harmonious with that of the surrounding country has given some trouble.

In an ordinary land survey, when all the angles and measurements are actually taken and a perfect "close" results, the work stands unquestioned. But if only a portion of the outline be measured, leaving the closing line to be supplied by calculation, grave errors *may* be made and remain undetected until some sub-division or re-survey of the property discloses them. Something like this may happen in a geological survey. Unless satisfactory connections have been made on all sides, we cannot be sure that no questionable identifications of strata have been accepted.

The survey in New York was carried forward from the east and north-east, and its special work terminated at the State line. The survey of Crawford and Erie is a continuation of a comparatively narrow belt of examination coming up from the south-west through Allegheny, Beaver, Lawrence, and Mercer. The survey of McKean gives expression to the eastern and south-eastern facies of structure as traced

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and therefore they are not shown. The Buffalo, Pittsburgh and Western, running down the Allegheny valley from Salamanca to Warren, skirting the east bank of the river from Corydon to Great Bend, then crossing to the opposite side and continuing on to Glade where it again crosses and makes a junction with the P. & E. RR. at South Warren. The Olean, Bradford and Warren extension, (narrow gauge,) running from Kinzua village up the Kinzua valley on the east side of the creek. The Warren and Farnsworth Valley, (narrow gauge,) running from Clarendon up the Farnsworth branch to Garfield, in Cherry Grove township; and the Tionesta, (narrow gauge,) running from Sheffield to Brookston along the east bank of Tionesta creek.

from formations in those directions. The surveys of Venango and Forest on the south show interpretations of structure as brought up through Armstrong, Butler and Clarion. In Warren county we have a central area upon which four surveys close from different directions, and across which identifications are to be carried from east to west and from south to north.

This would be a task of easy accomplishment if the region to be examined was of regular structure, the horizons of comparison well defined and the identifications already made, harmonious on all sides. But all these favorable conditions fail.

The Venango Third-sand, positively identified in Crawford and Erie on the west with the Panama conglomerate of the Chemung formation in New York, is made to be Catskill by the surveys of McKean county on the east;* and the geological structure of the county so changes in passing from south to north that it is difficult to determine which identification, if either, is correct.

It is evident then that no interpretation of the structure and no geologically colored map of Warren county can be made to match with all its surroundings. I have adopted as far as possible the colors and designations used on the Crawford and Erie maps for the sake of uniformity and because this coloration brings out the topography better than any other.

The color representing the sectional horizon of the Venango group (on the plan of general parallelism of strata) as laid on the Crawford and Erie maps and continued across the northern part of Warren, certainly covers Chemung rocks along that range. There should be no question whatever on this point; for the strata are directly traceable to localities in New York where the Chemung first received its name. The point to be settled is not whether these northern rocks are Chemung, but whether their deposition was coetaneous with the Venango group in the southern part of the county. My belief has been for several years,

* Another interpretation of structure makes it Pocono. See G^4, chapter VIII, &c.

and still is, that the Venango Third-sand cannot be satisfactorily identified with the Panama conglomerate. But this must not prevent the systematic coloring of the map in agreement as near as possible with those already published, for the map-coloring need not interfere with our study of the geology if the significance and scope of each color is understood.

No. 1 represents all the surface covered by carboniferous rocks, down to the base of the Olean conglomerate. This horizon is in agreement on all our maps.

No. 2 represents the shales (sometimes quite flaggy) immediately underlying the Olean conglomerate, and also the sub-Olean flat-pebble conglomerate underlying the shales, the two together being about 75′ thick.* They correspond to Prof. White's Shenango shale and Shenango sandstone in Crawford county.

On the maps of Crawford and Erie and also of Forest *this color only represents the Shenango shale*, the Shenango sandstone or sub-Olean forming the top member of the next color below.

On the map of McKean both the shale and the sub-Olean (well developed in some places) are included in the *Pocono* formation (No. X) and designated by its color.

I have colored the sub-Olean with the shales because it so frequently forms the surface rock on the highlands of the county, and its designation in many isolated places where the shales do not appear adds very materially to the value of the map as a topographical index. The sub-Olean is a well-defined and persistent horizon throughout Warren and its contiguous counties.

No. 3 represents all the measures between the base of the sub-Olean and the top of the First-oil-sand of the Venango group. Thickness about 400′. Theoretically the base of this color in Warren county should correspond with the base of the same color on all the maps surrounding it; but different views are entertained in relation to the age of the

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*This is the usual thickness assigned by Prof. White. It holds fairly good in Warren north-west of the Allegheny river but the shales appear to thicken very materially from the river south-east.

Venango group, and the color is meant to define not only the area but the age.

Prof. White includes in it his Meadville group, Orangeville shale, Corry sandstone, Cussewago group, and Riceville shale; being inclined (as I understand him) to classify the Riceville shale, 80′ thick, as of Chemung age.

Mr. Ashburner, in McKean and Forest, calls it all Pocono sandstone, and shows 350′± of Catskill below it before Chemung is reached.

I am inclined to view it as Pocono in the southern part of Warren county, and partly Pocono and partly Chemung in the northern part—varying according to the location of the section.

No. 4 represents the Venango oil group (thickness say 300′) as it should outcrop if it continues northward holding its parallelism to the sub-Olean conglomerate. In Crawford and Erie it is called Upper Chemung. In Forest it is unseen, being below drainage. But in McKean the same horizon—that is, the horizon intended to represent the Venango group—is colored and designated as Catskill.

No. 5 represents Chemung on all the maps referred to, but evidently not one and the same horizon in that formation; for the top of Chemung in the Crawford map is placed 80′ above the Venango group, while in the McKean map it is put below—a difference of 380′±. These facts should be kept in mind when the maps are compared.

In the vicinity of Tidioute the rocks have been thoroughly perforated by oil wells; deep gorges also afford excellent opportunities for studying the structure. The Olean conglomerate, sub-Olean, and immediately underlying shaly sandstones can be traced with assurance; but the Pithole grit is generally unrecognizable; and the Venango group changes in structure remarkably going north and east.

Near Warren no trace of the Venango Third-sand has ever been found, although many wells have been sunk in positions where it should have appeared, if these are all contemporaneous sediments, laid down in regular beds of shale and sand, ranging all the way from outcrops in New York to the oil wells of Clarion and Butler counties, as some would have us believe. Neither can we certainly recognize the Venango First and Second oil sands at Warren ; although sandstones are found there which might be considered their equivalents were we not warned by the structural irregularities observed throughout the county to avoid making too hasty conclusions. The Pithole grit is absolutely unknown at Warren in either its normal position or character. The sandrocks of the Warren oil group, lying from 400′ to 600′ below the horizon of the Venango group are as variable in position and constitution as those of the Venango group.*

In Mead, Cherry Grove and Sheffield townships the oil developments now progressing furnish new proofs of the facts above stated—not only confirming what had already been learned in other places of the rocks above the Warren group, but showing conclusively also, as attempts are made to extend the field of operations south-easterly toward the center of the old Devonian basin where the drilling is much deeper, that similar geological irregularities prevail in the underlying measures.

In the northern part of the county a vertical section reaching down 750′ below the base of the sub-Olean conglomerate contains but one massive pebbly sandstone, (probably the equivalent of Pope's Hollow rock in N. Y., and which I have elsewhere called, provisionally, the Wrightsville conglomerate.†) This varies from 15′ to 25′ in thickness and

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* See chapter IX.

† My attention was first called to Pope's Hollow conglomerate on Case run, N. Y., in 1875, while looking for a north-eastern equivalent for the Garland conglomerate. Four places were mentioned in the New York reports where the carboniferous conglomerate could be found. At the village of Panama on the Little Brokenstraw ; Pope's Hollow on Case run, 5 miles east of Frewsburg and 4 miles north of Pennsylvania line ; Rock city 6 miles south of Ellicottville ; Rock city 6 miles south-west of Olean—all in the State of New York.

I first visited Panama and found that the rock there not only lay at too low an elevation for the Garland (being over 200′ lower than that stratum where last seen, 10 miles to the south) but that it was entirely different in structure and association and the pebbles in it were flat while those of the conglomerate I had been following were round. I then visited Pope's Hollow and was surprised to find this also a flat pebble conglomerate, and still more confounded when my aneroid indicated an altitude nearly 200′ *above* the Panama rock—showing plainly, when its location was considered, that it could be neither Panama nor Garland. I next made a trip to Salamanca, feeling but lies about 230′ below the sub-Olean. At least this is the only persistent sandstone I have been able to discover there. The whole surface of the northern tier of townships is deeply covered with Drift, and consequently very few exposures occur; but as this rock is well escarped in many places, it seems probable that any other of like constitution would show also. It is hardly possible for Drift to be so deftly deposited everywhere upon the surface as to completely hide all evidences of an out-cropping massive sandstone. If the escarpment itself does not conspicuously ap-

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little doubt that I should find in the Ellicottville Rock city the conglomerate sought for. Procuring a horse I drove up to the rocks in the afternoon, and was again astonished to find a flat pebble conglomerate and an elevation which left me in doubt whether it might belong to the Panama or the Pope's Hollow horizon. Night coming on there was little time for examination and I was obliged to return to Salamanca in a very despondent mood. I could not believe that either of these three rocks—so different in general appearance from the Garland—could be its equivalent. And yet there was no positive data to work upon. I was not aware that the shape and quality of pebbles as a distinguishing feature in identifying conglomerates had ever been noticed before—the flat pebbles might have no significance, the aneroid levels might be unreliable, or if approximately correct, the Garland might moderate in dip as it spread north-east, so as to bring it down to the Salamanca-rock level. Still I could not be satisfied to attempt a connection with any of these rocks without further investigation and therefore determined to proceed the next day to Olean and make one more effort to clear up the obscurity surrounding the subject. This time I met with success. One glance at the large rounded pebbles and massive blocks of the Olean Rock city sufficed to assure me that the north-eastern outcrop of the Garland conglomerate had at last been found.

But what of the three other rocks, where should they come into the vertical section at the south? These questions have been a puzzle ever since, and they are not *positively* answered yet. To put the relative elevations of these rock cities beyond doubt, Messrs. Chance and Hale, in 1877, ran spirit levels from Grant station, on the A. & G. W. Ry., to Panama, from Frewsburg to Pope's Hollow, from Salamanca to the Ellicottville-Salamanca Rock city. The following are the accepted figures:

Top of Panama conglomerate,	. 1671′ A. T.	Thickness, 69′
Top of Pope's Hollow conglomerate,	. 1940′ A. T.	Thickness, 20′
Top of Salamanca conglomerate, . . .	. 2190′ A. T.	Thickness, 35′

Mr. Chance notes in relation to Pope's Hollow rock, "pebble character local. North side of cut but few pebbles, and only in upper layers. Going east (on south side of ravine) pebbles increase until nearly the whole rock is a flat pebble conglomerate, very marked in character. Five hundred feet of soft measures (no massive sandstone) seen below the conglomerate."

The results of my attempts to trace the Panama rock southward and south-westward, are given in I³, chapter VI, and in this volume, chapter VII.

For further details concerning the Salamanca and Pope's Hollow rocks, see chapter VIII.

pear loose blocks will be seen somewhere in the neighborhood and lead to the detection of the rock in place. There is nothing of this kind in the northern tier of townships to excite the suspicion that more than one conglomeritic rock like the Wrightsville conglomerate exists in this geological plane in that region.

The numerous vertical sections accompanying this report and the well records in the appendix, will further illustrate the geological variations and show how hazardous it is to depend upon dip calculations and assumed parallelism of strata in this county.

A space of about 15 miles separates the most north-easterly development of the Venango group at Tidioute from the Warren oil field. Theoretically, a well drilled to a sufficient depth at Tidioute, should find the Warren sands below the Venango. A well commencing at the proper elevation at Warren or on the high ground of this area between Tidioute and Warren, should pass through the Venango group before reaching Warren oil. A number of wells have been drilled where these conditions were fulfilled, but in not one of them, as far as I can learn, were both groups of oil rocks unmistakably recognizable.

The inference therefore is that certain peculiar conditions, not common to the whole of the old Devonian basin, obtained in this latitude toward the close of the Chemung period. What these conditions were can only be conjectured, but it is evident that they were potential in deciding the character and defining the limits of the Venango and of the Warren oil rocks. Perhaps some elevation of sea bottom or change in shore lines occurring at that time caused new currents to be formed or diverted old ones from their former courses, and thus made available new supplies of sediment to be swept into the basin through new deliveries, for the transporting and assorting ocean waves to operate upon. No one can describe the exact modus operandi by which these changes were brought about, but any one who is familiar with the history of oil developments on this area cannot fail to perceive that the agencies employed in laying down the sands of the Venango group encountered some disturbing element in this direction.

It cannot be denied that the measures exposed near water level at Warren have a decided Chemung aspect lithologically, and that they hold many fossils characteristic of the Chemung age; and, although no line of demarkation can be drawn between this kind of sediment and that of the succeeding age, it is quite certain that the aggregate thickness of all the measures between the top of the characteristic Chemung and the base of the Olean conglomerate, at Warren, cannot exceed 700 feet.

Chronologically the Chemung period is separated from the Carboniferous (Olean, Pottsville, No. XII) by the Catskill (No. IX) and Sub-carboniferous, (Nos. X and XI.) The measure of time belonging to these three successive periods must have been the same in Warren county as in the Anthracite region of Pennsylvania; and the fact that barely 700′ of sediment accumulated in Warren county, while from 6,000′ to 9,000′ were laid down in Eastern Pennsylvania during the same period of time, is good evidence that very dissimilar conditions of deposition must have prevailed contemporaneously in the two places. This very properly suggests the inquiry whether the remarkable thinning out of the three groups mentioned, when traced toward the west, was due to a gradual exhaustion of easterly derived materials, as the distance from the supplying sources increased and the currents holding the matter in suspension abated in energy and weakened in transporting capacity, or whether it arose from the fact that these were periods of *continuous deposits* in the east by reason of uninterrupted submergence there, while they were ages of *alternating deposit and erosion* near Warren county—that section being a part of the time sea bottom and a part of the time dry land.*

*The effects to be looked for, if the hypothesis implied in the first proposition be entertained, should be a distinct representation of the three groups (Ponent, Umbral, and Vespertine) in Warren county, laid down with that uniformity of structure and homogeneousness of composition necessarily accompanying the action of the agencies referred to. But if the other hypothesis be accepted, the resultant strata should be characterized, lithologically, by an interblending of materials belonging to different ages, local variability of sediment producing irregularity of structure, and a confusing inter-burial of fossil plants and shells. It seems to me that a study of the structure, lithology and fossils makes the latter hypothesis preferable.

[The thinning away of our great formations in a direction from the present Atlantic sea board toward the interior of continent is not confined to Pennsylvania ; it is quite as remarkable in Maryland, Virginia and Tennessee. And the *general* direction is not from east to west, nor from south to north, but from south-east to north-west ; in other words from the Highlands, South mountains and Blue ridge towards Lake Ontario, Lake Erie and the Ohio and Mississippi valley. In eastern New York and eastern Pennsylvania all the rocks thin rapidly northward and north north-westward, as described in Mr. White's reports on Pike and Monroe (G^6, 1882.) and on Susquehanna and Wayne, (G^5, 1881.) In middle Pennsylvania, they thin north-westward (see Reports F, and T.) In Fulton and Bedford they thin westward (see Mr. Stevenson's Report T^2, 1882.) In southern Virginia and Tennessee they thin north north-westward and north-westward. The ancient continent from which the river sediments came seems to be represented by the mountain range which crosses the Hudson at West Point, the Delaware below Easton, the Potomac between Harper's Ferry and the Point of rocks, and the James about Lynchburg, and which has its grandest development in the Black mountains of North Carolina.—J. P. L.]

Chapter V.

Pottsville Conglomerate, No. XII.

This formation underlying the productive coal measures, and about 300 feet thick throughout western and northern Pennsylvania, is sub-divided into upper, middle, and lower beds called *Johnsons Run rock*, *Kinzua Creek sandstone*, and *Olean conglomerate.**

In the greater part of the conglomerate-capped area of Warren county the lowest sub-division, the *Olean conglomerate*, is alone left; the middle and upper sub-divisions having been entirely swept away with all the true or productive coal measures overlying them.

What coal measures are found in Warren county, therefore, do not belong to the true coal measures, but to the Pottsville conglomerate formation No. XII, and correspond to the *interconglomerate coals* of Sharon, &c., in Mercer and Crawford counties, of Alton, &c., in McKean county, and to the Lykens valley coal beds in Schuylkill county.

The *Olean conglomerate* caps many of the summits along a central belt which stretches across Warren county from east to west; as shown by the color on the geological map accompanying this report.

In the isolated knobs, thus capped, the base of the Olean is exposed in such a manner that the elevation above ocean level can be ascertained with greater certainty than in more

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*See Reports R and V^2. Along the Ohio State line they received the names of *Homewood sandstone*, *Connoquenessing sandstone*, and *Sharon conglomerate*. See reports Q, Q^2, Q^3, Q^4.

In Report I, I^2, I^3 I have used the term *Garland conglomerate*. It is now demonstrated that my *Garland conglomerate* is the *Olean conglomerate* of Mr. Ashburner's report on McKean county, and I shall therefore use the latter term in this report.

southern localities where it is not only obscured by talus from higher rocks, but has also in many cases parted with much of its massive conglomeritic character, thus making it difficult to discover the precise line of division between it and the underlying shales.

Along the south county line the lowest elevations of the rock are found. West of the Allegheny its base rises from 1550′ A. T. to 1685′ A. T. East of the river the average altitude is about 1700′ A. T. Its highest level is in the northern part of Glade township, 19 miles from the south county-line; here its base lies at 2000′ A. T., showing an average rise in that direction of about 16′ to the mile. But this rise is by no means regular or uniform throughout the county. Evidently, the rock was deposited on an uneven floor, or else it has been slightly warped out of plane by unequal elevation. Probably both causes have contributed to its undulations. The variations in level are so obscurely shown by reason of the sparsity of outliers, that it is not easy to determine whether they are due to low anticlinal waves sweeping connectedly across the county, or to a series of dome-shaped elevations scattered about in no fixed order.

However, one quite prominent broad-topped low anticlinal wave seems to be fairly traceable along a curved line drawn from the south-west corner of Triumph township through the south-east corner of Pittsfield township, crossing Big Brokenstraw creek a little west of Irvineton and thence sweeping around to "Singular Rocks" in Glade township, near the south west corner of Elk township.*

Commencing at the south line of the county, where the base of the Olean has an altitude of 1685′ A. T., it rises at the corner of Pittsfield township to 1800′ A. T., and at York Hill (near the center of southern Brokenstraw township) to 1880′ A. T. Between York Hill and "Singular Rocks" no Olean conglomerate remains, but the sub-Olean caps the

* "Singular Rocks" lie in the region generally referred to as Quaker Hill, where the highway leading from Warren to Corydon passes through a rock city of Olean conglomerate, by one of its so-called "streets," about one rod wide, with perpendicular walls 20′ or more in height rising on each side. It is a feature of the road that naturally attracts the attention of every one traveling that way, and hence the name of "Singular Rocks" or "The Pass."

ridge west of Conewango creek, and thus fixes the place of the former within a possible error of a few feet at most. Two miles north-west of Warren its place is thus shown to be at 1940′ A. T. Hence passing on to "Singular Rocks" the Olean is found in place at 1996′ A. T.

The length of this curve is about 28 miles; total rise 311′; average per mile, say 11′.

The rates of dip along this line and at right angles to it are quite irregular:—from the county line to York Hill, 12½′; from York Hill to "Singular Rocks" 8′. The side dips are much steeper toward the south-east than the north-west. From "Singular Rocks" to Great Bend, in a south-east direction we find 27′ to the mile; from York Hill to Thompson's station in a line a little more toward the south, 36′. On the northerly side of the arch they seldom exceed 10′.

The Quaker Hill range, of which "Singular Rocks" form a part, is the most north-easterly outcrop of Olean conglomerate in the county—the hill rock in Elk township being wholly sub-Olean. Several detached ledges make up the range, as may be seen by reference to the map, and on connecting these by levels some very remarkable and interesting features of structure are brought to light.

The base of the Olean conglomerate at the "Pass" is 1,996′. About a mile south-west of this a small peak is capped with the same rock, base 1,998′ A. T. Under it comes 30′ of shales and then the sub-Olean. But go a mile to the north-east of the "Pass," to the last knob of Olean remaining in that direction, and its base is found at 2,090′ A. T., with 35′ of shales beneath, and the sub-Olean boldly exposed in ledges 20′ to 25′ high—a characteristic flat pebble conglomerate—top 2,055′. Now go north-west from the "Pass" about 2½ miles to Gardner's or North Rocks, a solid ledge 51′ thick, and the level falls from 1,996′ to 1,978′.

Just north of Germany post-office, in Elk township, the top of the sub-Olean rises to 2,105′; in the north-west corner of the township, where a fine escarpment occurs, to 2,160′; and in the north-east corner to 2,109′ A. T. The latter is a Rock City on the high peak at the junction of Willow creek with the Allegheny river, a little over the

State line into New York, and the elevation was carefully taken instrumentally by Mr. Chance. Allowing 35′ as the proper interval in this region between Olean and sub-Olean, we get the following results:

North of Germany, ...	top sub 2105′+35=base Olean 2140′ A. T.				
N. W. corner of township,	" 2160′+35= " 2195′ "				
N. E. corner of township,	" 2109′+36= " 2145′ "*				
"Pass" (1996′) to Germany, .	(2140)=144′	rise in	4	m.=38′	per mile.
" " N. W. corner,	(2195′)=199′	"	7+m	=28′	"
Germany, (2140′) to " "	(2195′)= 55′	"	4	"=14′	"
" " to N. E. corner,	(2145′)= 5′	"	6	"= 1′—	"

This shows how uncertain calculations of dip must be, except for short distances and within the limits of rates already ascertained.

The next exposure of Olean conglomerate of which I have any knowledge, lies in Warrant No. 4, near the east line of Salamanca township, Cattaraugus county, New York, and 2½ miles north of the State line. This I believe to be the most northerly outlier between Allegheny river and Tunangwant creek. Only a few large blocks remain in place—elevation of base 2,270′ A. T., showing a rise from Corydon of (2,270′—2,145=) 125′ in about 13 miles, or an average of less than 10′ per mile, in a direction E. N. E.

From this point to the noted Olean Rock city, where Mr. Ashburner gives the base of conglomerate at 2340′ A. T., is about 11 miles, in a direction a little south of east; 2340′—2270′=70′ or 6′+ per mile.

The few patches of Olean remaining in the north-western portion of the county, show quite as much irregularity of elevation as those above referred to. Pike's rocks in Sugar Grove township rise to 1950′ A. T., which is more than 100′ above Miller's Cliff, which is less than 3 miles west by north from them. They evidently cap a dome from which the dips descend more or less in every direction.

South-east of the Allegheny river, the summits are not so elevated as the highest in Elk and Glade; but the general

* Mr. Ashburner (R, p. 251) puts the base of Olean here at 2,175′ A. T., allowing 64′ for interval shales. I have never found them so thick along the north-western outcrop.

declination of all the rocks in that direction carries the Olean conglomerate below many of the hill-tops, and in several places traces of the *intra-conglomerate coal beds* appear above it. In consequence of this, reliable elevations of the Olean are hard to obtain; but enough facts can be gathered to indicate that the geological structure in this portion of the county as well as in the west has been affected by irregular deposits upon an unequal floor.

CHAPTER VI.

Sub-Olean Conglomerate.

(*Shenango Sandstone* of Crawford and Mercer counties.)

No rock in the county, offers better opportunities than this, for correct identification by continuously connected tracing from point to point; and yet, with its almost numberless exposures and its well-defined constitutional peculiarities, it is not always easy to keep hold of it except over certain areas. Especially is this true where it is overlaid by other rocks, as in the south-eastern portion of the county, and beyond the county limits to the south and east.

Heretofore we have been accustomed to assign a thickness of from 30′ to 60′ to the Shenango shales* lying between the Olean and sub-Olean conglomerates, and have felt so much confidence in the parallelism of the two strata, that the sure identification of either one of them in any locality was all that seemed necessary to fix the positions of both in the geological section. But my recent experience has led me to be more cautious in the use of this formula. These rocks may vary in relative position as well as others. There are localities where the sub-Olean seems to have been eroded

*Accepting the nomenclature adopted by Prof. White in the counties of Crawford and Erie.

and replaced by the Olean—both now lying side by side in the same horizon; others where the sub-Olean appears to be wanting; others where the interval between the two has thickened from the usual average of 45′ to about 200′.

If we view the sub-Olean as of Pocono age, (No. X,) and the Shenango shale as the representative of the Mauch Chunk red shale, (No. XI,) the thickening of the shaly mass towards the south-east does not seem surprising; in fact, it is just what might be expected. That the No. XI period must have been one of very great duration cannot be doubted. The immense deposits of red shale laid down in the anthracite region during its continuance, is sufficient proof of that fact. The insignificance of cotemporaneous deposits in Warren county indicates that the conditions of deposition must have been very dissimilar in the two localities. Erosion may have been at work in one place during a part of the time, while continuous deposition was going on steadily in the other. But the great change which ended the No. XI period seems to have ushered in an era of more equal conditions over a largely extended area, and one of the most remarkable phenomena of this change, was the introduction of new materials in the shape of large, irregular, ovoidal pebbles and coarse-grained sands, now apparently for the first time brought down into the carboniferous basin.

In report I^3 attention was called to the shape and quality of the pebbles of the Panama conglomerate, as compared with those of the Olean conglomerate, the former being lens-shaped or flattish, the latter ovoidal or irregularly rounded.* At that time the full significance of the distinction was not understood. Having since made this a special subject for investigation and collected many specimens of loose pebbles and conglomerate masses of both kinds, I can now assert with a great deal of assurance, as regards this part of the State, that the Shenango shales enable us to draw a distinct line of demarkation between the two kinds of conglomerate. The flat pebble rocks, thinly bedded, current bedded, and weathering generally into thin

*For the sake of brevity, I generally employ the simple terms *flat* pebbles and *round* pebbles to distinguish the conglomerates.

small blocks or plates, always lie below the shales; the round pebble rocks, massive, compact, and breaking up into irregular cuboidal blocks sometimes 40′ thick and of still greater length and breadth, invariably lie above them.

No doubt the shape of a pebble depends in a great degree upon the kind of attrition to which it has been subjected, and the length of time it has been exposed to the action of abrading agencies. A fragment of rock propelled altogether by rolling would acquire a rounded form, but if driven backward and forward, as by waves lashing upon the sea shore, it must eventually become flattened. This is well exemplified by two collections of northern drift pebbles in my cabinet. One came from a gravel bank at Warren, where they have lain embedded and undisturbed since the glaciers dropped them, the other from the shore of Lake Erie, where they have been exposed to the play of the waves for ages. A common origin is proven by the sameness of materials composing the two collections, but the gravel bank pebbles are ovoidal and irregular, while these from the lake shore have become very much flattened and polished.

Taking this view of the subject, and it appears to be a reasonable one, we may suppose that the materials of the flat-pebble conglomerates have been long exposed to the trituration of waves, having been slowly brought down towards the center of the basin from older shore deposits lying to the north. At some point during the process of basin-filling this worked and re-worked old shore material must have become exhausted. This would happen when erosion and deposition—cutting down the northern shore and filling up the basin—had brought the central deposits and shore deposits nearly in plane, provided a submergence occurred at that time which allowed the waves to sweep northward over the old shore. Supposing this to have happened while No. X was merging into No. XI, the last half-wrought materials within reach are seized upon and re-worked into the sub-Olean conglomerate and its contemporaneous beds. As the progressive depression of sea bottom continues the waves reach over into new materials which are thus prepared to be brought down directly into the carboniferous basin, when the next elevation of sea bottom occurs, without allowing time for the pebbles to become flattened by long trituration.

But whether the causes which contributed to produce flat pebbles at one period and round pebbles at another can be satisfactorily explained in this way or not, it is indisputable that the pebbles of the Olean conglomerate do differ in a very remarkable manner from the pebbles of the sub-Olean and of all of the other underlying conglomerates. A knowledge of this fact and a proper appreciation of its importance aids one materially in studying the stratigraphy of this part of the State. How far it may hold good in other geographical sections I do not know. In Ohio, Illinois, Kentucky, and Tennessee the carboniferous conglomerate always contains round pebbles as far as I have observed, but it has never been my good fortune to meet with any of the lower conglomerates there.

It must not be supposed from what has been said above, that the sub-Olean is always a conglomeritic rock. In its range across Warren county it exhibits great variability in constitution and structure. At Tidioute it is a yellow ferruginous sandstone, free from pebbles and identical in appearance with Prof. White's Shenango sandstone in some parts of Mercer and Crawford counties. In the northern part of Deerfield township it is much more shaly, but still characteristic. North of the Big Brokenstraw, in Conewango, Glade, and eastern Elk, it is often a mass of evenly assorted pebbles about the size of grains of wheat, and heavily charged with iron, which has segregated from the mass and collected in irregular seams, or formed concretionary iron-lined cavities filled with ochery clay. It weathers down in rough fragments a few cubic inches in bulk, and it forms steep-sided truncated hills, so peculiar and characteristic in outline that a practiced eye can trace the rock by them across the country.

Its exposures in Elk township show it to be quite a massive conglomerate. Pebbles more than an inch in diameter are frequently seen; but an uneven structure, caused by its irregular accretions of iron and incoherent sandy matrix, facilitates a crumbling erosion which seldom leaves a cliff exposed to view. Near the north-west corner of the township however, and also about half a mile over the State line into New York, two or three good rock cities may be found. Here the body of the rock is less charged with iron, and the disintegrated débris is screened and used for mortar making.

Wherever the rock appears along the Allegheny river east of Warren it is a massive stratum 30′ to 40′ thick, current bedded, pebbly and heavily seamed with iron, particularly toward its base. The escarpments show perpendicular faces, and ponderous blocks fall away and slip down the declivities after the fashion of the Olean conglomerate, for which it has often been mistaken by those who make no distinction on account of shape of pebbles and general structure. Throughout all the eastern and south-eastern portions of the county this type of the rock continues; but the interval between it and the Olean thickens materially and becomes more sandy.

One other peculiarity in relation to the character and geographical range of this rock remains to be mentioned. Throughout all the western and south-western portions of the county wherever the sub-Olean appears it is a medium grained iron-stained sandstone, without a pebble in its composition; and this is its character, so far as we know, through southern Crawford, Venango and Mercer counties into Ohio. But in the south-east corner of Erie county, north-west of this area of no pebbles, the rock appears in several exposures in its massive conglomeritic form, from 25′ to 40′ thick, and can be traced in a narrow belt toward the south-west for about 10 miles. As this happens along its northern outcrop it is probably only a remnant of a much larger area of the same kind once lying in that direction but now lost by erosion.

North-west of the Allegheny river the Shenango shales maintain quite an uniform thickness of about 50′, with two or three exceptions*, but south-east of the river they thicken quite rapidly, for at Sheffield they measure about 100′ and near Brookston 120′ or more.

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*See Elk, Glade and Freehold townships.

I have seen flat-pebble rocks similar in appearance to the sub-Olean in several places near Kane, McKean county—six miles south of Kane, in Highland township, Elk county—in the hills around the Wilcox wells and also around the village of Wilcox—at Ridgway and along the Clarion river at the mouths of Spring creek and Millstone creek, where the Oléan conglomerate is in nearly every case exposed near by, and where there can be little doubt of the identity of either rock. In all these places they are separated by from 100′ to 150′ of shales, or rather yellowish grey thin-bedded shaly sandstones, more sandy and less irony than the measures occupying the same interval in central and northern Warren.

In attempting to trace the sub-Olean east and north-east from Warren county, to ascertain its relation to the Tuna conglomerate (on the high point between the Tuna and Allegheny, 3 miles S. E. of Carrollton, N. Y.,) and the Salamanca conglomerate, I became involved in a number of unlooked for complications which make further examinations necessary before final conclusions can be drawn.*

The importance of the sub-Olean as a key-rock or guide to assist in making comparisons of structure, and correct identifications of the sandrocks below it, is not properly appreciated by the well-sinker.

The Ferriferous Limestone was known to be a good guide and it was watched for by every Butler county driller, who when he found it, knew just about how much deeper the drill would have to go to strike the oil sand.

The sub-Olean in Warren county is a key rock as persistent and reliable and as easily recognized as the Ferriferous Limestone in Butler and Clarion counties.

Yet the driller pays no attention to it and will not trouble to note it in his record. When he goes forward ahead of developments he relies solely upon surface elevations and assumed dips, and consequently sometimes makes very important mistakes in attempting to identify the rocks in one well with those in another. Could he be brought to realize the fact that the dips are liable to change in rate

*See Salamanca conglomerate, chapter VIII.

and direction at almost any point, even in this but slightly disturbed portion of the State, and that these changes—affecting the upper rocks as well as the lower—can be detected more easily and with greater certainty in a well-defined conglomerate like the sub-Olean than in the variable and less persistent sandstones of the oil horizons, he would be careful to note the position of this significant rock in every well.

Chapter VII.

Panama Conglomerate.

After a careful reconsideration of the premises on which I based my conclusions, in relation to the non-equivalence of the Panama conglomerate with the Venango Third oil sand, as given in Report I[3], and a faithful but ineffectual effort during the season of 1881 to discover the connecting links in Warren county, where they ought to be found if they can be found anywhere, I am compelled to adhere to my former opinion, to wit: That a satisfactory or reasonable identification of the two rocks cannot be made, on account of the palpable evidences that great changes occur in the constitutions of both rocks as they approach the dividing interval of 15 or 20 miles, over which neither one of them can be surely traced.

Prof. White, in Q[4], seems to have no doubt whatever upon the subject, and I regret that even with all his proofs before me, I am unable to indorse his conclusions. His theory greatly simplifies the systemization of the geology of this region and an adoption of it would have saved me many days of toilsome examination and anxious study.

Allowing that Prof. White's identification of the Panama conglomerate is absolutely correct through the several wells he refers to, from Le Boeuf to Beaver Falls, we are even then as far from a connection with the Venango Third sand as before that identification was made. These wells are all miles away from the Venango oil belt, and they were all unproductive, barring slight shows of oil (which can be gotten almost anywhere in this country) and amount to nothing, except to lure the unexperienced to further losses. Not a single well found the Venango group in anything approximating its normal structure, and the proof of identity of sandrock in any one of them with its nearest producing neighbor (on unquestioned Venango or Butler sand) is not shown, nor can it be demonstrated by tracing a direct or probable connection between them, with any less difficulty at any of the points named, than between Tidioute and Panama, where the two rocks have their maximum development.

Palæontologically, we have absolutely no proof whatever of the identity of the rocks in question. No one has ever seen an undoubted outcrop of the Venango Third sand; and consequently no fossils could have been collected from it for comparison with Panama fossils. Possibly some imperfect shells may have been found in drilling; but I have never seen one from the Venango Third sand,* although they are quite plentiful in the Bradford oil rock. A shaft 8′×16′ was sunk to the oil rock at Tidioute in 1865–6, but I cannot learn that any fossils were seen in it. I have over a dozen pieces of conglomerate from it and among them probably the largest specimen of Third sand now preserved. It would make a cube about 8 inches on a side and weighs 34 lbs. The rock, in appearance, somewhat resembles the Panama conglomerate, but not a trace of fossils can be detected in it.

The nearest point to the producing regions (within about 10 miles) where the Venango Third sand could possibly come up to daylight, and where its ascertained rise toward the north ought to bring it up to view, unless it fades out or very materially changes its rate of ascent, is on the Allegheny river between Tidioute and Irvineton. But no one

* If the Third sand=Panama and contains but a small percentage of the fossils so plentifully found in its north-western outcrop we ought frequently to find fragments of shells after torpedoing.

has ever claimed to have found it there. At no other point (owing to the topography of the country) can even its assumed outcrop be found within *20 miles* of a producing Third sand well.

We must therefore do without palæontological evidence; for if palæontology proves anything it only proves the integrity of the Panama rock along its extension west and south-west, where alone all its examined and reported fossils have been obtained. That these are Chemung fossils, under the nomenclature of New York, no one ought ever to have doubted, for they unquestionably belong to the formation so named by Prof. Hall; and whatever questions may be raised as to age or equivalence with the Waverly of Ohio, the name Chemung belongs to them by right of priority.

The simple fact that the Panama rock in many places contains oil affords no proof of its identity with the Third sand any more than it does of its identity with the First or the Second, or with the Warren oil sand, or Bradford, or Allegheny, or half a dozen other simple oil-show horizons in the Chemung rocks. We can no more classify the rocks by oil than by water or gas. They may all be good collateral aids under certain circumstances and within certain geographical limits, but they hold good no further.

Having for several years realized the importance of a correct identification (if identification were possible) of the Venango oil sands with the Chemung sandstones outcropping in New York, I have at all times embraced every opportunity of securing facts bearing upon the subject. These, with my last season's work in Warren county, have only produced proofs of a negative character. I have been totally unable to trace a connection between the Panama rock and Venango third sand, even in their geological horizons; allowing that a deposit of sand had fined down, disappeared, and then come in again in its proper place; or that a thick wide-spread sand sheet covering both ranges had been eroded and modified throughout its central area by the effects of fluviatile or sub-oceanic currents.

The great difficulty in keeping hold of the Panama rock is, that it so soon fines down and disappears when traced as far as it can be traced on the surface in a *southerly* direction.

The Third oil sand in like manner (as proven by the drill) fines away and disappears when followed *northward*, leaving an interval of from 15 to 20 miles across which neither the Panama nor the Venango Third can be carried, except by a calculation of dips and a comparison of intervals in the vertical section where we have some well-established horizon to work from. But this method with these strata is very unsatisfactory, for there are no limestones in Warren county as guides, and no persistent and well-defined sandstones in the upper measures, that continue far enough north to overlap the Panama rock.

The most reliable key rocks in Warren county, are the Olean and sub-Olean conglomerates. One or both of these can be traced over more than half the county. It seems almost certain, however, that they have been deposited on uneven floors and further thrown out of plane by slight corrugations of the earth crust since their deposition. These conspicuous irregularities make it a hazardous undertaking to attempt to fix the position of either one of them over hills to the north of their outcrops by a prolongation of ascertained dips, for it is evident that they are liable to change pitch slightly at almost any point and in any direction. The same uncertainties also attend a calculation of dips if applied to the lower sandstones. We can do no better, however, than to pursue this method sometimes, for the purposes of approximation or illustration, for it is the only thing under the circumstances that can be done.

The standard vertical section which Prof. White uses for comparison, and which agrees substantially with Venango county oil well sections, calls for an interval of about 750′ between the base of Olean conglomerate and the top of Third oil sand. Let us measure some of our ascertained facts by this scale.

The Rock city at Panama is a massive conglomeritic stratum 69′ thick. Top 1671′ A. T.

At Eureka well, three miles south, the rock is thinner, more flaggy, and contains fewer pebbles. Top 1569′. Dip to this point 32′ per mile.

About one mile south of Eureka well, and still in New York, it is occasionally quarried in the hillside west of the Little Brokenstraw. Here it is a close, hard, bluish-gray sandstone in courses from 4″ to 12″ thick, with some pebbles in the top layers and many of the usual Panama fossils. Not more than four or five feet of the rock can be seen, and the topography indicates a thin stratum at best. Top 1545′.

A mile and a quarter south-easterly from this quarry and perhaps a quarter of a mile south of the State line, another exposure occurs near the residence of W. H. Price, in Freehold township. Top 1510′.—— Here, only the pebbly portion is seen, and its actual thickness could not be ascertained. The dip from Eureka well to this point does not seem to be so great as that from Panama to Eureka, but the last two elevations are by aneroid, and the direction of this dip is more toward the east.

Continuing on about two miles and a half towards the south, we reach Lottsville Well, No. 1. In my recent examinations there I found in the creek bed, about 10′ below the well mouth, at 1440′ A. T. a thin band of irregularly bedded sandstone, greenish-yellow in color, coarse-grained in spots and sometimes attaining a thickness of one foot. It is associated with bluish-gray shales and flags, full of fucoidal impressions and permeated with an odor of petroleum. There are also some very thin bands of conglomerate to be seen above the level of the well mouth.

Here, then, seems to be a representative of the Panama rock. It cannot be very thick or hard to drill into, for the oil well commences on shales ten feet above it, and if any hard rock had been struck at this point before they were able to swing the tools from the walking-beam the drillers certainly would have noticed it. A dip of from 25′ to 28′ per mile would be required to bring the rock down from where we last saw it to this point.

We have now traced the rock as far south as it can be followed on the surface; for here it goes under, even along the deep cut valley of Little Brokenstraw creek. From Panama toward Lottsville (however imperfect our observations may have been) it is evident that the rock gradually decreases in thickness and radically changes in lithology and structure. We are still a mile and a half from the nearest outlier of Olean conglomerate (Miller's cliff) and must now go forward relying solely on rate of dip. Take 27′ to the mile (which is more than the direction seems to call for) and we have 1440′-40′=1400′ A. T., as the probable horizon of the Panama rock, when sought beneath Miller's cliff, about half way between Lottsville and Wrightsville, where the base of the Olean lies at 1840′ A. T. Hence 1840′—1400′=440′ is the interval between the two rocks. This is 310′ less than the normal test section calls for, and puts the Panama rock nearer to the horizon of the *First* oil sand than the *Third.*

Measured upon the map, Miller's cliff is about 9 miles from Panama and 18 miles from Tidioute, and the three points lie nearly in a line running S. S. E. by S. From Panama to Miller's the dip would be 1671′—1400′=271′÷9=30′+ per mile, which seems to be all that is reasonably warranted by the facts observed. To carry the Panama down 750′ below the Olean would place its top at (1840′—750′=)1090′ A. T., requiring a dip from Panama of nearly 65′ per mile, and from the State line exposure 100′+ per mile. Now follow it on this plane to Tidioute where the top of Third oil sand is 1008′ A. T. Thus, 1090′—1008=82′, which represents the fall through 18 miles—an average of less than 5′ to the mile.

I should be glad now to trace the Third oil sand from Tidioute northward toward Lottsville, but I have no data to work with. As before stated, there are no surface exposures and the oil wells furnish no facts, except a failure to find oil and the assurance of the driller that the Third sand thins out rapidly and becomes unrecognizable at from one to five miles from the oil belt. Over a space of 13 miles then, there seems to be no positive guide at this horizon. Fine-grained bluish-grey sands have sometimes been reported in wells that have been sunk there, but they are too thin, irregular and unreliable to be traced and classified as continuous strata.

Going west from Panama, we may now examine another test line, running from an undisputed outcrop of Panama rock to unquestioned sub-Olean.

At Upton's quarry, on Dutch Hill, about 2 miles N. N. E. from Clymer, N. Y., 3¼ miles north of the State line and 9 miles N. N. E. from Corry, occurs the best exposure of the Panama rock to be found west of the town of Panama. The distance from Panama is about 6¼ miles in a direction W. S. W. Elevation of top of rock (by aneroid) 1580′.

This is a very interesting exposure on account of the peculiar structure of the rock. The stream flowing over it cuts down in a series of little cascades through some 20 feet of massive fine-grained sandstone—bluish-grey, grey, and yellowish—lying in irregularly bedded courses from six inches to four feet thick. Wave marks, mud cracks, worm burrows, and fucoidal casts abound; but in my hasty examination I did not discover any of the fossil mollusks usually so abundant in the Panama rocks. All the layers seem to have been deposited on uneven floors sloping toward the north-west. The stream flows down the slope of the bedding until it has cut nearly to the bottom of the ledge, when it makes an abrupt turn to the left and exposes in the outer curve of the elbow an irony conglomerate mass of loosely cemented pebbles 10 feet or more in thickness, and lying in the same plane with the upper part of the sandstone over which the stream descends within sight of the bend. There are no pebbles in the sandrock forming the sloping stream bed, but the conglomerate in the elbow bank is scarcely anything but a bed of pebbles. The sandrock must have been first deposited with a bedding sloping toward the northwest, and then the pebbles were laid down in a wedge shape overlapping it. The stream has cut down along the division plane, thus exposing sandrock on the one hand and conglomerate on the other.

It is about 3 miles from the above described quarry to Beardsley's quarry, which lies a quarter of a mile west of Big Brokenstraw creek, and the same distance north of the

State line. Elevation 1500′ A. T. Hence the rock dips in that direction (S. by W.) 80′ in 3 miles, or 27′—per mile. No more southerly exposure can occur, as the stratum soon runs below water level in that direction.

The Downer well, at Corry,* (about 5¾ miles from Beardsley's,) commenced at an elevation of 1430′ A. T. "First sand, 8′ thick," was reported at 105′ from the surface, or 1325′ A. T. This evidently must be the Panama rock, if that rock be represented at all in the well; for the next sandstone is 137′ deeper, which would be altogether too low. We have, then, a dip from Upton's to Corry, as follows: 1580′—1325′=255′, which divided by 9 miles gives 27′+per mile.

From the Downer well at Corry we now continue on east by south about 3 miles to Walden's, where the sub-Olean is in place on the hilltop. Allowing 27′ per mile for dip, (81′,) and taking the rock 1325′ in the Downer well as base, the Panama rock at Walden's should be looked for at about 1244′. Here the base of the sub-Olean lies 1820′, and the base of the Olean should be 75′ higher or 1895′. Hence (1895′—1244′=)651′ represents the vertical distance down from the Olean conglomerate to the horizon of the Panama. This is 99′ less than the standard section of comparison calls for, but it approaches much nearer to it than the tracing brought down from Panama to Miller's cliff, by which it appeared that this same interval was only 440′ at the latter place.

There is enough in these plain and direct presentations of the situation to show that the Third oil sand cannot be identified with the Panama conglomerate by any reasonable interpretation of the theory of parallelism of strata, if tested by the vertical section which holds good over so large a portion of the Venango oil field; and we need not confine ourselves to one horizon for illustrations to confirm this. The same difficulties are met with in every attempt to connect the Pithole grit or the First and Second oil sand with any of the outcropping Chemung rocks in New York. A consideration of these facts should warn the investigator to work cautiously, and suggest to him the possibility of there

*See Freehold township.

being a plane of nonconformability in this latitude, over large areas of which parallelism of strata must be laid aside as a working theory.

Chapter VIII.

Salamanca Conglomerate.

(Pope's Hollow Conglomerate.)
(Wrightsville Conglomerate.)

The *Salamanca conglomerate* has frequently been mentioned in our geological reports, but it has not yet been positively identified with any one of the known sandstone horizons of Pennsylvania. Until quite recently, I have been inclined to view it as the probable equivalent of the Pope's Hollow conglomerate, which appears to be the first massive pebbly rock, coming in about 240′ below the sub-Olean, (see Pine Grove township;) but owing to an unsuccessful effort in 1881 to prove this identity, I am now inclined to think otherwise. Some of the facts in the case are these:

On the ridge between Little valley and Great valley, the rock can be traced without any uncertainty from the noted Salamanca or Ellicottville rock city, where its top lies at an altitude of 2190′ A. T., to the point where it is eroded from the hill just north of Salamanca. It is seen again in the hill south of Salamanca; and again on the point just north of Carrollton, where its elevation is 1975′ A. T. We thus find that it has dipped 215′ in going about 7 miles in a south-south-easterly direction, an average of over 30′ to the mile. All the intermediate exposures agree well with this rate of dip.

Continuing on, now, in nearly the same direction for about three miles, the point between Tunangwant creek and the Allegheny river is reached; and here, if the observed rate of dip continues, the Salamanca rock ought to be found at about 1975—90=1885′ A. T. I have not yet been able to discover it there, but the top of the point is capped with a similar flat pebble sandstone 25′ or more in thickness; top, 2120′ A. T. Either then his must be a higher stratum or else there must be a quite sharp anticlinal here, which is not at all probable.

When I first discovered this "Tuna"* conglomerate, about three years since, I thought it probably represented the sub-Olean, but in this I was also mistaken, for I now find that it dips strongly toward the south, and some of the hills on the east side of Tuna valley take in over 250′ of grey and red shales and shaly sandstones above it without catching the Olean conglomerate.

At Ireland, on the west side of the Tuna, 3 miles south-west of the last named exposure on the point, Irish run cuts through a similar conglomerate (top, 2000′ A. T.) where it forms a well-exposed horse-shoe curve across and on each side of a bowl-shaped valley. Below the outcrop the valley is covered with broken blocks, above it not one is to be seen up to the summit divide, 2200′ A. T.; a fair proof that no similar rock lies in the upper interval. This summit is one of those narrow ridges across which the ice-flow passed from the head of one stream into the head of another, forming steep-sided bowl-shaped basins on each side; and it is evidently composed of friable sandy shales and some red rocks which weather into a smooth surface and make a productive soil easy to cultivate. Just on the northern margin of this summit-notch lie a few very large blocks of Olean conglomerate, probably the most northerly outliers of this rock west of the Tuna; base, 2270′ A. T. As the distance between the escarpment in the run and the summit blocks is not over half a mile, we here get the vertical distance between the two rocks very approximately, say 275′.

I was surprised to find no evidences of the presence of the sub-Olean in this vicinity where numerous hilltops of proper elevation ought to show it if it comes in anywhere from 30′ to 70′ below the Olean.

Proceeding toward Bradford more complications arise.

Just south of the State line Buchanan hill rises to 2200′

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* Tuna is now the popular name for the original Tunangwant.

and is capped with a characteristic flat-pebble sandstone which weathers into thin plates, so that the faces of the escarpments do not stand in vertical cliffs, but cover themselves with a sloping shingle-like talus. About 300′ below the summit another exposure of pebbly rock is seen making a well-marked terrace and sending forth a number of springs. This is at the proper level to represent the Tuna rock if no change of dip has occurred.

Now we cross the Tuna to Mount Raub, south of Tarport and Bradford, and there find the same rock seen on Buchanan hill skirting the east side of the summit and the Olean conglomerate skirting the west, both lying side by side and at the same level, 2170′. At 1912′ a 20′ sandrock was reported in the Mount Raub well, lying between two red rocks.

Thus it seems almost certain that the Salamanca rock underlies the Tuna rock at the river hill by at least 225′. The Tuna underlies the Olean by about 275′ on Ireland summit, where the sub-Olean seems to be wanting; and it also lies about the same distance below the sub-Olean on Buchanan hill; which makes it probable that the sub-Olean had been eroded at Ireland summit before the Olean was deposited; as it evidently must have been on the west side of Mount Raub to allow the two rocks to be deposited in the same horizon.

What all this may mean I cannot venture to say; for, not anticipating any complications of the kind, I had so planned my autumn work that I could spend but three or four days in this region, and consequently for want of time was not able to follow the investigation to satisfactory conclusions.*

*Similar experiences befel me in Warren county during my last season's work. In every attempt to carry a uniform section across it from south to north so many checks were met with that I finally gave up the task as a hopeless one. I frequently studied up the situation at night and fixed upon some point to be specially examined next day, where it seemed almost certain that the connecting links in the structure could be found, but it often happened on arriving upon the ground that quite a different structure from what was anticipated presented itself. Sometimes no trace of the particular sandrock sought for could be found in *proper place*, and instead of it other massive pebbly strata would obtrude themselves, 100′ too high or 100′ too low to fit into the places where, according to our theories of persistent parallelism of strata, they ought to belong.

The most southwesterly exposure of Salamanca conglomerate that I have yet found lies on the summit west of Big Red House creek in or near the north-east corner of warrant No. 24, Salamanca township, Cattaraugus county, N. Y. Elevation of top 1950′ A. T. As this is about 18 miles in a direct line east north east from Pope's Hollow, and as I know nothing of the intermediate country, I shall not attempt in this report to identify these rocks in that direction.

Near Corydon in the north-east corner of Warren county I scaled a number of summits where the Pope's Hollow rock ought to appear, if it runs in a plane parallel with the sub-Olean, but did not succeed in finding it in place. This however is merely negative evidence which cannot be taken as conclusive, as I have frequently been taught to realize while traveling over this ice-smoothed, drift-covered, densely-wooded country, where sometimes the only outcrop of a rock to be found for miles is in such a situation that one might go within ten rods of it and not see it.

Tracing Pope's Hollow conglomerate into Warren county, the nearest exposure I have found lies on the farm of Mr. McCoy on the east side of the Conewango, about 2½ miles north-east of Russellburg, Pine Grove township. This is 6 miles south south-west from Pope's Hollow, and the elevation of top is 1800′, which gives a dip of 23′+ per mile from Pope's Hollow. The rock here juts out of the face of the hill and throws off large blocks into the valley. It is 25′ thick, massive, more or less pebbly all through, current-bedded and seamed and discolored by iron. Numerous exposures of it occur in the eastern part of Pine Grove and it can be satisfactorily traced to the Brigg's oil well No. 2 near the south line of the township, where it lies at 1705′,—a fall of 95′ in 3½ miles = 27′+per mile.

In Farmington and Sugar Grove townships three or four partial outcrops of sandstone were seen that seem to be properly referable to this horizon. Near Wrightsville, Freehold township, several fine escarpments occur of a rock very similar in appearance, which I have elsewhere called the Wrightsville conglomerate, and which, judging from its relations to the sub-Olean, is the same as the rock at McCoy's. Its elevation near the village is 1600′ A. T., which shows a fall of 12′ per mile from McCoy's in a direction west by south.

On the north side of Follet run in Conewango township, two miles north-west of Warren a quarry has been opened to furnish building stone for the Western Insane Asylum at North Warren. Its top is 1585′ A. T. or 120′ below the rock at Brigg's well, referred to above. The distance between the two exposures is 4½ miles; direction south south-west; average fall per mile 27′. Having found no outcrop of the rock between these two points we have nothing but the dip to guide us, and inasmuch as the oil wells along the Conewango valley show a rapid rise of strata up to North Warren, with a very slight rise above that point for some distance, it is fair to presume that very little stress can be laid upon dip calculations alone as a means of identifying the rocks in question, when any line of connection crosses this confused interval. I therefore merely give the figures without claiming to have satisfactorily identified the Pope's Hollow rock with Asylum quarry, and leave the matter here for the present to be further referred to in the township reports, in connection with the sandstones coming up from the south-west.

We will now examine the vertical section, and endeavor to ascertain how far below the sub-Olean conglomerate this Pope's Hollow or Wrightsville rock lies.

About one mile east of a direct line drawn from McCoy's to Pope's Hollow a fine cliff of sub-Olean is exposed—base 2100′ A. T. This is north of the State line and about equidistant from the two points named. It may be presumed then that the McCoy rock would rise about 70′ between its exposure on the point and its place beneath the sub-Olean cliff, which would put its top at 1870′ A. T., and make the vertical interval from the base of the sub-Olean down to the top of the McCoy rock, 230′.

The probable place of sub Olean over the Brigg's well south-east of Russellburg can only be approximately calculated, for its nearest outcrop is several miles away. Its base however cannot be far from 1950′ A. T., which makes the interval 1950′—1705′=245′.

The Asylum quarry lies about midway between two exposures of sub-Olean, the base of one being 1850′, and of the other 1860′. Using the mean we find the vertical interval between top of quarry (1585′) and base of sub-Olean (1855′) to be 270′.

The base of *Olean* conglomerate at Miller's cliff in Freehold township is 1840′. Beneath it lies the Wrightsville conglomerate; top 1620′; interval only 220′.

At the village of Wrightsville, the conglomerate is 1600′ and the base of sub-Olean as near as can be calculated from the surrounding exposures should be about 1840′.

Here we have an interval of 240′ between the *sub-Olean* and Wrightsville conglomerates; while at Miller's cliff, less than two miles north-west, the vertical section measures only 220′ up to the base of the *Olean* conglomerate; an intimation, as I have remarked in another place,* that the sub-Olean had been eroded before the Miller's-cliff-Olean was deposited.

From the above it will be seen that if we base our conclusions simply upon parallelism of strata, the Pope's Hollow-Wrightsville conglomerate appears to represent the Tuna conglomerate and not the Salamanca.

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* See Freehold township.

Chapter IX.

*Warren Oil Field.**

The rocks drilled through in the Warren, Glade, and North Warren districts contrast strikingly with those found at a higher geological horizon along the Venango oil belt, no pronounced conglomerates or well-defined coarse-grained sandstones being here interstratified with the softer measures. This area of deposition appears to have been one where no great or paroxysmal changes occurred to cause conspicuous variations in the character of the sediments deposited, but the conditions were such that slight intermittent alterations in the direction or intensity of the currents—here freighted only with fine sand and mud—decided the quality of local deposits.

In one place sand was dropped for a limited period, forming elongated beds trending in the direction of the currents and skirted at their edges by sandy shale. In another, at the same time, mud rocks were being deposited. Then by a swinging of the current hither or thither—and perhaps by a change also in its direction—a new sand bed was laid over the mud and a new shale bed over the sand, building up a mass of sediments homogenous in its general features, but extremely variable and difficult to study in detail.

It is not surprising, then, that drillers accustomed only to the well-pronounced stratification of the Venango group should here be at fault in their classification of the oil sands. The distinction in many places between the so-called

* This chapter was prepared for publication in Report I[3] before it had been decided to make a special report upon Warren county. Since then the oil developments in Warren county have occurred principally in the south-eastern districts, new work being almost entirely abandoned near Warren.

sandstones and the sandy shales is so slight that no two drillers would be likely to agree as to the precise distinction between sand and shale. Hence we may get in one well-record 100 feet or more of sandstone; in another at the same horizon two or three thin bands of sandstone with shales between; and in still another perhaps no sand at all—the recorded divisions depending entirely upon the driller's opinion as to what is sandstone and what is shale.

To add still further to the complications surrounding an intelligent development of the district, the oil horizons are as variable as the details of stratification, ranging through the vertical column from 350′ to 900′ below river level, and appearing irregularly in wells but a few rods apart, sometimes in sandstone and sometimes in shale. As a consequence of all this, well-records were very imperfectly kept, for it was soon found that they were of little practical worth in determining the depth at which oil might be looked for.

It will be seen, then, that with an obscure structure, uncertain oil horizons, and imperfect well records, the task of explaining and illustrating the stratigraphy of the district is by no means an easy one. The collection of facts is still insufficient for a proper study of the subject, and we must be content with a simple presentation of them in their most reasonable relationships, making only such deductions as seem warranted by the circumstances, and some of these no doubt will need modification hereafter.

During the summer of 1877 Messrs. H. Martyn Chance and Arthur Hale spent several weeks in Warren and its vicinity in leveling between well mouths, making sections of the most prominent outcrops of comglomerates and sandstones, examining the Quaker Hill and Big Bend coal beds, &c. The face of the country is so drift-covered, that but few surface sections could be obtained, and of all the wells leveled to they did not succeed in getting one *complete* register. Fragmentary memoranda of depth to so-called second or third sand, points where oil came, and depths of wells, were all that could be obtained.

Later in the season Mr. F. A. Randall, of the town of Warren, was engaged to make a short special report on the surface rocks and fossils of that locality, which for several years he had been studying solely to gratify a natural taste for geology and palæontology.* In his daily intercourse with well owners in the district he had also secured many facts relating to oil wells which otherwise could not have been obtained. He has furnished about 40 well records; and although none of them are as complete and reliable as could be desired, no better were obtainable, and they are sufficient, when properly grouped and studied, to pretty clearly indicate the general geological structure of the measures drilled through.

With these insufficient and fragmentary data I shall endeavor to trace the horizon of the so-called Third sand of Warren from place to place, working out carefully from a central point at Glade, or East Warren.

Beatty well No. 1, located in Glade, on the east side of Conewango creek, opposite the borough of Warren, and completed early in 1875, may be considered the pioneer well in the Warren field. It is true that an experimental well had been sunk within the borough limits more than ten years before, but having proved a failure, probably on account of the crude manner in which such ventures were managed in those times, its history had been forgotten and this territory was virtually untested when Mr. Beatty swung the drill at his well.

The oil sand was struck in Beatty well No. 1 at 615′ from the surface and oil came into the hole a few feet deeper. Elevation of well mouth 1217′ above ocean or tide level. Top of oil sand, therefore, 1217′—615′=602′ A. T. As this elevation above tide is confirmed by the records of other wells in this vicinity, we may accept it as the proper altitude here for the top of Warren Third sand, which here first received its name.

On plate No. 1 will be seen 4 sections arranged side by side, for the purpose of tracing the Third sand from Warren to Stoneham.

*After a full report upon the county was ordered, it seemed unnecessary to cover a part of the ground by a local report, and Mr. Randall requested that the materials furnished by him might be incorporated in a general way through my report, which has been done accordingly.

Fig. 1. Beatty well No. 1, East Warren, ... (No. 1655*)
" 2. Smith Bros. well No. 1, Glade Run, ... (" 1675)
" 3. Cobham well, near Hertzell's ferry, ... (" 1679)
" 4. Tolles well, No. 1, near Stoneham, ... (" 1722)

To enlarge the horizons of comparisons I have added to the Beatty, Cobham and Stoneham wells surface sections of the rocks exposed in the hillsides but a short distance from the well mouths.

In a study of the well sections we find one of the most definite horizons of comparison to be a persistent band of *red rock* about 10′ thick, overlaid by a greenish and grey sandstone, both of which are plainly traceable in the river bluffs at Sill's run 3 miles south-west of Warren, Reese's Eddy, 1½ miles south-west of Warren, Tanner's Hill in the borough, and near Ott's station on the P. & E. R. R., 2 miles south east of town—and whose elevations and dips can thus be accurately ascertained. It would lie above the well mouths at Beatty, Smith and Cobham wells as indicated in the sections given. Thus we have one reliable horizon to start with.†

Lower down in the sections another *red band* is seen running quite regularly through them all.

Next we have the *Second sand* uniform in the first three sections, but wanting in the fourth. Then the *Third sand* in the first but wanting in the other three, in which a lower or *Fourth sandstone* appears to be the one that preserves its regularity.

This seems to be the most reasonable way of comparing the sections; for, if we bring the lower sands of sections Figs. 2, 3, and 4 up to the plane of the Third sand in Fig. 1, the harmony of structure is destroyed in all the other rocks above.

By the arrangement adopted we get *three horizons* agreeing, viz: two red bands and one sandstone.

Were Smith well and Tolles well oil-sands the equivalents

* The numbers in brackets refer to the records as published in appendix.

† The red rock given in Tolles well No. 1, appears to be thicker and to lie a little higher than should be expected, if it be the same red band referred to above. But this may be owing to the inaccuracy of the record, or another band of red may come in at that place; for, marked changes of strata (particularly of the red bands) occur in going toward the east and south.

of Beatty well oil sand, none of the other horizons would be uniform, and the dip from Beatty well to Smith well would be over 55′ to the mile, a rate which is not warranted by anything observable in the other strata.

The probabilities that these sections are properly arranged are further reinforced by the facts that the record of Lacy well (No. 1677,) quite near Smith well, gives 20′ of shale and then 15′ of sandstone *above* the 65′ rock called Third sand (by the drillers) in Smith well; which puts the top of the 15′ sand in Lacy well, up to the plane of Beatty Third sand; Dingley well No. 6 (No. 1720) gives 27′ of shale and 4′ of sand *above* the same stratum; Struther's well at Stoneham (No. 1723) gives 25′ of shale and 30′ of sandstone *above* the Tolles oil rock; and the Logan well also near by (No. 1724) gives an interval of only four feet between the Second and Third sands; showing that the interval in Tolles well between the so-called Second and Third sands is composed of sandy shale or sandstone and shale in irregularly alternating layers, and that the precise position of the sandstone given in any record may depend upon accidental conditions which locally affected the deposition of the sediments, or perhaps in a great measure in some cases, upon the driller's idea of what should be called shale and what sandstone—the distinction here not being very clearly marked by the character of the sand pumpings brought up.

Furthermore, the oil from Smith, Lacy, and Tolles wells is altogether different in color and gravity from the Beatty oil. The former is transparent, amber-color and of about 47° gravity—the latter, almost opaque, dark green, and about 40° gravity.. The contrast is greater in every respect than that of the black and green oils of the Venango district, and is certainly suggestive of separate and distinct horizons.

Plate No. 1 also shows three other sections with the Beatty section repeated, for the purpose of tracing the rocks in a south-westerly direction.

Fig. 5. Smith Bros. well No. 2, 1$\frac{4}{10}$ M. N. E. of Beatty, (No. 1676)
" 6. Beatty " No. 1, ... (No. 1655)
" 7. Phillhart & Co. well, 2$\frac{2}{10}$ M. S. W. of Beatty, . (No. 1680)
" 8. Dingley well No. 6, 3$\frac{3}{10}$ M. " " " . (No. 1720)

The Tanner's Hill red band, above referred to, runs quite regularly through these four sections.

The Second sand horizon is well sustained in Figs. 5, 6, and 7, and fairly traceable in Fig. 8.

The Third sand in Fig. 8 corresponds with the Third sand in Fig. 5, but not with Figs. 6 and 7.

Evidently the sandy horizons are variable and no one of them alone can be relied upon as a guide except over limited areas. In one locality the First sand may be readily traced for short distances—in another it is unrecognizable and the Second sand becomes the key rock—while in others the Third sand or the Fourth becomes the leading member.* Only by a study of the *whole well section* and by changing from one horizon of comparison to another as circumstances demand can the true relationship of the several sandrocks be ascertained.†

Between Warren and North Warren, a distance of about a mile and three quarters, many wells have been drilled, and the identity of the so-called Third sand of the two localities is fully assured.‡ It is unnecessary therefore to trace the rock through intermediate wells in that direction. The elevation of top of Third sand at North Warren is 679′ A. T. as seen in Hazeltine Well No. 1 (No. 1683) on an island in the Conewango, and in Hull and Hodges well (No. 1692) on the M. Lesler farm.

Smith Bros'. Well No. 2, on the Knoph farm, (Fig. 5,) is about a mile and three quarters south-east of Hazeltine No. 1, and a mile and a half north-east of Beatty No. 1. Its record was carefully kept and is reliable. It shows the Tanner's Hill red band before referred to, with its overlying sandstone, and gives First, Second, and Third sands agreeing substantially with Hazletine No. 1. In addition to

* In records 1670, 1680, 1683, 1687, and 1720 considerable regularity is shown in the interval between 1st and 2d sands, being form 90′ to 110′, and from 2d to 3d sands from 80′ to 90′.

† If well owners could be made to realize this fact and be induced to keep accurate records of the upper parts of wells drilled as tests in new territory, they would be greatly benefited thereby.

‡ At North Warren it is little more than a sandy shale by the testimony of the drillers.

this—being but a short distance from a point where both Mr. Chance and Mr. Randall have made sections of the surface rocks—these strata may be added to the section; then we have a very complete column from the sub-Olean conglomerate down to Warren Third sand, agreeing in all essential particulars with Beatty well and others which are arranged in the same manner. The elevation of top of Warren Third sand in Smith Bros'. Well No. 2 is 644′ A. T., and this may be accepted as the true altitude of the rock at this point.

From the above sections the approximate dip of Warren Third sand *horizon* appears to be as follows:

					Distance.	*Rate per mile.*
Beatty No. 1 (602′)	to	Hazeltine No. 1,	(679′)	rise 77	1.7	45+
"	"	Smith No. 2,	(644′)	" 42	1.4	30
"	"	Smith No. 1,	(550′)	fall 52	1.7	30+
"	"	Phillhart & Co.	(560′)	" 42	2.2	20—
"	"	Dingley No. 6,	(526′)	" 76	3.3	23
Smith No. 1 (550′)	"	Cobham,	(550′)	" 0	0.8	0
"	"	Tolles No. 2,	(485′?)	" 65?	3.2	20?

These are all the points that can be fixed with an assurance of accuracy. But it is desirable to have some others, and although at the risk of making wrong identifications, on account of the unreliability of data at command, we must endeavor to trace the Warren Third sand still further north, that an approximate idea at least may be had of its position in wells near the State line.

Proceeding upon the Conewango from North Warren the rocks of the oil horizon appear to change in character and become unproductive, no paying wells having yet been obtained beyond the northern limits of the North Warren district. In consequence of this the position of Warren Third sand in these northern wells is not readily determined, and many well owners have sought for it far below its proper horizon.

From Warren to North Warren the oil rock rises, as shown above, at the rate of 45′ to the mile and this rise; if continued to the State line, would bring the Warren Third sand up to within about 200′ of creek level at the State line.

But, judging by the manner in which the sub-Olean conglomerate spreads over this part of the county, it seems probable that North Warren is near the axis of a slight anticlinal wave, which increases the dip toward the south, and perhaps causes a descent of a few feet in the first mile toward the north, when the strata again take their normal rise of 25′ to 27′ per mile.

Brigg's well No. 1 at Russellburg 3¼ miles above North Warren, found the so-called Third sand at 724′ A. T. A rise of only 45′ in the whole distance, or about 14′ per mile. In No. 2 the Third sand was not so definitely marked*, but probably this elevation represents the horizon very closely.

The Second sand is given in No. 1 at 824′ A. T. It is about 5¼ miles from Brigg's wells to the State line near Fentonville where Weeks well (No. 1717) was drilled. A rise of 140′ or 26′+ per mile would carry the Second sand of Brigg's well No. 1 up to 964′ A. T., and make it agree with the sandstone at bottom of drive pipe in the Week's well, 276′ below the well mouth. As the surface rocks in this locality dip from 25′ to 27′ per mile toward the south, this seems to be a reasonable construction to put upon the records of these wells, and it shows that the Brigg's well Third sand is wanting at Fentonville, but that it should be looked for at about 860′ A. T., or 380′ below the surface.

In the above presentation of facts I have endeavored to show the structural characteristics of the Warren oil rocks, and to ascertain the position of the strata with reference to ocean level. We may now inquire, what relation do these rocks bear to those of the Venango group.

There can be no question but that the Venango sands are of more recent age and overlie the Warren sands; but the vertical distance between the two groups cannot be exactly

* These two records furnish an illustration of how impossible it is in measures like these, where there is so little distinction between sandstone and sandy shale, for different drillers to make corresponding records. No doubt the stratification in the two wells is very similar. But in one record the driller has separated the sandstones from the shales, while in the other both are thrown together as "shelly" and "muddy" sandstones.

stated, neither can it be positively asserted that they are deposited in perfectly parallel planes.

It has generally been supposed that the upper members of the Venango group are traceable in the river bluffs about Warren; but while these hills are full of sandstone, the fact that massive strata may sometimes be found lying apparently in the proper horizons to represent the Venango First or Second oil sands seems to be the only ground for such a supposition, and the ground cannot be considered sufficient.

The fact is, between Warren (where the Warren group is found) and Tidioute (where the Venango group is in force) a marked change in structure occurs, as is clearly shown by all the wells drilled in that region; for neither does the Venango group in its integrity pass over to the north-east, nor do the characteristic strata of the Warren oil measures pass across to the south-west.

WARREN COUNTY.

PART II.

Detailed Geology by Townships.

Topographically and geologically the several townships seem to naturally group themselves as follows:

Northern Division.

1. Columbus.
2. Freehold.
3. Sugar Grove.
4. Farmington.
5. Pine Grove.

Brokenstraw Division.

6. Spring Creek.
7. Pittsfield.
8. Brokenstraw.

Southwestern Division.

9. Eldred.
10. South-West.
11. Deerfield.
12. Triumph.

Conewango and Allegheny Division.

13. Conewango.
14. Glade.
15. Elk.

Southeastern and Eastern Division.

16. Limestone.
17. Watson.
18. Pleasant.
19. Mead.
20. Kinzua.
21. Corydon.
22. Cherry Grove.
23. Sheffield.

Northern Division of Townships.

1, Columbus; 2, Freehold; 3, Sugar Grove; 4, Farmington; 5, Pine Grove.

These five townships, having the New York-Pennsylvania State line (42° north latitude) for their northern boundary, embrace some of the best agricultural lands to be found in the county. But few of the loftiest hills rise high enough to catch the coarse sandstones of either the carboniferous or sub-carboniferous formations. Hence, the soils are largely derived from shales and thin bedded shaly sandstones of Chemung age, except in the broad plain-like valleys, where a considerable admixture of other material was brought in from the north during the glacial period. They cannot be called strong and enduring lands, for they have always been deficient in lime; still with judicious management, in the cultivation of any of the ordinary products of this latitude, the farmer receives excellent returns for the labor bestowed upon them.

The soils may be classed under two heads—highland soil, derived mainly from the disintegration of local rocks upon or near which it lies—and the alluvion of creek-bottoms. The former varies somewhat, according to elevation and the nature of the particular stratum from which it has been chiefly derived; the latter is generally good productive land, but varies as the quality of drift left upon the surface varies. Sometimes it is too clayey or swampy to be cultivated without considerable labor and risk, sometimes too gravelly to insure profitable returns. It is often spotted, so that, to obtain the best results, one part of a field requires different treatment and different manures and crops from another part.

This region is emphatically a grass-growing country, possessing all the general characteristics of the great belt of grazing and stock-raising land belonging to this geological horizon, and stretching across Crawford, Erie, and Warren counties from Ohio to New York. It is also well adapted to fruit-growing, but this industry, in many sections, has not received the attention it deserves.

Timber.—Owing to the early settlement of this part of the county, its ready avenues for marketing lumber and the availability of the surface for tillage, no *large* bodies of valuable timber now remain in these townships. Of course there are yet plenty of woods for all home purposes—oak, maple, beech, &c.,—with some chestnut on the ridges, but the pine groves are gone and the hemlocks are fast disappearing.

Bowlders.—Large bowlders of northern rocks are not so plentifully scattered over these townships as in many other places further north and west, still they appear in sufficient numbers to prove that all this region was within the range of bowlder-transporting agencies. They are not distributed evenly, however, being more noticeable upon the ridges and in the short steep valleys running southerly from them, than upon the creek flats and gently sloping foot hills.

Quarries.—These townships contain no regularly worked stone quarries, and in some sections a really good building material is rather a scarce article. There need be no lack, however, of desirable stone and convenient ledges to work upon, if they were properly sought after, except, perhaps, in some parts of Columbus and Farmington. Wrightsville is surrounded by outcrops of an excellent sandstone, which dresses nicely, and the same, or a similar stratum, stretches all across the southerly parts of Sugar Grove, Farmington, and Pine Grove townships. The village of Sugar Grove also has a very good material, but in a lower geological horizon, on Mrs. Faichney's farm, within two or three miles from town, if a quarry were opened there in a systematic manner.

Hitherto, loose blocks upon the surface and chance exposures of thin sandstones in the stream beds, have supplied the demands of the county, and there has been no inducement for quarrying, even on a moderate scale.

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1. Columbus township. Organized in 1825.

All the surplus rainfall in Columbus township finds its way through numerous tributaries into Big Brokenstraw creek, and in that one channel leaves the township near the center of its southern line, hence, the stream at this place (elevation 1375′± A. T.) must be the lowest point in it. The highest observed summit is a prominent hill (which we will call Walton's Knob) in tract No. 59, and less than two miles north-east of the aforesaid lowest point—elevation 1850′ A. T. As the general rise of the valleys toward the north is probably as great as the rise of bed rock in that direction, we may say that all of the strata exposed in the township lie within the geological horizon of 475′ embraced between these two elevations.

To what part of our geological column do these exposed measures belong? Walton's Knob seems a little too low to catch the sub-Olean, but the general appearance of the summit—among other things the intermixture of flat pebbles with the small foreign bowlders and drift found on the highest part—led me while examining it to conclude that the conglomerate had barely been removed. I have therefore colored the hilltop as sub-Olean on the county map to give it prominence and emphasize the topography.

The nearest well-marked outcrop of sub-Olean lies in Concord township, Erie county, on the farm of D. Walden, about five and a half miles south-west of Walton's Knob, where it covers a considerable area on the summit between the south branch of French creek and Big Brokenstraw creek and forms several bold escarpments.

The top rock there is a conglomerate containing very white, flat pebbles, ranging in size from one inch in diameter down to a flax seed. The pebbles are loosely held together in a coarse sandy matrix which disintegrates readily, making locally a soil full of pebbles. The bottom is a coarse-grained, yellow, iron-seamed sandstone, corresponding to its typical character when not overlaid by conglomerate.

The whole rock is from 30′ to 40′ thick, and its top lies at an elevation of 1860′ A. T. Taking its base here at 1820′ A. T. we see that a rise of 7′ to the mile would carry it over Walton's Knob, and this probably represents very nearly the slope of the rocks in that direction.

A mile and a half north of the sub-Olean cliffs at Walden's, is the Colegrove quarry, in Prof. White's Corry sandstone.* This quarry is about a mile west and half a mile north of the south-west corner of Columbus township, and therefore about five miles west south-west from Walton's Knob. The altitude of the *base* of the quarry is 1740′ A. T., or 80′ below the base of the sub-Olean (Shenango sandstone) at Walden's. Allowing 20′ for dip of strata between the two locations, and 10′ for the thickness of the quarry rock, and we have 90′ as the interval between the base of sub-Olean and top of Corry sandstone. The Corry sandstone, then, should be found upon Walton's Knob, but the surface is so drift-covered, that I did not see it.

Having thus ascertained that the highest point, both hypsometrically and geologically, in the township, falls below the horizon of the sub-Olean, we have discovered one of the causes why the general surface of the township is smoother and the character of the soil less variable than in other sections further south, where the ridges are still capped with massive sandstones.

But the great fashioner of the present topography of the township was ice. This region was a portion of the preglacial summit occupied by the headwater branches of Little Brokenstraw, Big Brokenstraw, and French creek, and here the ice currents moving west and south, cut across from stream to stream and leveled down the divides where ever an opportunity offered.

Bear Lake station, on the A. & G. W. Ry., in Freehold township, near the north-east corner of Columbus, is the present valley divide between the waters of the two Broken-

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*See Q^4, p. 230.

straws; and Corry, in Erie county, about a mile west of the west line of Columbus, is the valley divide between Big Brokenstraw and French creek. The railroad levels from point to point are as follows:

Corry summit, ...	1441′ A. T.
Columbus station, ...	1427′ A. T.
(Water in B. Brokenstraw at Columbus 1390′ ±.)	
Bear Lake station, ...	1550′

The highland along the eastern line of the township ranges from 1600′ to 1720′ A. T. In pre-glacial times this was an unbroken ridge, but now it is cut through in three places. Prosser Run valley opens into Blue Eye Run valley, Coffee Creek valley into Swamp Run valley, and Phelps creek connects Little Brokenstraw valley with Big Brokenstraw valley, by an open passage through the divide.

Phelps creek or Pine Valley cut.—As a very evident result of glacial erosion, this cut deserves a special notice. The summit at Bear Lake station, (1550′ A. T.,) is the highest on the A. & G. W. railway, being 157′ above Salamanca, 251′ above Chautauqua Lake, 109′ above Corry summit, 470′ above Meadville, 266′ above Evansburg summit, near Conneaut Lake, in Crawford county, and 424′ above Johnson's summit, the highest altitude reached in Trumbull county, Ohio. It is situated at the head of a very broad sloping valley, which appears to descend steadily northeastwardly into Chautauqua Lake, distant about 13 miles. But the railroad levels in that direction show an uneven floor to the valley—thus—Bear Lake 1550′ A. T., New York State line, 1468′; Grant, 1437′; Watts Flats, (the valley divide between waters flowing south-westerly into Little Brokenstraw and easterly into Chautauqua Lake,) 1456′; Ashville, 1356′; Chautauqua Lake, surface of water, 1299′.

Bear Lake station to Grant,	3	miles;	fall	113′	or over	37′	per	mile.
Grant to Watts Flats,	3	"	*rise*	19′	" "	6′	"	"
Watts Flats to Chautauqua,	7	"	fall	157′	" "	22′	"	"

From the gradients of this valley floor, it is evident that the tendency of an ice-sheet impelled from the north and north-east, would be to check up against the Bear Lake ridge, (which is now on an average 150′ higher than the railway station,) and deflect down the Little Brokenstraw valley. But while doing this, a notch was started through the barrier, which the *under waters* eventually deepened to present level, for the general appearance of the cut indicates that but little ice passed through the lower part of it. The length of the notch is less than three quarters of a mile, its width probably not over 10 rods in some places, while the side walls rise abruptly from 50′ to 80′ and then more gradually, until at a distance of half a mile on either side, they reach an altitude of 1720′ A. T., or 170′ above the railway station. Phelps creek rises on the east, or Little Brokenstraw side of the ridge, passes through the narrow cut and emerges on the west, or Big Brokenstraw side, at an elevation about 80′ below Bear Lake summit, where it wanders off through a broad flat into Coffee creek and thence to Big Brokenstraw. The railroad in passing through the gap, crosses the stream four times and makes several side cuts in bed rock, exposing the following section :

Drift, ...	10′
Shale, sandy, with thin sandstone layers, ...	10′
Shale, brown, friable, ...	20′
Sandstone, one persistent plate, ...	0′ 3″
Shale, brown, ...	4′
Sandstone, fine-grained, false-bedded, blue, ...	4′
Shale, brown, to R. R. level, ...	6′
	54′ 3″

Coffee Creek and Swamp Run.—These streams head in a valley swamp in Freehold township, about a mile east of the Columbus line—elevation 1460′± A. T. A very strong and free flow of ice must have moved through this notch, to produce such wide and deep-cutting. Its depth is remarkable, being only 20′ above the Corry summit, and 85′ above the Big Brokenstraw where it leaves the township on the south at the lowest point in it.

Prosser run and Blue Eye run.—The divide between these two streams lies near the south-east corner of the township—elevation 1600′± A. T. A broad valley continues from one stream to the other, and few persons in driving along the highway would notice where the two streams start in opposite directions. The Blue Eye, however, soon enters the region of Carboniferous rocks where the valley contracts somewhat and its sides become more precipitous. Not having as free delivery toward the south as Swamp Run valley, the summit divide is not cut down so low.

It will be inferred from the coloring of the geological map that the western part of Columbus township is lower than its eastern part—and so it is. Just west of the county line and south of Corry the hills rise quite abruptly, 300′ or more above Corry summit. North-east of Corry and along the county line an isolated ridge between Hare creek and Big Brokenstraw attains an altitude of over 1600′ A. T. But bordering the Big Brokenstraw, where it enters the township from the north-west at an elevation of 1415′± A. T. throughout the wide valleys of central Columbus and across the Corry summit to the west, the average altitude over a large area can hardly exceed 1440′ A. T.

The summit basin at Corry is so directly connected with the valleys of Columbus township that it requires a passing notice here. It has received terrible treatment from the ice flows drafting from Big Brokenstraw to French creek. One stream broke over near the north-west corner of the township into the upper part of Hare creek, another drove across from the east into the lower part of the same stream. They met at Corry, where, held in check by southern hills and invited by more rapid drafts through French creek towards the south-west, they scoured out an irregular basin on the summit and studded it with drift hills.

A good exhibition of the character of the measures out of which this basin has been wrought, may be seen along the Pittsburgh, Titusville and Buffalo RR. just west of town, where the following section is exposed:

Railway level, ... 1455′ A. T.

1. Brown shales very fissile and inclined to weather into long narrow chips, ... 8′ to 1463′ A. T.

2. Concretionary, irregularly-bedded, flaggy sandstone, blue and hard; shale partings, . . 4′ to 1467′ A. T.
3. Brown fissile shale, like No. 1, ... 33′ to 1500′ A. T.

These shales appear to be the same as those seen in the Coffee creek cut, and like them they are exposed in a narrow notch of glacial origin, for it is quite evident that the south branch of French creek which now flows through this outlet, formerly entered the main stream by way of the old buried channel lying west of it.

The character of the shales at this horizon, furnishes a key to the topography. Such shales are easily eroded, but streams always cut down very tortuously through them, hence, under the combined action of ice and water, broad valleys with uneven floors result, and where drift is heavily deposited in such situations, the apparent drift hills are often formed over knobs of shale left between the changing channels, which have so influenced the movements of depositing currents as to catch and hold the materials carried by them.

The present valleys are much wider, of course, than the old ones were, and considerable shaft sinking might be done without striking the deepest parts of old stream beds; but the probabilities are, that no very great depth of drift will be found in any of these summit valleys, for it is very clear that *no pre-glacial stream crossed the divide* at this point between Big Brokenstraw and French creek.

No oil wells have been obtained in Columbus township, and in fact very little drilling has been done there. The Tarbox well, on Goose creek, 2½ miles east of Columbus, was sunk in 1868 or 69. No record can be obtained, but it is known that 30′ of drive pipe was used, and the drill went down from 900′ to 1100′ without finding sandrock, gas, or oil.

To show the underground structure in the neighborhood of Columbus township, the following records are appended: Downer well, at Corry, one mile west of the township line, and Loomis, or Capt. Hood well, in Clymer township, N. Y., about two miles north of State line.

Downer Well, 1878.

Located in the yard of the Downer Oil Works, at Corry, Erie county. Authority, T. A. Allen, Manager.

Well mouth above ocean in feet,		1430
Conductor,	48 to 48=	1382
?,	57 to 105=	1325
1st sand,	8 to 113=	1317
Slate,	137 to 250=	1180
SS.,	10 to 260=	1170
Slate,	364 to 624=	806
Red rock,	14 to 638=	792
Slate,	107 to 745=	685
SS., grey,	15 to 760=	670
SS., fine grained,	5 to 765=	665
Slate, (gas at 778′,)	153 to 918=	512
2d sand, shelly,	40 to 958=+	472
Slate, (shells at 1080′, 1206′, and 1352′,)	642 to 1600=—	170
Slate, dark, (measured,)	35 to 1635=—	205
Slate, (show of gas at 1640′ and oil at 1700′,)	260 to 1895=—	465
Sandstone,	8 to 1903=—	473
Slate, soft,	117 to 2020=—	590
Purple shale,	55 to 2075=—	645
Slate, soft, thin shells at bottom,	265 to 2340=—	910

Loomis Well, 1878.

On tract No. 11, Clymer township, Chautauqua co., N. Y. About 5 miles south-west of Panama and 4 miles east of Clymer. Authority, T. B. Loomis, Esq., Panama, N. Y.

Spec.			
	Well mouth above ocean in feet, (barometer,)		1545
Fossil 800,	?, (gas at 852,)	860 to 860=	685
	1st sand, a series of sand shells,	105 to 965=	580
	?,	267 to 1232=	313
	2d sand, (similar to first sand,)	108 to 1340=	+205
No. 1, 1382′, No. 2, 1560′,	Slate, ?,	445 to 1785=	—240
No. 3, 1787′,	Pebbles in slate,	4± to 1789=	—244
	?,	66 to 1855=	—310
No. 4, 1875′,	Slate very black, "pebbles quite plenty,"	25 to 1880=	—335
	?,	10 to 1890=	—345
No. 5, 1891′,	Slaty sand, full of iron pyrites,	1 to 1891=	—346
	Slate, lead color, ("full of oil,") November 14,	1 to 1892=	—347
	Slate to bottom,	83 to 1975=	—430

"The 1st and 2d sands were not solid sands but shelly; the well in fact has been a succession of slate and shells all the way down to 1855 feet, where the black slate was struck."

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2. Freehold township. Organized in 1833.

Little Brokenstraw creek, traversing this township from north to south, divides it by a fertile, broad valley into two approximately equal portions, and receives the drainage of nearly all of its surface. It crosses the State line at an elevation of 1415′± A. T. and falling 100′ in its course, leaves the township at the lowest point in it, 1315′± A. T. In the northern part, the hills bordering this valley rise by gradual slopes to table lands having an altitude of from 1650′ to 1750′ A. T., but in the southern part the country is more rugged and the average summit levels greater by 100′ or more. The highest point noted is on the State road two miles east of Lottsville, (1945′ A. T.,) being a portion of the ridge on which Pikes rocks are located.

But two small patches of Olean Conglomerate remain in the township; one, a mile and a half south-west of Lottsville, which I have called Miller's Cliff, the other on the south line of the township where the State road crosses it.

The sub-Olean was positively identified only in the vicinity of Pike's Rocks, on the east, where it is a characteristic yellow, iron-stained sandstone. On the ridge holding Miller's cliff there is ample scope for it to appear, but I was unable to find an outcrop of it, or anything in the soil which might indicate its presence. This range of hills, however, has been so cleanly swept, rounded and drift covered by glacial action, that the rock may possibly be concealed. I have therefore colored the map as if it had been found.

Nevertheless, it may be questioned whether there are not good grounds for inferring that the sub-Olean has been eroded here, and thus allowed the Olean conglomerate to bed upon lower rocks, which might partially account for its low elevation at Miller's as compared with the outliers east and south of that point:

Elevation of	Pike's Rocks	near east side of the township,	top—	1980′	A. T.
"	" Nuttall's "	" south-east corner	"	"	1955′	"
"	" Drake's "	on south line of	"	"	1890′	"
"	" Miller's cliff,			"	1880′	"

The latter view of the case seems warranted also, by the following facts: In the vicinity of Wrightsville, a massive flat-pebble sandstone or conglomerate, 15′ to 20′ thick, is plainly exposed in a number of places. Its top at Wrightsville is 1600′ A. T. The base of Olean, here, judging by the surrounding outcrops, would be about 1910′ A. T,—making an interval of 310′ between the two rocks. The Wrightsville conglomerate is also exposed in several places around the ridge containing Miller's cliff, where it lies, certainly, not more than 220′ below the Olean.

This Wrightsville conglomerate, which is probably the continuation south-westwardly of the Pope's Hollow rock,* is in some places very similar in appearance to Panama conglomerate. It is yellowish, iron-seamed, and sometimes contains numerous fossils, among which I have noticed Spirifers of two or three varieties and a small Aviculopecten.

A flaggy sandstone, sometimes containing thin layers of flat pebbles, was occasionally seen in the northerly part of the township, lying in about the proper horizon to represent the Wrightsville conglomerate, but it evidently has lost much of its massive character in that direction, or else it would show itself oftener and more boldly.

On lands of Mr. Perkins, about one mile south of State line and near the brow of the hills west of and facing Little Brokenstraw creek, some rough building stone has been quarried. The exposure, about 15′ on the face, shows an irregular stratification of brown, contorted shales and thin, false-bedded sandstones, in irregular layers from six inches to one foot thick. The sandstone varies in color and composition, being blue, yellowish or brown—fine, friable or pebbly, depending upon the spot from which it is taken; and occasionally thickens up so that an 18-inch block may be quarried. Its elevation is 1705′ A. T., which puts it somewhere near the Wrightsville conglomerate horizon.

The only *unquestioned* exposure of *Panama conglomerate* seen in the township, and in fact the only one noted in the county, is on the farm of Mr. W. H. Price, about

* See Chapter VIII.

half a mile south of the State line. Elevation, 1510′ A. T. Another *probable* exposure of the rock, but very much attenuated and changed in character, occurs near Lottsville, as mentioned in chapter VII.

The hill upon which Mr. Price's farm is located, forms a very conspicuous feature in the landscape. It is completely surrounded by broad valleys, and rises like a dome in the center of a rudely triangular basin. On the east flows the Little Brokenstraw, coming down through a wide valley from the State of New York; on the west is the Bear Lake branch, occupying another broad valley, and on the north-west these two valleys are connected by a cross cut, which forms a part of the great north-east south-west valley before spoken of as extending from Bear Lake ridge to Chautauqua lake.

At its base, this isolated hill is about a mile and a half long and from one half to three quarters of a mile wide, and its summit rises 250′ above the surrounding creek bottoms. Just under its western slope nestles Bear lake, a little circular pool of clear water without inlet or outlet, not more than 20 or 30 rods in diameter.

A moraine stretches across the valleys just south of the hill, at an average elevation of 1475′ A. T. This has held a lake north of it, of which Bear lake is all that now remains, since the outlet has been lowered by gradually cutting down through the morainal barrier. Quite a colony of well-weathered Panama conglomerate blocks, intermixed with northern rock, lie scattered here, and a reëxamination of the locality convinces me that the hypothesis in relation to their origin and transportation, as given in Report I[3], page 73, is correct.

Another broad moraine crosses the Little Brokenstraw valley three quarters of a mile south of Lottsville. Average level, 1440′ A. T. Above these two natural dams the old lake bottoms are plainly traceable. Alternations of gravely, clayey, and mucky soils, some of which have not yet become sufficiently desiccated for cultivation, occupy the bottoms, and beach terraces of well-worn lacustrine shingle border many of the slopes.

Lower down the stream, near Abbott's corners and Wrightsville, the valley has been obstructed with immense piles of irregularly deposited drift, through which the waters, wandering here and there—leveling down and re-arranging the materials—have gradually cut out new channels, into which the present drainage centers.

Bowlders of metamorphic rocks, some of them of large size are met with in every part of the township. They may be said to have been scattered broadcast, but seem, however, to have had a tendency to collect more plentifully in the ravines falling southerly from the highland ridges, than in other localities.

The discovery in this township of a good calcareous deposit, or a muck bed, that could be utilized for composts would be of great value, for some of its most genial soils have become impoverished from long cultivation and constant cropping, and now need nourishment. It seems quite probable that something of this kind could be found in some of the old pond and lake bottoms along Little Brokenstraw valley. Near Abbott's corners several wagon loads of calcareous tufa were found in a place where there has apparently been a drainage from the hillside, but where no living springs now exist.

Below Wrightsville a stream rises very singularly in the creek bottoms, whose waters have that peculiar translucence which characterises the waters from the marl beds at Harmonsburg, in Crawford county. I see no reason why deposits of marl should not be found along some of these old drift-filled valleys, as well as near Conneaut and Cassadaga lakes, where there are beds from 10′ to 20′ in thickness. At all events they are worth searching for.

Prospecting for oil in Freehold, thus far, has not been crowned with success. Following are the records of two or three of the most important ventures.

Lottsville Well No. 1.

Drilled in summer of 1877.

Located on land of Mr. Eastman just north of the village of Lottsville, on the south bank of Deer run and about 40′ above the level of Little Brokenstraw flats. Authority, Dr. Whitney, of Lottsville :

Well mouth above ocean in feet (barometer,					1450
Conductor,	5	to	5	=	1445
Slate, sandy, dark grey,	85	"	90	=	1360
Red rock, slaty, soft, (15′ to 20′,)	20	"	110	=	1340
Slate, dark grey,	152	"	262	=	1188
Pebbles, (thin streak,) at			262	=	1188
Shells (with some pebbles,) and soft gray slates,	488	"	750	=	700
SS. grey, coarse, slight show of oil,	13	"	763	=	687
Slate and shells, (oil show at 860′,)	237	"	1000	=+	450
Soft slate and thin shells,	515	"	1515	=—	65

Gas at 425′, 580′, 700′, 735′, 800′, 900′ and 920′. After reaching 920′ there was nearly enough gas to fire the boiler.

The well was deepened from about 1000′ to its present depth in 1881 without disclosing anything to warrant further drilling, and in August the casing was drawn and well dismantled.

Smith Well, or Lottsville No. 2, 1878.

On the flats of Little Brokenstraw creek about 80 rods west of Lottsville well No. 1, and say 50 rods east of the creek. Authority, A. M. Smith, one of the owners.

Well mouth above ocean in feet (barometer,)					1410
Surface loam and some gravel,	8	to	8	=	1402
River gravel, not coarse nor fine, medium,	22	"	30	=	1380
Quick sand,	7	"	37	=	1373
Clay, with some seams of quick sand and occasionally a few pieces of gravel, pronounced to be limestone,	163	"	200	=	1210
Alternating bands of quicksand and fine and coarse gravel, of many colors,	200	"	400	=	1010
Clay,	30	"	430	=	980
Sand and gravel,	20	"	450	=	960

"The above is given from memory, for we put off keeping a written record until we should strike bed rock. After driving 450′ of pipe, with no more indications of rock than when we were at 35′, the undertaking was abandoned. The string of casing was so long, that it sometimes required thirty strokes with a mall weighing about a ton, to force it down one inch. In the last bed of clay we drilled ahead of the pipe about five feet at one time, and that was the only time during the whole driving, that we went below the pipe. We thought we were exceedingly fortunate if we could keep the pipe cleaned out to the bottom. The mud would frequently rise up in the pipe from 20′ to 50′, and the water 150′. At first, we tried to keep the water out because the pipe seemed to drive easier, but during the latter part of the work, it was necessary to leave the water in to keep the mud down."

"One black stone, coming from a depth of about 300′, was filled with bright particles, and I sent it to a person familiar with minerals and he pronounced it to be *gold*, and promised to have it assayed, but I have since heard nothing from it."

The above, as a record of an oil well, amounts to nothing of course, for the hole had to be abandoned before the bed rock was reached. It is a record, however, of the longest string of drive pipe ever driven in the Pennsylvania oil regions. And this great depth to the old valley floor occurs in a place where it is difficult to account for such extraordinarily deep erosion. The bottom of the pipe, it will be noticed, reached to within 960′ of ocean level, and this midway in a valley which must have had an outlet either north or south—if north, into and through the valley leading into Chautauqua lake; if south, into the Big Brokenstraw to Irvineton, and thence either toward Warren or Tidioute. These now are the only possible outlets, and all the surroundings prove that there never could have been any others.

The elevation of the old valley floor at Tidioute is about 1050′ A. T., and at Warren, 1100′ A. T. Hence it is evident that the old stream could not have flowed in either of these directions. But it may have gone through the foot of Chautauqua lake and joined Conewango creek at Falconers, where the elevation, as calculated in I[3], is probably not more than 915′ A. T., which is sufficient to allow of a fall of about two feet to the mile. On this supposition the deepest drift-filling demanded (about 500′) should be in the vicinity of Grant station.*

*In conversation with Mr. Smith, the owner of Lottsville Well, No. 2, I could not learn that the depth of the hole had actually been measured after the drive pipe was put in. Four hundred and fifty feet seems to have been the length of pipe that was paid for, but as the work was abandoned by the first contractor and finished by another, and some of the pipe was spoiled in driving, Mr. S. admitted that the hole might not be quite as deep as reported.

It cannot be questioned, however, that a remarkably deep valley was eroded here, and inasmuch as we have evidences in other places of deep cuttings that seem uncalled for on the theory of regular slopes to old stream beds, it sug-

The following analysis of a specimen of clay taken from this well at a depth of about 150 feet from the surface, was made at the State laboratory by Mr. A. S. McCreath:

Silica,	65.120
Alumina,	15.939
Protoxide of iron,	5.464
Lime,	1.550
Magnesia,	1.848
Potash and soda,	3.580
Titanic acid,	750
Carbonic acid,	2.840
Water,	3.160
	100.251

For comparison I also give Mr. McCreath's analysis of clay from the "gravel pit" oil wells near Titusville:

Silica,	51.010
Alumina,	20.930
Protoxide of iron,	6.831
Lime,	3.010
Magnesia,	2.511
Alkalies,	4.372
Titanic acid,	1.090
Water and carbonic acid,	9.619
	99.373

And also Dr. Wormley's analysis of the Erie clay of Ohio (Geological Survey of Ohio, Vol. 1, p. 177):

Silicic acid,	59.70
Alumina,	14.80
Iron, sesquioxide,	4.60
Lime, carbonate,	8.90

gests the inquiry whether the under ice currents, under certain peculiar combination of circumstances, might not be capable of excavating in soft measures to a considerable depth below the level of the main outlet for the sub-glacial waters.

There appears to have been a time during the glacial period when many of the water-courses were undergoing very active erosion. A new system of drainage was being established under conditions quite different from those which prevailed while the former streams were slowly carving out their beds. The sub-glacial erosion was not governed by any fixed or steady methods, being necessarily dependent upon the erratic movements of the ice and water upon the surface. It was only at a later period, when the ice began to waste, that the streams were allowed to work out natural gradients for themselves by re-filling the old valleys and re-adjusting the drainage levels.

Magnesia,	5.14
Fixed alkalies,	3.40
Water,	4.00
	100.54

The very small percentage of lime and magnesia in the deep clay from Lottsville would seem to indicate that it was largely derived from local rocks, while the surface clays near Titusville were in a position to receive some lime from the northern drifts; but neither of them contains as large an amount of lime and magnesia as the Erie clay which was deposited around the borders of the lake basin.

Rocky Hollow Well, 1881.

On the farm of John Comstock, about one mile north-east of Wrightsville.

This well commenced at an elevation of 1495′ A. T., (barometer,) and was drilled to a depth of 1200′, or to within 295′ of ocean level, when, no favorable indications of oil having been found, it was abandoned as a "dry hole."

But little can be learned of its history. When I visited it in October, 1881, it was about 700′ deep, and the contractor assured me no well-pronounced sandrock had been passed through up to that time. He gave me the following notes: "At about 100′ from the surface we had a thin sand-shell containing a few pebbles, between 200′ and 300′ some red rock, then nothing but shale and slate with thin sand-shells. The first gas, (which had a fetid smell and decreased in volume gradually,) was struck at about 600′ in shelly slate, the second at about 700′." Below this there seems to have been nothing noticeable.

In this well the drill must have passed through the *horizons* of both the *Third* oil sand and the Panama conglomerate, whether they be one and the same stratum or not. As no representative of either was found, it affords corroborative evidence of the correctness of the views expressed in Chapter VII.

3. Sugar Grove township. Organized in 1820.

The northern half of this township is drained by the head-water branches of Stillwater creek, a stream which flows north-easterly into the State of New York, and enters Conewango creek near Frewsburg, four miles north of the Pennsylvania line; the south-eastern corner drains into Jackson run, which falls south-easterly into the Conewango, and the south-western into Matthew's run, a tributary of Big Brokenstraw creek.

The lowest point in the township is the Stillwater outlet at the State line, 1310′± A. T., (Jackson run leaving it at 1440′±, and Matthew's run at 1420′±.) The highest is Pike's rocks, in the south-western part, 1980′ A. T.

The Stillwater division of the township contains a large area of bottom lands along the numerous creeks, and the hills are comparatively low, only a few of the highest summits reaching to 1700′ A. T. The southerly watersheds are much more rugged, having steeper hills, narrower valleys, and a more variable soil.

An unbroken body of high land once extended from Warren into New York, between the valleys of Jackson run and the Brokenstraws. Near Chandler's valley it also connected with the highlands at the east, and formed a divide between Jackson's run and Stillwater creek. The highest altitudes in Conewango, Sugar Grove, and Freehold townships are upon these ridges, and they hold the most northern remnants of Olean and sub-Olean rocks. No situation could have been better planned to test the erosive powers of moving ice and water. Stillwater creek, flowing to the north-east, opened its valley directly in the face of the ice currents, and offered an open passage up to the highlands. The ice moved through it, filled all the head streams, and selected the most available points to breach the summits. The lower parts of Jackson run and Matthew's run already had direct communication with the Allegheny outlet, and into these channels the flowing mass commenced to force its way. Some of the results of its work are seen near Chandler's valley, in the triangular basin more than a mile wide and two miles long, connected by two broad valleys at the north with Stillwater basin, by the great valley of Jackson's run, toward the south-east with Conewango valley, and by a narrow deep-cut notch at the south with Matthew's run.

In the east gap between Sugar grove and Chandler's valley, the divide between Stillwater creek and Jackson run is cut down to 1510′, and the two streams, flowing in opposite directions, take their rise in one and the same swamp. The west gap summit is higher, being about 1680′, and seems to be composed of quite a narrow ridge of fixed rock extending across the valley, which deepens rapidly each way.

The recent excavation of a passage through the ridge at the "narrows," on Matthew's run is one of the plainest evidences of ice-action to be found in the county. This cut is very similar in character to the Coffee creek defile in Freehold township, and the new outlet of the Tionesta, near Barnesville, in Sheffield township.

Several years ago I was struck with the peculiarities of this "gate in the valley" and made a note of it. The lower part of Matthew's run is broad and has the appearance of holding a large and important stream; but at the "narrows," the side hills close in abruptly and one enters a narrow steep sided ravine not more than 15 or 20 rods wide, with hills rising from 250′ to 300′ on either hand. This continues for about half a mile, when he as suddenly emerges into the wide basin at Chandler's Valley. The valley now occupied by the head branch of Matthew's run, east of the ridge and before the stream enters the narrows, is four or five times as wide as the new cut outlet, and there can be no doubt whatever that this was formerly a branch of Jackson run, and that the stream was diverted from its course and carried through the ridge into Matthew's run during the glacial period.

Near the north-west corner of the township there was a strong draft of ice across the summit, particularly between the main branch of Stillwater creek and the small run which enters Little Brokenstraw creek at Lottsville; but no sharp cut was made here, for the lowest point on the divide is about 1650′ A. T., or only from 50′ to 75′ below other parts of the summit.

But one small outlier of Olean conglomerate is to be found in the township—Pike's Rock, the highest peak in that portion of the county lying north of Big Brokenstraw and west of Conewango creek and the most northern remnant of carboniferous conglomerate between the Allegheny river and Lake Erie. It is a conglomerate mass of not more than two acres, but the oppressive air of utter loneliness which surrounds it by reason of its complete isolation from all of its kind, makes it one of the most impressive and awe-inspiring rock cities I have ever visited. Perched upon the highest summit within the range of vision, and surrounded by well-cultivated, gently-sloping fields—its weathworn walls, studded with pebbles which glisten in the sunlight, rise bold and sharp on every side. No talus of broken rocks at its base—not a block in sight on all the slopes around. A huge pile of naked rock for man to physically gaze upon—a mere handful of pebbles when mentally viewed in connection with the great conglomerate bed of which it was once a part! Standing upon the pinnacle and looking out over the surrounding landscape so thickly studded with hills and dimpled with valleys, one is overwhelmed with astonishment when he attempts to realize that all this stupendous sculpturing of the surface has been accomplished entirely by sub-aerial and sub-glacial erosion in comparatively recent geologic times.

The sub-Olean, here a yellow, coarse-grained, iron-spotted sandstone underlies Pike's Rocks, and it, (with sometimes a portion of the Shenango shales) forms the top of quite a broad summit extending south-easterly to the south line of the township. It also caps a small area east of Matthew's run. Over all the northern part of the township it has been completely eroded.

The surface of this township is so completely covered by drift that very little bed rock is to be found. No sandstones were seen that could be satisfactorily identified either with the Wrightsville conglomerate or the Panama rock.

About a mile west of Sugar Grove, at an elevation of 1460′ A. T., the Stillwater flows over a rocky bed of blue, shaly sandstone, containing many imperfect impressions of fucoids and shells. About 8′ of this shaly sandstone may be seen and above it come 30′ or more of bluish and brownish shales, very similar in every respect to those seen at Corry and in the cut near Bear Lake station. A mile further up the stream we come to a quarry on land of Mrs. J. Faichney, from which some good stone has been taken for the foundations and trimmings of several brick buildings in Sugar Grove. It is not systematically worked and as the ledge can only be seen near where the water falls over it, nothing can be said of the measures above or below. As worked, it is a band of close-grained, hard, bluish sandstones about 5′ thick, bedded in flaggy layers from 2 inches to one foot thick. The bottom layer contains some flat pebbles. It is also fossiliferous. A large *Aviculopecten* and several *Spirifers* were seen. As usual with these Chemung sandstones, *fucoids* abound in it and when freshly broken some of the layers emit a strong odor of petroleum. Unless care is had in selecting the materials the blocks are inclined to discolor in weathering, in consequence of the unequal distribution of iron in them.

I do not feel warranted in referring this quarry to the horizon of the Panama conglomerate for the following reasons: It is apparently only a thin bed of flaggy sandstones, such as we are liable to find at almost any horizon in the Chemung measures throughout this range of country; its elevation (1540′.) seems too high; it evidently *overlies* the brown shales seen lower down the stream, and if these be the same as those seen in the cut at Bear Lake station and at Corry, the Panama rock should be found below them.

Dennison's quarry, two and a half miles east of Sugar Grove, (elevation 1525′ A. T.,) is another one of these thin, flaggy sandbands from which some inferior stone has been taken, because it was exposed in the stream, and no better or more accessible rock could conveniently be had. The succession here is better shown than at Mrs. Faichney's. Going up stream a bed of sandy shale, brown, quite micaceous and 20′ thick, is first seen, then 5′ of very irregular, contorted, fucoidal flags, then an uneven layer, 6 to 12 inches thick, of small, flat pebbles and fine-grained bluish sand, and then 4′ of fine-grained sandstone, false bedded, of an uneven bluish-gray color and inclined to weather into an irony-brown. The flags also smell strongly of petroleum.

On the point of the hill just north of Chandler's valley evidences of an outcropping conglomeritic sandstone appear at an elevation of 1690′ A. T., which seems to be about the right place to look for the Wrightsville conglomerate. At several other places its presence might be inferred from the topography or the horizon of springs, but I cannot affirm that I saw any positive exposure of it in the township.

An oil well was sunk several years ago on the Spencer farm, Jackson run, near the east line of the township, but nothing could be learned about it except that it was about 1200′ deep and failed to find sandrocks or oil.

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4. Farmington township. Organized in 1853.

Probably this township contains the largest percentage of arable land of any in the county. The northern part is largely composed of bottom lands bordering Johnson's run, Fairbank's run, and their tributaries. These two streams unite and flow north-easterly into Kiantone creek in New York, through which the waters reach the Conewango. South of the high dividing plateau on which these streams rise the drainage is all towards the south-east, and the topography of the county is more rugged.

Mud run and Grig run reach well up into the center of the township on the west side, and with other smaller streams carry off the water fall from about one quarter of its area into Jackson run, which passes through its south-western corner. The head branches of Rhind's run drain the south-east corner directly into the Conewango creek.

The lowest point is where Fairbank's run crosses the State line, at 1315′± A. T., the highest, Preston's summit, near the center of the township, on the road leading from Lander's or Farmington center to Jackson run post-office—elevation 1910′ A. T. Two other points of nearly equal altitude were noted on the divide—one near O. & E. Kingsley's on the western side, 1900′ A. T., and the other near N. A. Foster's, between Fairbank's run and Rhind's run—1880′.

No deep through cut has been made by the ice in this plateau, the lowest point noted in the ice-drafts between the headwater streams, being about 1700′ A. T. But there are low spots in the divide connecting nearly every one of the northerly flowing streams with those running south, and the southerly trending valleys show plainly that they have been enlarged and remodeled by the overflows of ice poured into them through these depressions.

At the eastern line of the township, the east branch of Fairbank's run heads in a broad valley with Russell run, at an elevation of 1520′ A. T. Here is another fine exhibition of the manner in which the valleys of opposite flowing streams have been joined together by glacial action.

No Olean conglomerate or sub-Olean remain in the township. But some of the highest parts of the central plateau appear to be well up towards the sub-Olean, as indicated by the quality of soil and character of timber. Chestnut trees seem to be quite plentiful here, and they love sandy soils derived from disintegrated conglomerates, or the immediately underlying sub-carboniferous rocks.

In the western part, near O. & E. Kingsley's, a ledge of quite massive yellow, current-bedded, sandstone with some flat pebbles, is probably the Wrightsville conglomerate.

Trending across the south-eastern corner of the township, a well-defined pebbly sandstone can be traced almost continuously in the several branches of Flat Bottom run and Rhind's run. On the farm of A. Anderson, three quarters of a mile north-east of Jackson run post-office, the stream cuts through it and exposes from 20′ to 25′ of massive sandstone; yellowish, compact and containing many large flat pebbles. Its top, here is 1550′ A. T. It is seen again to the north-east at 1585′ A. T., then at 1610′ A. T., and once more (in Pine Grove township) at 1640′ A. T. A prolongation of the line along which these exposures occur, would strike McCoy's cliff,* and the same average dip continued would place this stratum at the cliff, about 100′ *below* the rock escarping there. Is this, then, a lower sandstone or does the dip change from 22′ per mile, (the average where the rock can be traced) to 47′ per mile—the rate to bring it up to McCoy's from the place where last seen?

If it is a lower rock than McCoy's, it is rather remarkable that the latter does not appear in any of the valleys before mentioned, for it is a noticeable fact to be observed in all the southerly trending valleys in this part of the county, that the highest massive sandrock makes the most prominent escarpment. Where the hilltops are swept of conglomerate, one will invariably find the top slopes and the upper parts of the valleys, composed of smooth shaly soil, without a rock to interfere with cultivation as far down as where the stream cuts through the first or highest massive sandstone. Below that point, the stream bed, the valley bottoms, and often the hill slopes, become littered with broken blocks, and these, working down stream, generally obscure, and sometimes completely cover all other outcrops of similar character below. This is why it is so difficult to get a good exposure of more than one sandrock in the same cliff or stream bed. Broken blocks from two or three distinct strata may be intermixed along the valleys, but these flat pebble conglomeritic sandstones imitate each other so closely in every physical aspect, that the talus from one ledge cannot easily be distinguished from that of any other.

Bowlders.—Owing to the basined shape of the north-east part of the township, and the direction of its drainage, which puts it in connection toward the north with the great Conewango and Chautauqua valleys, the lands north of the dividing highlands in the center of the county have received more foreign bowlders than those to the south of the ridge. The bowlders are not very thickly scattered, however, but some of them are three or four feet in diameter.

In all this northerly basin the drift is deep, the streams have been inconstant, wandering here and there over the bottoms, while the waters were leveling the loose materials

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* See Pine Grove township.

and seeking a permanent channel; and there are terraces of lacustrine shingle around depressions where temporary lakelets have stood while this process was going on.

Oil wells.—I am not aware that any oil wells have been sunk in this township. No recent tests have been made, and whatever may have been done in former years, of course, amounted to nothing. Two or three wells were drilled on Jackson run, just south of the township line, and one on the east between Farmington and Russellburg. These being deep wells and showing unfavorably, have checked developments for the time being, in the direction of Farmington.

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5. Pine Grove township. Organized in 1820.

The great drift-filled, north-south valley of Conewango creek divides this township into two unequal parts—about one third of its area lying on the west side and two thirds on the east—and establishes an east and a west water shed, both of which drain directly into it.

The lowest spot in the township is creek level at the south line, 1210′± A. T. The summit table land in the north-east corner, capped with Shenango shales at 2125′, is the highest. This difference of 915′ in elevations is more than enough, after ample allowance for dip, to give exposure to all the strata from the sub-Olean down to and into the Chemung shales lying *below* the Venango group, as measured by the general section of 750′ from base of Olean Conglomerate to top of Venango Third sand. We shall see further on what evidences of the presence of the Venango group are found in this region.

It cannot be doubted that the pre-glacial Conewango flowed northward, for oil wells show that the old floor slopes in that direction,* and that it is now covered by from 150′ to 275′ of drift material—clay, quicksand, and gravel. The débris has been dumped in between the old walls in a very heterogeneous manner, and there left to be modified and re-arranged to suit the circumstances of the new system of drainage established by it.

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*See I³, Chapter XXXI.

Nearly all the lateral feeders come down from the highlands to the great valley, and on entering it turn toward the south and run down the flats before joining the creek. For example look at Jackson's run on the map.* When these waters were draining northward its channel swept around the northern bluff-point and joined the Conewango two miles or more above the present junction. A central range of drift hills in the valley at this locality—caused, it would seem, by the meeting of ice-currents coming down Jackson's run from the north-east with the great Conewango current from the north—obstructed the old outlet and threw the water back between the drift hills and south-eastern wall of bed rock where it finally worked out for itself the channel which it now occupies.

During my examinations in the county, several persons called my attention to these singular habits of the tributaries of the Conewango and Allegheny, and asked why the streams had not cut directly across the flats into the main channel. It was evident to them that the water courses had not always occupied their present beds, but by what agencies and when their locations were changed, was a mystery. To those who were well acquainted with the surroundings, or whom I happened to meet in the field where all the witnesses were in sight, a satisfactory explanation could always be given, based on the theory of northern pre-glacial drainage, an immense overflow of ice during the glacial period and the opening of new southern outlets in comparatively recent times.

The smoothest and most available lands for agricultural purposes are found upon the wide flats and low, broad-topped hills of the central and north-western portions of the township. In the eastern and southern parts, high elevations with steep hillsides, and a surface deeply scored by water courses and in many places thickly strewn with blocks of sandstone, render large areas unfit for cultivation.

None of these summits, however, rise high enough to catch the *Olean conglomerate*, unless it may be that the

*It will be noticed that there are two Jackson runs in the county, one in Pine Grove the other in Conewango. They both turn southward as they enter the creek valley.

extreme south-eastern corner of the township slightly encroaches upon the Quaker Hill outliers.

The sub-Olean is only seen in three or four patches along the eastern line, where it overreaches from the hills and ridges of Elk township.

Wrightsville conglomerate.—At a distance of about 240′ below the sub-Olean another massive sandrock shows itself in many outcrops. One of its best exposures is on the farm of Mr. McCoy 2½ miles north-east of Russellburg, where its top lies 1800′ A. T. It is a thick, persistent stratum, always making a conspicuous outcrop wherever cut by erosion under favorable conditions. Frequently, however, in consequence of the abundance of drift, the escarpments are concealed, but even in these situations, loose blocks upon the surface generally give notice of its presence. The geological horizon and equivalence of this stratum are referred to in connection with Pope's Hollow rock and the Wrightsville conglomerate in Chapter VIII.

Oil Wells.—Several drill holes for oil have been put down in Pine Grove since the Glade run and North Warren oil developments commenced, on the supposition that the oil-bearing rocks extended northward; but none of them have been productive. The drill passed through almost homogeneous beds of slaty shales, with very little sandstone to vary the monotony. Some sandrocks are reported but they hardly deserve the name, being nothing more than sandy shales or bands of thin sand shells interstratified with slate and shale.

As all the records that could be obtained have been published elsewhere, a simple list of names and locations of such wells as were visited will here suffice:

List of Wells.

	Elevation A. T.	*Depth.*
Week's well, near Fentonville, ...	1240	1830
Niver well, Niver farm, 1¾ m. N. E. of Russellburg, ...	1694	1020
Patterson well, No. 1, Brigg's farm, 1 m. S. E. of Russellburg,	1434	750
Patterson well, No. 2, Brigg's farm, 1¼ m. S. E. of Russellburg,	1235	1105
Eighmie well, Allen farm, 1¼ m, N. W. of Russellburg, ...	1395	1700±
Hopewell well, Akeley run, 1¼ m. S. E. of Russellburg, . . .	1330	?
Putnam well, Rhynd's run, 2 m. S. W. of Russellburg, ...	1305	?

Along the road by the residence of L. Sears, about a quarter of a mile from Niver well and 2 miles N. E. from Russellburg, quite an extensive gravel bed is seen, and it is composed entirely of ovoidal pebbles derived from the Olean conglomerate. Its position is rather remarkable, being 70′ below the crest of the ridge which rises to 2000′ A. T., and three or four miles north of the nearest outlier of that kind of rock. About 2 miles north-east of it the sub-Olean is seen in place at an altitude of 2100′ A. T., and this pebble deposit has resulted, no doubt, from the disintegration of large blocks of Olean conglomerate brought down from the highlands of Elk township, (now entirely denuded of this rock,) and dropped here at the head of a southerly flowing stream, where a crevasse was formed by reason of the accelerated movement of the ice passing down it. The conglomerate has not yet all weathered down to gravel. Some small lumps may be picked up from the surface and probably larger masses would be found by digging.

Brokenstraw Division.

6. Spring Creek; 7. Pittsfield; 8. Brokenstraw.

These three townships lie in the central tier, and extend from Crawford county eastward to the Allegheny river.

Whether viewed from a geological, topographical, or agricultural standpoint, they have many characteristics in common. The surface rocks in all of them have a range from the Olean conglomerate down to and into the Venango oil sands; they all are drained by Big Brokenstraw creek, and its affluents have rough, rugged, unevenly contoured surfaces, and offer to the farmer similar grades of land for occupation, so that he may select in any of them either hill locations with soils derived from Shenango shales and subjacent rocks, or level creek bottoms largely composed of drift materials.

Although some of the earliest settlements in the county were made on Big Brokenstraw creek, and some of the finest lands are to be found along its valley, these townships are not so densely populated as those of the northern tier. This is owing to a difference of topography rather than to an inferiority of soil, the surface being very uneven, and in many places the hill-sides too steep and rock strewn to invite cultivation.

An immense amount of lumbering has been done in the Brokenstraw region, it having originally been largely covered with the best of pine. Some good tracts of timber still remain on the hills away from the streams, but they, too, are now being rapidly worked up.

The inhabitants of these townships are well provided with railroad facilities—the Philadelphia and Erie R. R. passing through Big Brokenstraw valley and giving direct access to Philadelphia or Erie—and the Dunkirk and Warren R. R. following the Brokenstraw to Garland and thence the old glacial valley over to the waters of Oil creek, putting them in communication with Titusville and Pittsburgh at the south and Dunkirk and Buffalo at the north. By these roads they find ready markets for the products of farm, quarry, or saw-mill, and every branch of industry flourishes.

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6. Spring Creek township. Organized in 1820.

Spring Creek township adjoins the Crawford county line and lies south of Columbus. Its main artery of drainage is Big Brokenstraw creek, which, passing through the north-eastern portion, enters it at 1375′± A. T. and leaves at 1320′± A. T.—the lowest point in the township.

Through Spring creek and its numerous tributaries all the western and south-western surface is drained into Big Brokenstraw, while Hosmer run relieves the south-eastern corner and Blue Eye run, with several less important streams, the north-east.

The highest point observed is just north of the State road and near the Crawford county line—1880′ A. T., and another point on the State road near the north-east corner of the township reaches to over 1830′ A. T.

Just north of the junction of Spring creek with Big Brokenstraw large morainal deposits have been made, and above this the Brokenstraw valley is very broad with evidences of once having been a lake bottom.

Between Spring creek and Garland, some portions of the Brokenstraw valley are quite narrow and the hills on either side are steep and high, being capped in several places by the Olean (Garland) conglomerate. This comparatively narrow trough appears to have somewhat retarded the ice-flow in this direction, and the currents were also diverted above it into the valley of Spring creek, thus causing an ice crush and an eddying movement, from which resulted the drift mounds above referred to.

The upper branches of Spring creek rise on a broad plateau about 1775′ A. T., and no very conspicuous cuts have been made between them and the streams running south.

The north branch, however, rises in Erie township, Crawford county, near the P. T. & B. R. R. summit mentioned by Prof. White in report Q^4, page 36, elevation 1646′ A. T., where there was evidently a draft from the north branch of French creek into it, as well as into the east branch of Oil creek.

Another ice-movement took place through the south-easterly branches of Spring creek into Hosmer run; cutting down the dividing summit to about 1600′ A. T.

The through cut joining Prosser run with Blue Eye run has been referred to in the topography of Columbus township.

The Olean conglomerate has all been eroded from the surface of the township, except on the summit of the ridge between Big Brokenstraw and Hosmer run and two or three small summits in the north-east corner. But notwithstanding this fact, there has been considerable prospecting for coal here, several hundred dollars having been expended at one spot near West Spring creek, in vainly trying to discover a paying deposit where such a thing was an impossibility—for the search was prosecuted in rocks more than 500′ beneath the lowest possible coal measures. When will the people learn to read and observe for themselves, so that they may not be thus easily cajoled into spending money in foolish mining schemes, by any "experienced miner" tramp who comes among them? These men infest every part of the country and being ignorant of the first principles of structure and perfectly regardless of geological formations or the character of the rocks they propose to work in, they will promise to find gold, silver, copper, lead, iron or coal in any locality where men can be found who will listen to them and furnish the money to carry on their prospecting operations.

The Sub-Olean has a wider range but makes no notable outcrops. It seems to have been more fully developed in the north-west part, where the small patches remaining are quite massive and contain some pebbles. This is bordering the pebble range in Crawford and Erie counties, before referred to in connection with Walden's cliff. In the eastern part of the township the rock is principally a yellow sandstone, but in weathering it becomes incorporated with its associated sandy shales in such a manner that its precise position can seldom be satisfactorily ascertained. The middle portion of the township is cut down into the Crawford shales, and on the higher grounds no massive sandstones appear.

Hosmer Run oil sand.—On Hosmer run, near the east line of the township and just below the old saw-mill on tract No. 320, a massive conglomeritic sandstone was found—elevation of top 1430′ A. T. It is of the flat pebble type and 15′ or more in thickness. The largest pebbles, in the upper part of the rock, are about an inch in diameter, but the bulk of them may be compared to millet and mustard seeds. They are white and yellow, with rather an unusual percentage of red and pink. Among them are well-preserved specimens of Spirifer disjunctus, Rhynchonella, and a smooth cast, not clearly distinguishable, but apparently a Cypricardia. This is probably the rock which has furnished the oil in the old Hosmer run oil pits, a mile further up stream. It possibly represents also, toward the north, the conglomerate seen in the Cotter farm section, (Pittsfield township,) and the Wrightsville conglomerate, and towards the south the sand which has produced a little heavy oil in several wells in Eldred township.

The exposure of this rock is rather remarkably accidental, for it is seen on a point in the valley but little above stream level, a situation in which the bed rock is usually concealed. At first sight it might be taken for a slipped mass, but on examination, a well-defined bench is seen at its top, above which not a block of sandstone can be found up to the top of the hill which is more than 300′ high.

It will be seen further on that other proofs of its being a genuine outcrop are furnished by the appended fragmentary legends of the Hosmer run oil wells.

Hosmer run oil pits.—When, or by whom, the Hosmer run oil pits were excavated, we have no means of ascertaining. They probably belong to the same age as those along Oil creek and French creek, but being on a small and obscure tributary of the Big Brokenstraw, away from the natural routes of intercourse between different sections of the country, they seem to have escaped the notice of early travelers, and to have attracted only local attention prior to the completion of the Drake well at Titusville, in 1859.

It is rather a singular fact, and one indicative of the perfect acquaintance of the people who sunk these pits, with every stream and spring in the country, that old oil pits are found in every place where oil could thus be successfully collected. Not one available surface oil deposit has been overlooked by these pre-historic oil seekers.

About twenty-five old pits may be counted in the valley of Hosmer run, but they are fast becoming obliterated. They were dug upon the flats where the stream wanders from side to side. Obstructions of fallen trees, against which the drift-wood piles and makes temporary dams, cause partial overflows of the bottoms during periodical freshets. New channels are thus cut, old excavations are filled up, and the face of the valley is constantly changing. Some of the pits were partly opened a number of years ago, and they are said to have been about 8′ square, 10′ or 12′

deep, and to have had a crib work of quite well preserved timbers at the bottom.

The surface oil indications did not long remain unnoticed after the success of the Drake well was announced. The Hosmer Run Oil Company, Garland Oil Company, and others, eagerly took up the lands in the neighborhood of the pits and commenced to bore for oil. But they made the same mistake that others have made since—the oil shows came from rocks near the surface—they sought for larger supplies from deep drilling. The wells were bored wet and seed-bagged on the tubing from 200′ to 700′ from the top, to shut off the surface water, consequently the rock which furnished the oil was not tested at all.

Mr. Andrew Zuver, who drilled one of the wells in the immediate locality of the old excavations, states that in digging the conductor hole, water and oil came in shortly after getting below creek level and interfered with the work. Believing that bed rock was not far below, and wishing to set the conductor upon it, he procured a common pump and set men at work to keep down the water while the digging went on. In this way 20 or 30 barrels of oil were pumped out with the water. The conductor was put in place, the well drilled to 600 feet, tested in the usual way, and abandoned. Considerable oil has been dipped from the old conductor since the tubing was drawn, and some may be seen there even now.

The elevation of this well is 1475′ A. T. or 45′ above the top of the conglomerate before referred to, which is seen lower down the stream about three quarters of a mile towards the east. The record gives conductor hole and soft shales 47′; "good pebble rock," (about one-third of it very coarse pebbles) 28′; soft drilling and no well-defined sands. 525′—total depth 600′.

The "deep well," near the above and about 8′ higher, was sunk to 1061′—a remarkable depth in those days. No record was preserved, but the driller remembers that the upper part corresponded with Zuver well and that a hard "flinty" sandstone 15′ thick was pierced at about 800.′

There was also a "good deal of red rock in the well." Being tested in the usual way it produced no oil.

Mr. Lewis Van Orman, on old resident, who superintended and assisted in drilling a number of wells, furnishes the following facts in relation to them. Two were put down by the Hosmer Run Oil Company, on the south branch which comes into the main stream with quite a rapid fall, near our conglomerate exposure. No. 1 found 30′ of sand at the surface; then soft drilling for 700′; then sand rock about 10′ in thickness, with 58′ of soft rocks below, down to 798′. It was seed-bagged at 730′ and pumped for several days, "giving a good show of oil of light gravity." The record of No. 2 was very similar, but the lower sandrock was mixed with slate and inferior in quality to that in No. 1.

Of well No. 3, which was not far from the Zuver well and about 130′ above it, he gives the following record from notes made while drilling:

Record of Well No. 3.

	A. T.
Elevation of well mouth, say	1605′
1. Conductor,	5 to 5=1600
2. Slate,	24 to 29=1576
3. Sandstone, gray,	5 to 34=1571
4. Slate,	10 to 44=1561
5. "Putty rock," (fresh water at 75′)	81 to 125=1480
6. Sandstone, gray, about	10 to 135=1470
7. Slate and shells,	35 to 170=1435
8. White sandstone,	30 to 200=1405
9. "Soapstone,"	228 to 428=1177
10. Pebbles at	428=1177
11. "Soapstone,"	302 to 730= 875

No. 8 seems to represent the rock exposed below the old mill.

Red rocks were found although they are not mentioned in the notes.

Well seed-bagged at 420′ and tested. Unproductive.

In all these wells we see a sandrock noted at about the proper place to represent the escarping conglomerate below the old saw-mill. The wells were drilled several hundred feet below it—the holes meanwhile standing full of water for weeks and sometimes for months. They were then seed-bagged far below it and pumped persistently without obtaining a show of the kind of oil so plentiful upon the surface. Could any other result have been expected? Yet none of the old operators seem to have comprehended the situation. They continued to drill deep wells until their funds were exhausted, and then abandoned the district in disgust—and now, after a lapse of more than 15 years, old boilers and engines still remain at some of the wells, and small old fashioned drilling tools lie scattered around, while trees of considerable size are growing among the deserted ruins in the valley.

It is by no means certain that the Hosmer Run rock contains a sufficient quantity of oil to bring large fortunes to those who might undertake to drill for it, but I see no reason why—especially as there is now such a demand for heavy oil, and at good prices—a judicious and economical system of testing and working this oil horizon along the axis of its best development, should not prove fairly remunerative.

The rise in the Hosmer Run conglomerate toward the north and north-east should bring it up to sight along Big Brokenstraw and Spring creek. If it is shown in the Cotter farm section, (see Pittsfield township,) by the 15′ conglomerate at 1455′ A. T., its rise in that direction (nearly northeast) must be very slow, for the distance between the two exposures is about two miles and a half. This is the only place along the Big Brokenstraw where I have seen any rock that could be regarded as its equivalent.

On Spring creek the following section, (reproduced from I[3] page 30) may possibly give a trace of the rock, but if so it has greatly changed in structure. This, however, would not be remarkable, for it would only be in keeping with the general habits of all these Warren county conglomerates.

Section seen at Johnson's Saw-Mill at W. Spring Creek.

		A. T.
	Top of exposure,	1477′
1.	Shale,	10 to 10=1467
2.	Sandstone, with shale partings,	6 to 16=1461
3.	Shale, brown,	3 to 19=1458
4.	Sandstone, in thin layers,	5 to 24=1453
5.	Shale, brown,	4 to 28=1449

6.	Sandstone, brown, laminated,	2 to 30=1447
7.	Shale, brown and blue,	6 to 36=1441
8.	Sandstone, pebbly, contorted, *coal films,*	2 to 38=1439
9.	Sandstone, brown,	1 to 39=1438
10.	Shale, brown.	1 to 40=1437
11.	Sandstone, yellow, rather massive,	6 to 46=1431
12.	Sandstone, greenish, soft, friable; to water level,	3 to 49=1428

No. 12 probably extends below water level. It is an imperfectly cemented incoherent mass, and easily crumbles in the hand when wet. It contains many fossils, among which Mr. Hall recognizes *Sanguinolites*, *Cardiomorpha*, and *Productella.* It also smells strongly of petroleum, and when crushed and dropped into water the iridescent colors, which constitute a "good oil show," are abundantly manifest. Good specimens of *Spirfer disjunctus* are seen in No. 6 and also in Nos. 8 and 12.

The following section seen at Spring Creek station, about 3½ miles north-east from West Spring creek, gives some intimation of the character of the measures overlying the rocks of the foregoing section, but unfortunately, the precise horizon exposed at Johnson's mill cannot be examined at the station, for it comes in the concealed interval of No. 13.

Spring Creek Station Section.

Seen in the face of the bold cliff north of Big Brokenstraw creek and but a few rods from the railway station.

		A. T.
	Summit over exposure,	1730′
1.	Concealed,	50 to 1680
2.	Shale, brown, fissile with a few 6″ sandstone layers, more sandy near the top,	63 to 1617
3.	Thin-bedded sandstone,	1 to 1616
4.	Blue shale,	3 to 1613
5.	Thin-bedded sandstone,	3 to 1610
6.	Sandy shale, brown, a few 1″ sandstone layers,	40 to 1570
7.	Thin plates of sandstone, interleaved with blue shale,	10 to 1560
8.	Thin-bedded sandstone, bluish-gray,	3 to 1557
9.	Shale, fawn color,	2 to 1555
10.	Shale, sandy, brown, some pebbles, wave marks,	6 to 1549
11.	Flaggy sandstone, layers 1″ thick,	1 to 1548
12.	Sandy shale,	8 to 1540
13.	Concealed to railroad station,	148 to 1392

No. 7 has been quarried to some extent for local purposes on the opposite side of the road from this exposure, where it appears to be a little more solid, but it is a very inferior stone and only fit for rubble work.

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7. *Pittsfield township. Organized in 1847.*

This township is thoroughly trenched by deep, wide, drift-filled valleys. Big Brokenstraw Creek passes centrally through it from west to east; Little Brokenstraw cuts across its north-eastern portion; Blue Eye Run enters from the north-west and joins Big Brokenstraw near the center. These all are through-cut valleys, along which the northern ices traveled without interruption, from the highlands several miles north of the State line; and consequently they are wide, deeply drift-filled and contain interesting evidences of morainal dams and post-glacial lakes.

Near Garland these great ice flows were caught in the bend of the Big Brokenstraw and forced over the hills southward; a part finding outlet into the several runs entering the Allegheny river at and near Tidioute, a part through Crouse's run into Caldwell creek, and thence into Oil creek as described in Report I^3. The energy of this ice-movement is plainly shown by the manner in which the country invaded by it has been scoured and degraded. Most of the carboniferous rocks have here been removed. But the action did not continue long enough to form any *deep* through-cut valleys, and hence the drainage of the southern part of the township is still northward into Big Brokenstraw, through Andrews' run on the eastern side and Crouse's run on the west.

The valley of Crouse's run is continuous with that of Caldwell creek, both streams rising side by side on an almost imperceptible valley-divide which is only about 150′ above Garland.

The lowest point in the township is where the Big Brokenstraw leaves it, 1220′± A. T. The highest, Nuttall's conglomerate peak, in the extreme north-eastern corner, 1955′ A. T.

The Olean conglomerate occupies a number of the higher summits north of the Big Brokenstraw, where it is the surface rock, all of the higher measures having been eroded. South of the creek a greater thickness of carboniferous strata remains some of the knobs rising high enough to catch the Kinzua creek sandstone; but no evidences of any coal of value have been seen here.

The Sub-Olean and overlying shales, here not so easily separable as in many other places—by reason of the sandy character of the shales and the imperfect development of the sandstone—cover the knobs and ridges surrounding the Olean outliers and weather into a smooth, easily cultivated and fairly productive soil.

In consequence of the excessive erosion to which this township has been subjected and the prodigality with which the drift has been spread along the hill slopes not many exposures of the lower rocks can be seen. Occasionally a few feet of fixed rock may be noticed—sometimes in one horizon, sometimes in another—barely enough, in connection with the topography and soil, to give the investigator a general idea of the structure as he passes along; but nothing of sufficient importance to merit notation or to be of any particular use if put on record.

The measures between the Sub-Olean and water level, evidently carry no conspicuous beds of persistent conglomerate or sandstone, else more frequent outcrops would appear, notwithstanding the universality of the surface deposits. The only geological sections of importance obtained in the county are the following.

Cotter Farm Section, in Pittsfield township.

Seen descending the cliff on the northerly side of Big Brokenstraw creek, about half a mile north-westerly from the Garland quarries, and near the old Cotter farm dwelling, now the property of Mr. C. W. Hare.

The summit over the exposure reaches an altitude of 1780′ A. T. It is smooth and no bed rock appears in sight. The sub-Olean should be seen here if it retains anything like its usual massive character, but nowhere in this section of the country have I been able to recognize it, unmistakably. It appears to have lost its distinctive individuality, and to have degenerated into a thin bedded mass that makes no conspicuous outcrops.

As the Garland quarries are but a short distance from this summit, and the Olean conglomerate is there found at 1810′ A. T., we may take this rock as the starting point of our section, which will then be as follows:

		A. T.
	Base of Olean conglomerate,	1810′
1.	Concealed, (apparently, mostly sandy shale,)	200 to 1610
2.	Thin-bedded sandstone; thickness ±,	20 to 1590
3.	Concealed, (apparently sandy shale,)	135 to 1455
4.	Conglomerate, small flat pebbles, yellowish, iron-stained, current-bedded, massive, but weathering into small blocks,	15 to 1440
5.	Shales, bluish, with some thin sand plates,	65 to 1375
6.	Layer of argillaceous, fine-grained sandstone,	1 to 1374
7.	Shale, a little sandy, blue and brown,	41 to 1333
8.	Sandstone, quite massive, greenish-gray, seen,	3 to 1330
	To level of experimental well No. 1, the record of which may here be added. (See Report II, p. 196.)	
9.	Concealed, (conductor in the well,)	13 to 1317
	Level of water in Big Brokenstraw creek,	1315
10.	Slate, blue and gritty,	6 to 1311
11.	Sandstone, grey,	2 to 1309
12.	Slate,	11 to 1298
13.	Sandstone,	2 to 1296
14.	Slate,	49 to 1247
15.	Shale,	30 to 1217
16.	Sandstone, white, flinty, show of oil,	40 to 1177
17.	Soapstone,	54 to 1123
18.	Slate, gritty and mixed with quartz,	18 to 1105
19.	*Red rock*,	4 to 1101
20.	Soapstone,	5 to 1096
21.	Slate, with thin white sand shells,	16 to 1080
22.	Soapstone,	43 to 1037
23.	Sandstone, quartz, thick oil and gas,	2 to 1035
24.	Soapstone, oil show,	35 to 1000
25.	Sandstone, (crevice,)	2 to 998
26.	Soapstone, show of oil and soot,	20 to 978
27.	Slate,	10 to 968
28.	Soapstone,	14 to 954
29.	Sandstone,	4 to 950
30.	Not described, (undoubtedly soft drilling,)	240 to 710
31.	Slate, hard,	10 to 700
32.	Sandstone,	5 to 695
33.	Soapstone and slate,	97 to 598
34.	Sandstone, (3d sand,)	7 to 591
35.	Slate, soft and soapy,	8 to 583

The above section has only recently been laid bare by a large land-slip which leaves a beautiful exposure of the face of the cliff.

No. 4 appears to represent the Hosmer Run conglomerate, (see Spring Creek township,) although we should have looked for that rock here at a higher elevation.

No. 8, (which is probably thicker than this partial exposure makes it,) is the only stratum that can correspond with the 10′ sandstone (top, 1343′ A. T.,) of the Garland section given below. If it be the same, it also lies very low. Is there a depression in the rocks at this point, or are these really different strata? It may be noticed that the well-defined Spirifer band seen at Garland does not appear above the Cotter farm sandstone.

About a mile north-east of the Cotter farm in a cutting along the valley road, a 2′ massive fine-grained, grey sandstone is seen lying upon shale. (Elevation, 1365′ A. T.) Over it are 15′ of fissile, irony shale, overlaid by 5′ of false bedded flaggy sandstone.

Garland Section, in Pittsfield township.

Seen on the point of the bluff, about 80 rods west from the Philadelphia and Erie railway station at Garland.

		A. T.
Top of exposure,		1365′
1. Shale, blue and brown, sandy,	15	to 1350
2. Sandstone, weathering brown, a mass of *Spirifers*,	2	to 1348
3. Shale, brown,	5	to 1343
4. Sandstone, fine-grained, massive, grey,	10	to 1333
5. Shale,	½	to 1332½
6. Plate of sandstone with fossils,	½	to 1332
7. Shale, fissile, brown and blue,	18	to 1314
8. Thin sandstone with *Spirifers*,	½	to 1313½
9. Shale to RR. level,	2	to 1311½
10. Concealed to creek, about,	18½	to 1293

On the east branch of the Little Brokenstraw about two miles north-west from Pittsfield and three miles north-east from Garland (tract 173) a massive 20′ sandstone makes a very bold outcrop. It is fine-grained, yellowish and gray, breaks with an irregular fracture, and some of the most solid layers measure 4′ in thickness. Wave marks and fucoids are numerous on the thinner plates and fossils are quite plenty. A well-preserved *Spirifer band* comes in near the top, which has an elevation of 1390′ A. T. This sandstone probably represents No. 4 of the Garland section.

Oil Wells.—A large number of drill holes have been sunk in Pittsfield township in quest of oil, but they all have proven unremunerative. Most of them were put down in 1865 or shortly thereafter, when the methods of drilling and testing wells were very unsatisfactory. These were in the valleys, along the Big Brokenstraw, Crouse's run, Hosmer run and Little Brokenstraw.

The majority of them were only from 200′ to 300′ deep; but some went 600′ or 700′, and one is reported as 1500′. Very little can now be learned about them. Nearly all had "shows of oil" but only one seems to have produced a sufficient quantity to warrant the supposition that it might have been made a paying well if it had been treated as wells are treated now. This was the Payne well on the McIntyre or Holcomb farm on the east side of Little Brokenstraw about two and a half miles above Pittsfield. The depth of the well and the point at which the oil came in have been variously reported. Mr. N. F. Wright of Wrightsville, who watched the drilling of this test well with great interest, thinks the oil was found at 584′ from the surface, although the drill was not stopped until between 700′ and 800′. The elevation of the well mouth is 1325′ A. T., therefore this version of the record would place the oil rock at 741′ A. T., which brings it close to where the Warren oil sand might reasonably be looked for. Oil can still be dipped from the old conductor. It is of amber color and very similar in general appearance to the Warren oil.

So promising were the indications in this well that the surrounding lands were secured a few years later, (about the year 1871) and the Young well was drilled a short distance from it. The latter seems to have been judiciously managed and it certainly was drilled deep enough, but no oil was obtained.

Another well was located about 50 rods south of the old hole, in the fall of 1881. I can only learn of this venture, that at the depth of about 800′ the boiler exploded, after which the well was abandoned—the owners probably being satisfied that it was useless to make further outlay as they had already passed through the horizon which furnished the oil in the old well.

More recently other wells have been put down on the higher lands—dry cased holes, managed by experienced men and therefore reliable tests. One was on the Cole farm on Cole hill about 2 miles S. S. E. from Garland. Elevation of well mouth 1766′ A. T. The original owners sunk the hole to a depth of 1020′, passing through the horizon of the Venango group without any indications of oil and finding so little of interest to note that they kept no record of the drilling. Messrs. Struthers and Taylor of Warren then obtained control and cut on down to a depth of 1785′—19′ below ocean level and more than 1100′ below the place of the Third oil sand of Tidioute. Mr. Taylor states that in the 765′ drilled for him, no sands were found—nothing but a homogeneous mass of slate or shale with an occasional thin sand shell. The massive and thick sandstones of Warren, Clarendon and Cherry Grove are evidently wanting here.

Another well was sunk on tract No. 173 about 2 miles north-west from Pittsfield late in 1881. The record is withheld for the present, but as no oil was obtained after drill-to the proper depth, the presumption is that no new features of structure were developed by the experiment.

About three quarters of a mile above the Holcomb farm an interesting morainal dam is thrown across the Little Brokenstraw valley. It lies just below the mouth of Miles' run, which enters the Little Brokenstraw from the north-west and heads in the highlands in Freehold township, and was caused no doubt by the counter currents of ice coming in from that direction. The average altitude of its top is about 1365′ A. T. which is sufficient to flood the valley as far up as Wrightsville. The drifts here, both in the main stream and in Miles' run, have a decided lacustrine aspect, and there can be little doubt that the present stream has gradually worn down the barrier and lowered the water by successive stages, which accounts for the old beaches and terraces now lining the valley.

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8. Brokenstraw township. Organized in 1820.

Big Brokenstraw creek and the Allegheny river meet near the center of the eastern line of Brokenstraw township; the former dividing it into two nearly equal parts, the latter forming the easterly boundary of its southerly half. The northerly part has a direct southerly drainage—its eastern side through Irvine run into the Allegheny; its central part through Matthew's run and tributaries into Big Brokenstraw; its western through Mead run into the same.

An elevated north-east south-west ridge decides the direction of drainage in the southerly half, throwing a part of it northward through York run into the Brokenstraw and a part eastward through Dunn's run and Ander's run into the Allegheny.

The valley of Matthew's run is wide and out of proportion to the size of its present stream, showing that its excavation must have been partly due to other causes than those now operating within it. It is the direct southerly outlet to the glacial gap cut through the ridge south of Chandler's valley. (See Sugar Grove township.)

The lowest point in the township is at its south-east corner: surface of water in the Allegheny river, 1140'±. The highest York Hill near the center of the southern half, 1905'.

The Olean conglomerate caps this summit but the rock in place occupies only a very small area. Large loose blocks lie scattered on the slopes, and being composed almost wholly of pebbles they disintegrate by exposure and crumble into beds of beautiful white gravel and sand. This is the most northerly outlier of conglomerate in the township. In the south-west corner a greater thickness of carboniferous measures are found, extending up in some places above the Kinzua creek sandstone. Some indications of coal have been noticed here, but they do not promise anything valuable.

The Sub-Olean covers two or three of the summits along the northern township line, where it seems to be more silicious, harder and less discolored with iron than usual. The shales both above and beneath it are also quite sandy. In the southern part the rock is yellow and irregularly bedded. It is of considerable thickness; friable; weathers evenly with the enclosing shales; no bold outcrops.

A number of exposures of quite massive sandstone, lying between water level and the sub-Olean, are seen in the township. These bands seem to grow more numerous and more massive in structure as they are traced eastward.

In the west bank of Matthew's run, about a mile above Youngsville, 8′ of quite massive sandstone shows itself, lying on 15′ of bluish-brown, fissile shales which contain some irony concretions. It is a grayish, medium grained sandstone, somewhat irregularly bedded, with thin shale partings between layers. Elevation of top 1265′ A. T. This, it will be perceived, is a lower stratum of sandstone than any before noticed upon the surface.

Between Youngsville and Pittsfield 20′ of shales similar in appearance to the Matthew's run shales are seen at an elevation from 1300′ to 1320′ A. T. Too high to be identified with them, they belong above the sandstone.

Higher up in the measures two massive flat pebble rocks appear, as shown in the Irvineton section (Allegheny series No. XIII.) One or both of these rocks can be seen in a number of places along the streams north and east of Youngsville, and they are well developed in Conewango township. On a small run entering the Big Brokenstraw about a mile west of Irvineton both make good escarpments. They may also be detected in going up the road about a mile northeast of Youngsville. After ascending the hill, the road winds around to the north-west and then to the south-east, and just where it descends into the valley of Irvine run another fine exposure of conglomerate occurs. About 10′ of the face is visible—elevation of top 1430′ A. T. Below this for a mile or more the valley is full of large blocks, some of them the last remnants of Olean conglomerate swept from the hills at the north. About two miles from the river, a summit east of Irvine run holds a rock city of the same kind of conglomerate as that seen at 1430′ A. T. Elevation on top of rock city 1490′ A. T.

Throughout the eastern part of Brokenstraw and the whole of Conewango, there are many exposures of massive flat-pebble conglomerate, all very similar in appearance and they vary so singularly in their relative elevations, (as ascertained by the aneroid,) that it may be questioned whether there are two, three, or more conglomeritic sandstone horizons, changing in level because the deposits forming them were laid down over restricted areas and in different planes; or whether in this region the rocks have been warped or thrown into small domes and dimples, so that no dependence can here be placed upon the usual calculations of dip; or whether a part of the difficulty in making satisfactory identifications may not be due to the inaccuracy of barometric observations of height. It is obvious that these conglomerates materially change their physical characteristics, and that within short distances. They all imitate each other in this respect. Two exposures may be seen in one cliff, the upper conglomeritic, the under a sandstone. Within a mile these conditions may be reversed. Hence the aspect of the rock is no absolute guide to its identity, and when only one outcrop can be seen and the level does not appear to correspond with any other known horizon, we cannot be sure but that some stratum, unimportant elsewhere, has locally expanded so as to demand recognition as a distinct member of the geologic section. Only by a careful system of spirit leveling and a thorough examination of every available exposure can positive identifications be got.

South of the Brokenstraw are few exposures; slopes more uniform; bed rock almost always concealed.

At the "Sulphur Spring," on Ander's run, about two miles west of the Allegheny river, a massive sandstone, containing some pebbles toward the top, makes several very prominent outcrops. Top, 1450′; thickness at least 20′. The same stratum shows on the ridge north of Ander's run about half way from the spring to the river at 1440′.

"*Sulphur Spring*" has become quite a popular place of resort within the last two or three years. Its location is pleasant, the surroundings are romantic, and the waters are found to be very beneficial to those who suffer from rheumatic affections and other diseases of a kindred nature. The spring issues with a copious flow from a crevice in the top of the sandrock, at a point in the valley just above where the stream cuts down through it. A neat spring-house has been erected over the spot, and an excellent hotel is open for the accommodation of visitors. Some thirty or forty summer cottages have already been built, and walks and drives are being put in order as far as the restricted dimensions of the glen will permit. A bathing house where hot and cold baths of spring water are scientifically administered, is one of the chief attractions of the place. Good approaches have been made so that the spring can be reached by a pleasant drive of about three miles either from Irvineton or from Youngsville.

An analysis of some of the water, bottled and hermetically sealed at the spring and sent direct to Dr. Genth of the University of Pennsylvania reads thus:—

"The water is from the 'Sulphur Spring,' two and a half miles south-west from Irvineton, Warren county, Pa., and contains in one gallon of 231 cubic inches—as follows:"

"Chloride of sodium,	= 0.97911	grains.
Sulphate of calcium,	= 0.61382	"
Carbonate of iron,	= 0.18465	"
" magnesium,	= 2.47384	"
" calcium,	= 4.74604	"
" sodium,	= 7.49054	"
" potassium,	= 0.50571	"
Silicic acid,	= 0.60586	"
Carbonic acid,	= 6.59603	"
	24.19560	"

PHILADELPHIA, *November 14, 1881.*

Oil, in paying quantities, has not yet been found in Brokenstraw township, although ten or more wells have been sunk in search of it. Some of these were put down at the commencement of petroleum developments, and did not go deep enough to reach the Warren oil sands, but others have been drilled more recently, and may be considered as fair tests of the territory. As no records can be obtained, we are not enlightened by them as to the character of the lower rocks. One well, drilled near Youngsville, in 1881, seems to have met with partial success, for after having been torpedoed and manipulated in the most approved manner, it produced a small quantity of oil. But that the indications in this well are such as to authorize the expectation of finding a profitable oil field here, may be fairly questioned when we remember the want of success which has attended all other experimental drillings in the district.

Southwestern Division.

9, Eldred; 10, South-West; 11, Deerfield; 12, Triumph.

In its extension north-eastward, the Venango oil group enters Warren county west of the Allegheny river, and the four townships which form the southwestern division embrace all the oil territory in the county, (except that small portion of Limestone township which lies directly south of Tidioute,) that has yielded profitable returns from that series of rocks. Here, as in every other section where reasonable hopes of finding oil might be entertained, agricultural interests have suffered as oil developments advanced. Stimulated by successful ventures near Tidioute and Enterprise, land values became inflated throughout those townships, even before the excitement of 1865, and many tracts changed hands at prices far beyond their value for any purpose except the production of oil. Of course a very small proportion of this prospective territory proved valuable, but nevertheless the lands were withheld from improvement for oil company lands, whether productive or not, soon deteriorate for farming purposes, and generally lie neglected for years before they again come under the plow. But the lack of agricultural enterprise is not chargeable entirely to the impediments thrown in its way by the oil business, for there are large tracts of unimproved lands, heavily timbered, of uneven surface, rocky, and sometimes inconvenient of access, which would not be speedily settled under the most favorable circumstances.

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9. Eldred township. Organized in 1843.

This township joins the Crawford county line, and is the second north from Venango county. With the exception of small areas in its north-western and north-eastern corners, it all drains southerly through the west, middle, and east branches of Caldwell creek and their tributaries, into the Oil Creek basin.

Its lowest point is found where East branch leaves the township at the south—probably about 1300′ A. T. The highest elevation noted (1805′ A. T.) is near Ezra Trim's, in the northern part, about a mile and a half north-east from Eagle post-office, but possibly there may be a higher point in the north-eastern corner.

East Branch crosses its south-easterly portion, flowing in the broad and deeply drift-filled valley before referred to, as extending from Big Brokenstraw to Oil creek. The other streams rise within the township, and their valleys are not so broadly excavated.

The average altitude of the table lands is probably about 1700′ A. T. An elevated border extends along the westerly and northerly sides, the highest points of which take in the sub-Olean and part of the overlying shales. On these smooth, broad topped hills some excellent farming lands are found. The central portion, being deeply trenched by numerous streams, is thus by reason of its broken surface, not so well adapted to cultivation; nevertheless, there are many spots here, where a considerable acreage of good tillable ground can be had. In the south-eastern part, the Grand valley of Caldwell creek holds some of the most fertile lands, and its convenient railroad facilities have tended to centralize the lumbering interests there, to a great extent, so that this section promises to become one of the most flourishing portions of the township.

The Olean conglomerate scarcely retains a foothold in the township. Only in the south-east corner is it to be recognized, and there it is almost devoid of pebbles and makes no conspicuous outcrops.

The Sub-Olean, wherever seen, (except in the north-west corner) appears as a medium-grained, yellowish, friable sandstone and weathers into small approximately cubical blocks—the same type which is presented in South-West township and in Crawford and Venango counties, in the vicinity of Titusville. But in the north-west corner it seems to be more massive, weathers into larger blocks and contains quite a percentage of pebbles.

Oil Wells.—No good surface exposures of the underlying measures are to be seen, but a number of oil wells have been drilled, some of them commencing well up under the sub-Olean, and from them we may get a pretty good idea of the structural peculiarities at this horizon.

The record of Cattasaque well, drilled in 1865 about a mile E. S. E. from Eagle post-office (elevation 1549′ A. T.) shows 28′ of sand at 1307′ A. T.—the Ackerman well 43′ of sand at 1239′ A. T. and the White well 30′ of sand at 1225′.*

This persistent stratum appears to be the Hosmer run conglomerate, which, according to these figures, dips at the rate of about 24′ per mile from Hosmer run to Cattasaque well, (about 5½ miles S. W.) and 33′ per mile from there to White well, (2½ miles S. S. W.) The Ackerman well is about 100 rods N. W. from White's, and they both are located near the Spring creek road in the third tract north of South-west township. No other layer of sandstone has sufficient individuality and persistence to secure for it a recognition in any two of the wells. The other parts of the records show how variable these sandy shales may be made to appear by the classifications of different drillers. The Cattasaque well gives only "slate and soapstone"† for 231′ above the pebble sand; Ackerman well gives 221′ of "sandstone slate and soapstone" in the same interval; while the

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* See Report II, page 195, and page 52 in this volume.

† "Soapstone" was the common designation with old-time drillers for any kind of argillaceous shale or slate, which, when ground up by the drill in a hole full of water gave sediments smooth and soapy to the touch. As a general term it represents soft drilling, although the rocks may be partly argillaceous and partly muddy sand-shales.

White well, in a space of 191′ finds a *First sand* 50′ thick and a *Second sand* 25′ thick. In all probability there was great similarity in the rocks at this horizon in all the wells. The drillers of 1865, not yet having learned what the "regular" order of structure should be, simply noted the facts as they found them, using their best judgment in describing the character of the drillings brought up by the sand-pump, without attempting to make them correspond with any pre-arranged formula. The drillers of 1880 were more experienced. They knew what "regular drilling" should be, hence they must find a *First* and *Second* sand in the well, or the territory would not be considered promising. By introducing three sands the impression is conveyed that the oil producing rock here is identical with the *Third sand* of oil creek. But we must not be deceived by names thus arbitrarily used, for it is plain that the "Third sand" of the White well (if it belongs to the Venango group at all) represents the *First sand* of Oil creek and not the *Third.*

In the Church run district of Crawford county, about a mile and a half north-east of Titusville and six miles south-west from White well, the *First oil sand* is found from 30′ to 60′ thick. Elevation of top, 1100′ A. T. (See II, p. 66.) In the Newton gas well, (elevation, 1632′ A. T. See II, p. 198,) about 3¼ miles from Church run, and 3 miles from White well, the top of 40′ of *First sand* is given at 1157′.

From Zuver well on Hosmer run, (Pittsfield township,) south-westerly to Church run, we may trace a well-defined sandrock quite continuously in a number of wells, as follows:

		Dist. miles.	Direction.	Total fall.	Rate per mile.
Top 1st. SS.					
1428 A. T.	Zuver well to Cattasaque, . .	4¾	S. W.	121′	25½′
1307 A. T.	Cattasaque well to White,	2¾	S. S. W.	82′	30 ′
1225 A. T.	White well to Newton, .	3	S. by W.	68′	23 ′
1157 A. T.	Newton well to Church Run,	3¼	S. W.	57′	17½′
1100 A. T.	Church Run wells to Zuver,	13¼	N. E.	328′	24¾′

These are only approximate calculations, but they make it appear quite probable that the sandstone noted at all these points belongs to one and the same stratum, the *First sand* of the Venango group.

The top of *Third oil sand* in the Church run records is given at 829′ A. T. If the White well so-called *Third sand* be the same rock, it must dip toward the south-west at the rate of 66′ to the mile. Again, the *Third sand* at Church run lies about 740′ below the base of the Olean conglomerate; while the White well oil rock only about 500′.

The White well oil is reported at 47° gravity. I have not tested it fresh from the well, and therefore cannot dispute the weight, but it is quite certain that it is very much heavier when taken from the tank a few days after. It is much darker in color than the Church Run oil, and makes a good natural lubricator.

In that part of the township lying south-west of the Caldwell valley, quite a prolific oil district has been discovered. Some forty wells have been drilled there, over twenty of which are still producing oil. The first one of importance, the Atlas well, was struck in 1867. It started at about 15 barrels per day, and produced several thousand barrels of oil; but other wells sunk near it proving dry, the field was abandoned as unprofitable, and lay almost unnoticed for about ten years, when Mr. T. C. Joy commenced a new development a mile south-west of the old well. This proved more successful than the former ventures, and resulted in outlining a narrow deposit of oil-bearing rock about a mile in length, which has now been pretty thoroughly drilled over. Naturally the wells are not large producers, but torpedoes have a good effect upon the rock, and by their use a yield of 40 or 50 barrels per day has been obtained from some of the wells, hence when the shallow drilling and ready facilities for shipping oil are taken into consideration, it may be regarded as a desirable location to operate in.

The oil is said to vary somewhat in color and quality in different wells, ranging in gravity from 47° to 33°, the heaviest coming from wells at the south-west, and probably from a higher rock than the *Third sand*, which here appears to belong to the *Third sand* horizon of the Venango group.

Joy well, No. 3, on the Dunderdale tract, Warrant No. 194, gives the following record:

Well-mouth above ocean, in feet, (barometer,)	1380
Conductor, about	80 to 80=1300
Shale and thin sand shells,	148 to 228=1152
First sand,	25 to 253=1127
Slate and shells, (including 2d SS. which was only shells,)	170 to 423= 957
Third sand, white, fine-grained, pebbly on top,	57 to 480= 900

The Third sand in the productive wells is from 50′ to 55′ thick, and nearly all the wells pump more or less salt water.

On the ridge south of this well the sub-Olean is exposed, top, 1560′ A. T.

Comparing these elevations with others to the west and towards the south-east, we see that all the rocks are slightly depressed in this locality.

The *First sand* (called the *Third*) in the White well lies 73′ higher than the *First sand* here.

The *Sub-Olean* near White well lies about 120′ higher than it does here.

The *First sand* at Tidioute is from 80′ to 100′ higher, the *Third sand* 50′ higher, and the sub-Olean 70′ higher than the corresponding rocks here. Tidioute lies 6 miles E. S. E. from the Joy wells, and a *rise* of over 10′ to the mile in that direction is rather remarkable.

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10. South-West township. Organized in 1838.

As implied by its name, this is the most south-westerly township in the county, having Crawford county for its western boundary, and Venango county for its southern. Its surface is diversified with broad valleys, in some places swampy and unsuited to cultivation, smooth summit table-lands and gently sloping hillsides, deep ravines, and steep rocky declivities. An irregularly outlined dividing ridge, holding upon its summit a broad plateau which gradually rises from about 1550′ A. T. to 1650′ A. T., extends diagonally through it from south-west to north-east, bounded on the north-westerly side by the deep broad valley of Caldwell creek, which receives about half the drainage of the township, and on the south-easterly side by Pine creek valley, into which centers the drainage of the other half. These two streams unite immediately upon entering Crawford county, and flow onward to Oil creek and thence to the Allegheny.

Pine creek valley has been considerably enlarged by the movements of ice driven into it from the vicinity of Grand valley, and also through a low divide just west of Triumph, but it is not so wide and not nearly so much obstructed by foreign drift as Caldwell creek valley.

The lowest point in the township is where Pine creek crosses its westerly line, 1200′± A. T. The highest, where the northerly line crosses the dividing ridge before referred to 1700′ A. T. This ridge at Wales' corner near the center of the township is 1660′ A. T.

The Olean conglomerate is the surface rock on the first ridge east of Caldwell creek, where it shows as a very pebbly loosely cemented stratum and has weathered into a rocky gravely soil which has sustained a heavy growth of gigantic pines and chestnuts. Throughout the central portions of the township it appears to be sandy friable and thin bedded, forming no conspicuous outcrops, and is so obscured by surface deposits of a homogenous character, that its exact limits are not easily ascertained. It is evident, however, that no considerable thickness of carboniferous rocks overtops the conglomerate in this region. Near the south-east corner it again appears as a massive pebbly conglomerate, forming bold cliffs faced with large cubical blocks, and here some of the higher knobs run up to the base of the Kinzua creek sandstone. But the areas covered by these higher measures are so small, that no coal need be looked for in the township.

The sub-Olean in every part of South-West is a yellowish, medium-grained, iron-stained sandstone. Being thinly-bedded and checked by innumerable cleavage planes, it makes no bare escarpments, for the rock on weathering universally covers its face with a sloping talus of small angular blocks, which become so intermixed with the sandy shales above and below it, that nothing but a steep pitch remains, under the most favorable circumstances, to indicate its position. It is probably from 20′ to 40′ in thickness, and generally furnishes abundant springs of good water at its base.

The overlying shales are quite sandy, and produce a genial soil, free from stone, easily tilled, and particularly well adapted to the cultivation of fruit. The underlying measures are also a mass of sandy shale, but rather more argillaceous and considerably charged with iron.

On the road from Enterprise to Titusville, and lying in about the right position to represent a portion of the Third mountain sand or Pithole grit, a bed of irregularly bedded, flaggy, yellowish sandstone is exposed, one of the layers being quite massive and a foot or more in thickness. It is wonderfully fossiliferous, the under side of one layer being nothing more than a confused mass of shell casts. Fossils of the Spirifer family greatly outnumber all others in the thickest layer, but the variety of forms to be found here in a simple road cutting of not more than five feet, is something remarkable. See list below.

Spirifer Carteri, and two or three other varieties.
Orthis Michelini.
Hemipronites crenistria.
Athyris lamellosa.
Rhynchonella contracta.
Productus, (same as Figs. 3 and 4, Ohio Report, Vol. 2, plate 10.)
Platyceras.
Aviculopecten.
Straparollus.
Orthoceras.
Crinoids.
Ctenecanthus triangularis.

Layers of fossiliferous sand-plates of similar character outcrop near the Joy wells at Grand valley at 1425′ A. T. The stratum seems also to be traceable as the "Mountain sand" in the four wells of the Woodland Oil Company, (well records, pages 49 and 50,) located in the north-east corner of the township, where it is noted as lying in quite a regular plane, but varying in thickness from 15′ to 123′—an illustration of the unsteadiness of deposits at this horizon, where the acquisition of a little more sand in one place than in another converts sandy shales into hard drilling, and causes them to be classed as sandstones by drillers.

No mountain sand is mentioned in the records of the Colorado wells in the south-east corner of the township (see II, p. 88, &c.,) although quite a number of them drilled through it, neither was its outcrop seen, for it could only appear along some of the lower streams where the bed rocks are usually covered with drift, hence we cannot trace the fossil bearing horizon in that direction.

Oils Wells.—Between two and three hundred oil wells have been drilled in South-West. The first were early tests attempted along Pine Creek, but they amounted to nothing and no important developments were made until the great oil excitement of 1865 when all the country was invaded by land speculators and petroleum company organizers, and this township, with those surrounding it, became the theater of a great deal of active work. Many wells where put down during that year, but the only promising field discovered was in the vicinity of Enterprise, where operations have been continued ever since, but on rather a limited scale, however, for the oil sand has been found to be so treacherous and uncertain in its yield and so restricted in its area, that only those who controlled the best of the territory and moved cautiously, succeeded in making the business of oil producing a profitable one.

Not until the summer of 1870 was the noted Colorado district opened. This is located in the south-east corner of the township, east of the valley of Pine creek, and the position and direction of the narrow belt along which oil was obtained, is very closely designated on the geological map of the county by the road running north-easterly and approximately parallel with Pine creek. As the oil producing rock was a continuation toward the south-west of the thick and remarkably prolific sandrock ranging through Triumph township, from Tidioute to Triumph, New London and Clapp farm, it proved to be very productive, and it is quite improbable that anything like it remains to be discovered in this region. The south-westerly end of the belt seems to terminate rather abruptly and although a prolongation of the line would intersect good developments at Shamburg and on Oil creek, in Venango county, the connecting links, in the form of paying oil wells, are entirely wanting—the chain breaking a mile or more before reaching the county line.

Near the center of the township, and on a line between the Enterprise and Grand Valley developments, some oil was obtained several years ago and the indications were considered so flattering that eight wells have since been drilled in that immediate locality. A very fair sandstone rock is reported, and every well produces oil, but they are so small —soon settling down to two or three barrels per day—that the district attracts but little attention. The oil rocks belong, evidently, to the same range as those of Enterprise and Grand Valley, and it is possible, therefore, that better deposits will yet be discovered when the price of oil advances so that more thorough tests are warranted.

Between this Enterprise-Grand Valley range and the Colorado belt in the south-eastern part of the township, a great many wells have been drilled but with rather discouraging results. It would seem from what can be learned from the imperfect accounts given of them, that the structure and composition of the oil group there are quite variable and do not compare favorably with the productive belts on either side. But still there is room for further experiment in this region, and a series of systematically conducted tests, like those made to develop the Colorado belt, may result in opening up some limited beds of productive sandrock.

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11. Deerfield township. Organized in 1820.
and
12. Triumph township. Organized in 1878.

In topography, drainage, surface rocks and other general characteristics, these two townships are so much alike that they may very properly be described together. The old boundaries of Deerfield formerly included Triumph and it is remarkable how nicely they outline a water shed contributing directly to the Allegheny river—only a very small portion in the extreme north-west corner being traversed and drained by the through-cut valley from Big Brokenstraw to Oil creek, which valley here attains its summit altitude, about 1460′ A. T.

The elevated plateau referred to in South-west township, continues on through Deerfield and Brokenstraw, and from it several rapid, deep-cut and short streams descend to the Allegheny. Tidioute creek, reaching further north and west than the other streams, and therefore having been subjected to more active erosion, makes quite a break through the table lands. The effects produced by the northern ice-sheet which was caught in the curve at Garland and impelled over the dividing ridge toward the Allegheny near Tidioute, is partially shown by the coloring on the geological map. The ice flowed over and cut through at every favorable point where streams headed in proximity to each other, and it had sufficient energy to scour down the country along its lines of greatest activity and remove nearly all the carboniferous rocks. As another result, it dumped immense drift beds into the Tidioute basin.

The lowest point in Deerfield is the Allegheny river at Tidioute 1098′ A. T.; the highest may be found near the south-east corner of Pittsfield 1890′ A. T.

The lowest point in Triumph (and also the lowest in the county) is where the Allegheny river crosses the county line 1082′± A. T. Just west of Triumph the summit rises to 1750′ A. T. and north-west of this, near the road from Tidioute to Grand Valley, the same altitude is reached. These are probably the highest points, but there are several others not more than ten or 20′ lower.

The Olean conglomerate on Triumph ridge carries some shale above it, and in several places black, bituminous beds, resulting from the incipient processes of coal making—but of no value—have been found. On the summits north-west from Triumph, also, the conglomerate is overtopped by shales, but in all other parts of Triumph township where the geological map is colored to designate carboniferous rocks the basal member (Olean conglomerate) is all that remains.

Deerfield township contains a greater thickness of these measures but only in the northern part. Across the center where the most direct and active ice-flow from Big Brokenstraw to the Allegheny occurred, hardly a trace of Olean conglomerate can be found. To the north-east of this the surface gradually rises—the Olean comes in as a massive coarse pebble conglomerate, forming bold cliffs along the streams—and, on the higher eminences, bearing shales and sandstones above it, which extend up to, and perhaps in some cases above, the horizon of the Kinzua creek sandstone. Only slight indications of coal have been noticed here, and it is quite improbable that any valuable deposits will be found in the township.

Some of the conglomerate outcrops approach nearer to the river than the map coloring implies. Where the surface is so trenched with streams as this is, and the conglomerate only lies on points and narrow crooked hog-backs, it is impossible to properly represent every exposure—and especially so where the streams are not laid down accurately on the map.

The Sub-Olean and overlying shales give character to the greater part of the hill soils in Triumph township, and both rocks and soils are very similar to those of the adjoining township, South-West.

Across the center of Deerfield the sub-Olean seems to be less massive and more argillaceous, and to assimilate more closely with the sandy shales enclosing it. This section is also covered with an unusal thickness of surface deposits and the hill slopes are smooth and unbroken—hence very few good exposures for a satisfactory examination of the rock can be seen. In the north-eastern part, some pebbles appear, and the rock here begins to assume somewhat of the more massive and conglomeritic structure which characterizes it further toward the north-east and east.

Pithole Grit.—Referring to the series of surface sections along the Allegheny river, and the numerous well records published elsewhere, we see that the Pithole grit (Third

Mountain sand) loses its individuality to a great degree as it is traced towards the north. Instead of a well-defined sandstone, holding a fixed place and lying between thick beds of ordinary shale, a mass of flaggy, irregularly bedded sandstone and sandy shale comes in at this horizon, and it is so variable in the thickening and thinning of its sandy members, that no particular stratum can be traced in the same plane for any great distance.

The First Oil sand also seems not to be so well defined in the eastern parts of Deerfield and Triumph as in the west. The *Second oil sand*, at Triumph and along the river, is divided into two members, while two or three miles northwest of this range its place can scarcely be recognized by drillers, so homogeneous have all the rocks become between the First and Third sands.

The Third Oil sand, 120′ thick at Triumph, is only about 30′ at Tidioute, and three miles or less either north or east of the latter place, if present at all, it is so thin and poorly developed that it hardly deserves to be called a sand.

Oil wells.—No township in the county has been more thoroughly drilled over for oil than Triumph. Long before the Drake well was struck, raftsmen upon the Allegheny had been accustomed to see globules of oil rise upon the water at Tidioute, as they poled their rafts around the bends and islands, hence, as soon as the possibility of getting large quantities of petroleum by drilling for it was demonstrated, this locality became a central point for experiment. The islands and river banks were quickly occupied by the quaint old-fashioned derrick and spring-pole, and as the oil rock here approaches to within a hundred feet of river level, several wells were "kicked down" before the steam engine was called into use. Only those of them, however, were successful which were located upon the islands or close along the river banks on the bend in front of the town. As the river and the mouths of incoming streams either north or south of this point were tested, the operator met with disaster. Hence developments soon received a check, and the principal production obtained was confined to Tidioute island and the Economite wells on the south bank of the Allegheny, in Limestone township.

But in 1866–7 a new life was infused into the place, by the discovery of the Dennis run oil deposit. This proved to be very prolific, and probably no place of equal extent in the oil regions has been so thoroughly perforated with holes as the narrow belt extending west by south from Tidioute island to and beyond Triumph. As many as four or five wells were sunk upon an acre in some localities. The hill-top at Triumph was literally covered with a forest of derricks.

At this time the present method of dry casing had not been introduced. The holes were full of water while being drilled, and its pressure was sufficient to hold back the oil and gas so that the exact points at which they were encountered could not be ascertained with precision. After the drill had been sunk to what was considered a proper depth in the oil sand, the well was cased with 100′ or 200′ of 3¼ inch casing, to shut out the water which is generally confined to the upper rocks. Then upon inserting the tubing and starting the pump, gas and oil made their appearance as the water gradually exhausted.

It will be seen that by this plan of manipulation the upper or cased part of the bore-hole was only 3¼ inches in diameter, while the lower part remained the full size of the drill, (5½ inches,) consequently, cleaning out a well or drilling it deeper after the casing had been put in was rather unsatisfactory work, for only small tools of light weight, cutting a 3⅛ inch hole could be employed. It therefore became a matter of considerable importance to finish a well to the proper depth before casing it. At Triumph it happened that the "Stray" and "Third sand" as named on Oil creek, (and which generally lie from 20′ to 30′ apart,) came very close together, being separated only by a thin shaly streak containing some salt water. The representative of the "Stray" was unusually thick and well charged with oil, but some of the wells drilling too deep and passing through it into the shaly seam, or "mud vein" as it was then called, were damaged by salt water. This led others to carefully stop the drill before the "mud vein" was reached, and hence the actual thickness of the whole sandrock was not ascertained at this time.

The district was rapidly drilled over, and the wells being close together, soon began to decline in production. As the excitement abated, the mushroom oil towns of Triumph, Babylon, &c., went into decay.

In 1869 some well owner concluded to clean out his well and drill below the sand to make a pocket. To his surprise he found that about 60′ of sandrock remained to be perforated, and that it contained a new supply of oil. This started up developments anew. The whole field was worked over again as far as this state of things existed. In some places over 120′ of sandrock was reported, and the wells taking a new lease of life poured out abundance of oil.

Probably there are now about 25 wells producing in that vicinity, but the output is small and they are only kept alive by careful management, by shutting off all water from abandoned holes, and a persistent use of gas pumps.

Two very deep wells have recently been sunk in Triumph township for the purpose of ascertaining whether the oil producing rocks of south-eastern Warren and the Bradford sand extend south-westwardly beneath the Venango group. Both wells were on proven oil territory, and had produced oil for years from the Venango sands. One is located on the Henderson or Clapp farm, about 3 miles west of the Allegheny river and the same distance north of the county line; the other, on the Fagundus farm, 20 rods from the county line and about a mile and a quarter west of the river. The Clapp well drilled to a point about 2550′ below the Olean conglomerate, the Fagundus 150′ deeper. No well-defined sandrocks were found in either below the Venango group. The records of these wells will now be given.

Clapp Well, No. 45. March, 1882.

Located on the Henderson farm, Triumph township, about a mile and a half W. S. W. of Triumph hill, and 3¼ miles N. 33° W. from the deep well at Fagundus. This well was drilled through the *Third Oil sand* Nov. 25, 1872 and proved a good producer, although not as large as some others on the farm. No record was kept except that the third sand was struck at 644′ and the drill stopped at 690′.* After having produced a large quantity of oil it became unprofitable to pump it longer, and in the spring of 1882 the machinery at the well was put in condition to drill deeper in search of the Warren and Bradford oil sands.

The owner, Mr. E. E. Clapp, who has always manifested his appreciation of the Survey by giving it all the assistance in his power—and to whom its museum is indebted for a number of valuable specimens of fossils and Indian implements—made very complete arrangements when the last drilling was commenced to preserve a portion of the sand-pumpings every time the tools were drawn. Mr. W. G. Sampson, superintendent of the farm also entered enthusiastically into the work and gave his personal attention to securing the specimens and measuring the well. The sand-pumpings were washed and dried and put into paper bags, plainly marked with numbers and depths. From these bags I have filled a series of 356 bottles, (and there is material enough for several sets more) each bottle being about one inch square and representing an interval of five feet in the well. When they are placed side by side upon a shelf prepared for them, they cover about 28′ in length and show a complete geological section, in stone, of all the measures drilled through.

In this spot the drill seems to have sunk into a very homogeneous mass of Chemung shales, varying so little in quality that it is not easy to describe the slight changes shown by the specimens at different depths. A slight increase of sand at about the proper horizon, is all that can be seen to indicate the Warren group, but no trace of the Bradford oil sand appears. Neither salt water, gas nor oil was found and at a depth of 2464′, where the end of the drilling cable was reached, the work stopped.

*The details of this part of the record may be supplied very approximately from the Foresman well, given below. The two wells are not far apart, and the general features of structure, no doubt, are the same in both.

	Well mouth above ocean in feet,		1580
	Not described, (see Foresman well,)	644 to 644=	936
	Third oil sand (productive,)	41 to 685=	895
	Commencement of specimens, (2d drilling,)	685=	895
No. of spec. as marked on bottles.			
1 to 3,	inclusive. Sand and rubbish from old hole,	15 to 700=	880
4— 28,	Slate, dark,	125 to 825=	755
29— 36,	Slate, sandy, with reddish clay,	40 to 865=	715
37— 51,	Slate, a little sandy,	75 to 940=	640
52— 54,	Slate, sandy, with fossils,	15 to 955=	625
55— 60,	Slate, a little sandy,	33 to 988=	592
61,	Sand shells, slaty,	7 to 995=	585
62,	Sand shells, fine-grained, brownish-gray,	2 to 997=	583
63,	Sandy slate,	5 to 1002=	578
64,	Sand shells, fine-grained, brownish-gray.	3 to 1005=	575
65— 91,	Slate, with thin layers of sandy slate near bottom,	135 to 1140=	440
92,	Sand shells, dark gray and light gray, fine,	5 to 1145=	435
93— 94,	Slate, purplish, micaceous, with gray sand shells,	13 to 1158=	422
95,	Slate, more sandy,	4 to 1162=	418
96,	Sandy slate, with gray sand shells, fossils,	4 to 1166=	414
97— 99,	Sandy slate, with gray sand shells, flaky,	14 to 1180=	400
100,	Sandstone, gray, some slate,	5 to 1185=	395
101—107,	Slate,	35 to 1220=	360
108—113,	Sandy slate, micaceous,	30 to 1250=	330
114,	Sandstone, gray, very fine, flaky, hard drilling,	5 to 1255=	325
115,	Slate and hard sand shells,	5 to 1260=	320
116—118,	Sandstone and sandy slate, hard, flaky, mica,	12 to 1272=	308
119—134,	Slate,	83 to 1355=	225
135—140,	Slate, with infrequent sand shells,	30 to 1385=	195
141—142,	Slate, very little fine grit,	10 to 1395=	185
143—152,	Slaty sandstone and slate, flaky, mica,	50 to 1445=	135
153—163,	Slate,	55 to 1500=	80
164—170,	Slate, some thin sand shells,	35 to 1535=	45
171—172,	Slate,	10 to 1545=	35
173—177,	Slate, some sandy,	25 to 1570=	+ 10
178—182,	Slate,	25 to 1595=	— 15
183—189,	Slate, some sandy,	35 to 1630=	— 50
190—197,	Slaty sandstone, gray and brown, flaky,	40 to 1670=	— 90
198—215,	Slate,	90 to 1760=	—180
216—217,	Slate and shells, (very hard drilling,)	10 to 1770=	—190
218,	Sandstone, dark-gray, quite friable,	3 to 1773=	—193
219—231,	Slate,	67 to 1840=	—260
232—237,	Slate, a little sandy,	30 to 1870=	—290
238—241,	Slate and sandy slate,	20 to 1890=	—310
242—254,	Slate,	65 to 1955=	—375
255—256,	Slate, a little sandy,	10 to 1965=	—385
257—258,	Slate,	10 to 1975=	—395
259—272,	Slate, a little sandy in streaks,	70 to 2045=	—465
273—276,	Slate, more sandy, quite shelly,	20 to 2065=	—485
277—284,	Slate,	40 to 2105=	—525
285—286,	Slate, a little sandy,	10 to 2115=	—535

287—307,	Slate,	105 to 2220= —640
308—315,	Slate, a little sandy,	40 to 2260= —680
316—326,	Slate	55 to 2315= —735
327—328,	Slate, a little sandy,	10 to 2325= —745
329—334,	Slate,	30 to 2355= —775
335—337,	Slate, a little sandy,	15 to 2370= —790
338—356,	Slate, to bottom,	94 to 2464= —884

Foresman Well.

Drilling September 8, 1877.

On the Pierce and Neyhart tract, Triumph township, Warren county, between Triumph and New London. Authority, one of the drillers.

Well mouth above ocean in feet, (barometer,)	1740
Conductor,	10 to 10=1730
SS. yellow and coarse (Olean)	50 to 60=1680
Slate, soft,	40 to 100=1640
SS. grey, (Sub-Olean)	40 to 140=1600
Slate, shelly,	150 to 290=1450
SS. "Mountain Sand,"	25 to 315=1425
Slate, (cased at 325')	20 to 335=1405
SS. fine, hard,	10 to 345=1395
Slate,	140 to 485=1255
Red rock,	3 to 488=1252
Slate,	27 to 515=1225
SS. shaly, "1st sand,"	20 to 535=1205
Slate, (upper 10' shelly,)	75 to 610=1130
SS. "2nd sand,"	25 to 635=1105
Slate,	35 to 670=1070
SS. "Stray," (depth at date,)	25 to 695=1045
Other wells in this vicinity find below this	
Slate,	90 to 785= 955
SS. "3d sand,"	52 to 837= 903

Fagundus Well No. 37.

Drilled to Third sand in 1872. Deepened in May and June, 1882.

Located on the Fagundus farm, in Triumph township, about 20 rods north of Forest county line, and a mile and a quarter west of Allegheny river. Owned by the Fagundus Farm Oil Company, Grandin and Beatty principal stockholders. A. Clinger, Superintendent.

Specimens of sand-pumpings from this well have been kept and arranged in a similar manner to those from Clapp well No. 45, and our thanks are in like measure due to the owners and superintendent for their kindness in going to the expense and trouble of procuring such a valuable exhibit, to aid in a study of these deep measures that are so seldom reached by the drill.

If a record of Watson's deep well at Titusville, (sunk to about 3750′ below the Olean conglomerate) had been preserved in the same way, we should have had a complete column of sand-pumpings from the Corniferous limestone up to the Coal measures, and many interesting questions now debatable and obscure, might have been decided by it. In the interest of the oil operator as well as of the geologist, the importance of preserving sand-pumpings in all deep wells, cannot be to strongly insisted upon.

So many wells were put down on the Fagundus farm, and the place of Third sand was so well known, that no record of the upper part of No. 37 was kept. From other wells it is ascertained that the top of Third sand should be about 945′ A. T.

Mr. Clinger states that the following sand rocks are found in all their wells:

Surface sand, variable, (sub-Olean,)	15′	to	40′	thick.
Mountain sand, variable, (Pithole grit,)	15	to	40	"
First sand, variable, shelly,	10	to	20	"
Second sand, (Second sand B,)			20±	"
Stray sand, (Second sand A,)			18±	"
Third sand,	25	to	45	"
Shells below Third sand, quite hard,	75	to	100	"

He thinks the following would be a fair approximation to the record of the upper part of No. 37:

Well mouth above ocean, in feet,				1690
Soil and shales, (base of Olean 1680±,)	60	to	60	=1630
"Surface sand," (sub-Olean,)	35	to	95	=1595
Shales,	175	to	270	=1420
"Mountain sand," (Pithole Grit,)	25	to	295	=1395
Slate and shale,	200	to	495	=1195
First sand,	17	to	512	=1178
Slate,	80	to	592	=1098
"Second sand," (Second sand B,)	20	to	612	=1078
Slate,	35	to	647	=1043
"Stray," (Second sand A,)	18	to	665	=1025
Slate,	80	to	745	= 945
Third sand,	40	to	785	= 905
Slate,	12	to	797	= 893
Hard shell,	1	to	798	= 892
Slate,	15	to	813	= 877
Hard shell,	2	to	815	= 875

	Slate, shelly,	55 to 870=	820
	Commencement of specimens, second drilling,	— 870=	820
No. of spec. as marked on bottles.			
1— 11,	inclusive, Slate,	55 to 925=	765
12— 17,	Slate, slightly chocolate color,	30 to 955=	735
18— 27,	Slate,	50 to 1005=	685
28— 36,	Slate, a little sandy,	45 to 1050=	640
37— 78,	Slate,	210 to 1260=	430
79— 80,	Slate, a little sandy,	10 to 1270=	420
81,	Sand shell with fossils,	5 to 1275=	415
82— 85,	Slate and sand shells,	20 to 1295=	395
86— 96,	Slate,	55 to 1350=	340
97—103,	Sand shells and sandy slate,	35 to 1385=	305
104—105,	Slate and shells,	10 to 1395=	295
106—113,	Slate,	40 to 1435=	255
114—117,	Slate, a little sandy,	20 to 1455=	235
118—135,	Slate,	90 to 1545=	145
136—138,	Slate and shells,	15 to 1560=	130
139,	Sandstone, yellow-grey, fine, flaky,	5 to 1565=	125
140—142,	Slate and shells,	15 to 1580=	110
143—148,	Slate, a little sandy,	30 to 1610=	80
149—152,	Slate,	20 to 1630=	60
153—157,	Slate, a little sandy,	25 to 1655=	+ 35
158—168,	Slate,	55 to 1710=	— 20
169—172,	Slate and shells,	20 to 1730=	— 40
173—174,	Slate,	10 to 1740=	— 50
175—179,	Sandstone and sandy slate, flaky,	25 to 1765=	— 75
180—184,	Slate, a little sandy,	25 to 1790=	— 100
185—193,	Slate,	45 to 1835=	— 145
194—196,	Slate, a little sandy,	15 to 1850=	— 160
197—249,	Slate, a little sandy in some parts,	265 to 2115=	— 425
250—262,	Slate, a little sandy,	65 to 2180=	— 490
263—277,	Slate,	75 to 2255=	— 565
278—280,	Slate, a little sandy,	15 to 2270=	— 580
281—295,	Slate,	75 to 2345=	— 655
296—299,	Slate, a little sandy,	20 to 2365=	— 675
300—366,	Slate,	335 to 2700=	—1010

The following additional records were copied from the company's books:

Fagundus Well No. 15.

Well mouth above ocean, in feet,		1705
?	300 to 300=	1405
Mountain sand, say	20 to 320=	1385
?	454 to 774=	931
Third sand,	31 to 805=	900

Fagundus Well No. 22.

Well mouth above ocean, in feet,		1710
?	290 to 290=	1420

Mountain sand, say	20 to 310=1400
?	458 to 768= 942
Third sand,	41 to 809= 901

Fagundus Well No. 23.

Well mouth above ocean, in feet,	1710
?	290 to 290=1420
Mountain sand, say	20 to 310=1400
?	455 to 765= 945
Third sand,	39 to 804= 906

Fagundus Well No. 30.

Well mouth above ocean, in feet,	1712
?	290 to 290=1422
Mountain sand, say	20 to 310=1402
?	458 to 768= 944
Third sand,	41 to 809= 903

Fagundus Well No. 31.

Well mouth above ocean, in feet,	1709
?	280 to 280=1429
Mountain sand,	20 to 300=1409
?	467 to 767= 942
Third sand,	34 to 801= 908

Fagundus Well No. 34.

Well mouth above ocean, feet,	1703
?	280 to 280=1423
Mountain sand, say	20 to 300=1403
?	459 to 759= 944
Third sand,	37 to 796= 907

Allegheny River Sections.

The following sections were measured along the cliffs of the Allegheny river, from Tidioute up to Kinzua:

I. *Dennis Run;* west end of Tidioute.
II. *Potter Run;* east end of Tidioute.
III. *Perry Magee Run;* west bank of river.
IV. *South of Cobham;* east bank of river.
V. *Cobham Post-office;* east side, running section.
VI. *Cobham Station;* west bank of river.
VII. *North of Cobham;* west bank of river.

VIII. *South of Thompson's;* west bank of river.
IX. *Pennsylvania House;* west bank of river.
X. *Township line;* west bank of river.
XI. *Dunn's Run;* west bank of river.
XII. *Sulphur Springs;* west side, running section.
XIII. *Irvineton;* junction Brokenstraw with river.
XIV. *Jackson Station;* north bank of river.
XV. *Sill's Run;* south bank of river.
XVI. *Reese's Eddy;* north bank of river.
XVII. *Tanner's Hill;* junction Conewango with river.
XVIII. *Warren;* compound section.
XIX. *Hertzell's Ferry;* north bank of river.
XX. *Dixon farm;* north bank of river.
XXI. *Great Bend;* south bank of river.
XXII. *Tuttle's Cliff;* east bank of river.
XXIII. *Kinzua;* junction of Kinzua creek and river.

Allegheny river section, I.

I. *Dennis Run*, in Triumph township; outcrops along the highway, descending the hill from Triumph to Tidioute.

Top of large rock at Triumph, A. T.,	1720′
1. OLEAN CONGLOMERATE; sandstone and pebbles,	40 to 1680
2. Concealed,	70 to 1610
3. SUB-OLEAN; yellow sandstone, seen,	5 to 1605
4. Concealed,	105 to 1500
5. Thin bedded sandstone and shale,	25 to 1475
6. Sandstone, quite massive,	5 to 1470
7. Sandy shale,	10 to 1460
8. Sandstone, 2′; shale, 3′—alternating bands,	75 to 1385
9. Sandy shale,	20 to 1365
10. Shale and thin, false-bedded sandstones,	55 to 1310
11. Brown shale, with a few sandy layers,	30 to 1280
12. Massive sandstone layer,	1 to 1279
13. Brownish shale, fissile,	9 to 1270
14. Sandstone, false-bedded, shale partings, most sandy at top,	35 to 1235
15. Brown shale, fissile,	30 to 1205
16. Thin-bedded sandstone,	5 to 1200
17. Brown shale, fissile,	20 to 1180
18. Concealed,	40 to 1140
19. Sandstone, gray, quite massive (2d oil sand B,)	20 to 1120
20. Shales—partly concealed—to river level,	22 to 1098

No. 3 is a small exposure of a portion of the sub-Olean, here a medium grained, yellow, iron-stained rock of the characteristic Shenango sandstone type. It is evidently 25′ or 30′ thick, extending upward into the concealed interval above the exposure.

At the base of No. 8 (1385′ A. T.) is seen one of those Spirifer bands so frequently found in these measures. The bands almost always occur at the bottom of a sandy layer reposing upon shale. They vary in thickness from two or three inches to a foot, and, where not exposed to the weather, frequently contain considerable lime. This band is about four inches thick in a matrix of fine-grained, micaceous sandstone weathering brown. A few quartz pebbles are intermixed with the shell-casts.

Another and thicker Spirifer bed may be seen in the hill north of this on the Tidioute and Grand valley road, at an elevation of 1280′ A. T.

These fossil bands cannot be relied upon as persistent horizons except over very limited areas, for within short distances they are known to vary in position, one band fading out and another coming in at a different level. They are evidently only local accumulations of sea-drift. That is, the animals have not lived and died where they are now found, but they have been torn from their beds by changing currents and swept together by millions to form these reefs of shells. The same currents that destroyed their homes carried also great burdens of sand, and hence we find that when the shells were dropped, (generally upon shaly floors teeming with algæ, whose impressions still remain,) the sand covered them, and a new formation commenced. The shells are of all sizes, packed one within another and intermixed in such confusion, that in a day's hunt it is almost impossible to find a specimen with both valves perfect. In one band the Spirifer may be the principal fossil, in another the Rhynchonella or the Productus, and again, all three of these may be interbedded in a mass, while occasionally a large Orthoceras filled with small shells, and an Aviculopecten, a Straparollus, or some other fossil of this period will be found in association.

The contrast between such fossil beds and those in which the mollusks have been entombed undisturbed, in their natural habitats, where they lie in colonies at reasonable distance from each other, in natural positions and with both valves perfect, cannot fail to attract the attention of the most careless observer.

No. 19 is the upper member (B) of the *Second Oil sand*, which is here separated from the lower member (A) by from 25′ to 35′ of brownish shale, as may be seen by reference to the well records in this vicinity, on Dennis run.

The horizons of the Pithole grit or Third Mountain sand and of the First Oil sand are not sharply marked in this section being only beds of flaggy sandstone interstratified with shale. These rocks are here losing their individuality, and a little further north-east become wholly unrecognizable.

Comparing the records of Foresman well (a short distance east of Triumph,) and the Dennis Run and Economy wells, the reader will perceive how variable all the sandrocks below the sub-Olean are in this locality. While the records agree in general features, they differ materially in details.

The fact is, the whole formation here is a mass of sandstone and sandy shale, interbedded in such a manner that no two exposures or drill-holes will give results exactly alike.

The record of well "N," (No. 989, II, page 178,) on the Economy tract, (the deepest well in this vicinity of which a record has been obtained,) shows 652′ of soft drilling, 8′ of hard sandstone, and 127′ of soft drilling down to a depth of 787′ below the Third Oil sand.

Allegheny river section, II.

II. *Potter Run*, in Deerfield township; at the east end of Tidioute, near the 13th mile post of the Buffalo, Pittsburgh and Western Railroad.

Top of *Second Oil Sand B*, A. T.,	1160′
1. Sandstone, gray, medium grain, massive from 15′ to 20′ thick,	20 to 1140
2. Shale, brown, fissile,	15 to 1125
3. Concealed in part, shales and sandstones,	17 to 1108
4. Sandstone layer, ochre color and brown,	1 to 1107
5. Sandstone, *Second Oil Sand A*, visible down to water level in river,	5 to 1102

No. 5 is rather a variable greyish sandstone in courses from six inches to two feet thick. In some places it is wave marked in an extraordinary manner, in ridges like interrupted plow furrows. The depressions are often a foot wide and four inches deep. A few flat pebbles are seen in some layers.

Allegheny river section, III.

III. *Perry Magee Run*, in Deerfield township; rocks seen on the west bank of Allegheny river, just north of Perry Magee run.

	Top of exposed sandstone, A. T.,	1185′
1.	*Second Oil Sand B*, massive, mostly gray, but with some thin layers of red and green,	30 to 1155
2.	Brownish shale,	10 to 1145
3.	Concealed to river,	40 to 1105

Allegheny river section, IV.

IV. *South of Cobham*, in Limestone township; rocks seen on the east bank of the Allegheny, about one mile below Cobham post-office.

	Top of exposure, A. T.,	1320′
1.	Layers of thin-bedded sandstone and shale,	35 to 1285
2.	Concealed,	25 to 1260
3.	Sandstone, quite massive, streaks of flat pebbles,	10 to 1250
4.	Concealed,	60 to 1190
5.	*Second Oil Sand B*, { Flaggy, 8′; Massive, 10′ }	18 to 1172
6.	Concealed,	35 to 1137
7.	*Second Oil Sand A*, yellow, irregularly bedded in layers 8 inches to 3′ thick, matted impressions of plants and fucoids, very similar in appearance to Tanner's Hill quarry,	15 to 1122
8.	Shale, clayey,	2 to 1120
9.	Concealed to river,	10 to 1110

Allegheny river section, V.

V. *Cobham Post-Office*, in Watson township; outcrops seen along a descent of two miles from the summit near P. Mickelson's to Cobham Post-Office.

	Summit—approximate base of Olean Conglomerate, A. T.,	1785′
1.	Concealed,	50 to 1735
2.	Yellow and blue sandstone, found in water well, (sub-Olean,) say,	35 to 1700
3.	Concealed,	100 to 1600

4.	Shales, plainly seen,	50 to 1550
5.	Concealed,	15 to 1535
6.	Sandstone layers, separated by shale,	30 to 1505
7.	Sandy shale,	70 to 1435
8.	Sandstone in layers,	15 to 1420
9.	Sandy shale,	70 to 1350
10.	Thin sandstones and shale,	25 to 1325
11.	Concealed,	120 to 1205
12.	*Second Oil sand B*, seen,	5 to 1200
13.	Concealed to post-office,	60 to 1140
14.	Concealed to river,	25 to 1115

Allegheny river section, VI.

VI. *Cobham Station*, in Deerfield township; rocks seen on the west bank of the Allegheny, near the 9th mile post of the B. P. & W. RR.

	Top of exposure, A. T.,	1220′
1.	Massive sandstone seen in several places,	1 to 1219
2.	Brown shale, fissile,	5 to 1214
3.	*Second Oil sand B*, { Layers of flat pebbles, . 4′; Quite massive SS., gray, 15′ }	19 to 1195
4.	Concealed,	40 to 1155
5.	*Second Oil sand A*, { Sandstone and shale, . . . 10′; Massive SS. layers, 1 to 3,′ 8′ }	18 to 1137
6.	Shale, blue and brown, fissile,	4 to 1133
7.	Concealed to river,	18 to 1115

Nos. 1, 2 and 3 of the above section were seen along the road about half a mile north of the station and not directly over Second sand A.

Allegheny river section, VII.

VII. *North of Cobham*, in Deerfield township; rocks seen on the west bank of the Allegheny, near the 8th mile post of the B. P. & W. RR.

	Top of exposure, A. T.,	1210′
1.	*Second Oil sand B*, massive; probably lower part,	10 to 1200
2.	Concealed,	45 to 1155
3.	*Second Oil sand A*, massive,	8 to 1147
4.	Shale,	9 to 1138
5.	Concealed to river,	18 to 1120

Allegheny river section, VIII.

VIII. *South of Thompson's Station*, in Deerfield township; rocks seen on the west bank of the Allegheny half a mile south of Thompson's Station and near the 7th mile post of the B. P. & W. RR.

	Top of terrace, A. T.,	1410′
1.	Concealed, but evidently sandy shale,	50 to 1360
2.	Thin sandstones, weathering in plates 1″ to 1½″ thick,	50 to 1310
3.	Concealed,	80 to 1230
4.	Second Oil sand B, massive, pebbly, manganese spots,	20 to 1210
5.	Shale, blue and brown, fissile—to highway,	30 to 1180
6.	Ditto,	15 to 1165
7.	Second Oil sand A, massive, mottled grey,	8 to 1157
8.	Shale, blue and brown, fissile—to railway,	15 to 1142
9.	Concealed to river,	17 to 1125

Allegheny river section, IX.

IX. *Pennsylvania house*, in Deerfield township; rocks seen in descending the river hill on the west bank of the Allegheny, a little south of the Pennsylvania house and near the 5th mile post of the B. P. & W. RR.

	Summit and top of a rock city, A. T.,			1790′
1.	OLEAN CONGLOMERATE,	Conglomerate,	2′	27 to 1763
		Massive sandstone,	5′	
		Conglomerate,	1½′	
		Massive sandstone,	5′	
		Conglomerate,	1½′	
		Sandstone in layers,	2′	
		Massive sandstone,	10′	
2.	Concealed to nose of hill, base of Olean?			11 to 1752
3.	Concealed,			37 to 1715
4.	Sub-Olean sandstone partially exposed on "hog back," and terminating in another nose and steep pitch,			35 to 1680
5.	Concealed,			75 to 1605
6.	Flaggy sandstones, seen,			5 to 1600
7.	Concealed,			120 to 1480
8.	Layers of yellow sandstone, seen,			6 to 1474
9.	Concealed,			49 to 1425
10.	Flaggy sandstone, seen,			3 to 1422
11.	Concealed,			32 to 1390
12.	Flaggs 1″ to 2″ thick seen at intervals,			37 to 1353
13.	Concealed,			103 to 1250
14.	Sandstone, quite massive, some pebbles about,			30 to 1220
15.	Concealed to RR. level,			75 to 1145
16.	Concealed to river,			15 to 1130

No. 14 is not well exposed, but it probably shows the place of Second Oil sand B.

Allegheny river section, X.

X. *Township line*, in Deerfield township ; rocks seen descending the river hill, west side of the Allegheny, near the north line of Deerfield township, going down from the summit toward the south-east.

Summit, smooth shaly soil, not a stone to be seen, covered with oak, chestnuts, and hickory trees, A. T.,	1770′
1. Concealed to top of long hog-back, 2 rods wide,	85 to 1685
2. Concealed, very steep, (flat pebble block at 1670′,)	215 to 1470
3. Thin bedded sandstones ¼″ to 2″ thick,	20 to 1450
4. Concealed,	75 to 1375
5. Thin false bedded sandstones, fucoids, seen,	5 to 1370
6. Concealed, indications of sandstone at 1300′,	100 to 1270
7. Sandstone, quite massive, seen,	4 to 1266
8. Concealed, surface covered with plates of sandstone, to river,	126 to 1140

From the top of No. 7 (1270′ A. T.) down to river level, the hillside is covered with a talus of thin-bedded sandstone. This then appears to be the top of Second Oil sand B, which, lying at the east end of Tidioute at 1160′ A. T., has risen 110′ in a little less than 8 miles or at the rate of 15′ per mile.

Allegheny river section, XI.

XI. *Dunn's run*, in Brokenstraw township ; rocks seen descending the river hill on the west side of the Allegheny and south of Dunn's run. Starting from the same summit as the last section, but a little further north, and going toward the north-east.

Summit, smooth shaly soil, A. T.,	1775′
1. Concealed,	270 to 1505
2. Flaggy sandstones, seen,	3 to 1502
3. Concealed,	52 to 1450
4. Thin sandstones, seen,	5 to 1445
5. Concealed, loose blocks SS. at 1380, plants,	100 to 1345
6. Sandstone, massive, some flat pebbles,	15 to 1330
7. Concealed to river,	185 to 1145

Allegheny river section, XII.

XII. "*Sulphur Spring*," in Brokenstraw township ; a running section from the highway summit north-west of the Sulphur Spring on Ander's run to the Allegheny river, a distance of about three miles and a half.

Summit overlooking Big Brokenstraw valley to the north, cultivated and apparently composed of sandy shales, smooth, A. T. .	1775′
1. Not well exposed, but evidently mostly sandy shale, ...	325 to 1450
2. Massive sandstone, gray and yellowish, some flat pebbles, well escarped in several places. The spring issues from a crevice in the top of this rock, in the basin made by the stream before it finally cuts down through it, ...	20 to 1430
3. Concealed to river, ...	280 to 1150

About half way from the spring to the river road, No. 2 is exposed on the Brokenstraw ridge at an elevation of 1445′, and below it, at 1390′, appears to be another outcrop —a yellow sandstone, containing vertical and horizontal fucoids and some flat pebbles.

Allegheny river section, XIII.

XIII. *Irvineton*, in Brokenstraw township; exposure at Irvineton, where the railway cuts around the point at the junction of Big Brokenstraw with the Allegheny river.

Top of narrow hog-back, A. T., ...	1450′
1. Sandstone, rather flaggy, a few pebbles, ...	15 to 1435
2. Concealed, ...	95 to 1340
3. Sandstone; top conglomerate, bottom flaggy sandstone, ...	25 to 1315
4. Concealed, ...	90 to 1225
5. Blue slaty shale, with irregular sandy layers, ...	30 to 1195
6. Sandstone, bluish-gray, of concretionary structure, ...	3 to 1192
7. Blue and violet slaty shale, with irregular sandy layers, 1″ to 4″ thiok; numerous fossils; to RR., ...	19 to 1173
8. Concealed to Brokenstraw creek, ...	15 to 1158

The massive sandstones Nos. 1 and 3 outcrop, and form escarpments along a small run coming into the Brokenstraw about a mile above Irvineton. They have apparently not changed much in level or relative position in that distance.

Allegheny river section, XIV.

XIV. *Jackson's Station*, in Conewango township; rocks seen in descending the river hill near Jackson's station, on the D. A. V. and P. RR., about 3 miles west of Warren.

Summit, A. T., ...		1670′
1. Concealed, ...	20	to 1650
2. Yellowish SS., thin layers, false bedded, warped, ...	40	to 1610
3. Concealed, ...	80	to 1530
4. Sandstone, yellowish, some pebbles, about	20	to 1510
5. Concealed, ...	26	to 1484
6. Sandstone, quite massive, some pebbles; seen	4	to 1480

7.	Concealed; some sandy shale seen,	40 to 1440
8.	*Spirifer band* in yellow sandstone,	½ to 1439½
9.	Sandy shale,	12½ to 1427
10.	Yellow sandstone; place?	5 to 1422
11.	Concealed, some sandy shale and spirifers seen,	40 to 1382
12.	Conglomerate, massive, current bedded, irony,	25 to 1357
13.	Blue shale, soft,	3 to 1354
14.	Flags, gray, 2'' to 3'' thick, shale partings,	20 to 1334
15.	Blue shale,	2 to 1332
16.	Purplish sandy shale,	3 to 1329
17.	Concealed to RR. level,	145 to 1184
18.	Concealed to river,	22 to 1162

No. 12 is a remarkable conglomerate of white quartz pebbles, showing very curious current bedding from top to bottom. The bulk of the rock is composed of pebbles varying in size from a mustard seed to a grain of wheat, apparently cemented together by the infiltration of water charged with silica and iron. The large pebbles are lentiform and water worn, the smaller ones irregular in shape, and many can be seen which still preserve the original facets of crystalization, as if they had been formed in the interstices of the mass after the other pebbles had been deposited. When the rock is broken, these small and almost perfect crystals glisten in the sunlight like diamonds.

Allegheny river section, XV.

XV. *Sill's Run*, in Pleasant township; rocks seen in descending the bluff point at the intersection of Sill's Run with the Allegheny river. West side of Sill's run. (By F. A. Randall.)

	Summit, A. T.,	1856'
1.	SS., massive, coarse, gray,	20 to 1836
2.	CONGLOMERATE, *ovoidal pebbles*,	30 to 1806
3.	Flags, thin-bedded, buff color,	55 to 1751
4.	CONGLOMERATE, *flat pebbles*,	40 to 1711
5.	Concealed,	243 to 1468
6.	Ferruginous shale,	15 to 1453
7.	Concealed,	107 to 1346
8.	SS., fine grained, buff colored,	8 to 1338
9.	Shale, brown,	100 to 1238
10.	Flags, brown,	11 to 1227
11.	SS., green, with layers of shale,	15 to 1212
12.	Shale, olive with red spots,	2 to 1210
13.	SS., flaggy and massive, irregular, grey,	15 to 1195
14.	Shale, red,	10 to 1185
15.	Flags, blue to river,	19 to 1166

Dingly well No. 6 is but a few rods from the foot of this section. Elevation of well mouth 1226′, or 60′ above river level at this point. The section may be continued down this well, as seen in Fig. 8, Plate 1.

Allegheny river section, XVI.

XVI. *Reese's Eddy*, in Conewango township; rocks seen in descending the hill at Reese's Eddy RR. cut, ¾ of a mile west of P. & E. Ry. depot at Warren, (by F. A. Randall.)

	Elevation of hill-top, A. T.,		1644′
1.	Concealed,		72 to 1572
2.	Shales and flags, drab color,		15 to 1557
3.	SS. fine-grained, gray,		5 to 1552
4.	Shale, gray and drab,		10 to 1542
5.	Flags, gray and brown,		50 to 1492
6.	Shales, sandy, brown,		30 to 1462
7.	SS. fine-grained, blue,		2 to 1460
8.	Shale, brown,		20 to 1440
9.	SS., massive, gray,	6	19 to 1421
	SS., irregularly bedded, gray,	3	
	SS., thin-bedded, gray,	5	
	SS., massive, gray,	5	
10.	Shale, light brown,		30 to 1391
11.	CONGLOMERATE, (wheat pebbles,) *fish horizon*,		2 to 1389
12.	Shale,	7	20 to 1369
	SS., fine-grained, gray,	1	
	SS., thin bedded, flaggy,	5	
	SS., massive, fine-grained,	2	
	Shale,	5	
13.	SS., brown, iron concretions,	5	14 to 1355
	SS., fine-grained, blue,	1½	
	SS., shaly, brown,	1½	
	SS., massive, yellowish,	6	
14.	Concealed,		100 to 1255
15.	SS., green, with shaly layers,		15 to 1240
16.	Shale, olive, with red spots,		2 to 1238
17.	SS., very irregularly bedded, massive and flaggy,		14 to 1224
18.	Shale, red,		10 to 1214
19.	Shale, blue and brown, to RR. level,		8 to 1206
20.	Concealed to river level,		36 to 1170

The Phillhart well (No. 1680) is about 20 rods west of this outcrop. Elevation of well mouth 1216′ above ocean, or 46′ above river level. We may, therefore, continue the section downward by adding the record of this well, as seen in Fig. 7, Plate 1.

Allegheny river section, XVII.

XVII. *Tanner's hill*, in Warren, Conewango township; rocks seen in descending from the summit of Tanner's hill on the west side of Conewango creek, in the borough of Warren, (by F. A. Randall.)—See Fig. 1, Plate 1.

	Summit, A. T.,	1700′
1.	Concealed,	12 to 1688
2.	Shales, dark,	10 to 1678
3.	Concealed,	10 to 1668
4.	Shales,	10 to 1658
5.	SS., massive, fine, gray,	8 to 1650
6.	Flags, gray,	30 to 1620
7.	Concealed,	90 to 1530
8.	SS. shown by broken fragments, say,	19 to 1511
9.	Concealed,	47 to 1464
10.	CONGLOMERATE, fine pebbles, *fish horizon*,	2 to 1462
11.	Shales, brown,	15 to 1447
12.	{ SS., yellowish iron stained, . . . 5 } { SS., buff, . . . 14 } quarry,	19 to 1428
13.	Partly concealed, shales where seen,	120 to 1308
14.	SS., green, with layers of shale,	15 to 1293
15.	Shale, olive, spotted with red,	2 to 1291
16.	SS. and flags, gray,	14 to 1277
17.	Shale, red,	10 to 1267
18.	Shale, blue with sandy layers seen in water wells put down along hill-side, to RR. level,	67 to 1200
19.	Concealed to river,	24 to 1176

Allegheny river section, XVIII.

XVIII. *Warren*, in Glade and Conewango townships; a section composed from various exposures, and reduced to location of Tanner's Hill, by Mr. H. M. Chance.

At the mouth of Sill's Run, two and a half miles west by south of Warren, the interval between the base of the OLEAN CONGLOMERATE and the red rock lying there near water level is 623′.*

By adding this to the level of the same red rock at Tanner's Hill in Warren, we get the place of the Olean Conglomerate at Warren, thus: 1277′+623′=1900′.

The base of the SUB-OLEAN CONGLOMERATE is indicated by a well-marked terrace, on the Quaker Hill road about

* Mr. Randall's section, taken near the same place, makes the interval 611′. See section attached to Dingley well No. 6.

one mile and a half east of Warren, at an elevation of 1870′ A. T. Going north-east this terrace rises between 12 and 15 feet to the mile. Carrying it back to Warren on this dip, we get 1870′—25′=1845′ as the place for the base of the sub-Olean at Warren. Therefore 1900′—1845′=55′ as the interval between the bases of the two rocks.

This agrees with the section at Great Bend, where we have

Olean Conglomerate,	77′	
Soft measures,	25′	55′
Sub-Olean, (massive SS.,)	30′	

Going down towards Warren from the east, the following section is observed:

	Top of SUB-OLEAN CONGLOMERATE, A. T.,	1900′
	Sandstone, massive, ground covered by coarse sandstone,	30 to 1870
	Carrying this down to Warren, and allowing 25′ for dip, as explained above, this elevation should there be 1870′—25′=A. T.,	1845 *
1.	Shales, with some sandy beds and spirifer bands,	23 to 1822
2.	SS., hard, fine-grained, (in water-well,)	5 to 1817
3.	Concealed,	11 to 1806
4.	SS., thin-bedded, fine-grained, greenish-gray,	8 to 1798
5.	Concealed, (soft measures,)	3 to 1795
6.	Spirifer band, 2½′ to 3′,	3 to 1792
7.	Concealed, (soft measures,)	3 to 1789
8.	SS. or sandy slate, thin-bedded, fine, micaceous,	9 to 1780
9.	Concealed; but evidently soft shales or slate,	29 to 1751
10.	Sandy shales,	10 to 1741
11.	SS., thin-bedded, fine-grained, greenish-gray,	6 to 1735
12.	Concealed, (soft measures,)	20 to 1715
13.	Slaty sandstone or sandy slate, thin-bedded, fine-grained,	5 to 1710
14.	Concealed, (soft measures,)	10 to 1700
15.	Slaty sandstone and shale, thin-bedded,	5 to 1695
16.	Concealed, (soft measures,)	14 to 1681
17.	Shales, brownish-gray,	2 to 1679
18.	Concealed, (soft measures,)	19 to 1660
19.	Shaly and slaty sandstones, with reddish-gray shales,	11 to 1649 †

* This is the surface section attached to Smith Bros. well, No. 2, Fig. 5, Plate I; the allowance required for dip being about the same to this well as to Warren.

† Between the base of this section (1649′ A. T.) and the top of Tanner's Hill section, (1492′ A. T.,) there is an interval of 157′, in which comes the massive sandstone of the Asylum quarry, opened about a mile north-west of Tanner's Hill. The top of the quarry exposure is 1605′ A. T. Reducing this to its place at Warren, we have 1605′—20′=1585′ for the top of this section at the latter place. Hence 1649′—1585′=64′ for the unexposed interval, which probably very closely approximates the truth.

20.	?		64 to 1585′
21.	Olive shales, very soft,		20 to 1565
	Conglomerate, red matrix, pebbles large as peas,	2′	
	SS., fine-grained, with shaly partings,	3′	
22.	SS., fine-grained, beds 6″ to 1′ thick,	5½′	19 to 1546
	SS., excellent building stone,	2′	
	SS., fine-grained, beds 6″ to 1′ thick,	6½	
23	?		54 to 1492 *
24.	SS., thin-bedded, fine-grained,		10 to 1482
25.	Concealed, (rather sandy but shaly,)		23 to 1459
26.	Pea Conglomerate, (fish bed,) about		1 to 1458
27.	Concealed, (soft measures,)		11 to 1447
	SS. overlying quarry rock,	7′(?)	
28.	SS. quarried, good stone,	9′	19 to 1428
	SS., softer and grayer than above,	3′	
29.	? (soft shales, ?)		56 to 1372
30.	SS., thin-bedded, fine-grained,		18 to 1354
31.	? (soft measures,)		14 to 1340
32.	Shales, olive color at base,		16 to 1324
33.	Shaly sandstone and shale,		6 to 1318
34.	? (shales, with shaly sandstone,)		27 to 1291
35.	Shales, olive color,		3 to 1288
36.	Shaly sandstones, thin-bedded, fine-grained, olive-gray, with hard bands and beds of shale,		11 to 1277
37.	*Red shale,*		9 to 1268
38.	? soft measures, with some shaly sandstone and chocolate-colored sandy shale,		68 to 1200
39.	RR. level, P. & E. depot, Warren,		1200
40.	Concealed to low-water level in river,		24 to 1176

Generalization from the above data.

Sandstone, massive (in terrace) "say,"	30′
Shales, fine-fine.grained, thin-bedded shaly and slaty sandstone with no massive or coarse-grained or light-colored sandstone,	280′
Sandstone, massive, (with fish bed,)	19′
Shales, with shaly SS. and *conglomerate fish bed,*	99′
Sandstone, massive,	19′
Measures containing massive and light-colored SS.,	137′
Shales, shaly sandstône and red rocks, having a Chemung character,	228′
Total generalized thickness,	675′

*Since this section was made, I have attempted to trace the Asylum quarry rock from the quarry to Tanner's Hill. It is not exposed along the Conewango bluff, nor does it maintain its massiveness at all points, but still its base is pretty clearly defined a short distance above the Tanner's Hill quarry. The interval between the two rocks does not exceed 70′. The dip in a little over a mile is about 45′, instead of 20′ as allowed above—a rate which corresponds very nearly with the Warren oil sand dip. With this correction the section will be brought more into agreement with Mr. Randall's.—[J. F. C.]

Allegheny river section, XIX.

XIX. *Hertzell's Ferry*, in Glade township; 3 miles S. W. of Warren; descending from the hill top to the Allegheny river, at Cobham well, (by F. A. Randall,) see Fig. 3, Plate 1.

	Elevation of summit, A. T.,		1883′
1.	SS. coarse, yellowish,		30 to 1853
2.	SS. CONGLOMERATE, *ovoidal pebbles*,		30 to 1823
3.	Concealed,		55 to 1768
4.	SS. conglomerate, coarse at top, fine at bottom,		40 to 1728
5.	Concealed,		269 to 1459
6.	SS. coarse, buff color, top well-defined, (seen,)		5 to 1454
7.	Concealed,		52 to 1402
8.	SS., buff color,	1	29 to 1733
	Flags,	4	
	SS., with pebbles,	1	
	Shaly, thin-bedded sandstones,	4	
	SS., coarse, friable, iron-stained,	2	
	Flags,	2	
	SS., friable, buff color,	2	
	Flags and shale,	1	
	SS., massive, fine, buff color,	6	
	Flags,	4	
	SS., fine-grained, buff color,	2	
9.	Concealed to well mouth,		152 to 1221
10.	Concealed to river,		36 to 1185

The above section is given in Mr. Randall's figures. He made the measurements with spirit level, and spent several days in carefully tracing and connecting the several exposures on the hill. I have visited the locality twice and find the section substantially correct.

By barometer I should have placed the summit at 1900′ A. T., the base of Olean conglomerate at 1820′ A. T. and the top of the Sub-Olean at 1750′ A. T., making an interval of 70′ (instead of 55′) between the two conglomerates.

Beneath No. 6, lie 5′ or more of thin flaggy sandstones; and near the center of the interval represented by No. 7, there are layers of quite massive sandstone. In one place an exposure was seen about 15′ thick. Probably the whole of No. 7 is composed of layers of flaggy sandstone irregularly inter-bedded with shales.

Allegheny river section, XX.

XX. *Dixon*, in Glade township; rocks seen descending the river hill, (north side of river) on the Dixon farm about three quarters of a mile west of Great Bend.

	Broad sandstone-capped summit, A. T.,	2000′
1.	Carboniferous measures, but divisions not well-defined, down to approximate base of OLEAN CONGLOMERATE,	120 to 1880
2.	Concealed,	40 to 1840
3.	SUB-OLEAN cliff, massive flat pebble conglomerate,	30 to 1810
4.	Concealed to top of well-defined bench,	80 to 1730
5.	Concealed,	100 to 1630
6.	Concealed, but evidently much sandy shale,	115 to 1515
7.	Sandstone, massive; seen,	5 to 1510
8.	" thin-bedded,	10 to 1500
9.	" " " brown and irony,	20 to 1480
10.	Concealed,	30 to 1450
11.	Sandstones, thin-bedded; seen,	4 to 1446
12.	Concealed.	16 to 1430
13.	Red shale and greenish shaly sandstone; place,?	3 to 1427
14.	Concealed to bench mark on bridge,	199 to 1228
15.	" to river level,	29 to 1199

Allegheny river section, XXI.

XXI. *Geer, or Great Bend*, in Kinzua township; rocks seen in descending the steep river hill on the south curve of Great Bend, near Geer's ferry. A stream of water here rushes down an old "timber slide" and completely bares the rocks, which, in some places, are very steep. The section was carefully taken with spirit level by Messrs. Chance and Hale in 1877, and nothing more reliable could be desired. Mr. Chance has published this, in connection with the following Tuttle cliff and Kinzua sections, in report G[4], page 147, and the illustration is given on Plate IX of that report:

	Base of OLEAN CONGLOMERATE, A. T.,	1813′
1.	Sandy shales,	25 to 1788
2.	SS., massive, coarse-grained, (SUB-OLEAN,)	30 to 1758
3.	Shale, soft olive, with sandy layers 1″ to 6″ thick,	51 to 1707
4.	SS., dark, slaty, thin bedded, fine-grained,	5 to 1702
5.	Shale, sandy, underlaid by sandy slate, some thin sands,	39 to 1663
6.	SS., slaty, thin bedded, fine-grained, some shale,	6 to 1657
7.	Shale, with a few beds of slaty sandstone 6″ to 1′ thick,	41 to 1616
8.	SS., slaty, fine-grained,	3 to 1613
9.	Shale, bluish, sandy, and slaty,	17 to 1596

10.	SS., hard, thin bedded, slaty, bluish-gray,		5 to 1591′
11.	Slates, sandy beds $\frac{1}{16}$ to $\frac{1}{2}$ inch thick; dark gray,		21 to 1570
12.	SS., grayish, slaty, false bedded and fine-grained,		13 to 1557
13.	Slate and shale,		4 to 1553
14.	SS., slaty, thin bedded,		5 to 1548
15.	Slate, sandy, with slaty shale, dark; beds 3″ to 18″ thick,		12 to 1536
16.	*Red and greenish sandy shale,*		3 to 1533
17.	SS., massive, fine-grained, hard, grayish,	4′	17 to 1516
	SS., flaggy, fine-grained, grayish,	4′	
	SS., massive, loose-grained, fine,	9′	
18.	Shales, soft olive, clayey near bottom,		43 to 1473
19.	*Red sandy shale,*		2 to 1471
20.	Shale, olive and blue, sandy,		9 to 1462
21.	SS., hard, massive, grayish, iron stained,	10′	14 to 1448
	SS., hard, flaggy, false bedded,	2′	
	SS., hard, massive,	2′	
22.	Shale, bluish-olive,		3 to 1445
23.	Concealed, (soft,)		62 to 1383
24.	Shale, soft, bluish, a few hard bands,		15 to 1368
25.	SS., flaggy, blue,	1′	3 to 1365
	Shale, blue, sandy, 1′ 6″ to	1′	
	SS., hard, blue,	1′	
26.	Shale, blue, iron-stained, sandy,		9 to 1356
27.	SS., massive, fine-grained, hard, oxide of manganese spots,	3′	18 to 1338
	SS., false-bedded, yellowish-gray,	7′	
	SS., massive, hard,	2′	
	SS., coarse-grained, iron-stained, (Sanguinolites,)	3′	
	SS., pebbly, pebbles size of wheat,	2′	
	SS., thin bedded, fine-grained,	1′	
28.	Shale, olive to chocolate, concretionary,		27 to 1311
29.	Concealed to extreme low water in river,		110 to 1201

Allegheny river section, XXII.

XXII. *Tuttle's Cliff and Coal Hill,* in Kinzua township; rocks seen descending in a northerly direction from the summit over the old coal openings on the ridge between Kinzua creek and Great Bend, to Tuttle's Cliff and the river at "Tuttletown." (By H. Martyn Chance.)

	Summit of Coal Hill (probably the highest point in county,) A. T.,		2154′
1.	Concealed; soft measures,		8 to 2146
2.	SS., hard, massive, coarse, loose-grained, (about,)		20 to 2126
3.	Concealed; soft measures,		25 to 2101
4.	*Coal*; (reported,)		2 to 2099
5.	Concealed; soft measures,		25 to 2074
6.	*Coal*; (cannel) overlaid by slates,	3′ 4″	14 to 2060
	Fire clay, (?,)	7′ 0″	
	Coal; (bituminous,)	4′ 0″	

7.	Fire clay; about,	2 to 2058′
8.	Concealed; (SS., reported;) containing soft measures,	61 to 1997
9.	SS., coarse and massive,	20 to 1977
10.	Concealed; soft measures, with Quaker Hill coal,?	62 to 1915
11.	CONGLOMERATE; pea to hazelnut, 10′ " coarse SS., with some conglomerate, 15′ " pea to hazelnut, 15′ " and conglomeritic SS., in thin layers, 33′ " hazelnut to egg, 4′	77 to 1838
12.	Concealed; soft measures,	24 to 1814
13.	Sandstone; massive, coarse-grained, (sub-Olean,)	32 to 1782
14.	Concealed to river level,	579 to 1203

Allegheny river section, XXIII.

XXIII. *Kinzua*, in Kinzua township; rocks seen about half a mile south of Kinzua village at the bluffs facing Kinzua creek on the road leading to Anderson's mills.

The point above this exposure is capped with a *rock city* of SUB-OLEAN CONGLOMERATE—massive, current-bedded, and containing many flat pebbles. All the higher measures have been eroded. The summit elevation was taken by aneroid but the lower part of the section was carefully measured by Mr. Chance in 1877.

	Top of rock city, A. T.,	1865′
1.	Coarse-grained, conglomertic SS., flat pebbles, (sub-Olean)	35 to 1830
2.	Concealed,	485 to 1345
3.	SS., shaly, greenish-gray, mixed with red,	18 to 1327
4.	Concealed; softer measures,	11 to 1316
5.	SS. or sandy shale, greenish-gray and red,	10 to 1306
6.	Shale; olive and brownish,	34 to 1272
7.	SS., thin-bedded, flaggy, 6′ to 8′,	8 to 1264
8.	Shale; dark,	15 to 1249
9.	Spirifer band,	1 to 1248
10.	Shale; soft, olive and chocolate color,	8 to 1240
11.	Shale; dark and slaty; breaking into aciculous fragments,	6 to 1234
12.	Concealed to the level of Kinzua creek above the dam,	6 to 1128

Allegheny river section at Warren.

(F. A. Randall's Section.)

The following generalized section of the rocks seen above water level in the vicinity of Warren, has been prepared by Mr. F. A. Randall. No man is more thoroughly acquainted than he with every rock exposure and every fossil bed in this locality. But with strata as variable as these have proven to be, it is impossible to construct a generalized section that will not be open to criticism, and one that may not sometimes unintentionally convey false impressions. A chart of this kind is only intended to show that certain rocks found within the district it is intended to represent, belong to certain geological horizons, not that every particular rock or fossil bed mentioned preserves precisely the same characteristics in every locality and runs persistently throughout. For instance, the "*fish bed conglomerate*" N, in the section below, viewed simply as a *fish bed*, is entirely local, for it cannot be traced as a conspicuous fossil fish horizon except over a very small area in the vicinity of Warren. At the Asylum quarry, about a mile to the north, another fish bed is seen, and this comes in at the bottom of division K of the section. So also with the other rocks, even the conglomerates and coal beds, they are all very variable, and no generalized section can properly represent them in all of their phases. But generalized sections, when used intelligently, are of great value, and Mr. Randall has arranged this one systematically and lettered the divisions, so that he could place in their proper geological horizons the many fossils which have been collected from different exposures around Warren. The fossils furnished by him for the State museum are all numbered and lettered with reference to this section.

Division A.—Summit rocks at Great Bend.

1.	Sandstone, massive, yellowish and white, ...	30′
2.	Slates and shales with thin coal beds, ...	70′
3.	Concealed measures, ...	20′
4.	Sandstone, massive, yellowish and white, ...	30′
5.	Sandstone, massive, gray and white, ...	35′
6.	Conglomerate, massive, pebbles angular, ...	10′

Divisions B and C.—Sharon Shale horizon.

7.	Shales and slates with one or two thin coal beds, ...	45′ to 50′

Divisions D and E.—Olean conglomerate.

8.	Sandstone, massive, coarse, yellow and gray, ...	15′ to 30′
9.	Sandstone, massive, ovoid pebbles, generally largest at the base and graduating upward into sandstone No. 8, ...	30′ to 40′

Division F.—Shenango shales.

10.	Buff colored, thin,bedded sandy shale becoming silicious in the upper layers, ...	40′ to 50′

Division G.—Sub-olean conglomerate.

11.	Conglomerate and sandstone, massive, flat pebbles ½″ to 2″ in diameter in in the upper part. These grow smaller toward the bottom and graduate into a yellowish loose-grained sandstone; generally current bedded and seamed with iron, ...	40′ to 50′

*Division H.**

12.	Sandy shales; buff color, ...	40′ to 50′

Division I.

13.	Micaceous slates and flags, with layers of shale, ...	100′ to 110′

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* The divisions F, G, and H, differ from the overlying rocks both in lithological characteristics and fossils. The latter are conglomerates; yellow, gray and white, coarse-grained sandstones and drab and bluish shales; and in them have been found Lepidodendra, Sigillariæ, Calamites and Ferns, with only one species of Mollusks, a Rhynchonella, and a few species of Ctenecanthus. But the former, particularly F and H, are much more fossiliferous and abound in Fucoids, (Dictyophyton,) Crinoids and Archæocidaris? Of Mollusks there are many, such as Rhynchonella, Orthis Michelini, Productus, Lingula, Chonetes, Platyceras, Straparollus, &c., &c., also several species of Lamellibranchs. In all about 100 species have so far been found. Although there may be many Chemung species among them, thé greater portion are undoubtedly of Waverly types and many of them have been specifically identified as such by western geologists, among others Orthis Michelini and Rhynchonella Missouriensis.

Division J.

14. Sandstones, massive, fine-grained, gray, ...	10′
15. Shales, yellowish brown, ...	10′
16. Flags; some massive layers; green and brown, ...	50′

Division K.

17. Shales; yellow-brown; with a 2′ calcareous sandstone, ...	50′

Division L.—Asylum quarry.

18. Sandstone, gray; partly flaggy, partly massive, ...	19′

Division M.

19. Shales, dark, weathering brownish, ...	10′

*Division N.—Fish horizon.**

20. Conglomerate, flat pebbles; variable in character, ...	15′ to 25′

Division O.

21. Shales, bluish, ...	20′

Division P.—Tanner's Hill quarry.

22. Sandstone, yellowish, partly massive, partly false-bedded, . .	14′

Division Q.

23. Shales, sandy, bluish, weathering yellow-brown, ...	100′ to 110′
24. Flaggy, false-bedded sandstone; yellowish, ...	10′ to 20′

Division R.†

25. Sandstone, massive, green and brown, ...	15′

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*This stratum is variable, in some places being massive and conglomeritic throughout, and in others containing pebbles only at the top and bottom, while the center is a mass of irregular flaggy sandstone. The conglomerate layers at Warren hold many fish remains, among them the teeth of a Dipterus and plates of a large Placo Ganoid.

†These layers, (always accompanied by the underlying red shale) are well exposed in the vicinity of Warren and constitute a mass about 30′ thick. They may be seen at the head of Liberty street; (Tanner's hill exposure) near the brewery in the west part of Warren; at the railroad cut half a mile west of Warren; (Reese's Eddy section) near the mouth of Sill's run on the south side of the river about 2½ miles south-west of Warren and near Ott's Station, about a mile and a half south-east of Warren.

Lepidodendra are found in the lower sandstone and in the shaly partings of the upper member; near the brewery, Crustaceans (Ceratiocaris?) were obtained.

26. Shale, mottled olive and red,	. . . .	2'
27. Sandstone, massive, frequently changing to mica slates,	. . . .	14'

Division R².—"Tanner's Hill Red."

28. Red shale, dark,	. . . .	8' to 10'

Division S.

29. Blue shale and irregular flags; to river level,	. . . .	91'
Low water at Warren=1176' above ocean.		

Mr. Randall also furnishes the following *notes:*

Venango Oil sands.—I am inclined to view the Tanner's Hill quarry rock (P) as the representative of the Venango *First Oil sand*, as it seems to lie about the proper distance below the Olean conglomerate. In that case division R would correspond to the *Second Oil sand*; and it will be seen that in its structure and association with red rock, it is very similar to the *Second Oil sand* of Clarion and Butler counties.

In this region there is no important stratum of sandstone or conglomerate answering by its position to the Venango *Third Oil sand.* In one or two wells a thin sandstone has been noticed, but it nowhere attains a considerable thickness, nor has any oil been obtained in or near this horizon.

Dip of Strata.—Upon an east and west line the rocks dip slowly toward the west, as may be seen from the following levels:

The base of Olean conglomerate at Great Bend is 1859' above tide—at Garland 24 miles west the rock is 1793' A. T. —a dip of 96', or 4' per mile.

The top of Tanner's hill red shale near Ott's Station as mentioned above, is 1208' A. T., and at the mouth of Sill's run, 3 miles west it is 1195' A. T.—showing about the same average dip as the conglomerate.

The dips from north to south are in the main, of course, much greater. From North rocks to Hertzell's Ferry, a distance of 5 miles, the Olean conglomerate falls 160' or 32' to the mile. North of Hatch's run the rise is more moderate; and south of Hertzell's ferry as far as Clarendon there is a slight rise and then a descent of 20′ or more to the mile.

Drift.—Large accumulations of drift are to be seen in the neighborhood of Warren, and some of the deposits reach an elevation of 1450′ A. T. The materials composing the beds are Granite, Gneiss and Syenite of Azoic age, and sandstones, chert and limestones of Palæozoic times, all greatly water-worn and irregularly interbedded with sand and clay. There are also many blocks of local rocks which by their angularity show that they have not traveled so far nor been so long subjected to attrition and the action of water as their neighbors.

Along the Allegheny valley many fine fossils are found in the drift, which belong to the Upper Helderberg, Clinton and Niagara groups, a fact indicative of the northern origin of these deposits.

No large erratics have been noticed in the immediate vicinity of Warren, although they are plentiful both to the north and west.

The Warren oil rocks.—The horizon from which most of the Warren oil has been obtained, the Warren so-called Third sand, is a variable fine-grained bluish-gray sandy stratum lying at an average distance of about 1325′ below the base of the Olean conglomerate.

At North Warren, on the State asylum grounds and the Crull farm, oil is found in shales about 120′ above the place of the Warren Third sand, or say 1200′ below the conglomerate. In the Hoffman well on the east side of Jackson run road at North Warren, and Tolles well No. 1, at Bugbee's mill, near Stoneham, the oil appears to come from a Fourth sand lying about 1400′ below the base of Olean conglomerate. This Fourth sand has produced considerable gas at North Warren, and some little oil has also been found there in strata lying 250′ deeper, or about 1650′ beneath the Olean conglomerate.

Depth of Valley Drift as shown by Drive Pipes.

Tabulated statement showing the length of drive pipe used in 42 wells in the Conewango valley, from Warren to the State line. See map of Conewango Creek oil territory.

	Well mouth above ocean.	Drive pipe.	Old valley floor above ocean.
1. Well on an island in the Allegheny, a little above the foot of Liberty street, (from memory,)	1190′	60′	1130′
2. Old Tannery well, S. cor. of Water and Short sts.,	1188	90	1098
3. Well at west end of covered bridge to Glade,	1188	95	1093
4. Allen well, Offerlee lot, 600′ N. E of covered bridge,	1217	85	1132
5. Hines & Hopewell well, above Conewango dam,	1191	60	1131
6. Waters well, on island above Third street,	1191	71	1120
7. Fertig well, east end of Fifth street bridge,	1191	80	1111
8. Walker well, W. of road and 500′ north of bridge,	1199	82	1117
9. Wing well, No. 1, Roy farm,	1217	95	1122
10. Roy well, 100′ S. of Roy's residence,	1212	90	1122
11. Roy well, N. W. of Roy's residence,	1200	70	1130
12. Anderson well, below and near saw-mill,	1196	67	1129
13. O. Hall well, 300′ E. of Anderson's saw-mill,	1197	68	1129
14. Trushell & Co. well, Hook lot, near Hook's dwelling,	1213	97	1116
15. Struthers, Taylor & Co., Hook lot, N. E. Hook's house,	1258	140	1118
16. Ellicott Oil Company, Stewart lot, North Warren,	1200	68	1132
17. Chaffee well, S. W. side Jackson run road,	1223	100	1123
18. Wing well, Cowan lot, Jackson run road,	1223	103	1120
19. Griffin well. Griffin lot, N. of Berry's corners,	1216	73	1143
20. Amman well, No. 1, on Race island,	1201	72	1129
21. Bishop well, opposite Allen's dwelling,	1216	105	1111
22. Allen well, No. 1, on bank of mill race,	1214	100	1114
23. Hazeltine, or Osmer, No. 1, on Race island,	1204	65	1139
24. Osmer & Co., No. 3, between road and race, (not on map,)	1217	100	1117
25. Osmer & Co., No. 4, between road and race, (not on map,)	1207	90	1117
26. Osmer & Co., No 5, between road and race,	1218	87	1131
27. Osmer & Co., or Hazeltine, No. 2, on Race island,	1205	62	1143
28. Osmer & Co., No. 6, north of No. 2; E bank,	1226	86	1140
29. Nesmith well, on a bar below the dam,	1212	50	1162
30. Struthers & Co., No. 3, near N. end of Asylum farm,	1230	98	1132
31. Struthers & Co., No. 2, near N. end of Asylum farm,	1235	102	1133
32. Struthers & Co., No. 1, near N. end of Asylum farm,	1235	97	1138
33. Watson & Raydure, Crull farm, near RR.,	1240	116	1124
34. Holt & Coleman, Holt farm E. bank, above dam,	1215	87	1128
35. Critchlow farm well, W. of road, S. of dwelling,	1237	120	1117
36. Campbell well, Hiller farm, W. bank of creek,	1223	95	1128
37. ——— well, Hiller farm, near RR.,	1242	125	1117
38. Boyington well, Hatch farm, opp. Carr run,	1252	120	1132
39. Watson & Raydure, Reese farm, 1 m. N. of No. 38,	1221	120	1101
40. Patterson, No. 2, Briggs farm, 1 m. S. of Russellburg,	1235	127	1108
41. Well on Sloan farm, 2 m. N. of Russellburg,	1244	220	1024
42. Week's well, State line near Fentonville,	1240	276	964

Mr. Randall undertook the collection of the above facts hoping to obtain the requisite data for mapping the floor of Conewango valley so that the windings of the old stream could be definitely followed in its course northward. But unfortunately for the purpose in view, the oil wells were not confined to the creek flats. From Glade to North Warren the development took nearly a straight line, which carried it east of the valley, so that no light was thrown upon the depth of stream bed drifts between those points.

A few scattering wells are not to be depended upon in carrying out a design of this kind. They prove a certain depth of drift, but unless a closely connected line is carried completely across the valley there is no certainty that the deepest part has been found. There are no sure rules for marking out an old channel without drilling. Sometimes it may be near the center of the valley, at others quite close to the bluffs on the right or left.

The wells at North Warren seem to indicate that the old floor there is not quite as low as at Warren. But an untested space remains, where a deeper channel might have run—swinging around west of the railroad and curving to the north-east between the wells on the Hiller farm and the Hatch farm. This in a stream flowing northward would not be an unnatural course for it to take and the shape of the present valley is favorable to it.

But no very serious obstacle to the theory of pre-glacial northern drainage is presented, if we admit that the old floor here is a few feet higher than at Warren, for a rapid descent from this point northward, can be proven, and there must be a crown or summit somewhere in the beds of all these reversed streams.

It is evident, (particularly on the southerly slope of the old divide) that at certain points, a number of pre-glacial streams were diverted from their courses and thrown into new channels during the Ice age; and that the gradients of streams which still remain in original valleys were greatly modified, also, during the same time. We may see the proofs of this in several of the tributaries of the Allegheny.

Tionesta creek is now plainly flowing in a new channel at a point about three miles above its mouth. A hill of fixed rock rises between it and the old valley which lies at a somewhat higher level than the new.

Oil creek, formerly made a loop to the west at Petroleum Center. The present stream cuts across the neck leaving a circular hill almost surrounded by a wide, dry valley.

At Franklin, an old channel filled with 100′ or more of drift runs north of the bluff point at the junction of French creek with the river. Both French creek and the Allegheny appear to be flowing in new channels in the Franklin basin and at lower levels than the former streams.

Prof. White refers to similar occurrences in Allegheny and Beaver counties, where the side streams come into the Allegheny and Beaver rivers over bed rock lying considerably above the floors of the main streams.

The explanation of these phenomena, I conceive, is this: During the middle ages of ice invasion there was a period of excessive cutting along the main lines of drainage toward the south. The outlets south of the divide were very materially deepened in this manner, and the gradients of some of the former north-flowing streams were altered, also.

For instance, if the Allegheny once flowed eastward from Irvineton to Warren, (as I have endeavored to show) it must have had a slope in that direction. Now, when the water from the Chautauqua basin commenced to flow south, it was at a high level on the divide and the new southerly stream must gradually adjust a bed to a natural gradient. When it had cut down at Irvineton to the level of the old easterly or northerly delivering stream at that point, there would be a crown there with a fall in the connected river bottoms, toward Tidioute in one direction and toward Warren in the other—although the waters were all draining southerly. As the river bottom erosion continued this crown or summit between the gradients would necessarily travel toward Warren (for the southerly stream was the only one engaged in lowering its bed) and continue to do so until erosion ceased and the valley-filling process began. If these views be correct we would be as likely to find the old summit near North Warren as at any other point. But we need fuller and more reliable data before a satisfactory tracing of these old streams can be made.

Conewango and Allegheny Divisions.

13, Conewango; 14, Glade, and 15, Elk townships.

If one should drive from Chandler's Valley to the county seat, Warren, along the "Yankee Bush road," which follows the ridge south-easterly through Conewango township, and then continue on north-easterly over the Quaker Hill or Corydon road through Glade and Elk, he could not fail to notice a great similarity in the topography, soils, and indigenous flora of the three townships included in this division. These are summit roads undulating in levels, of course, but after rising the river hills, nearly always keeping well up towards the plane of the sub-Olean Conglomerate and more frequently running above it. The table lands of Elk are some 200′ higher than those of Conewango, but the erosion has worked so conformably to the slope of the rocks, that the present surfaces of nearly all the higher eminences along the roads mentioned are formed of either the sub-Olean or Shenango shale, and these strata taken together only measure about 75′ in thickness. Only in the northern part of Glade and over comparatively a very small area are the shales overtopped by carboniferous rocks

Quaker Hill coal, the only workable bed west of the Allegheny river, and, indeed, the only coal that has been profitably mined in Warren county lies partly in Elk, but principally in Glade township.

Conewango and Glade have a community of interests in the oil rocks of the Warren group, for outside of their boundaries no paying oil wells have thus far been obtained from these rocks north of the Allegheny. They hold, also, in common, a remarkable development of sandrocks and conglomerates lying between the sub-Olean and drainage level. For these reasons, and because they naturally follow each other as river-fronting townships in the order named, they have been grouped together into one division.

13. Conewango township. Organized in 1820.

This township has the Allegheny river for its southern boundary and Conewango creek for its eastern. Jackson run passes diagonally through the northern part, from north-west to south-east and with its tributaries drains about half the township. A continuous ridge trends north-westerly from Warren to Sugar Grove, from which several short, rapid runs deliver southward to the Allegheny.

Jackson run enters the township at an elevation of 1375′±, Conewango creek at 1210′±, and the Allegheny makes its exit at the lowest point in it at 1155′±, (low water at Warren being 1176′). The highest point observed (1915′) is at the small cemetery on the "Yankee Bush road," about three miles N. W. of Warren. But Mr. Randall gives a higher point (1945′) near G. Speackman's, a mile north of Jackson run and a mile and a half west of the Conewango.

No Olean Conglomerate is found in place in the township, but the "Yankee Bush ridge" contains quite large areas of *sub-Olean*, which here well exhibits its fine-pebble, ferruginous type, weathering into small cubes and forming those peculiarly shaped truncated knobs already described. Some thin patches of *Shenango shales* remain. They, also, are heavily charged with iron, and are frequently rich in fossils, crinoids being most abundant. The *under shales* are likewise irony and weather into brown, fissile chips, the whole covering the surface with rather a fertile soil, although not deep and rich, and making this ridge a desirable place for agriculture. The most of the table land is well cleared and occupied by a thrifty farming community, who have a preference for these hills notwithstanding the fact that they are sometimes greatly inconvenienced by a scarcity of water in seasons of long continued drouth.

North of Jackson run the country is not so thickly settled; the Conewango hills are steep and woody and a greater percentage of untillable surface is presented. A strip of similar character skirts the Allegheny river and extends across the western end of the township; but fine farming lands are found all along the wide valley bottoms. Of course these are not now as productive as formerly for they have been long under cultivation, and in many cases continual and injudicious cropping, without proper fertilizers and needed rest, has resulted, as it always must result, in an impoverished soil.

The cultivation of some of the lower reaches of the side streams coming into the main valleys is more or less interferred with by blocks of sandstone that have descended from the outcrops exposed by the undercutting of the stream. In some cases these valleys also contain the latest fragments of massive rock which once capped the neighboring summits.

Immediately beneath the sub Olean Conglomerate and for 150′ below it, the measures are uniformly sandy shales varying but little in general composition in different parts of the township. Below these within a range of about 350′, there are several layers of sandstones and conglomerates, so variable in character and irregular as to levels, that one of them is very likely to be mistaken for another, when attempts are made to identify their outcrops several miles apart. The whole mass is very sandy, and about Warren forms steep cliffs of thin-bedded sandstones, which weather in thin leaves after the manner of the Vespertine (Pocono) rocks further to the south-east. The more massive sandstones and conglomerates of the series seem to be local beds, of restricted dimensions, interleaved at varying levels in this sandy horizon, rather than persistent layers running regularly and in parallel planes for long distances. An examination of sections along the Allegheny river confirms this.

From Tidioute to the north line of Deerfield township the two members of the *Second oil sand* can be traced very satisfactorily, the upper one (B) retaining its thickness, and gradually rising at the rate of 14′ to the mile from 1160′ at the east end of Tidioute to 1270′ at the Deerfield line. The lower one (A) keeps almost a parallel plane with B, but evidently thins out toward the north, being only 8′ thick where last seen. From the county line to Irvineton (about 4 miles) we have no good exposures; but the same rate of dip would carry the Second oil sand, B, up about 60′, or to 1330′ A. T.

On the point of the narrow hog back between the Brokenstraw and Irvine run, at an elevation of 1340′, occurs an exposure, partly conglomerate, partly sandstone, which has heretofore been regarded as the equivalent of the *First oil sand of the Venango group;* but immediately over it and capping the ridge at 1450′ lies another sandstone (and these two sandstones are noticeable in several other places to the north-west, holding about the same relative positions) which seems to correspond more nearly than the lower one with the horizon of the *First oil sand.*

In the Allegheny river sections it may be noticed that the lower member (*Second oil sand, A*) apparently thins out when traced toward the north, and we learn from the history of the wells on the north-western range of the Venango oil belt, as seen on the upper part of Oil creek, at Church run and in South-West and Eldred townships, that both members of the Second sand have lost their individuality in that direction and merged into a mass of sandy shales. Along any N. W.-S. E. cross-section of the Venango belt north of Oil City, the Second sand appears as sub-divided into two or three members to the south-east; as a single massive rock near the center; and as sandy shales to the north-west. Knowing then the variable character of this sand when not followed along the trend of its deposition, we may suppose that at Irvineton we have come upon the range where only one rock was deposited, or, (what seems to me to be quite as possible, in view of the difference in the geological structure north-east of this point as compared with that along the Venango belt) that the *Irvineton rock* is not the exact equivalent of either the First or Second oil sand, but belongs to an older series of sediments upon which the oil sand group has been deposited with a slight nonconformabilty, in such a manner that wrong identifications might easily be made in passing from one series to the other where there is a gap of several miles between actual exposures.

Going east from Irvineton these measures appear to rise quite rapidly; for, at Jackson station a fine exposure of conglomerate occurs at 1382′, and this is evidently the *Irvine-*

ton rock which has risen 42′ in two miles, or 21′ to the mile. Between Jackson station and Warren (4 miles) traces of conglomerate may be seen in a number of places; but the stratum becomes more sandy and shaly and less clearly defined.* It appears to be represented at Warren by the *Tanner's Hill quarry rock*, the top of which is 1447′, a rise from Jackson station of 16′ to the mile. This quarry rock contains no pebbles. It is very similar in appearance to the lower part of the exposure at Irvineton, where the top is conglomerate; and it is possible that the *fish conglomerate* at Tanner's hill, instead of the *quarry rock*, may represent the top of the Irvineton and Jackson station conglomerate; in which case the dip would be quite uniform throughout the whole distance.

A rise in the strata of over 20′ to the mile on a line running nearly due east, however, is rather remarkable. It is quite certain that the coal measure rock do not have such a rise; for, taking the nearest exposures of *Olean Conglomerate* we find the *line of strike to be nearly east and west.*

Another quarry is opened a little more than a mile northwest of Tanner's hill, from which the stone used in building the West Pennsylvania Insane Asylum was taken. Other sandstones of similar character, but generally containing more pebbles, are found along the lower reaches of all the streams running southerly from Yankee Bush ridge to the Allegheny. There are several bands of them; and these lie so irregularly that I have not been able to trace a single positive horizon throughout the township.

Section exposed at Asylum quarry, on the north side of Follett run, about 1 mile south-west of State Insane Asylum at North Warren.

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*On the Mead farm, about a mile and a half west of Warren, a very prominent, sharp-cut knob rises to 1530′ A. T. or 360′ above the river. At 1400′ the top of *Jackson station conglomerate* can be traced. Here it is quite pebbly but not very massive, weathering into small thin blocks. The escarpment above it is very steep and principally composed of thin and false-bedded, yellowish sandstones which frequently expose little cliffs from three to five feet high and show a face of naked rock. In these situations the formation is never massive, but always presents foliated edges and breaks up into thin plates as disintegration goes on.

Asylum quarry section.

	Elevation of top of exposure above ocean,	1613′
1.	Sandstone, fine-grained argillaceous,	2′ to 1611′
2.	Shale, brown, friable, iron stained,	20′ to 1591′
3.	Conglomerate, red, irony matrix, containing bones of large fish and matted masses of carboniferous plants,	1′ to 1590
4.	Shale, brown, friable,	4′ to 1586′
5.	Clay, soft, greenish-blue, variable in thickness,	1′ to 1585
6.	Sandstone, massive, but irregular in composition and bedding, pebbly and irony near top; seamed and fractured, some of the fissures containing masses of carbonate of lime deposited from the water percolating through them,	7′ to 1578′
7.	Sandstone, a massive layer containing a peculiar curved fucoid,	1′ to 1577′
8.	Sandstone, brownish-gray, containing minute specks of iron, but making an excellent building stone,	4′ to 1573′
9.	Sandstone of more variable structure and inferior to the above, seen,	8′ to 1565′

No. 3. The fish conglomerate is well exposed along the face of the quarry and is seen to thin out and disappear both right and left at a distance of about 150′ from the center. It has every appearance of being a local deposit made in a sheltered lagoon whose mud-accumulating conditions of deposition were momentarily disturbed by some paroxysmal movement of the earth crust which caused the ocean waters to sweep over it bringing in large fish to strand and perish in the shallow waters, as the wave receded. The fish bones are mingled in great disorder with land plants and pebbles, in a thin layer interbedded between masses of muddy shale, and there seems to be no more plausible way of accounting for the accumulation of such a mass in such surroundings, than that suggested above.

An analysis of a specimen of carbonate of lime taken from the crevices of sandstone No. 6 was made by Mr. A. S. McCreath with the following results:

Carbonate of lime,	98.035
Carbonate of magnesia,	1.793
Carbonate of baryta,	None.
Oxide of iron,	.020
Siliceous matter,	.010
	99.858

About two and a half miles N. N. W. from Asylum quarry, near the residence of Mr. William Smith, on the road going over from Jackson's run to the south-east corner of Farmington township, a massive sandstone about 20′ thick, outcrops at 1630′. One of the lower layers, a very compact, medium-grained, yellowish sandstone 4′ in thickness, has been blasted to widen and improve the roadway, and in the solid rock thus opened are many casts of a peculiar fossil form which I have never seen described, and never found elsewhere in place, although looking for it diligently.

This *fossil form* is about the size and shape of a medium sized cigar, tapered at both ends. The specimen before me is 4 inches long and ⅝ of an inch thick in the middle, tapering a little more gradually towards one end than the other. Each end terminates in a slightly twisted flat paddle ¼ of an inch wide. From the two edges of the paddle start spiral whorls which run exactly like the threads of a double-threaded screw, from one end of the cast to the other. There are 15 whorls, raised about one sixteenth of an inch above the body of the fossil; and the one starting on the right hand side of the flattened point at one end, terminates on the left hand side at the other end. In sand or water, a rotary motion either towards the right or the left would propel the body forward or backward. As the specimens are merely cores of sandstone, there seems to be nothing about them to indicate what the internal structure of the organism may have been.

Similar specimens have been obtained frequently from loose blocks in the town of Warren, but, although they have evidently come down from the neighboring hillsides, I have never been able to find an actual escarpment of the rock there, and consequently do not know exactly where it belongs. It is a rather singular fact that the casts are very seldom seen on the outside of a block broken out by natural causes. They usually lie in the most solid parts of the stone, and are only discovered when the larger masses are being worked up for use. They appear to have no habitual position in the rock, but lie in all attitudes from horizontal to perpendicular. Some of the fragments at Smith's indicate that the organisms were 6 or 7 inches long.

This rock also holds in association an *Orthoceras*, an inch and a quarter in diameter; a large *Spirifer;* an *Avicula;* and what appears to be a *Cypricardia.*

The Warren oil field, which created such an excitement among oil producers while being opened in 1876, lies partly in Conewango township and partly in Glade, skirting both sides of Conewango creek. The principal development on the west side of the creek was at north Warren, where some wells were obtained which flowed when first struck from three to four hundred barrels a day. They speedily declined in production, however, and the territory was found to be not only limited in extent, but treacherous and uncertain as to yield, in consequence of which many operators lost money, even in what was considered good locations, and, becoming discouraged at the prospects, withdrew to the more uniformly productive fields of Bradford. From the close of 1877 to the summer of 1881, but little new work was attempted, but in the latter year some prospecting was done, and twenty or thirty new wells have been drilled, with satisfactory results, on a belt line running from east Warren across the Conewango in the vicinity of the brewery north of Warren borough. How far this pool or belt may extend westwardly remains to be seen. It is not at all improbable that some good oil land may yet be discovered in the south-eastern part of Conewango township. To be sure a number of dry holes have been drilled there, but in such a variable field as this is known to be, it ought to be no surprise if some of the intermediate untested areas should yet prove to be productive. The western part of the township has been partially tested by several wells on Jackson run on the north, and Irvine run on the south, and one near Jackson station on the Allegheny river. As far as can be learned, the indications for oil in these wells were not such as would be likely to inspire one with great confidence in the future possibilities of this section of the township. For a fuller account of the Warren oil field, see chapter IX.

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14. Glade township. Organized in 1844.

The Allegheny river forms the eastern and southern boundaries; Conewango creek the western. All the drainage gravitates southward through Hemlock run, Glade run, and other smaller streams, into the Allegheny river, and westward, through Hatch run, into the Conewango. An elevated plateau, partly in Glade and partly in Elk and Pine Grove, with a spur south-eastward toward Warren, holds the head-water branches of all these streams.

The Allegheny enters the township at an elevation of 1225′; the Conewango at 1210′±; and the lowest point is at Glade, where these two streams meet, 1177′±A. T. The highest point observed is in the wilderness between Quaker Hill coal mines and Kinzua, 2095′.

Other high points on this Olean-Conglomerate range are:-Top of summit rock at "the Pass" 2080′;—Middle knob of north rocks 2045′;—Gardner's rocks 2030′;—Snyder's summit, a mile and a half east of the Conewango and near the Warren and Corydon highway is a very prominent point, 2015′ A. T.

The eastern half of the township is largely covered by carboniferous rocks. In the western parts none remain except on three or four knobs near the northern line, where the hills and valleys assume the characteristic outlines due to the erosion of shales; but some of the hillsides are very steep and occasionally expose rocky ledges, and the valleys often contain colonies of sandstone blocks not far removed from their original site.

The Olean Conglomerate covers all the higher land in the eastern end of the township, and carries along the line of Elk the only workable *coal bed* in Warren county, north-west of the Allegheny river. It also caps three or four summits in the north-western part, one small knob near the center, and a narrow ridge in the south-west corner facing the Allegheny river.

The varying character of the *Olean Conglomerate* is well exhibited in these several exposures. Along the escarpments of the large area in the eastern part of the township cliffs of coarse conglomerate occur in one place, and almost clear sandstone in another. At the "Pass," (S. W. corner of Elk township) both conglomerate and sandstone are seen, the pebbles seldom larger than hickory nuts. At the exposures next west, the pebbles are frequently as large as hens' eggs, and the matrix contains considerable iron in irregular seams and patches. The most westerly outlier (Gardner's rock) is an almost solid sandstone with comparatively few pebbles, and these seldom larger than hazel nuts.

This *Gardner's rock* stands alone on the summit of the divide between Hatch run and Akeley run, overlooking Conewango valley, robbed of all its associates, a solitary witness to the erosion that has taken place on all sides. An area of about five acres is all that is left of the great sheet of pebble-rock that once connected it with the conglomerates toward the south, and which no doubt spread also over the country for many miles to the north. Its top is almost a bare platform ; but sufficient mold has accumulated in the inequalities of the surface to support vegetation, and many trees, with their roots in the fissures, have found sufficient sustenance to grow to a large size. Its sides, particularly towards the north, west, and south, are almost vertical. Few loose rocks lie around it, except on the south. where solid blocks 70′ long, 40′ wide, and 30′ thick are sliding slowly down into the valley of Hatch run. Its southern face is a remarkably straight wall of rock 50′ in height, running nearly due east and west.

The bottom layer is 30′ thick, and frequently presents a front without crack or seam, current-bedded in irregular lines, and streaked with layers of pebbles, *always of the ovoidal type*, generally small, and rather sparsely scattered through the sand.

The layers which compose the uppermost 20′ are not so massive, and being very irregularly bedded, with thin clayey or shaly partings, weather into small blocks or even into quite thin plates.

The *Quaker Hill or Dinsmoor coal bed*, about a mile and a half east of the southwest corner of Elk, is one of the most interesting sporadic deposits in the State, on account of its geological position and association. Coal has been mined here in a moderate way for forty years or more; first by stripping and from pits, and then by drifting into the hill which rises in the highest point about 70′ higher.

The quantity thus far taken out has not been very great, for no cheap means of transportation have been available, and the output has been restricted to local demands. Consequently, the mine has not been extensively or systematically worked, and questions concerning the probable extent and value of the bed are surrounded by about as much uncertainty now as they were years ago.

This coal bed is twice briefly referred to in the final report of the first geological survey, (1858, Vol. II, p. 556 and 557:) In one place, as lying "*above* the *Seral conglomerate*;" and in another, as "in the Seral sandstone, or *under* the conglomerate." These were evidently the notes of different observers who visited the mine; and the want of agreement in the conclusions arrived at in relation to the horizon of the coal was caused by the fact that in the vicinity of the mine the *Olean Conglomerate* (bottom member of the Seral) and the *Sub-Olean* (the next conglomerate below it) are found reposing in very nearly the same horizontal plane, both of them appearing as coarse pebbly rocks.

The characteristic contrast between the egg-shaped pebbles of the upper rock and the lens-shaped pebbles of the lower rock had not then been noticed, and, therefore, it is not surprising that the juxtaposition of the two rocks at the mine (where the coal lies in a basin, with patches of conglomerate both above and below it) should have led to erroneous identifications, and been the cause of confounding the upper conglomerate, (Olean,) with the lower conglomerate, (Sub-Olean.)

Even at the present time, with the additional light the second geological survey has been able to throw upon the relationship of these two conglomerates, and after still more particular examination of the surrounding rock exposures have been made, the precise geological position of the *coal bed* is somewhat obscure; and, in fact, its true situation cannot be satisfactorily made out until a number of drill-holes have been sunk in that vicinity, not only to the coal horizon, but to a sufficiently considerable depth below it to disclose the character of the underlying measures.

The map of the coal field, accompanying this description, has been copied from the county atlas, and is inaccurate in many particulars, but it will serve as an illustration. The lines of warrants may be correct, but the roads are only approximately located, and the streams are apparently sketched in without verification, except, perhaps, where they cross tract lines. Many small branches are not noted at all. Hence, the outline of the carboniferous rocks can only be given in a very general way, for on the summit covered by them there is not a clearing, a dwelling, or an open highway, (except immediately at the mine,) to assist in locating the points where outcrops and exposures have been examined.

It is evident, however, that the shape and size of this fragmentary patch of *coal measures* must necessarily be limited by the deep valleys sorrounding it, viz: *Hodge run* on the north, the *Allegheny river* on the east and south, and *Hemlock run* on the west.

Only on the narrow ridge towards the north-west would it be possible for the conglomerate to extend beyond the general limits assigned to it on the map, and there, as we shall show, *the lower member has never been deposited*, or else it *has been completely eroded.*

All the coal thus far mined within the carboniferous areas designated on the map (and, indeed, all that is positively known to exist there) lies within an area of about 50 acres; in the south-west corner of warrant No. 5553, Elk township; and the north-west corner of No. 5554, Glade. By far the greater part of this conglomerate-covered plateau remains to-day unproven, for no systematic tests have been made to ascertain the limits of the coal seam.

Three drifts have been opened in the coal bed:

1. The *North opening* on the north slope of the ridge, and marked N. on the map.

2. The *Old South opening* (marked S) and 3. The *New drift*, both of them on the southerly slopes, where the erosion at the head of a small stream has cut well nigh across the summit. The South opening was the first one made on the property; the other, toward the west, is the present entrance to the mine. The air shaft (of which a section is given below) was over the South opening; and the old stripping ground and pits referred to above, are located in the cove near the mouth of this drift.

The elevations noted on the map are based upon bench marks established by a line of spirit levels run up from Warren to the mine, and they ought to be reliable as the benches have afforded abundant checks upon the barometric work.

The base of the coal seam at the North bank was ascertained to be 2000′ and at the South bank, 2011′ A. T.; the distance between the two openings being about 1600′ on a line running very nearly north and south.

The South opening was driven into the hill about 35 rods, sloping downwards, it is said, at the rate of nearly a foot to the rod. Quite effectual drainage was secured for some time by a line of two inch pipe so laid as to act as a siphon, but this failing eventually to give relief, the working was discontinued and another opening started on the north slope of the ridge where no difficulty in drainage was anticipated.

This *North opening*, was carried in some 15 rods or more, but it also dipped so much that the water became troublesome. At that point the seam took an abrupt rise at an angle of about 45°. The coal was mined up the slope some ten or twelve feet, when, as it pinched out somewhat, and the under rock appeared to be a hard conglomerate threatening much expense, the miners abandoned this opening also. The entries to both drifts have since fallen in so that no inside examinations can be made.

The new drift, which furnishes all the coal now mined, enters the hill from the south-west slope and like the others, dips toward the center of the basin. In a distance of 35 rods the coal seam lowers about 25′, but not with a uniform descent, the fall being moderate for the first five rods from the entrance and then quite rapid for 10 or 15 rods when it again moderates. This drift and the side workings are drained effectually by the use of a small steam pump. From six to ten tons of coal per day is the usual output, but the demand does not require steady work at this rate throughout the year.

Some large sandrocks, having all the characteristics of the *Kinzua creek sandstone*, lie upon the summit 15′ above the mouth of the old air shaft of the south drift.

Mr. Dinsmoor's shaft record.

Summit, A. T.,		2060′
Loose blocks of sandstone and concealed, to top of air shaft,	15′	to 2045
Shales and slates, gray and fawn color,	40′	to 2005
Coal, slaty,	3″	
Shale. olive; sometimes partly sandstone or partly conglomerate; very variable,	4′ 9″	to 2000
Coal, (varying from 1 6″ to 2′,)	2′	to 1998
Black slate, (varying from 4″ to 12″,)	1′	to 1997

A conglomerate of ovoidal pebbles underlies the slate; thickness unknown, but thought to be thin and irregular.

Head-room has been made in the roof shales. In all the drifts they work down easily and leave a safe roof without props. No conglomerate has been met with in the roof in the new shaft; but in the old workings some conglomerate layers a foot or more in thickness were encountered. The pieces taken out are composed of sharp white sand, rough ovoidal pebbles, and films of coal and compressed clay-smeared plants, intermixed in the greatest disorder. They have a dark lead color, even the pebbles being so completely coated with carbonaceous matter that they must be broken to prove that they are of quartz.

The conglomerate in the floor of the mine, as far as can be judged from a few small pieces obtained in different places with a pick, is of a similar character.

A fair sample of coal taken from the new opening, where the seam runs from 20″ to 22″ thick and mines after the manner of the block coals of Ohio, was sent to Mr. McCreath at the State laboratory, for analysis, and yielded the following results:

Dinsmoor's Quaker Hill Coal.

Water,	2.948
Volatile matter,	35.217
Fixed carbon,	58.096
Sulphur,	.689
Ash,	3.050
	100.000
Color of ash; red, with white specks.	
Coke, per cent,	61.835

The horizon of the coal bed is very low when compared with either the Olean Conglomerate at the west, or the Sub-Olean at the north-west, as the level figures on the map show. Evidently, these conglomerates could not have been deposited in the vicinity of the coal mine under the same conditions as generally elsewhere. The usual parallelism between them does not here exist; but on the contrary the two rocks lie in such relationship to each other that an actual non-conformability of strata seems quite probable.

At the "Pass" the base of Olean (with the Sub-Olean about 30′ below it) is at 1,995′.

Less than a mile north, where a low spot in the ridge occurs at the head of Hemlock run, the Olean has all been eroded at 2,030′.

Half a mile further north the sub-Olean comes to the surface at 2,090′.

A few rods west of this the summit holds a coarse, white sandstone, entirely devoid of pebbles, at 2130′.

Turning from this road south-east towards Dinsmoor's, the Sub-Olean is again seen at 2,095′.

From that point sandy and argillaceous shales are plainly visible to the summit at 2,129′.

This summit is under cultivation; a smooth, shaly soil, where no conglomerate or sandstone could possibly be concealed.

Descending the slope, shales are uncovered down to the top of sub-Olean at 2,055′.

Here the road is filled with flat pebbles weathering from the top of the rock, escarpments of which show a short distance east.

Shales outcrop from this point to the next summit, on which, a few rods west of the road, lies a nest of coarse sandstone blocks in place at 2,090′.

From this point to Dinsmoor's shales are again well exposed, and in digging for the foundation of his barn the Sub-Olean was uncovered at 2,020.

A few rods beyond this the surface begins to rise toward the coal hill.

In the depression we first notice the *change from the flat pebbles* of the Sub-Olean on the west, *to the ovoidal pebbles* of the Olean on the east.

Continuing easterly, Olean pebbles and small thin lumps of conglomerate cover the surface for perhaps twenty rods; then carboniferous shales overtop them, succeeded by large blocks of coarse, white sandstone on the summit, at an elevation of 2,060′.

East of this the Sub-Olean is exposed at 2,000′ by the erosion of a little stream which heads near the South opening.

Following now the wood road to the south-east we travel upon a shaly surface for nearly a mile, (very gradually rising from 2,000′ to 2,055′.)

Here Olean pebbles begin to appear in profusion, and an escarpment of coarse conglomerate 8′ thick is seen facing Hodge run.

A rapid rise of about 30′ is now made.

Continuing onward for about half a mile we come to an extensive *rock city* overlooking all the country to the north-west and north, apparently the highest point on this table land, 2,095′.

The rock here is a pure white sandstone, having all the characteristics of the *Kinzua creek sand* of McKean county.

Half a mile further on the path descends into a depression cut into the ridge at the head of *Billy run*, where a clean escarpment of massive, coarse pebble *Olean* conglomerate 20′ thick appears as the north-east limit of the carboniferous plateau; top, 1,990′.

But a few rods from the cliff and apparently not over five feet (5′) below its base, the *Sub-Olean* is seen on the hog-back, and continues for a half mile or more along it to its end or nose, (here the more rapid descent to the river commences,) where it forms a *rock city* and noted rattle-snake den; top, 1,975′.

On the west side of the highlands, facing Hemlock run, no clean cut escarpments of *Sub-Olean* can be seen, for its outcrop is obscured by the débris from higher rocks. But in passing up the path from the forks of Hemlock to the mine, the general horizon of the *Sub-Olean* can be plainly traced, both by the topography and by large quantities of flat pebble conglomerate removed only a few feet from its bed. Its position on this side seems always to be low enough to bring it into its normal place beneath the *Olean*.

The "Wolf den," somewhere near the south-west corner of warrant 5,544, is a grand exposure of *Olean* conglomerate and its overlying sandstones, (resembling Gardner's rocks in N. E. Glade,) 40′ high; base, 1,915′.

Other sandrocks, with probably some shaly partings, appear above it up to the summit at 2,045′.

This is the south-western limit of the conglomerate area directly south of the Dinsmoor mine.

It will be noticed that for some distance south-west of the Pass the *Sub-Olean* lies almost level; but going north-east the *Sub-Olean* rises 130′ in about a mile and a quarter.

From this point (near the junction of Dinsmoor's road with the Warren and Corydon highway) towards the north-west, the *Sub-Olean* falls 65′ in about a mile; and towards the coal mines, south-east, 75′ in a little greater distance; while to the north it flattens down to nearly a horizontal plane.

The bottom 25′ of the *Olean* at the Pass is conglomeratic. Over it lie 60′ of sandstones, (with apparently, some shaly divisions,) reaching up to the summit at 2,080′.

As this *Olean* rock is completely eroded at the depression to the north, where the Shenango shales are laid bare at 2,030′, it must either rise conformably with the *Sub-Olean*, or else lie *nonconformably* upon it. If it rises conformably with the Sub-Olean its bottom conglomeratic member should appear in the summit still further north, at 2130′. But that summit contains only sandstone of precisely the same type as the sandstone *above* the conglomerate at the Pass.

The only conclusion that can be drawn then is that the carboniferous rocks were deposited upon a bed sloping from the north, the pebbly portion, or *Olean* wedging out where the depression now cuts across the ridge; and the upper sandy part, or *Kinzua creek rocks* overlapping and bedding upon the *Shenango shales*, as seen in the summit further north.

South of the depression conglomerate can be traced at 2040′; but it is apparently much thinner than at the Pass. North of it none is to be found.

The summit west of Dinsmoor's is capped with sandstone of the same kind, (Kinzua creek;) and also the summit to the north. No conglomerate is found on either of the summits, although the deposits lie upon typical Shenango shales, at about the same distance above the *Sub-Olean* as the conglomerate does at the Pass.

Over Dinsmoor's mine the same sandstone appears; but beneath it come, not the Shenango shales, but coal shales, coal and thin conglomerates, extending down below the horizon of the *Sub-Olean* as it is seen east and west of the coal basin. *It would seem as if the Sub-Olean must have been cut out before the coal bed was deposited;* but of course it is possible that it was warped into a narrow basin for the reception of the coal. A few drill holes are needed before it can be definitely ascertained which hypothesis is the true one.

That the *Quaker Hill coal* lies very low down in the base of the Olean conglomerate is evident. It must have been deposited in a sheltered basin, protected from the strong currents that were playing upon the conglomerates east and west of it. The limits of the basin cannot yet be defined for want of data. But inasmuch as the coal seam probably lies within six or eight feet above the base of the *Olean* conglomerate, we should not expect to find a continuation of the bed towards the east and south, beyond points where the Olean is known to be a massive conglomerate 20′ or more in thickness, for in such situations the conglomerate must cut out the coal.

We have seen that the Olean is thick and massive at the "Wolf den," and also at its most north-easterly escarpment between Hodge run and the Allegheny. It presents the same features all along the Allegheny; and at Great Bend it attains a remarkable volume, as shown *in the Tuttle cliff section, in which no trace of the Quaker Hill coal appears.*

It is probable, then, that the coal bed will be found restricted principally to warrant No. 5554, and even to limited portions of that tract.

Snyder's summit, by far the highest point between Hatch run and Hemlock run, (except the small conglomerate-capped peak a mile south-west of the Pass, which is about 5′ higher,) is located a mile and a half east of the Conewango, about midway between the north township line and the Allegheny river. The Warren and Corydon road winds around it west and north, attaining an altitude of 1,890′ at the cross-road that runs southerly along its east side. The cross-road descends somewhat from the corners, and passes through a notch which cuts off this summit from another dome to the south-east. Toward the south-west the surface falls of rapidly, but in irregular spurs, toward the Conewango and Allegheny. Thus the *Sub-Olean* and all the measures above it are isolated, and the conglomerate is so frequently exposed in its characteristic type of a fine-pebble iron-charged rock that its horizon can be very satisfactorily traced. In about a mile it rises north-eastward from 1,890′ to 1950′.

A belief having obtained in the neighborhood that coal could be found in the hill, Mr. Randall was led to make several examinations of it. No traces of a coal bed were discovered; but the remarkable altitude of the summit, the character of the shales upon it, and the thickness of measures above the *Sub-Olean*, furnish interesting subjects for study.

His section was made near the Quaker hill road, 2½ miles north-east of Warren, and a quarter of a mile south of Norman Snyder's dwelling.

F. A. Randall's Snyder's Summit Section.

Elevation of summit above ocean, ...	2015′
1. Shales, drab, (coal type,)	38 to 1977
2. Fragments of conglomerate in loose blocks, containing species of *Ctenecanthus formosus* lying here at, ...	1977
3. Thin bedded shaly sands, containing *Fucoids* and *Crinoids*, . .	37 to 1940
4. Conglomerate (Sub-Olean) of small flat pebbles in an irony matrix, graduating downward into fine-grained buff-colored sandstone, . . .	51 to 1889
5. Shaly sandstones, thin bedded, and containing *Crinoids*, seen, .	20 to 1869

Standing upon Snyder's summit, we may get a very good idea of the general dips prevailing in this region.

Looking across the Conewango, one sees Yankee bush ridge, 4½ miles W. by S., holding the top of *Sub-Olean* at 1895′. Hence, 1940′—1895′ = 45′, which is the fall in that direction, an average of 10′ to the mile.

Across Hatch run, 2 miles north, Gardner's rocks appear, with the *Sub-Olean* beneath them at 1960′, a rise of 10′ to the mile.

Two miles E. N. E., in the direction of the Pass, the conglomerate maintains about the same rate of ascent, 10′ to the mile.

Two miles E. S. E. (near Cobham park) it has a fall of about 10′ to the mile.

Two and a half miles S. by E., at the Allegheny cliffs over Cobham well, (see section No. XIX,) a remarkable dip is apparent, to-wit: 1940′—1768′ = 173′, or an average of 69′ to the mile.

The general dip from the Pass southwestward is, therefore, about 10′ per mile; and from Gardner's rocks, south by east for 2 miles, 10′ per mile; then for 2½ miles, 69′ per mile.

Similar irregularities north-east of the Pass have already been shown.

The Crawford shale horizon is not so open to examination in Glade as in Conewango, being more generally obscured by drift; but there are exposures and well records enough to show that no radical change in structure occurs in passing from one township to the other. Below the shales, however, we may notice some variation. The coarse pebbly sandrocks of south-western Conewango apparently take a north-east trend and fine down into sandstones toward the south-east. Hence, in this horizon no pebble rocks of importance are seen in Glade, except in the north-west part. In the débris along the river cliffs, blocks of yellow, massive sandstone are frequently noticed, but pebbles are very rare. The Great Bend section, Allegheny river series No. XXI, may stand as a fair exponent of the structure in the south-eastern portion of the township.

Oil wells are numerous in Glade, but they have been confined, principally, to the western and south-western parts. Beatty well No. 1, located at East Warren or Glade city, was the first in the county to demonstrate the existence of oil there in paying quantities, in measures beneath the Venango oil sands. Developments naturally spread out from this center; North Warren was opened on one side and Stoneham on the other, but being checked by unsuccessful ventures toward the north-east very little has been done in that direction. Two thirds of the township remains to-day untested, save by a few wells around the borders and one in the vicinity of the Pass at Quaker hill. The Reed well, (elevation 1,715′ A. T.,) on Culbertson farm, west branch of Hemlock run, was drilled in 1880 to a depth of 1,450 or 1,500 feet without finding favorable indications; and this dry hole, with the previous failures of Hodge run well, in Elk, Wolf run well, in Kinzua, Tuttletown well, near Great Bend and other wells on the north-east end of the Stoneham belt, has put a damper for the present on all further development of the eastern part of the township. Still it is not impossible that some paying oil pools may yet be found when the region is more thoroughly tested.

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15. Elk township. Organized in 1830.

Elk township lies in the north-eastern corner of the county adjoining the State of New York, and is bounded on the east by the Allegheny river, into which about three quarters of its surface drains directly through streams having their deliveries as well as their sources within the limits of the township. The rainfalls along its westerly margin seek Jacksons run and Akeley run and thence proceeding south-westerly through Pine Grove township enter Conewango creek.

The Allegheny river crosses the State line at 1,270′± A. T. and the south township line at 1,225′ A. T.—this last point, of course, being the lowest spot in Elk. From the elevated table land lying in the south-west corner, and before referred to in Glade township, another broad-topped divide trends north-easterly and northerly four or five miles and then bears off towards the north-west corner of the township, and continuing north along the line between Chautauqua and Cattaraugus counties in New York, it forms a central dividing ridge between the Allegheny river and Conewango creek for a distance of about four miles, where it is completely cut through by the glacial valley joining Case run, flowing north-westerly, with Bone run, flowing south-easterly. The summit in this valley (1,530′ A. T.) is about 250′ above the Allegheny, and 600′ below the table lands on the divide.

One of the highest summits in Elk is found in its south-west corner, on the road leading from the Warren and Corydon highway to Dinsmoor's coal banks; altitude, 2,129′.

From this point north to where the divide trends toward the north-west the average summit level is 2,100′.

The highest point (measured barometrically) in this township and in Warren county is reached at the school-house at D. Hess' corners, where, on the map, the roads fork in the center of the second full tract south of the State line and adjoining Pine Grove township; altitude 2,170′ A. T.

The Olean Conglomerate is only found in small patches in the southerly part of the township where it overlaps from Glade, and as it is freely referred to in the report on that township it demands no further notice here.

The Sub-Olean is widely distributed over all the higher elevations, and often bears a considerable thickness of Shenango shales above it. Hence in many respects the hill soil in Elk is very similar to that on "Yankee Bush ridge" in Conewango. This difference may be noted, however. In Conewango the ridge is quite narrow and the surface is undulating, numerous depressions having been cut into the crest between the streams rising upon it and flowing in opposite directions. Consequently the soil is more or less a mixture of the Shenango shales, the fine pebble conglomerate and the underlying shales. But the highlands of Elk furnish many broad plots of table-lands. Some surfaces lie wholly within the plane of the Shenango shales; some within the conglomerate, and others in the shales below, therefore the soil is rather spotted on the higher points, for each plane differs from the other, as the rocks from which the soils have mainly been formed differ, the mixed soils coming in only on the slopes and lower levels. It would be wise for the farmer to study these characteristics of the various soils, so that he might learn how to adopt his treatment of them to their requirements.

In consequence of the incoherent nature of the materials forming the *Sub-Olean* in this township, it is inclined to crumble in weathering, and, intermixing with the surrounding débris, conceals its outcrops in gentle slopes. Occasionally, however, it assumes a more massive character, and then its escarpments are easily discernible.

Near the Quaker Hill coal mine, low cliffs may be seen, which have thrown off large blocks, sometimes six or eight feet in thickness, and principally composed of sandstone, but the wagon road passes over the top of the rock on a bed of loose white pebbles.

Less than a mile east of this the *Sub-Olean* shows as a mustard-seed pebble rock, and about the same distance west as a yellow coarse-grained friable sandstone. Throughout the central part it makes a great deal of pebbly soil, and is apparently quite a compact sandstone toward the bottom. Its north-eastern extension is a heterogeneous mixture of pebbles and sandstone, very much discolored by iron. In the north-west corner it forms escarpments, and throws off massive blocks. Here, also, its physical constitution is not uniform, being in some spots pebbly; in others, sandy; in one place, soft; in another, hard. The pebbles and sand of the softer parts disintegrate readily, and the material, containing much less iron than usual, is screened and used for mortar-making.

Not more than two miles from this, but over the State line into New York, the rock thrown from a water well fifteen feet deep is identical in appearance with that on Yankee bush ridge in Conewango and Snyder's summit in Glade. It consists of fine pebble conglomerate, firmly cemented by iron and containing iron-lined cavities filled with clay, and coarse-grained ferruginous sandstones inclosing a profusion of *Crinoid* stems and flowers promiscuously intermixed, with now and then a *Spirifer* or an *Orthis Michelini.*

Half a mile east of this well, a similar exhibition is given by another well; but here conglomerate predominates, and the pebbles are much larger, some of them being two inches in diameter, and half an inch thick.

Within a mile of these two wells are several escarpments, showing 25′ of massive sandstone, and forming rock cities of considerable magnitude.

There seems to be no more reasonable way of accounting for the variations in the constitution and structure of this rock than to suppose, either, that it was originally deposited by very unsteady and irregular currents, so that the materials were in some places re-worked and re-deposited, (being transferred from one place to another, the pebbles and sand meantime undergoing various modifications, according to the circumstances controlling them) or, that it has been subjected to somewhat similar treatment since its original deposition, in consequence of exposure before consolidation to certain conditions of erosion and re-arrangement, which conditions may have been partly sub-aerial and partly sub-oceanic.

Surface sections in Elk township are hard to get. Only along the Allegheny and the streams flowing into it are the rocks cut through to any considerable depth, and here the hills are generally so sloping and drift covered that but little fixed rock can be seen. None of the massive sandstones and conglomerates, so conspicuous in Conewango and Glade, which should here lie between the *Sub-Olean* and water level, could be seen. A more thorough search perhaps along the river front might bring some of them to notice, but I think it improbable, for I was equally unsuccessful in my efforts to discover them on the opposite side of the river, in Corydon township, where the ground was gone over carefully.

Oil wells.—Several drill holes for oil were put down in early days along the river bottoms—one at Cornplanter falls, said to have been 1,050′ deep and one opposite Corydon, reported 316′ deep. These were both wet holes and nothing now is remembered about them, except that some little gas was obtained.

A more recent test was made in 1878 on the south branch of Hodge run, not far from Dinsmoor's coal bank. But this also was a failure, although drilled in the most approved manner and carried down to a depth of 1,500′—or to within 104′ feet of ocean level—deep enough no doubt to pierce all the known oil horizons down to and probably a little below the Bradford sand. The record is given on page 30 of additional records.

Another well was completed in September, 1882, and abandoned as a failure at a depth of 1,980′. It was located on the south branch of State Line run in warrant No. 5548, (the second full warrant south of State line.) The altitude of the well mouth is unknown, but judging from the surroundings, I infer that the drill reached ocean level, and probably penetrated a few feet below it.

South-Eastern and Eastern Division.

16, Limestone; 17, Watson; 18, Pleasant; 19, Mead; 20, Kinzua; 21, Corydon; 22, Cherry Grove; 23, Sheffield.

Skirting the Allegheny river and along the Tionesta valley are some good alluvial bottoms, where farms are occasionally seen, under a fair state of cultivation. Clearings have also been made and comfortable homes established on portions of the table-lands of Watson, Limestone, Pleasant, and Cherry Grove townships; but by far the greater part of the south-eastern division of the county is yet in a wild state; and, although a great deal of lumbering has been done, extensive tracts of native pine, hemlock, and hard woods still remain.

The dense hemlock forests have induced the establishment of large tanneries at Sheffield, Clarendon, and Stoneham. Saw-mills are at work in many places. The inhabitants being largely engaged in occupations connected with these industries, comparatively little attention is paid to farming.

All the higher summits are covered by the Carboniferous rocks. In some places the Olean conglomerate is at the surface; in other places the clay shales or sandstone above it. A thickness of more than 200′ of these measures remain on some of the ridges, and several unimportant deposits of *coal* have been noticed in different places.

As a consequence of the variability of these rocks, the upland *soils* derived from them vary according to geological location, and the hill slopes are frequently so littered with sandstone and conglomerate that cultivation is impracticable.

No important deposits of *limestone* or *iron ore* are known in this region, and it is doubtful whether any of the coal beds above referred to will be found of sufficient thickness and purity to render them commercially valuable.

But below all the surface rocks lies a source of wealth little dreamed of by those who located their claims upon these rugged hills on account of timber alone. The discovery of *oil* has revolutionized values within the last two years, and introduced a new industry, which, just now, overshadows all others. Some of the most unpromising tracts of land—denuded of timber, covered with rocks, and scarcely considered worth the taxes—have suddenly come to command $1,000 or more per acre. How great the range of the prolific oil bearing rocks may be, how persistent the yield, and how profitable are to be the results to the oil operator—these points remain to be determined by future developments.

16. Limestone township. Organized in 1829; and 17. Watson township. Organized in 1880.*

The old township of Limestone had the Allegheny river for its western and the Forest county line for its southern boundary, with Pleasant township on the north and Pleasant and Cherry Grove on the east.

Its high table lands are covered with rocks belonging to the base of the Coal measures, and are deeply scored by erosion; their western front draining through a number of short, rapid streams into the Allegheny river. The easterly water-shed slopes partly east, (holding the head branches of Tionesta creek,) and partly south-east into Minister run, and Pine or Bob's creek, branches of the Tionesta, which join that stream in Forest county. East Hickory creek and its branches drain all the southerly central part.

Watson township was set off from Limestone March 4, 1880; but there is no special reason for describing these townships separately. The only feature not possessed by them in common is this: Limestone township, as now defined, embraces all the territory in the county lying east of the Allegheny river which has produced *oil from the horizon of the Venango oil group;* and only the western half of that portion has been productive. Here the Venango group may be said to fade out eastward and disappear, being unrecognizable (in anything like its normal structure) in wells drilled further to the north-east, in Limestone township.

The lowest point in Limestone township is at the county line—surface of water in Allegheny river 1,082 ± A. T.

The highest observed is between the west branch of

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* On the geological map the south-east line of Limestone township is wrong. It is drawn on the *north-west* line of warrants Nos. 5220 and 5131. It should be on the *south-east* line, for these two warrants are in Limestone township.

Hickory and the river, near the north township line, 1,840′ A. T.

The *highest point* in Watson township is Snaveley's summit, near the center of northern part, 1,930′.

As there are many hills obscured by timber there may be higher points than these.

Along the river above Tidioute the bottoms are very narrow and the valley walls rise so abruptly that little land can be had for cultivation, except at the mouths of some of the largest streams; therefore, the principal farming districts are upon the table lands. On the Economy tract, south-east of Tidioute, and following the high ground along the road to Warren, are many farms which will compare favorably with those of the less rugged townships at the north. The topography of these highlands is such, however, in consequence of the plane of erosion so generally ranging horizontally within the horizon of the bassal sandrocks and shales of the Coal measures, that large areas must always remain unfit for cultivation.

The Olean conglomerate occupies only the highest summits in Limestone township, and seldom carries any great thickness of carboniferous strata above it. But in Watson, where the dividing ridge between the Allegheny river and Tionesta creek sweeps around in a curve from Cherry Grove to Pleasant, the surface rises so that about 80′ of Coal measure shales and sandstones remain on top.

At one of the highest points on the Warren road, near the residence of Mr. L. Snaveley, a water well was put down by spring-pole in 1881, of which the following is a record:

Snaveley's Water Well.

				A. T.
Mouth of well elevation, above tide,			0	=1,930′
Surface clays	9	to	9	=1,921′
Sandstone,	9	to	18	=1,912′
Coal,	½	to	18½	
Sandstone, brown and white,	45½	to	64	=1,866′
Slate or shale,	6	to	70	=1,860′
Sandstone, white,	7	to	77	=1,853′
Slate or shale,	6	to	83	=1,847′
Sandstone, white, pebbly, (OLEAN CONG.,)	34	to	117	=1,813′

Drilling was suspended before reaching the bottom of the Olean conglomerate and without obtaining as much water as was desired.

Comparing this record with the sections given elsewhere in Pleasant, Kinzua, Glade and Cherry Grove, we see how very irregular in structure these bottom Carboniferous strata are. The thin coal beds appear to be local and can only be classified as lying in a general way at the horizon of either the Sharon or the Mercer coals without perhaps being the exact equivalents of either.

The sub-Olean conglomerate and Shenango shales retain the same characteristics in Limestone township as in Triumph.

On Economy hill, opposite Tidioute, the *sub-Olean* weathers into thin blocks ; is very ferruginous ; and contains a few remains of *fish* fins and teeth.

In the eastern part of Watson it becomes more massive and pebbly.

A fine exposure is seen on the north-west side of East Hickory creek, near the plank road leading from Cobham to Baxter's mills. Top of cliff (about 20′ high and skirted with solid blocks of flat pebble conglomerate 8′ to 10′ thick) 1720′ A. T.

A short distance from this cliff and about 40′ higher the base of a 30′ escarpment of Olean conglomerate is seen. Here also the rock is very solid, being composed principally of coarse sand containing a few small pebbles. In some parts of the exposure the layers are 25′ thick, without flaw or seam. In many other places the *sub-Olean* betrays its position by the shape of the ground, by loose blocks, and by springs ; but few plain outcrops can be found.

Crawford shales.—This group, occupying the interval between the *sub-Olean* and the *Venango oil sands*, lies entirely above water level along the principal streams ; but has no conspicuous outcrops. Its constitution can nevertheless be understood by examining the well records furnished by the Economy Oil Company, published on pages 31 to 48.

The upper part of the group is less argillaceous in Limestone township than further south and south-west; and it contains more thin, variable beds of shaly, false-bedded sandstones. The *Pithole grit* is not massive; nor is its horizon always constant, or clearly defined. The *red shales* above the *First oil sand*, (which form such a prominent feature in the wells drilled around Franklin and in Forest county,) are here bluish or brownish shales interstratified with bands of shaly sandstones.

The formation as a whole is composed of alternating layers of shales and thin-bedded, false-bedded sandstones, irregularly interbedded; so that even the sandstones in the horizon of the Pithole grit have not the solidity or the persistence generally characteristic of that stratum in central Venango.

Venango Oil Group.—At no other place in the county, or indeed in the State, is the Venango oil group so favorably exposed to surface examination as in the vicinity of Tidioute.

The *Second* oil sand B, on the Economy tract underlaid by bluish and brownish shales, can be traced continuously, in the river bluffs, from the suspension bridge to Hemlock run; and north of this run several good exposures occur.

The *Second* oil sand A, rises from the river bed at the bend east of Tidioute, and may be seen in a number of places both below and above Cobham post-office; (see Allegheny river section.)

The *Third* oil sand, which lies about 90′ below river level at Tidioute, is nowhere visible. Its rise northward should bring it up to daylight before reaching Irvineton; but, thinning out rapidly in that direction, it becomes unrecognizable in the wells before its horizon is cut through by the Allegheny river. A study of the Economy oil well records confirms this statement; and it receives additional support from the testimony of well owners and drillers who have thoroughly prospected the country to the north and northeast of Tidioute.

The *Lower oil sands*, (those of Warren, Clarendon, Cherry Grove and Sheffield,) are little known; for very few wells in Limestone and Watson have been sunk deep enough to reach them.

Economy Oil company's well N, (see Report II, page 178,) located on Dunn's run at an elevation of 1158′ A. T. was drilled to a depth of 1005′, *i. e.* to 153′ A. T. By this well in all the 787 feet of rocks lying beneath the *Tidioute Third sand*, only one hard shell of sandstone was reported; this being 8′ thick, and 652′ below the *Third sand.* The well appears to have been deep enough to have reached the *Cherry Grove sand*, if that had been present; but not deep enough for the Sheffield sand.

A well at Tidioute was sunk years ago to the depth of about 1000′; but it proved a failure.

Two deep wells have recently been put down above Cobham; one, at the mouth of Conklin run, on the west side of the river; and one, I believe, on the east side, in Watson township. Both records have been closely withheld from the public; it is only known that the wells were unproductive; which is not at all surprising, for other deep drillings on that range show that it is very questionable whether the oil producing sands of south-east Warren extend this far north-west.

A well, on tract No. 543, Watson, in the northern part of the township, (being the second lot from the north line and the fifth from the east line, as seen on the geological map,) was drilled in 1882, by experienced operators, as a test for that section. Without giving any particulars, they assert that having been drilled to a proper depth it proved a hopeless failure.

The *Shaw Bros. & Green well*, (of which a complete record is given on page 20,) located on lot No. 573, Watson township, (the second lot west of the N. W. corner of Cherry Grove, the north line of Cherry Grove and the south line of 573 being continuous,) was drilled in 1878, about the time the *Tolles well*, at Stoneham, was completed, and before any oil had been obtained in the Clarendon, Cherry Grove, and Sheffield districts. It cannot be said, therefore, that the record was made after any prearranged formula; for nothing was then known about these lower oil rocks.

The presumption is, that the record is a faithful one; and as it seems to show that the general characteristics of the oil bearing measures of south-eastern Warren prevail at this locality, it would not be surprising if a productive oil pool should yet be discovered somewhere near it.

The first paying oil well in the Allegheny river valley was obtained on the Economy tract, in the fall of 1860; the second ("B") was completed shortly after; and on the 25th of December, of the same year, the first *flowing well* ("A") was struck.

Mr. William Merkel, superintendent of the Economy Oil Company, has kindly furnished the following facts in relation to these developments:

The first well was small, yielding only two or three barrels per day.

"B" well produced but little oil when first struck and looked rather unpromising, but upon being properly tested increased to 30 barrels a day, and proved to be an excellent well, holding a remarkably steady production, and continuing to yield profitably until June, 1868.

When first opened, the flowing well ("A") threw out large quantities of salt water, with about 75 barrels of oil per day. It flowed some nine months and was then tubed and pumped, but did not yield much oil after ceasing to flow.

These wells were drilled by spring-pole or "kicked down," no steam engines having yet been brought upon the property.

About 15 wells were sunk along the river bank, on the lands of the Economy company, before any drilling was attempted upon the river hill. Only five of these were good, paying wells, and a fair estimate of their average production would be about as follows:

First well,	2	barrels.
"A" or flowing well,	15	"
"B" well,	30	"
"C" well,	12	"
"D" well,	12	"

Three other wells produced some oil, but too little to entitle them to be classed as remunerative.

The Tidioute Oil Shaft, which was similar to an ordinary mining shaft, and sunk for the purpose of exposing large surfaces of the oil-bearing rock, so that oil could come in more freely than in a small drill hole, was located in Limestone township, on the bend of the river, about 80 rods below the suspension bridge. I have been unable to get a complete history of the undertaking, but Mr. L. H. Sprague, foreman of the Oil Farm when the shaft was being sunk, has kindly sent me the following facts in relation to it:

"The work was commenced in the year 1864 and abandoned in the fall of 1865; size of shaft, 8'×12'; depth, 165'; cost, about $48,000.

"The point at which bed rock was struck is not remembered, [it was probably from 40' to 60' from the surface,] but below that, to the depth of 141', came slate and soapstone, containing a few sand shells, from 1' to 2' thick. At 141' a hard, flinty, fine-grained sand-rock was found, underlaid by a stratum containing coarse pebbles interbedded in a bluish clayey matrix, but very hard and compact. This ended at 152' where the oil-bearing rock, 5' in thickness, was struck.

"A specimen of the oil-rock shows it to be a mass of quartz pebbles varying in size from a mustard seed to a grain of wheat, with occasionally a flat pebble half an inch or more in diameter. The sandy matrix is coarse and scanty. When fresh dug and freed from oil the rock was so porous that a lighted match could easily be extinguished by blowing through a piece of it an inch in thickness. A hard, fine-grained sandstone containing many large flat pebbles, white, pink, and slate color, occupied the 8' interval between the oil-producing stratum and the bottom of the shaft.

"After completing the excavation several holes were drilled in the floor. These varied in depth from 10' to 40'. Some of them were perfectly dry, some filled with water, and one threw water to the height of 50'; but none of them produced oil.

"The 5' pebble rock was the only oil-bearing stratum found. The oil did not come in from veins or fissures, but oozed out of the conglomerate and dripped down on all of the side walls alike. On the spot where the shaft was sunk a five-inch hole had previously been drilled, which produced about 4 barrels of oil per day, and that was as much as ever could be collected in the shaft. This is rather remarkable, for it will be noticed that in one case only 6.55 square feet of oil-rock surface was exposed, and in the other 200 square feet.

"It was the intention of the company to drift from the shaft into the oil rock, to expose more surface for the exudation of oil, but shortly after the drifting commenced the air-pump employed to ventilate the pit gave out. The miners came up, and before attempting to return, Mr. Hart, the foreman, wishing to ascertain if gas had accumulated, thoughtlessly lit a piece of oiled waste, and, looking down to see the effect, dropped it in. An explosion instantly followed. He was thrown to the top of the derrick and then fell to the bottom of the shaft. After considerable delay, his mangled remains were recovered, and the pit was abandoned, for no miners could be induced to work in it.

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18. Pleasant township. Organized in 1834.

Having a long frontage upon the Allegheny river, both on the west and north, the whole township naturally drains into that stream, except the rectangular extension running southward to Cherry Grove. The Tionesta flows through this part in a north-easterly direction having cut out a broad deep valley into which a number of tributaries fall.

The lowest point is found where the Allegheny river crosses the south line, 1140 ± A. T.

The highest points are at *Dailey's coal knob* near the Warren and Tidioute road 1935′, and at *Dible's coal knob* near the road from Warren to Tionesta creek, 1955′.

The greater part of the desirable alluvial lands of the township lie along the river east of Sill's run, where some fine farms are located. Between Sill's run and Grunder's run the river flows close to the steep bluffs, leaving no tillable bottoms. Between Grunder's and Irvineton the river hills are cut back to the south, and what looks like a broad valley opens; but the greater part of this valley is occupied by low foot-hills, composed mostly of rock in place, with a soil too rough and variable to invite cultivation.*

Some alluvial bottoms are found, also, along Tionesta creek, in the southern part of the township; but these are of a different character, being composed wholly of local drift materials.

On the highlands very few improvements have been made; in fact the surface there is so furrowed by erosion, and littered with broken sandstones, that but little desirable farming land can be found.

The Olean conglomerate exposes its most northerly outcrop in the spurs and ridges of the river hills; but nowhere except on the point west of Sill's run does it approach very near to the Allegheny river; for, at all other places, the first range of hills is too low to hold it. This escarpment presents a frontage towards the north of 5 or 6 miles. On the opposite side of the river, in Conewango township, and in Farmington, the conglomerate has all been removed.

No other such clean cut escarpment as this, terminating as it does abruptly, without a single outlier to the north of it, is to be found in Warren county, nor any such in the adjoining counties.

The Olean conglomerate is here about 30′ thick, very massive, and remarkable (particularly in the central part of the township) for the size of its pebbles, some of which are *larger than a goose egg.*

As a surface rock it crowns the points and hog-backs to the north with cliffs and *rock cities;* but going south, the gentle dip, and the rise of surface in that direction, put about 125′ of Carboniferous measures above it, at the summit between the Allegheny river and Tionesta creek. The highest part of this divide appears to be covered by the *Kinzua creek sandstone;* and in the interval between that rock and the Olean conglomerate some traces of coal have been noticed.

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* The topography plainly shows the effects of an ice-gorge in this basin before adequate relief could be obtained through the great southern outlet.

The *Dailey coal opening* is on the west brow of the highlands, about 4 miles south-east of Irvineton.

The *Dible coal opening* is 3½ miles a little north of east from Dailey's, and on the east point between the Allegheny and Tionesta. A continuous range of highlands extends from one point to the other; but this summit is so indented by the cutting of interlocking streams, rising upon it and flowing in opposite directions, that no large areas of the higher rocks remain.

The following geological sections were made by Mr. Randall, after a special examination of the localities:

Section seen on land of Emery Dailey, in tract 479, (near north line of tract,) Pleasant township, 5½ miles south-west of Warren. By F. A. Randall.

Dailey section.

	Summit between Lenhart's run and Sill's run,	A. T. 1,934′
1.	S. S. coarse, yellowish; seen,	50′ to 1,884′
2.	Concealed,	23′ to 1,861′
3.	Shale, brown, containing large ovoidal concretions of gray iron ore,	8′ to 1,853′
4.	*Coal*, bright and good,	1′ to 1,852′
5.	Shale, soft, brown and purple,	10′ to 1,842′
6.	Concealed,	6′ to 1,836′
7.	S. S. coarse, grey, iron stained,	30′ to 1,806′
8.	Conglomerate, ovoidal pebbles, small egg-size at bottom, graduating to the size of a pea at top, (OLEAN CONGLOMERATE,)	30′ to 1,776′

Section near the coal opening on land of Smith & Dible, tract No. 456, Pleasant township, 3 miles south of Warren: composed from various exposures in the neighborhood and reduced to location of the opening. By F. A. Randall.

Smith and Dible section.

	Summit between Allegheny river and Morrison run, A. T.,	1,955′
1.	Sandstone, white,	24′ to 1,931′
2.	" yellowish brown,	35′ to 1,896′
3.	Conglomerate, angular pebbles,	2′ to 1,894′
4.	Shale and thin, flaggy sandstones,	18′ to 1,876′
5.	*Coal*, thin,	1,876′
6.	Shale and flaggy sandstones,	10′ to 1,866′
7.	Sandstone, coarse, friable, iron-stained,	42′ to 1,824′
8.	Conglomerate, ovoid pebbles, base coarse, top fine, (OLEAN,)	30′ to 1,794′
9.	Sandstone, shaly, fine-grained, buff color,	52′ to 1,742′
10.	Conglomerate, flat pebbles, coarsest at top, (SUB-OLEAN,)	20′ to 1,722′

In running the levels from Warren to this coal opening the following benches were established:

Datum, P. & E. depot, Warren, A. T.,	1,200′
B. M. on hickory, E. of road, Lauffenburger and Dible line,	1,373′
B. M. S. of road, at bars of west field of Myer's farm,	1,706′
B. M. on small oak, W. of road, J. Siechrist's S. field,	1,893′
B. M. east side of road, on summit,	1,955
B. M. east side of road at old coal opening,	1,867′

The *sub-Olean conglomerate* furnishes no very prominent exposures in Pleasant township, being generally hidden by the débris of overlying rocks.

Along the river front west of Sill's run it is an irregularly bedded, fine-pebble, iron-charged rock; the same as in Conewango township. But in the eastern part it becomes more massive and contains *larger pebbles*, being very similar in structure to the conglomerate at Stoneham and Clarendon.

A fair exposure of about 20′ of *sub-Olean* may be seen 2½ miles south of Warren, just south of the road leading from Sill's run to the Warren-Tionesta road, probably on land of J. Lauffenburger; base 1790′ A. T.

Opposite the residence of Mrs. Knupp, half a mile northwest from the last-named outcrop, lies a very peculiar bed of fine pebble, ferruginous conglomerate, and fine-grained, yellow, shaly sandstones, about 20′ in thickness; base 1645′ A. T. The sandstone contains large quantities of *Crinoid* stems and both sandstone and conglomerate are similar in appearance to those seen on the hills of Conewango township; but they do not lie in the same horizon; for the Conewango beds come in at the *top of the sub-Olean*, while the Pleasant beds lie about *125′ below it.* Not having noticed this peculiar deposit in any other part of the county, I infer that it is local and of quite limited extent.

The only *thick massive sandstone* seen *below the sub-Olean* along the river front, outcrops in one of the foot-hills between the highway and river, nearly opposite Jackson's station. The top of this hill is composed of sandy shale at 1510′ A. T. At 1440′ a 25′ massive sandstone, containing some layers of flat pebbles, cliffs out on the side toward the river. This rock can hardly be identified with the *Jackson's station conglomerate* which lies at 1382′ A. T. It more probably represents the top rock in the Irvineton section, (No. XIII.) The Jackson station conglomerate may be concealed below.

Oil Wells.—No profitable oil wells have yet been drilled in the township. Indeed, but few proper tests have been made there. Years ago three wells were drilled on Tionesta creek, but they were only 700′ to 800′ deep and therefore did not reach the Clarendon oil sand.

Capt. Dingley drilled six wells on or near Sill's run (for records see page 19.) None of them were paying wells, but they found some oil in sandstones lying in the Warren oil horizon, thus showing that the territory lies within the limits of a possible oil field.

In the summer of 1882 a well was completed on tract No. 452, at the head of the west spur of Sill's run, (near the two southerly branching roads on the map,) of which nothing can be said except that it was properly drilled and dry.

These Sill's run wells may all be included in a narrow belt running south-west in continuation of the Warren development and their failures cannot be said to condemn the whole of the township.

Another well is now being drilled, I understand, in the eastern part of the township, on Morrison run. This will be an important test in a new direction.

19. Mead township. Organized in 1847.

The togography and drainage of Mead are deserving of more than passing notice. Here are seen bold, bare escarpments of conglomerate, valleys deeply filled with Drift, reversed streams, and summit swamps like some of those on the lake Erie divide. One deep, wide valley, evidently excavated by waters anciently coming from the south, and delivering northward through the old Conewango channel, parts the township into two nearly equal halves. This ancient channel is filled at Clarendon with Drift clays and gravel to the depth of at least 250′. From the low divide here formed flow southward the upper waters of the present Tionesta, leaving an insignificant stream called Dutchman's run in sole possession of the northern part of the grand old valley.

This very remarkable reversal of drainage was briefly referred to in Report III, page 349. When that was written no oil wells had been drilled at Clarendon in the deep part of the valley, and the actual depth of Drift was unknown. The theory of pre-glacial drainage then advanced, and the figures then published, called for a depth of about 250′; but no *positive* proof existed that the Drift in this part of the valley was deeper than in other places. Now, however, the flats are covered with derricks, beneath which drive pipes were put down from 200′ to 250′ before reaching bed-rock.

Even on some of the knolls and foot hills long strings of drive pipes have been required. Operators were surprised to find the depth of Drift greatly varying within short distances, and sometimes in directions least expected. It is evident that the ice which caused the filling up of the old valley re-dressed its side walls, and, in some cases, cut down their salient points below present water level; afterwards covering them with Drift. When the new stream selected its bed it had the greatly widened valley to wander in, and as it flowed in a contrary direction to the one which had originally excavated the much deeper original valley, its meanders bore no relationship to those of the old stream.

By glancing at the maps of pre-glacial drainage accompanying Reports I^3 and Q^4, the reader will perceive how favorably this old valley was situated to catch the northern ice-currents. Other streams in the Chautauqua basin, such as the Upper Allegheny river, Tunangwant creek, and Kinzua creek flowed northward; but none of these were so peculiarly located as the Tionesta. They were all more or less protected from the ice-shove by the northern highlands of the basin. The Tionesta valley, on the contrary, opened directly into the main northern valley, through which the ice had free movement until checked by the highlands at the south.

The center of Mead township must have been already deeply trenched by the old streams converging there; and all along their valleys the ice filled in and lay perpetually wasting, and being perpetually renewed by fresh supplies from the north, so long as the southern outlets were kept open, and were being deepened. Similar operations were going on in the other valleys just mentioned, but less energetically. No southern outlets were enforced at the heads of the Allegheny and Tunangwant; therefore the streams still continue to flow northward as of old. But the Kinzua, finding relief through the Great Bend cut, allowed the Allegheny to supercede it north of that point, and now occupies only about half of its original valley.

Meantime the Tionesta had been acquiring two outlets; one through its connection with the Allegheny, the other across the southerly rim of the basin into the main trunk of modern Tionesta. By the latter, direct southern communication was had with the lower Allegheny, through a valley already prepared, outside of the great ice-filled basin, and joining the river at a point 20 miles or more below the summit highlands, where the grand sluice-way for the Chautauqua basin was being excavated.

The comparatively unobstructed drainage through the southern or Barnesville gap, must have invited a general movement of water and ice in that direction, while, at the same time, the north end of the valley was under the influences of the Allegheny river drafts. Hence, currents were induced to flow in opposite directions in the same valley. As a result of this but little motion would prevail at the point of diffluence, and there the ice-borne débris accumulated more rapidly than in other places, building up a barrier which formed a permanent divide as the waters lowered and ice wasted.

Similar causes have produced like effects in all the other basins. As the Great Bend cut became sufficiently enlarged to accommodate all the northern Allegheny waters, the old, unused, and consequently still-water channel between Steamburg and Randolph filled up and became a valley-summit. As the Allegheny outlet deepened at Thompson's and all the currents set southward towards it, the old preglacial valley at Cassadaga filled up. As Oil creek opened southward its former northern outlet into French creek filled up. As new French creek opened into the Allegheny the old Conneaut outlet filled up. For every southern outlet opened, a northern outlet filled.

They go in pairs—fill near Steamburg, cut at Great Bend; fill at Cassadaga lake, cut at Thompson's; fill at Clarendon, cut at Barnesville; fill north of Titusville, cut south of it; fill at Conneaut lake, cut above Franklin.

The fact that each glacial cut now drains a distinct basin of its own, from which an old drift-filled northern outlet can be traced, seems to me to be a cogent argument in favor of pre-glacial northern drainage. And, inasmuch as all these southern gateways are opened through highlands rising from 250′ to 500′ above the drift-filled barriers at the northern ends of their respective basins, it is evident that the summit erosion at the gaps must have been inaugurated by agencies much more potent and universal in action than any that could possibly have prevailed within their comparatively narrow limits. The hypothesis of a grand *Mer-de-glace* filling the old valleys of Erie and Ontario, and overflowing the dividing ridge at the south, is the only one that affords a reasonable explanation to account for this extraordinary erosion of deep gorges upon high summits.

The *Drift-divide* in Tionesta valley occurs on the range of east and west highlands, continuing across Mead from Pleasant to Kinzua, and hence the township is divided nearly centrally into a north and a south water-shed, the former being drained by Hook's run, Dutchman's run, and Morrison's run into the Allegheny river, the latter contributing directly to the Tionesta.

The *lowest point* in Mead township is at the north-west corner, where the surface of the water in the Allegheny is at 1,178′ ±.

The *highest point* observed, 1,910′ A. T., is in the eastern part of the township on the divide between Dutchman's run and "Mile run,"* 1,910′.

The *farming lands* of Mead lie wholely along the valleys, the summits being so universally rough and rock covered

* This is an error on the map. It should read "Six Mile run."

that very few, if any, attempts have been made to clear them. As but little northern drift has penetrated south of Clarendon, the soil of Tionesta valley differs somewhat from that along the Allegheny river, but not enough perhaps to be noticeable in any remarkable degree. It is probably a little more clayey and colder, but, nevertheless, is capable of producing very good crops where properly cultivated.

Drift deposits. I have never been able to get a complete suite of specimens from any of the deep drive pipe wells at Clarendon to show the exact stratification of the Drift deposits there. Sufficient is known, however, to warrant the assertion that *very little northern material* can be found, and this only upon or near the surface.

In Anchor Oil Company's well No. 1, Eagan tract, Clarendon, 215′ of pipe was driven principally through clay. Two beds of pebbles and sand about 12′ thick were pierced; one at 150′, the other at 208′. Samples of these gravels have been preserved, and they are composed entirely of *local rocks.* It is noteworthy that not one particle of the metamorphic rocks so common in all the surface Drifts of the country north-west of the Allegheny can be detected in them. The pebbles are of bluish-gray and yellow sandstone, flat and water-worn. Some of them are 1½″ in diameter, and contain fossil impressions, others are fine-grained and micaceous. Intermixed with them are many quartz pebbles derived from the disintegrated conglomerates of the surrounding hills.

Conglomerate bowlders of considerable magnitude are sometimes struck by the drive pipe, but they are generally so soft that the pipe can be forced through them after a full sized hole has been drilled ahead. These facts indicate that the old valleys commenced to fill long before the northern drift-bearing ices reached them.

The *Olean conglomerate* has nearly all been eroded from the surface of Mead township. Throughout the central portions none of it remains. On the western side it caps the two highland spurs which form the heels of the horseshoe ridge which surrounds the head-water branches of Tionesta creek. On the east it covers a few of the higher summits. In all these situations it is not overlaid by higher rocks, or with a very little if any.

The *sub-Olean* has a wider field of occupancy, and covers nearly all the high points and ridges between the streams. It often makes prominent cliffs, as at Clarendon and Stoneham. Here it is a massive current-bedded, coarse-pebble stratum, from 30′ to 40′ thick. Towards the south it dips beneath the summit surfaces and the Shenango shales overlying it give character to the soil.

Of the measures underlying the sub-Olean no good exposures can be found.

A massive flat-pebble conglomerate, 25′ (?) thick, outcrops on the west side of the valley at Stoneham, and also along the hills to the north-east. This stratum lies about *270′ below the sub-Olean.* The interval between the two rocks seems to be composed almost wholly of sandy shales or shaly sandstones.

This massive conglomerate seems to be restricted to this locality, for I have not detected it elsewhere, either in oil wells or in surface exposures. Below it come sandstones, shales and red rocks, arranged in different order in different localities, as the oil well records (given elsewhere) plainly show.

Oil Wells.—The first paying oil well obtained in the Warren oil group south-east of the Allegheny river, was Tolles well No. 1, struck in January, 1878. (See page 20.) Since then several hundred wells have been drilled in the vicinity of Stoneham, Clarendon and Tiona, and the central part of the township has been developed into an important oil field. The wells are comparatively small but lasting and with better prices for oil the district would be a flourishing one. The effects of the oil business are seen in the increase of the inhabitants of the township and the rapidity with which the town of Clarendon has been built up. In 1878, when the Tolles well was struck, probably not more than 450 people resided in Mead; in 1880 there were 1150; and a census taken in 1882 would have shown, no doubt, more than double that number.

20. *Kinzua township. Organized in 1820.*

This township, lying east of Mead and adjoining McKean county, is a wild forest tract with scarcely a habitation, except along the Allegheny river front and in Kinzua creek valley. All the rest of it may be called table land, with a variable surface, rising from 1,800′ A. T. in the southern part to 2,154 at *Coal Knob*, a little south-east of Great Bend, where the highest point in the township is found ; the lowest being on the Allegheny river, 1,199 ±.

From Coal Knob a spur of the highland runs out westwardly between the Allegheny river and Hook run ; and another south-eastwardly along Kinzua creek. This spur widens toward the west into the range of highlands which crosses Mead and Pleasant townships. These broad summits determine the direction of drainage ; the northern half of the rainfall going west and north and east into the Allegheny and Kinzua creek ; the southern half wholly into the Tionesta.

Several hundred acres of fine alluvial lands are under cultivation near Kinzua village, in the broad basin at the junction of creek and river. The flood-plain is here skirted by beaches and terraces similar to those seen at Warren, Barnesville, Irvineton, and, in fact, on every considerable stream in the county where a wide basin is cut at its confluence with another stream and the outlet narrows below.*

* We may reasonably suppose that there came a time during the recession period when the Chautauqua basin, by reason of its elevation of over 700′ above lake Erie, became relieved from all extraneous ice-pressure. This happened when the northern *mer-de-glace*, reduced in volume and finding ample outlet through the low levels of Ohio, retired within the lake basin. The Chautauqua basin then became a small independent *mer-de-glace*, but left alone to its own resources and subjected to climatal conditions constantly growing more unfavorable to accumulations, the ice-sheet gradually diminished in thickness and eventually became so much reduced that it ceased to flow over the southern divide. From this time the movements of the wasting ice must have been governed principally by the topography of the surface beneath it. Gravitating toward the main lines of drainage, it first left bare the highest summits, then the table-lands were uncovered, and finally only a network of ice-cores remained in the gorges. As many of the valleys are deep and wide these ice-cores, wasting but slowly, may have held possession of

The Olean conglomerate in the Allegheny-Kinzua ridge is of extraordinary thickness, as may be seen in Tuttle cliff section, Allegheny river series No. XXII, and carries above it about 240′ of carboniferous measures. The section at the highest point, about a mile south-east of Great Bend, extends up to the top of the *Johnson run sandstone*, and contains *three coal beds* which appear to lie at the geological horizon of the Alton coals of McKean county. The *Quaker Hill coal* appears to be entirely absent from the section.

Coal beds. Little can be said about these beds for they have never been thoroughly proven. Years ago a small quantity of coal was taken out and hauled to Kinzua village for local use, but the workings are now inaccessible, and no fair sample of any of the beds could be procured for analysis. The details given in Mr. Chance's section were furnished by Mr. Wm. English, who made the openings.

Whatever may be the value of these coals they cannot be of any *very great* commercial importance, for the ridge upon which they are located is cut down below them at the saddle-back between Mead & Eddy run and Hook's run, and thus the productive area is limited. The southern part of the township is probably all too low to catch them.

The sub-Olean is a persistent and well-defined stratum throughout the township. It forms many escarpments along the steep bluffs bordering Kinzua creek and the Allegheny, and caps the point south of Kinzua village. In the western and southern parts it is the surface rock on most of the hills skirting the streams, the higher rocks coming in

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them long after the highlands were uncovered. In effect they were islands occupying a large portion of the valleys and causing the water currents to flow in side channels. When freshets occurred and the waters ran high, one shore was beaching along the bluffs, leaving permanent deposits, the other upon unstable ice islands, ever changing and ever shedding whatever they might hold or receive, into the moving waters at their bases. The large pyramidal masses in the basins at the confluence of streams were the last to disappear, and therefore we might expect that the areas occupied by them, which had so long been protected from silt accumulations, while the rest of the valleys had been receiving them, would be considerably lower in level than their surroundings. In some cases, the ice-cores seem to have given place to temporary lakelets, which have gradually drained as the river finally completed the adjustment of its bed.

above it on the table lands of the divides. Wherever seen it is a massive and generally conglomeritic rock from 30′ to 50′ in thickness, current-bedded, reticulated with thin seams of accretionary iron ore, and always inclined to weather in layers. Frequently the blocks are large and massive, but as a rule they measure much less in a direction transverse to the bedding than in any other.

The interval between the Olean and sub-Olean at Great Bend is only 25′, while at the south line of the township it widens to 75′ or more.

Few oil wells have been drilled, and these in such locations that by far the largest part of the township may still be classed as not thoroughly tested territory. In 1879 two unsuccessful ventures—located about a mile apart—were made on the highlands near the center, and one on Wolf run near Kinzua village. The records of these—Beatty, Logan and Van Scoy wells—may be found on pages 27–29, forward.

The central wells were drilled very deep; one 2285′, the other 2240′ which carried them down 380′ and 420′ *below* ocean level. The geological horizon of the Clarendon oil sand ought to be reached at about 450′ *above* tide at which point we find a sandstone reported in the records, but no oil. The structure, both above and below this sand, shows plainly that the same band of sandy measures that furnishes oil at Stoneham, Clarendon and Garfield, ranges through central Kinzua; but whether any of its members will here prove productive of oil or not, remains for future developments to show.

Van Scoy No. 1 seems to have made quite a flattering show of oil while drilling, but after being for some time manipulated as a "mystery" it was abandoned; the belief being still strong among the surrounding land owners that it was spoilt intentionally.

Van Scoy No. 2, on Kinzua creek, 2½ miles south of Kinzua village, was completed in November, 1880, and starting off at the rate of 30 barrels per day, first demonstrated the fact that oil existed in paying quantities in Kinzua township, and created no little excitement in the oil trade.

About the same time a test well at Great Bend near Tuttle cliff rocks came in with a good flow of gas but no oil.

These were all the wells drilled up to that time that could be regarded as fair tests of the territory. Since then, however, several more have been sunk in the vicinity of Van Scoy No. 2, but with such indifferent success that the development of only a small pool has resulted. At present no special efforts are being put forth to connect it with other oil fields either to the north-east or to the south-west, but no doubt the scarcity of proven territory to operate upon and the prospects of better prices for oil will soon start the drill again in this and other parts of the township.

21. Corydon township. Organized in 1846.

This small and unimportant township is only a narrow strip skirting the Allegheny river and Kinzua creek and extending eastward to the tops of the river hills. It holds the mouths of *Sugar creek* and *Willow creek*, two streams of considerable size which reach well up into McKean county.

Along the river and creek bottoms are some fine farming lands. Being so accessible to the river most of its valuable timber has been removed ; and it has neither coal nor iron-ore.

The Buffalo, Pittsburgh and Western Railroad, following the east bank of the river from Corydon to Kinzua, and to be in operation before the close of 1882 will add greatly to the vitality of the township for it thus becomes the natural outlet for the products of all the north-western portion of McKean county.

The *lowest point* in the township is at the mouth of Sugar run, 1225′ ±.

The *highest* point is on top of a rock city on the river hill, along the road from Kinzua village to Marshburg, 2030′.

The Olean conglomerate retains possession of but one summit—the highest point above mentioned.

The sub-Olean caps several hills along the creek and river in the southern part, but is cut back into McKean county on the northern. It furnishes an excellent stone for masonry, and the railroad bridge abutments of this part of the valley have been constructed almost entirely from loose blocks of it which have traveled down from the hill-tops. On the Marshburg road the interval shales lying between the Olean conglomerate and the sub-Olean appear to be about 30′ thick.

No paying oil wells have been obtained in Corydon. In fact no proper tests have been made within its lines. Two or three wells were sunk in early times along the river; one at Cornplanter falls said to have been 1,050′ deep, which furnished gas and mineral water, but was never tubed or tested in any way.

Near the south-western corner of the township some oil is now being produced on Kinzua creek; and some also on Sugar run, in McKean county, about two miles east of the county line. No direct connection between the two pools has yet been traced.

On Willow creek several tests have been made near the county line, and although these particular wells came in dry they leave large areas still untested, where it is quite possible that a prolific oil rock may yet be found. Below are records of two of these wells.

Bailey & Sunderlin Well No. 1.

1879–80.

Located on Willow creek about one mile from the village of Corydon, on tract No. 3703, McKean county, on the south-west quarter, and near the county line. This is the most north-westerly warrant in McKean county. Authority Mr. Sunderlin's note book.

Well mouth above ocean in feet,		1,320
Drive pipe,	103 to 103=	1,217
Slate and shells,	87 to 190=	1,130
Red rock,	10 to 200=	1,120
Slate and shells, (cased at 203′,)	225 to 425=	895
"First sand," close, gray,	6 to 431=	889
Slate and shells,	123 to 554=	766
"Second sand," close, gray,	77 to 631=	689
Shelly, (gas at 1,019,)	483 to 1,114=	206
Sandstone, fine-grained, blue, (gas)	15 to 1,129=	+191
Slate and shells,	472 to 1,601=	−281

Bailey & Sunderlin Well No. 2.

Sept. 1880.

Located on Willow creek, warrant No. 3703, McKean county, about a mile and a quarter east of well No. 1. Authority, Mr. Sunderlin's note book.

Well mouth above ocean in feet,			1,370
Drive pipe,	128 to	128=	1,242
? (cased at 228,)	332 to	460=	910
"First sand,"	80 to	540=	830
Shelly sands,	40 to	580=	790
Slate,	15 to	595=	775
"Second sand," (good gas,)	87 to	682=	+688
Slate and shells,	850 to	1,532=	—162

22. Cherry Grove township. Organized in 1847.

Cherry Grove is the only township in the county whose boundaries form a complete parallelogram and whose subdivisions are uniform throughout. The original warrants composing it contained nominally 1,000 acres; that is, 1,000 acres and 5 per cent. allowance for roads, making really 1,050 acres. They were laid out 525 rods long north and south, and 320 rods east and west. Having been sub-divided into six lots, the theoretical dimensions of the present tracts are 175 rods north and south, and 160 rods east and west; equal to 175 acres. But the original measurements upon the ground were not accurately made, and there is a surplusage of from five to ten acres in nearly all the lots. As the maps are now plotted, there are 12 lots in an east and west range and 14 lots in a north and south range, but those adjoining the Forest county line are not full lots.

Commencing at the N. E. corner with lot No. 587, they are numbered continuously from east to west, (including the two square lots in Limestone township,) then from west to east, and so on, to and fro, down to the Forest county line.

On our geological map no numbers are given, but they can be readily supplied from Mr. Howland's excellent map accompanying this report.

The central portion of Cherry Grove is occupied by high table-lands connecting at the west with those of Limestone, and throwing out a spur towards the north-east, between Farnsworth branch and Arnot run. These summits have the highest average altitude (about 2,000′, A. T.) of any in this part of the county, and they form a broad water-shed from which the rain-fall drains both north and south; but both slopes contribute to the Tionesta.

The south-flowing streams lie in rather narrow, deep-cut valleys, which may generally be followed over the ridge, through notches from 50′ to 75′ lower than the summits, into the valleys of northerly flowing streams. Here, as in every other part of the county, the topography bears witness to the action of ice. Toward every place where a free movement was guaranteed, the ice currents centered, and the accelerated motion along such lines, caused more rapid erosion and deeper cutting.

North of the divide, the country is far more broadly eroded than south of it, and the northern streams contain much greater deposits of Drift than the southern. For instance, Farnsworth branch rises within a short distance of the head of Minister run. Its waters fall into Tionesta creek at Clarendon, about 20 miles above the point where the waters of Minister run reach the same stream. Its valley is very broad, and has been proven to be deeply Drift-filled, by the length of drive pipe used in oil wells at its mouth.

The Minister run valley is comparatively narrow and evidently holds no deep deposits of Drift, about 50′ being all that has been found in wells near its mouth. The contrast in the physical aspects of the two valleys is apparent to the most casual observer; but when in addition to this a comparison of relative levels shows the old valley floor at the mouth of Farnsworth branch to be from 25′ to 50′ *lower* than the old valley floor at the mouth of Minister, which is 20 miles further down stream, an anomaly is presented which is hard of explanation by any other theory than that of a preglacial northern drainage for the waters of the present upper Tionesta.

The *highest points* noted in the township are on lot 616, in the north-eastern part, (2015′,) and on lot 668, near Mr. Farnsworth's, (1980′.)

The *lowest spot* is probably on Minister run at the south township line, (1250 ±.)

Farms.—Comparatively few clearings have been made in Cherry Grove, as is shown by the fact that while it contains an area of about 45 square miles, the census of 1880 returns only 158 inhabitants.* The farms are all upon the table lands of the central east and west ridge and spur running out from it toward the north-east, and are therefore located upon soils derived from carboniferous rocks, which, although fairly productive, are rather cold and clayey and possess no great depth of mold. South of the central road, and in the north-west corner all is a wild wilderness.

Previous to the advent of the oil seeker, the wealth of the township was supposed to lie in its forests and the principal business was bark-peeling and lumbering; but now a great change has taken place. Surface values are little thought of, and lands that formerly sold for five or ten dollars per acre readily command prices varying from $50 to $1,000, with ⅛ or ¼ of the oil reserved in addition. The richly productive portions however, bear but a small proportion to the whole area and probably it will not be very long before some of the lots which have changed hands at high prices will again be advertised in the treasurer's annual tax sales.

The *Olean conglomerate* makes many conspicuous outcrops, and loose blocks obstruct the upper parts of the valleys of most of the streams, particularly those on the southerly slope. Copious springs issue from it and the overlying sandstones, feeding streams which wander over pebbly bottoms and afford some of the best trout fishing to be found in the State. The summit areas of the central part rise some 200′ or more above the base of the Olean, and appear to reach high enough in two or three places to include all the members of the conglomerate series. No good surface

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* In August, 1882, when the new oil towns of Farnsworth, Garfield and Vandergrift city were in their prime, it is probable that a census would have shown a population of three or four thousand.

section of these rocks can be obtained, and the records of wells drilled upon the plateau have not been kept sufficiently in detail to be of any service except in a very general way. Some traces of coal have been noticed in wells near Garfield, but nothing worthy of mention. The carboniferous sandstones appear to be irregularly stratified, one driller reporting almost a continuous sandstone to the depth of 150′ or more from the surface; another claiming in the same horizon several bands of sand with slates and shales intervening.

Coal seams of considerable thickness are known to exist south-west of the oil development at Garfield for the outcrops of two beds are seen. The lower one is laid bare in the bed of a small branch of Arnot run, and is said to have been the first coal discovered in Warren county. Mr. Montgomery Farnsworth, on whose land the exposure occurs, says that considerable coal has been taken from this spot (by stripping) at different times for blacksmithing purposes; for which it answers very well, although it makes a great quantity of ash. He reports the succession as follows:

1′ of good coal, thinly laminated.
2′ of coal slate.
1′ of good coal, more solid.
1′ of slaty coal, resting upon clay.

This coal bed evidently lies not far above the top of the Olean conglomerate, as shown by surrounding exposures and records of oil wells.

Near the south line of lot No. 668, about 150 rods toward the south-west from the above mentioned coal bed and 70′ higher lies another coal seam which has been drifted into to a distance of about 200′. This is also on land of Mr. Farnsworth, and as nothing has been done at mining for several years, and the drift is now impenetrable, we can only give his description of it.

Farnsworth's coal bed.

1′ 6″ of coal, thinly laminated, but burns well, making a hot fire and but little ash.
0′ 2″ of slate and yellow mud.

0′ 4″ of coal, good, but thinly laminated.

1′ 0″ of slate and mud with some iron pyrites.

2′ 0″ of coal, a little better than the first.

4′ 0″ of indurated clay not cut to bottom and full thickness unknown.

The coal comes in under a coarse-grained yellowish sandstone about 20′ in thickness, which within 50′ of the entrance forms a safe roof to the drift. It seems probable that this is the representative of the Johnson run sandstone of McKean county. Its base is 1950′ A. T. and as far as the drift extended it rises very perceptibly toward the west.

The underlying indurated clays are gritty, micaceous and full of carbonized rootlets ramifying in all directions. The slates and clays interbedded between the coal seams contain masses of plants, contorted and pressed together in indistinguishable confusion.

Of the sub-Olean and Shenango shales as surface rocks but little can be said, for they are generally covered by débris from the hills above. At Garfield, according to drillers' statements, the sub-Olean varies in thickness from 45′ to 110′. The Shenango shale interval also varies, but it is plainly seen that it has expanded here to nearly double its average thickness north-west of the Allegheny river. Drillers claim that above the Mountain sand they find the structure in no two wells exactly alike. The measures appear to be a mass of variable sandstones and sandy shales. Sometimes the sub-Olean is found coarse-grained and pebbly, with its position well defined by softer measures above and below it; at others it is a fine-grained bluish rock graduating imperceptibly to the driller into shaly or flaggy sandstones, which are all regarded by him as "Mountain sand." No doubt a careful inspection of the drillings would reveal more regularity of structure than is generally conceded, but it is useless to expect the driller to pay any particular attention to the stratification at this horizon, while drilling in the "wet hole" before the casing is put in.

The first oil well drilled in Cherry Grove township appears to have been sunk by Mr. Charles Sullivan, in 1865.

It was located on tract No. 665, about 10 rods north of the road leading to Sheffield; elevation 1,970′±A. T. Mr. M. Farnsworth says the drill stopped at a depth of about 400′, after having penetrated 25′ into a close-grained white sandstone, which was pebbly on top and furnished a considerable show of gas. The well was never tubed or tested.

At about 10′ from the surface a 7′ coal seam was reported, and after the well was abandoned a shaft was sunk near by, for the purpose of testing the coal. This enterprise also proved a failure; nothing but black bituminous slates having been found, as is shown by the excavated material now lying around the old shaft.

Another well was sunk, (probably in the same year,) on lot 587, in the extreme north-eastern corner of the township. The history of this is unknown.

Of course, neither of these wells furnished a test of the territory, for the first apparently stopped in the conglomerate which forms the cliffs at Clarendon, (sub-Olean,) and the latter could not have gone deep enough to reach the Clarendon oil sand.

The next venture in search of oil was the Badger well, on lot No. 745, in the south-western part of the township. This was drilled in 1878: a cased hole, properly drilled, sunk deep, but unproductive. (See page 27.)

Following this, in 1879, came the Landsrath well, on the farm of Mr. Montgomery Farnsworth, lot No. 668, a mile east of the center of the township. This also failed to find oil, and the drill ceased work at a depth of 2,004′ from the surface, equal to 139′ below ocean level. (See page 26.)

This was the situation when the Jamestown Oil Company's well, on lot No. 646, (since known as the "Mystery,") was commenced. The Shaw Bros. & Green well (page 20) had been drilled in Limestone township, about a mile west of the N. W. corner of Cherry Grove; the Clarendon development had approached to the lot adjoining the N. E. corner, where strong gas wells had been obtained; the Blue Jay wells in Forest county, (page 80,) were producing some oil, 2½ miles S. E. of the south-east corner; and encouraging prospects for oil had been found near Balltown, in Forest county, (page 79,) not over 2 miles south of the southwesterly part of Cherry Grove. But within the township limits no developments had been attempted, except as mentioned above.

Drilling commenced at the Jamestown oil company's well during the last week of January, 1882. In February, when the well was between 800′ and 900′ deep, the lease expired by limitation and certain difficulties in the way of renewing it caused considerable delay. About the 10th of March the "shell" or hard pebbly layer on top of the oil sand was struck and penetrated only a few inches, when the tools were drawn and the cable showed nearly 300′ of oil in the hole. Wooden plugs, (already prepared for the purpose,) were immediately dropped in and driven down upon the fluid to prevent its rising higher, every vestige of oil was cleaned from the cable and derrick and connections were made from the well mouth to the tank—for although "plugged" in the most approved fashion, a strong well will occasionally flow and betray itself if this precaution is not taken.

Before commencing work the drillers had been put under oath not to divulge anything concerning the well, and the premises had been carefully guarded from outside intrusion up to this time, but now picket lines were established at a considerable distance from the derrick and vigilant guardsmen patroled both day and night to prevent any one from penetrating within their lines.

Thus they held the secret for several weeks until the well owners had accomplished their purposes in securing adjoining lands and had also negotiated a sale of the property to the Union Oil Company. Meantime the scouts employed by other operators and speculators on the market to watch and report upon every wild-cat venture approaching completion, were constantly lying around the well, scanning the derrick and tools with field-glasses, examining the stream below for indications of oil, listening to hear if any flows occurred, and hoping for an opportunity to steal in unobserved or to bribe some one of the guards so that a "pointer" might be obtained for their principals—but so completely was everything covered and guarded that they could get no satisfactory information and the well remained a complete "mystery" until the 17th of May, when the new owners proceeded to drill the plugs out preparatory to cutting deeper into the oil rock.

The opening, at first, was rather disappointing to those who had predicted a large well. No flow occurred until 4 o'clock in the afternoon, and although this was strong it was not thought to indicate a capacity of more than 200 barrels a day. On the 18th as the oil sand was punctured deeper the flows became frequent and estimates ran from 300 to 500 barrels. The next day, however, it was plainly seen that these estimates were altogether too low, and the oil trade began to realize that a much larger well had been obtained than even the most sanguine anticipated.

On the 23d of May the well was reported to have been gauged by two reliable parties, who found the output in 24 hours to be from 1,050 to 1,100. After having been drilled a little deeper on the 13th of June it responded with a production of about 2,000 barrels, which, probably, was its maximum yield.

With this well commenced the most astonishing oil development ever witnessed in the country. It was quickly followed by two other large producers, (the Murphy well and the Mahoopany,) which seemed to define the direction of the oil belt for at least two miles, and gave assurances of the continuance of a uniformly productive rock throughout the whole distance. Operators in the old districts soon suspended new work, and all were eager to secure locations for 2,000 barrel wells in Cherry Grove, at almost any price. This resulted in a very rapid development of an exceptionally productive oil field, and in the latter part of August the Cherry Grove or Garfield district—unknown, and we may say unproductive, on the 15th of May—was pouring out probably 40,000 barrels per day. This, however, was its maximum yield, and its decline was more rapid and remarkable, if possible, than its rise.

The following record of wells drilled, which I compiled for my own use, adding to it daily as new ones were reported, shows how rapidly developments were forwarded and how wonderfully prolific all the initial wells were. Its last column shows also how quickly the brightest prospects may fade. The production figures are of course largely estimates, for under the circumstances very few actual gauges could be obtained, but I have selected them carefully from the published newspaper reports, and am satisfied that they are fair approximations to the truth :

Wells drilled in Cherry Grove; May 17 to Aug. 1, 1882.

Ordinal numbers.	When opened.	No. of lot.	Sub-division.	Names of Wells.	Best production.	Production Aug. 1.
1	May 17,	646	N.W. cor	Union Oil Co. No. 1 ("646" or the "mystery,")	2,000	150
2	" 31,	619	S.W.	Murphy No. 1—fully opened June 2,	2,000	100
3	June 2,	635	1	Anchor Oil Co. No. 1,	2,000	200
4	" 15,	647	2	" " No. 2, (No. 1 on 647,)	3,000	400
5	" 21,	611	W.	Mahoopany or Forest Oil Co. No. 1,	1,800	200
6	" 23,	635	1	Reed & Brenneman (N. W. cor. 30 acre purchase,)	2,000	250
7	July 3,	619	S.W.	Murphy No. 2 (480′ S. of No. 1,)	3,000	200
8	" 6,	634	S.E.	Union Oil Co. No. 2 (No. 1 on 634,)	1,000	200
9	" 6,	635	12	Sheidemantle,	2,000	300
10	" 6,	659	C.	Anchor Oil Co. No. 3, (No. 1 on 659,) near center,	20	10
11	" 7,	672	11	Goldsborough,	800	150
12	" 7,	635	9	Nickle Oil Co.,	1,500	200
13	" 10,	648	E.	Whale Oil Co.(E.side below middle,)	Dry.	
14	" 11,	635	10	Clark & Goldsborough,	1,500	200
15	" 11,	635	20	Cramer No. 1,	2,000	300
16	" 12,	633	N.W.	Murphy & Co.,	Dry.	
17	" 12,	647	3	Anchor Oil Co. No. 4, (No. 2 on 647,)	2,500	400
18	" 13,	635	13	Caldron Bros. & Leckey,	1,800	200
19	" 14,	646	W.	Union Oil Co. No. 3, (south of No. 1—No. 2 on 646,)	2,000	400
20	" 15,	635	14	Allshouse,	1,500	200
21	" 15,	635	7	Clark & Goldsborough,	775	100
22	" 17,	620	24	Carter & Hurd, (S. E. corner,)	2,000	300
23	" 18,	590	S.W.	Forest Oil Co.—virtually dry,	Small.	
24	" 18,	672	2	"Tim" Mullen,	1,800	300
25	" 18,	635	22	Thompson & Andrews,	1,500	400
26	" 18,	635	11	A. P. Tanner,	1,200	200
27	" 19,	619	12	Tack Bros. (on Murphy purchase,)	2,400	200
28	" 20,	635	26	Valiant Oil Co.,	2,400	350
29	" 20,	647	4	Anchor Oil Co. No. 5, (No. 3 on 647,)	1,500	300
30	" 21,	645	W.	Kervin & Glatsaw, (175 rods E. and 50 rods S. of "646,")	300	75
31	" 21,	659	.	Wetmore & Murphy, (W. of center,)	60	15
32	" 21,	635	21	Cedar Oil Co. No. 1,	2,300	300

33	"	21,	635	4	Stafford & Barnsdall, ...	2,000	400
34	"	21,	635	3	Berry & Kelly, ...	2,000	700
35	"	22,	610	E.	Bayne, Fuller & Co., (500′ N. of Barnsdall Bros.)	400	100
36	"	22,	611	8	Forest Oil Co. No. 8, ...	1,800	700
37	"	22,	618	W.	Book & Clark, (50 rods N, of Guffey,)	500	250
38	"	22,	620	8	Grace & Book, ...	500	200
39	"	23,	610	S. E.	Munhall & Smithman, ...	1,000	700
40	"	23,	621	S. E.	Thompson & Filkins, ...	Dry.	
41	"	24,	610	E.	Barnsdall Bros., (500′ S. of Bayne & Fuller,)	1,000	250
42	"	24,	646	W.	Union Oil Co. No. 4, (No. 3 on 646,)	2,000	500
43	"	24,	619	6	Murphy No. 3, ...	1,200	400
44	"	25,	618	W.	Guffey No. 1, ...	800	350
45	"	25,	635	7	Eaton & Howe, ...	1,000	400
46	"	25,	635	27	C. Miller, ...	1,500	500
47	"	25,	635	25	Maj. Comfort, ...	1,500	500
48	"	26,	635	23	Sardine Oil Co., ...	2,000	300
49	"	26,	635	20	Cramer No. 2, ...	1,500	500
50	"	26,	647	1	Anchor Oil Co. No. 6, (No. 4 on 647,)	600	300
51	"	26,	636	2	Northwestern Oil Co., ...	1,200	400
52	"	27,	646	W.	Union Oil Co. No. 5, (No. 4 on 646,)	1,500	500
53	"	27,	610	E.	Armor & Hayes, ...	1,300	600
54	"	27,	619	4	Christie Bros., ...	800	500
55	"	27,	620	20	J. Snow, ...	1,000	400
56	"	27,	635	5	Zeigler & Smith, ...	1,000	400
57	"	27,	611	W.	Forest Oil Co. No. 5, (2 lots N. of No. 1,)	2,000	900
58	"	27,	671	S.W.	R. E. Green, ...	75	50
59	"	27,	620	S.	D. Brown, (near middle on S. line,)	500	200
60	"	28,	635	8	Merrick & Harris, ...	700	400
61	"	28,	635	18	Pemberton & Co., (south part of 18,)	800	300
62	"	28,	610	N.E.	Broder Oil Co., ...	Small.	
63	"	28,	619	17	Fertig & Clark, ...	1,000	400
64	"	29,	672	7	McDonald & Markham, ...	Dry.	
65	"	29,	610	E.	J. Bryan, ...	1,200	400
66	"	30,	635	6	F. Wright, ...	1,300	1000
67	"	30,	658	27	Wolf & Co., ...	2,500	2000
68	"	30,	657	S. E.	Book & Arters, ...	2,000	1800
69	"	31,	635	16	S. Crosby, ...	1,500	1500

The above list shows that 69 wells were completed in the district on the 31st day of July. After that time the wells came in so rapidly that I did not attempt to record them. I have prepared another table, however, which shows the number of wells drilled during each month, up to the 1st of December, 1882, and the lots on which they are located. The prolific tracts can readily be picked out by the number of wells drilled upon them. Each lot contains about 185 acres, and about 5 acres are allowed to a well, therefore, from 35 to 40 wells develop a whole lot. If a smaller number has been drilled, it is because a part of the lot was found to be unproductive. Lot 619 was cut up into smaller subdivisions, and therefore contains the greatest number of wells.

Wells drilled in Cherry Grove; May 17 to Dec. 1, 1882.

No. of Lot.	May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Total.	
	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.	Prod.	Dry.
584,								1								1
589,									1				4		5	
590,						1	1		3				3	1	7	2
608,							1								1	
610,					6		7	2	2		2		1		18	2
611,			1		2		3		4				3		13	
612,									2		1				3	
617,									1						1	
618,					2		1		6		2		2		13	
619,	1				5		35		5	1					46	1
620,					4		10	2	3						17	2
621,						1										1
633,						1										1
634,					1		3	1	1						5	1
635,			2		23		14		4						43	
636,					1		14		10		1				26	
644,								1								1
645,					1		3	1	2	1					6	2
646,	1				3		11		12		2		1		30	
647,			1		3				8		4				16	
648,						1										1
657,					1		9		5						15	
658,					1		20		8		2				31	
659,					2		2	1	7				1		12	1
660,								1								1
671,					1		1		6		1		1		10	
672,					2	1	14		12		8		1		37	1
673,													1		1	
680,									2		7	1	3		12	1
681,							1		1		8		3		13	
683,								1								1
697,									1				1	1	2	1
722,														1		1
Totals,	2	.	4	.	58	5	150	11	106	2	38	1	25	3	383	22

Summary.

		Productive.	*Dry.*
Wells completed in May,	2	2	0
" " June,	4	4	0
" " July,	63	58	5
" " August,	161	150	11
" " September,	108	106	2
" " October,	39	38	1
" " November,	28	25	3
Total,	405	383	22

In September, the field began to show very evident signs of exhaustion. Many of the old wells stopped flowing. Torpedoes only resuscitated them for a few days; they were not improved by tubing and packing; and when sucker rods were introduced, it was frequently found unprofitable to pump them, as the oil carried large quantities of loose, fine sand, which quickly destroyed the valves and stopped the output, unless the wells were overhauled and cleaned out every day or two. Hence, a rapid decrease of production occurred, notwithstanding the new wells daily coming in.

Some of the new wells of September were abandoned after having produced but little oil. When they ceased to flow, the owners could not afford to incur any further risks, by expending time and money to put them in pumping order, with the prospect of only 10 or 15 barrel wells at best. A quarter or a half of the oil was to go as royalty to the land owner, and there seemed little hope of paying running expenses out of the producer's share, with oil at about 70 cents per barrel.

On the first day of every month the leading newspapers of the oil region give carefully prepared reports, showing in detail, with names and locations, the number of wells drilling and preparing to drill, the number completed during the previous month, and the production of each new well on the last day of the month. In September, 30 of the *new* wells of Cherry Grove were reported as having already ceased before the month ended, and in October, 10. No doubt some of these were subsequently resuscitated, but it shows that the supplies of oil and gas were rapidly diminishing.

In the following summary, compiled principally from the *Oil City Derrick* and the *Era of Bradford*, the reader may see how rapidly the average daily production of the new wells declined.

Monthly New Production and Average per Well.

		Producing.	*Average bbls.*
May.	Wells completed, ...	2 — 3,000 bbls.	May 31—1500
June.	"	4 — 4,800 "	June 30—1200

July.	Completed, 63 Dry, 5	. . . .	58—18,750	"	July 31— 323.2
August.	Completed, . 161 Dry, ... 11	. . . .	150—27,165	"	Aug. 31— 181.1
September.	Completed, . 108 Dry, . 2 } 32 Ceased, . 30 }	. . . .	76— 3,296	"	Sept. 30— 43.3
October.	Completed, 39 Dry, . 1 } 11 Ceased, . 10 }	. . . .	28— 515	"	Oct. 31— 18.4
November.	Completed, 28 Dry, . . 3	. . . .	25— 286	"	Nov. 30— 11.4

The characteristics of the Cherry Grove wells may be further exemplified by the following quotations:

"Some of the papers have been giving estimates of the production of the wells now producing in the Cherry Grove district. The *Bradford Star* makes fourteen wells producing over 17,000 barrels; the *Era* has fifteen wells producing 14,350 barrels. The production of these wells varies so much from one day to another that it is impossible to get accurate figures which will hold good for twenty-four hours. Two or three new wells which may gauge 3,000 barrels to-day, to-morrow would not gauge more than 2,000 barrels. The *Derrick's* estimate of the production of the wells Friday morning, (July 14, 1882,) is as follows:

Lot.		*Names of Wells.*	*Production.*
No. 1,*	646.	"Mystery," actual gauge,	612
2,	619.	Murphy's Nos. 1 and 2, estimated,	1,600
3,	635.	Anchor Oil Co.,	900
4,	647.	Anchor Oil Co., No. 1, est.,	900
5,	611.	Mahoopany, est.,	600
6,	635.	Reed & Brenneman,	450
7,	619.	Murphy, No. 2, included with No. 1.	
8,	634.	Union Cil Co.,	500
9,	635.	A. Sheidemantle,	960
11,	672.	J. R. Goldsborough,	500
12,	635.	Nickle Oil Co.,	1,000
14,	635.	Clark & Goldsborough,	1,200
15,	635.	C. H. Cramer,	1,700
17,	647.	Anchor Oil Co., No. 2, est.,	2,000
18,	635.	Caldron Bros. & Leckey,	1,800
Total,			14,722

This table shows that fifteen wells are producing 14,722

*These numbers correspond with those in the first list given.

barrels. Of the fifteen seven have been opened within a week, and are comparatively fresh. The estimates on these wells are based on the best possible information. Some of the figures have been obtained from the owners, and others are actual gauges on the wells. The 612 barrels given to the Mystery was its actual gauge from Wednesday to Thursday. It is safe to say that if a gauge could be obtained on these same wells in three days their production would be much less than the figures given above." (*Oil City Derrick*, July 15, 1882.)

"If accurate daily gauges on the wells in this district could be obtained, the difference between the actual figures and the rumors would be a surprise to those who are not acquainted with the field. Those who hear of wells which begin producing at the rate of 1,500 or 2,000 barrels a day, naturally estimate in their minds that the well will make 20,000 or 25,000 barrels in a month. But hard facts prove that such figures are merest fiction, and the thousand barrel well is like a toy balloon punctured with a pin. The following record of the production of the Sardine Oil Company's well on lot 635, as obtained by actual daily gauges, will well illustrate this fact. The well is six days old and its production daily has been as follows:

First day's production,	2,000
Second,	1,128
Third,	594
Fourth,	444
Fifth,	350
Sixth,	274
Total,	4,790

In six days, this well, which put 2,000 barrels in the tank the first twenty-four hours, had produced 4,790 barrels, and at the end of the week was doing less than one sixth of its first day's production. This well is no exception to the rule, but is a good example of the whole field, for it is located in the richest part of the territory, being in the northeast corner of 635, and near the Murphy and Cramer wells. Its daily decline, as will be seen by the figures given above, maintained about the same proportion. Its decline the second day was not quite one half, and so on the third day. On the fourth the decline was nearly one third, and the same on the other two days. In six days it had declined about four fifths. Apply the record of this one well to the whole field, and allowing the same proportionate decline, and the difference between estimates and facts would be enormous." (*Oil City Derrick*, August 4, 1882.)

With nearly all the wells coming in after the middle of September, the facts were substantially as told in the last quotation. It is not at all surprising, therefore, that many wells were abandoned on ceasing to flow, after having produced only 5,000 or 8,000 barrels of oil, for the impossibility of ever getting first cost out of them—in such a rapidly declining district, with expensive leases and low-price oil, at once became apparent—as may be seen by the following:

"A number of operators have secured territory in Cherry Grove, for which they are to pay 1,000 barrels oil bonus per acre and one half royalty. A business man while waiting for the train at Clarendon, after doing some figuring, said that such parties must first produce 25,000 barrels of oil before they can count on any profit. The following is his estimate:

Drilling 1,700 feet, at 60 cents,	$1,020
Carpenters' rig,	450
Boiler and engine, and cost to deliver,	850
Casing 350 feet, at 60 cents,	210
Tubing for connections, and other expenses,	250
Tankage,	1,600
Total cost of well,	$4,380

The well at one half royalty would have to produce 10,000 barrels to pay the bonus, (on a five acre lease,) and one half of the next 15,000 barrels going to the operator, at sixty cents, amounts to $4,500, which will pay the cost of drilling the well, or he must first produce 25,000 barrels of oil before he clears the first cost." (*Bradford Era*, August 3, 1882.)

Reviewing the Cherry Grove field on the 1st of December, the *Titusville Herald* remarks: "Of the operations in Cherry Grove during the past month there is little to be said. Only 28 new wells were completed with a production of 286 barrels, and out of these three were as good as dry, never having produced a barrel of crude. For the future there is no hope. There are only 11 wells drilling, and but three rigs up. * * * The old wells have been kept producing by continual pumping and attention, and average perhaps 15 barrels apiece. It is estimated by our reporter that fully two thirds of the wells have ceased to produce. The production of the entire field may be placed with accuracy between 2,500 and 3,000 barrels per day."

"Brown Bros. completed a 'duster' on lot 590, only a few hundred feet north of their good well. This, of course, condemns the territory to the north, (if it needed any condemnation.)"

"A number of failures were made on lot 659, showing that even in the 'one thousand-barrel tract' nothing is to be expected.

"All operations in the south-west—the forlorn hope—have developed very small wells or dry holes."

"The result of Gailey Bros.' venture on lot 722 completely shuts off further operations in that direction. Thus any hope of extending the field is banished."

A few days later in December the celebrated "Mystery" well was reported pumping less than one barrel per day.

The following are the only complete well records that I have been able to obtain in the Garfield district:

The "Mystery" or 646 Well.

May 17, 1882.

Located on N. W. corner of lot 646, Cherry Grove township, Warren county. Authority, George H. Dimick, one of the owners.

Well mouth above ocean in feet,		1,805
Conductor,	46 to	46=1,759
Slate,	94 to	140=1,665
S. S. coarse and white,	110 to	250=1,555
Slate, (cased at 225',)	200 to	450=1,355
Red rock with streaks of slate,	110 to	560=1,245
Slate,	160 to	720=1,085
Pebble sand,	10 to	730=1,075
Slate and gravel alternating,	75 to	805=1,000
Shelly,	45 to	850= 955

Red shale,	12 to 862= 943
Slate,	273 to 1,135= 670
Pebble sand,	18 to 1,153= 652
Slate,	167 to 1,320= 485
First sand,	25 to 1,345= 460
Slate,	180 to 1,525= 280
Second sand, { Shells 40′ / Slate 10′ / Sand 25′ }	75 to 1,600= 205
Slate,	10 to 1,610= 195
Third or Oil sand, 15′ to 20′,	20 to 1,630= 175

Cedar Oil Co. Well No. 2.

September, 1882.

Located on sub-division No. 21, lot No. 635, Cherry Grove township. Authority, J. C. Goal, contractor.

Well mouth above ocean in feet, (about,)	1,725
Conductor,	32 to 32=1,693
Sandstone, solid,	5 to 37=1,688
Slate, soft,	15 to 52=1,673
S. S. hard, fine-grained, solid,	40 to 92=1,633
Slate and shells, (cased 218′ and 320′,)	268 to 360=1,365
Red rock, quite red, gritty,	25 to 385=1,340
Slate, soft,	37 to 422=1,303
Red rock, darker, gritty,	18 to 440=1,285
S. S. medium-grained, bluish,	16 to 456=1,269
Red rock,	18 to 474=1,251
Slate and shells,	96 to 570=1,155
S. S. same as last,	20 to 590=1,135
Slate,	20 to 610=1,115
Red rock, brownish red, shaly,	60 to 670=1,055
S. S. coarser than last, good drilling,	50 to 720=1,005
Slate, blue,	32 to 752= 973
Red rocks in layers, dark brown,	40 to 792= 933
Slate and shells,	198 to 990= 735
Red rock in layers, dark and variable,	90 to 1,080= 645
Slate and shells,	80 to 1,160= 565
S. S.,	30 to 1,190= 535
Slate and shells,	115 to 1,305= 420
S. S. quite solid, bluish,	50 to 1,355= 370
" and shale alternating, principally sandstone,	165 to 1,520= 205
Slate, soft, free from shells,	17 to 1,537= 188
S. S. white, pebbly, (not through,)	11 to 1,548= 177

This well flowed 1,500 barrels or more per day when first struck, but coming in late began to decline at once. It was agitated frequently and gradually drilled through the oil sand which was from 20′ to 25′ thick. The good sand, or productive portion, was not more than 8′ or 10′ thick.

Mr. Goal says that the drilling in No. 1 and in No. 2 (both on the same lot) differed very materially, No. 2 being more sandy toward the bottom. At 1305′ quite a massive sand was struck which continued for about 50′ and graduated into flaggy layers with shale partings. Altogether there were 215′ of this sandy drilling where every bit required dressing and often before running a full screw. He considers this sandy range as the equivalent of the Second and Third sands of Clarendon. Comparing the sections given on plate No. 2, this view of the structure seems to be a reasonable one.

23. Sheffield township. Organized in 1833.

This large township, occupying the south-eastern corner of the county, with McKean county on the east and Forest county on the south, is very similar in general to Mead. There is, however, this difference.

In Mead the deepest Drift and *highest* point of filling in the pre-glacial valley of the Tionesta is near the center of the township whence the present streams flow both north and south.

In Sheffield the *lowest* point of filling in the old valley is near the center where the waters collect from the north and south to pass out through a gap in the western valley-wall which must have been opened by the same agencies that filled the old channel in Mead. By reason of this basin shape of the valley all the drainage of the northern and eastern parts centers in the Tionesta at Barnesville or old Sheffield and the south-western corner drains directly into the same stream lower down.

The center of the basin at Barnesville is 1305′. The lowest point in the township being on the Tionesta at the county line 1275±′. Two of the highest points are about 2000′. One of them may be found on the Cherry Grove road near the west line, the other in the north-east corner, on the ridge between Four-Mile run and Two-Mile run.

Tionesta valley, that is the wide pre-glacial excavation extending from the county line north-westerly to Mead township, contains large areas of arable bottom lands composed of drift derived almost entirely from local rocks, and here the principal settlements in the valley have been made. A few farms have been cleared along the highway leading to Cherry Grove, and some also along the valley of Two-Mile run. Elsewhere the country is almost an impenetrable wilderness, without roads and accessible only to the hunter, the lumberman, and bark peeler. The topography of the country is unfavorable to a rapid advance of agricultural interests, but the location of large tanneries at Sheffield has greatly enhanced the value of hemlock lands, established a home market for most of the products of the farm, and been the means of more than doubling the number of inhabitants within the last decade, so that Sheffield now ranks in population the sixth township in the county, instead of the fourteenth as in 1870.

The Olean Conglomerate covers considerable areas along the eastern and western borders, and also occupies the ridge between South Branch and the main trunk of Tionesta creek. In some places 100 feet or more of carboniferous rocks overlie it and traces of coal have been noticed. But no where, as far as I am able to judge, is there a prospect of discovering a seam of sufficient purity and thickness to make mining profitable. In the southern part the Olean is less massive and contains fewer pebbles than in the north, the underlying shales become more sandy and the interval between Olean and sub-Olean increases in thickness to about 150′.

The *sub-Olean* is excellently exposed in the hills around Sheffield, along Two-Mile run, (notably near Roystone station,) on east branch Tionesta, near Henry's mill, and at Brookston, just over the line in Forest county. Its variable constitution is well exhibited in these several exposures. At Roystone, and ranging across the country in a south-easterly direction from Clarendon to Ludlow, it is a massive current-bedded conglomeritic sandstone, covering the hill slopes with large cubical blocks measuring from 10 to 15 feet in thickness; at Sheffield, although conglomeritic, it generally weathers into much smaller and thinner fragments, and its base graduates into a crumbling, irony, fine-pebble conglomerate, similar to that seen in Conewango and Glade. At the forks of East Branch and at Henry's mill it is massive, while at Brookston the crumbly, irony character again asserts itself. In levels it varies also, giving indications of a slight synclinal in the vicinity of Brookston, as the following figures show:

Elevation on top of sub-Olean at	Clarendon, A. T.,	1,775′
" " "	Sheffield,	1,705′
" " "	East Branch,	1,585′
" " "	Brookston,	1,565′
" " "	Henry's Mill,	1,550′
" " "	Roystone,	1,715′
" " "	Ludlow,	1,720′
Elevation of same in Elk county, 8 miles east and one mile south of Brookston,		1,865′
Elevation of same in Forest county, $3\frac{1}{2}$ miles south of Henry's Mill, (P. and E. well, S. W. of Foxburg,)		1,460′

Oil Wells.—The first experimental oil well was drilled in 1864 or 1865, in the center of the valley at Sheffield. After driving 110′ of pipe and boring to a depth of 825′, the well was seed-bagged and pumped for a few days and then abandoned, only a slight show of oil and gas having been obtained.

The next was drilled in 1875, about two miles and a half east of Sheffield. This one went to a depth of 1,645′, and proved to be one of the most remarkable gas wells ever opened in the oil region.* (See Hague gas well No. 1, page

*In drilling this well a 16′ conductor was used and a 9″ hole started in the bed rock. A strong water-course encountered at 70′ necessitated the insertion of 90′ of 8″ casing. From the bottom of this an 8″ hole continued down to about 175′, where the ordinary $5\frac{5}{8}$″ casing was put in. After this no more water appeared until the drill reached a depth of 418′ where a little salt water came in, but not enough to be considered detrimental. Subsequently, however, as we shall see further on, this water caused one of the most remarkable accidents that ever happened to a well. Some show of oil was seen at 1035′, and at 1045′ the well was torpedoed and tested. Not proving productive, it was sunk deeper, and at 1350′ reached the gas sand. Here the flow of gas was so strong that every device for introducing water to drill with failed. Attempts were made to lower water in a sand pump arranged to open when it struck bottom, but the water froze in the sand pump and came up in it as ice. This was in in June. For a considerable distance below the gas vein the drill had to be slowly forced through dry rock; then some water could be gotten to the bottom and the boring continued down to 1645′.

In March, 1877, (the spring following the laying of pipes to Sheffield) the gas weakened and finally stopped flowing entirely. In sounding the well it

23.) Every method was employed by torpedoing and testing at different points, to make this well produce oil; but failing to respond, the tubing was drawn from it and the gas allowed to go to waste, until October, 1876, when it was conveyed in pipes to Sheffield, where it has been used ever since for heating and illuminating purposes. The gas-flow is still so voluminous that it supplies the whole town and leaves a surplus to burn both night and day in three or four open waste pipes located in the most public places.

In 1876-7, Hague well No. 2, was drilled between the gas well and Sheffield. Scarcely a show of oil was obtained in it and much less gas than in No. 1.* (See page 24.)

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was found to be bridged by some obstruction above the gas vein. Tools were swung and run down to cut out the barrier. After working a while with a reamer, the sand pump was inserted and very much to the astonishment of of all present brought up only water and pounded ice. It was then realized that the salt water coming from above had fallen to the gas vein and been frozen to the wall—after the same manner that ice had been formed in the sand pump while drilling--until it had gradually filled the whole well-bore and completely stopped the flow of gas. The tools were kept in motion 24 hours, all the time drilling in ice, when suddenly they broke through and an expansion or explosion of the pent up gas occurred which threw the tools with the 175′ of $5\frac{5}{8}''$ casing, the 90′ of 8″ casing, and the conductor completely out of the ground. The casing shot up through the derrick, almost demolishing it, and coming down, toppled over and broke into sections. The 70′ water-course now being open, flooded the well, and the surface, no longer supported by the conductor, caved in, making the ruin complete. The driller, noticing instantly when the gas struck the tools, rushed from the derrick and fortunately escaped without serious injury.

No doubt the cable and tools caused the casings to be thrown out. First the tools were lifted by the gas; as they rose the slackened cable coiled and kinked into a wad, which shot up and wedged into the $5\frac{5}{8}''$ casing. When that started upward, the cable below it spread out and wedged in the 8″ hole with sufficient force to carry the 8″ casing also.

The flooding and caving of the well mouth soon checked the gas and forced it to find exit in a number of vents around the pool at the surface.

After working four or five weeks the damages were repaired and casing was inserted below the salt water vein, since which no trouble from freezing has occurred, and the gas still flows copiously, although, probably, with not so great force and volume as when the well was first opened.

*Allen, Truby & Co.'s well, on lot No. 212, (third lot south of the north-east corner of the township, and adjoining McKean county line,) was completed in October, 1882. It is about two miles north-east of Hague well No. 1; and 85′ higher. No record can be obtained, but it has a tremendous flow of gas, which comes, no doubt, from the same horizon as that of the Hague wells. Here then we have three large gas wells within a distance of about 3 miles, producing from the same sand rock.

Mr. Hague sunk another well on Four-Mile run, about a mile from the Tionesta and the same distance south of the township line, in 1877. The elevation was 1,380′, A. T., and its depth 1,565′. He reports no sands worthy of note, and consequently it was barren of both gas and oil.

The following year Badger's well was drilled at Brookston on south branch of Tionesta, and just over the line in warrant 2,960, Forest county. Elevation of well mouth 1,410′, A. T., depth of hole, said to be, over 2,200′. No record was kept, but the general report is that the drilling was soft and shaly, with a good deal of red rock and no sands at all promising for oil. A little show of gas was all that the well produced.

The Barnesville well, 2 miles south of Sheffield, (see page 24,) follows next in order, having been drilled in 1879. It was and still is a strong gasser, but evidently has no connection with the Hague wells, for the gas comes from a sand rock lying geologically about 200′ *above* their gas rocks.

We now come to the first oil producing well opened in the township—the Donaldson, or Magee & Horton well No. 1—on the Tionesta, 3 miles south of Sheffield, (see page 25.) This well was located on a north-easterly line from Blue Jay well No. 1, opened in November, 1880, in Forest county, (see page 80,) and proving to be a profitable investment started quite an extensive development in that section, which is now known as the Sheffield district. In a north-easterly direction the present developments are already checked by small wells or dry holes within a mile of the initial venture, but to the south-west a number of paying wells have been obtained and developments are still progressing favorably. There seems to be little prospect, however, of tracing a direct connection along the line at first regarded as the probable one between the Sheffield district and the Blue Jay district, for the axis of profitable development apparently trends more toward the west, crossing the Tionesta before it leaves the township and then curving more toward the west and passing on diagonally across tracts Nos. 2735 and 2791 in Forest county, which is as far as it has been followed up to the present time—Nov., 1882.

Oil Rocks of South-eastern Warren.[1]

In Chapter IX reference was made to the peculiarities of structure exhibited by the rocks of the Warren and North Warren oil horizons, and the plate of illustrative sections accompanying it ended with the Tolles well, No. 1, near Stoneham. On Plate 2 nine other sections are given in association with the Tolles well for the purpose of tracing the structure southward into the edge of Forest county, at Balltown and Foxburg—the latter being known as the Blue Jay district.

The several oil and gas sands, now known in this part of Warren county are, in descending order, as follows: "Second" and "Third" oil sands, (both productive in some places) at Stoneham—the "Third" being now generally referred to as Clarendon sand; Gas sand at Barnesville—apparently near the Clarendon sand horizon; Clarendon gas sand, variously reported 125′ to 175′ below the Clarendon oil sand; Cherry Grove oil sand; Balltown oil sand; Darling well oil sand, in the Blue Jay district; Sheffield or Blue Jay oil sand, about 190′ below the Darling oil sand, and Sheffield or Hague well gas sand.

Some operators are inclined to view all these as separate horizons, others see but two wide-spread layers of sand, the first or upper one including Clarendon, Cherry Grove, Balltown and Darling oil sands and Barnesville gas sand; the second lying from 175′ to 190′ lower including Clarendon gas sand, Sheffield gas sand and Sheffield and Blue Jay oil sands.

It may seem strange to persons unacquainted with the present methods of oil development, that the structure of this district is still so imperfectly understood, notwithstanding the number of wells that have been sunk there during the last four years. But it must be remembered that the chief aim of the prospector for oil now is to prevent every one but himself from knowing what the drill reveals in his well. So far is this secrecy carried, that, before commencing work, the drillers are put under oath not to divulge anything concerning the drilling, and quite frequently they are discharged when the horizon of the oil rock is approached and the owners themselves, with guards stationed around the derrick, complete the well.

Every wild-catter has some cherished theory of his own upon which he is working, and instead of keeping an accurate record of the rocks as they are pierced, he thinks it only necessary to note certain strata, such as first and second sands, for instance, which according to his ideas of "regularity" should be found everywhere in about the same relative positions. Having approximately fixed their depths by calculations of dip, &c., he neglects all other parts of the well and only begins to wash and examine the sand pumpings when what he conceives to be the proper horizon is approached. Of course some sand is found when looked for (if the drillings are sandy shale) and he concludes it is the stratum sought, although it may not be as solid or well-defined as he expected. Then the drillings are again dumped under the derrick floor without examination until another *important* horizon is reached when the same process is repeated. A record kept in this way is absolutely of no account whatever to the geologist. It only gives a representation of the ideas of the well owners and these ideas are more variable than the rocks themselves. If actual facts were recorded, regardless of theories it would often be seen that there was more sand in some of the unwashed and unexamined drillings than in the horizons noted as sandstones through this partial and improper method of watching the drillings.

For these reasons I have been unable to obtain reliable records in sufficient number and in proper places to satisfactorily exhibit the structure going southward from Clarendon.

The sections on Plate No. 2 are the only ones I have that can be considered at all reliable, and some of these are deficient in details. To increase the horizons of comparison I have added the sub-Olean and in some cases the Olean also; but as all the elevations are barometric and the well measurements are partly by wire and partly by cable, absolute numerical accuracy cannot be claimed.

The geographical positions of the wells may be seen on Howland's map of parts of Warren and Forest, where they are designated by name.

Two of the sand rocks reported in Shaw Bros. and Green's well, south-west from Tolles', seem to correspond very fairly with the "Second" and "Third" sands at Stoneham. The one at 1,302′ from the surface is said to have contained some oil, and those who saw the indications while drilling, now believe the well might have been made a small producer if it had been stopped there and managed as the wells of the Clarendon district now are. Several of the early wells at Stoneham were considered of little account and remained neglected for a year or more before it was discovered that they could be made profitable by the use of large torpedoes, and wells have since been drilled with so little show of oil when completed that from 7 to 10 barrels of crude from other wells had to be poured in for tamping before a torpedo could be exploded effectively. Many of these apparently unpromising wells, after being so treated and tubed and packed in the usual way, have started off and flowed from 10 to 15 barrels per day.

Comparing the sections on a line toward Balltown, in Forest county, the Clarendon sands appear to grow indistinct and a lower sandrock comes in. This is the productive Cherry Grove or Garfield sand. The Balltown oil sand (as given in well No. 1) seems to be in the Garfield horizon, but, considering the unfavorable results of wells drilled between the two fields, it is hardly probable that a direct connection exists between them. Whether the Grandin & Kelly well on the Cook tract near Balltown, which commenced to flow in August last, but is not yet fully opened, draws its supplies from this sand or not is only known by its owners for they alone know the depth of the well. I judge, however, that it does.

The next two sections, Figs. 14 and 15, are east of the Cherry Grove belt and exhibit quite a different structure;

the Landsrath well comparing favorably with the Tolles, but giving no trace whatever of the Garfield sand.

In Figs. 16, 17, and 18 considerable similarity will be observed, both in the red rocks and sandstones near the surface, (which lie in the horizon of the Venango group,) and in the lower, or oil producing rocks of the Sheffield district. The Darling well oil sand is fairly traceable in them all, and its distance below the sub-Olean puts it approximately in the plane of the Garfield sand. This is all that can now be said in favor of their identity; for several unsuccessful ventures between the two fields prove that the sand sheets are not continuous.

The Sheffield-Blue Jay oil horizon is the lowest known in the county. It appears to include the Sheffield gas sand; but just how the two rocks are related to each other remains for future drilling to demonstrate.

As the developments in south-eastern Warren and the contiguous portion of Forest county have been conducted with so much secrecy and beclouded by so many misrepresentations, and as it seems to be the aim of operators to prevent any systematic study of the structure which might result in giving the general public some idea of the possibilities of the territory yet to be developed, and thus, perhaps, render the occupation of drilling "wild-cat mysteries" less profitable, I do not feel that I am warranted in attempting to identify these several oil horizons, or that it ought to be expected that I should do so with the meager facts at command. I therefore give the plate of sections for what it is worth and leave the operator to draw his own conclusions.

Barometric Elevations above tide.

I. Columbus township.

On the road from Columbus to Clymer, in N. Y.

RR. station at Columbus,	1427′
S. W. corner of Public Square,	1430′
Stream crossing—E. Munger's,	1415′
Forks in road—School-house No. 7,	1430′
Big Brokenstraw Creek at county line,	1415′±

On road running N. from Columbus.

Main street corners,	1395′
Summit—G. Faulkner,	1465′
Bend in road—C. Schramling,	1410′
Cross-roads—School-house No. 8,	1470′
Summit—D. Schramling,	1680′
" —C. Walton,	1665′
" —State line,	1620′

On road from Columbus to Pine Valley.

Main street corners,	1395′
Next corner, east—Road south,	1410′
Barnes' corners—Turn north,	1450′
Bakers' corners—Turn east,	1635′
Forks—C. Marble,	1650′
Forks—P. Parker,	1445′
RR. crossing,	1455′
Pine Valley corners,	1450′

Going north from Pine Valley.

First fork in road,	1585′
Summit—R. Henry,	1720′
School-house No. 9,	1530′
Corners north of school-house,	1545′
School-house No. 11—½ mile *south* of Pine Valley,	1450′

On road from Columbus to Blue Eye Run.

RR. crossing,	1430′
Kennedy corners—Turn south,	1445′
Forks—H. W. Owen,	1540′
Walton's corners—East of Owen's,	1520′
Walton knob, summit,	1850′
Cross-roads—J. Cady,	1790′
Summit—H. Dejean,	1785′

Corners—Road west,	1750′
Corners—School-house No. 3,	1630′
Blue Eye Run—Crossing,	1570′
Corners—Mead's saw-mill,	1585′
Corners north of Mead's—C. Jaques,	1645′

On road from Corry to Spring Creek.

Cross-roads and school-house—Howard's tannery,	1410′
Corners—Road west,	1450′
Cross-roads—Road north and south,	1445′
Corners—Turn south,	1405′

II. Freehold township.

On road from Lottsville to Columbus.

Lottsville corners,	1420′
Bridge over Little Brokenstraw,	1400′
Corners—Valley road to north,	1420′
Corners—road south to Miller's cliff, (*A*,)	1460′
Summit—C. Spencer,	1825′
Corners—E. Hamilton, (*B*,)	1765′
Cross-roads—E. E .Baker, (*C*,)	1745′
Cross-roads—C. Walker,	1670′

On road from A to B, as above.

Lottsville and Columbus road, (*A*,)	1460′
Corners—N. King,	1810′
B. T. Miller's house—S. E. of King's,	1820′
Miller's Cliff—top of rocks,	1880′
Summit west of King's—F. Wilson,	1830′
Summit west of King's—H. Kelley,	1805′
Summit west of King's—C. and O. Wilson,	1790′
Columbus road, (*B*,)	1765′

On road from C, north to Bear Lake Station.

Columbus road, (*C*,)	1745′
Cross-roads—J. H. Gregg,	1690′
Summit—L. Risley,	1755′
Summit—J. Carter,	1770′
Valley road ½ mile E. of Bear Lake station, (*D*,)	1565′
Railroad—Bear Lake Station,	1550′

Valley road, from Bear Lake Station to Lottsville.

Corners—road south, (*D*.)	1565′
Cross-road near Bear lake, (turn south.) (*E*,)	1520′
Bear lake school-house,	1490′
Bear lake, surface of water,	1487′

Road forks,	1430′
Cross-roads—A. Bush,	1415′
Columbus road, (turn E. to Lottsville,)	1420′

From E, going east, south, and south-west to Lottsville.

First cross-roads—D. Beals,	1495′
Summit—C. T. Fowler,	1600′
Little Brokenstraw bridge,	1430′
Cross-roads—W. J. Woodburn,	1445′
Corners—road south,	1610′
Summit—R. Russell,	1685′
Cross-roads—A. Russell, (*F*)	1660′
Corners—near north-east cor. of township,	1695′
Next cross-road south—G. Howles,	1645′
Summit—J. Abbott,	1690′
School-house corners—Sugar Grove turnpike,	1720′
Summit west—J. Broughton,	1750′
Road forks—W. Woodburn,	1560′
Lottsville corners,	1420′

From Lottsville, north to cross-road at F.

Summit—P. Morton,	1680′
Cross-roads—E. J. Finch, (turn east,)	1720′
Corners—J. G. Brookmire, (turn north,)	1660′
Forest school-house,	1720′
Cross-roads (*F*,)	1660′

On the State road.

South line of township,	1910′
Top Olean conglomerate—S. Drake,	1890′
Dead Man's run,	1610′
Summit,	1780′
Road forks—S. Woodburn, (*G*,)	1680′
Top Wrightsville conglomerate, in road,	1580′
Cross-roads—Swamp run,	1450′
Swamp run bridge,	1440′
Little Brokenstraw bridge,	1365′
Abbott's corners,	1410′
Summit—A. Sampson,	1845′
School-house,	1895′
Road forks,	1905′
Summit—S. Matthewson,	1935′
Road forks—C. Barlow,	1875′

From G, west.

First summit—E. Farnham,	1810′
Summit—F. Doty,	1805′
Corners—road north,	1785′
Forks ¾ mile N. N. E.—Swamp run divide,	1460′

Wrightsville, up Stony Hollow.

Wrightsville corners,	1355′
Comstock farm drill-hole,	1495′
Corners—road north,	1575′

Wrightsville towards Pike's rocks.

Top of Wrightsville conglomerate,	1600′
Summit—Mrs. Bull,	1770′
Summit—C. Haupin,	1825′
Cross-roads—East township line,	1810′

III. *Sugar Grove township.*

Along turnpike from Sugar Grove to Lottsville.

Sugar Grove—at hotel,	1400′
State road corners,	1640′
Road south,	1705′
Summit—J. Broughton,	1720′
Turnpike school-house, No. 11,	1720′

From Sugar Grove, north and west.

First corner south of State line, (turn west,)	1480′
Cross-roads—C. Elliott,	1670′
Road south, (corners $\frac{3}{4}$ mile S. of this=1540′,)	1665′
Road north,	1640′
West township line,	1700′

From Sugar Grove, east and south.

Towards Busti.

First corners,	1375′
Stillwater creek at State line,	1310′±

Towards Landers.

Bridge over Stillwater,	1360′
School-house corners,	1440′
Church cross-roads, (turn south,)	1495′
School-house cross-roads, (turn east,)	1735′
Corners at east township line,	1705′

Towards Chandler's Valley.

Stillwater bridge,	1380′
Road forks,	1400′
Summit—M. O. Gorman,	1750′
Forks—north and south road—A. Peterson,	1790′
Summit—A. Anderson,	1820′
Chandler's Valley corners, (turn north,)	1490′

Lutheran church corners, at Chandler's valley,	1535′
Swamp summit ½ mile north,	1510′
Bridge over branch of Stillwater,	1435′

Towards Youngsville.—Hill road.

Corners—A. Strand, (turn west,)	1810′
Cross-roads—Mrs. Smith, (turn south,)	1840′
Summit—Mrs. Smith,	1860′
School-house,	1650′
Matthew's run bridge,	1640′
Summit—J. G. Jones,	1840′
Road forks—H. Pilling, (turn south-east,) (*A*,)	1480′
Matthew's run road, near church, (turn north,)	1425′
Matthew's run bridge,	1475′
Road east,	1490′
Saw-mill, in Matthew's run gap,	1520′
Cross-roads near church, (turn east,)	1570′
Next corners to east, (turn N. E. to Chandler's valley,) (*B*,)	1505′

From Chandler's valley, southerly

First corners, (*B*,)	1505′
Stream crossing,	1490′
Forks,	1580′
Road east, (*C*,)	1770′
Summit west of this, in field,	1850′
School-house,	1810′
Corners—C. J. Samuelson, (turn west,)	1810′
Summit—L. Johnson,	1870′
Road south,	1810′
Matthew's run road,	1490′

Going south-westerly from C.

Summit—J. Devirs,	1820′
" P. Hanson,	1820′
" D. Samuelson,	1830′
School-house and forks, S. E. corner of township,	1730′

In south-west corner of township, starting at A.

First corner north-west—F. Thayer,	1555′
Second corner—road north, (turn west,)	1655′
School-house on north and south road, (turn north,)	1870′
Next corner north—road west, (*D*,)	1890′
Summit—N. Woodin,	1895′
Corners—H. Woodin, (turn west,)	1875′
" Rocky run road near W. township line,	1705′

Going south-west from D.

Top of Pike's rocks—east of road,	1980′
Cross-roads at west township line, (turn east,)	1810′
Corners—north and south road, (turn south,)	1930′
Road east,	1920′
S. line of township, near Nuttall's rocks,	1895′
Road corners ¾ of a mile east of this,	1875′

IV. Farmington township.

From Lander's toward Russellburg, and north-west.

Lander's corners,	1565′
Summit—Mrs. Ewer,	1620′
" M. Louck's, (between road S. and road N,)	1590′
School-house and cross-roads, (*A*,)	1530′
Summit near E. line of township,	1675′
Intersection of roads near E. line, (turn north,)	1490′
Summit—E. W. Jenkins,	1545′
" E. Jones,	1575′
Corners ¾ mile south of State line, (turn west,)	1460′
Next corners west,	1340′
Fairbanks run bridge,	1340′
Cross-roads,	1595′
Johnson run branch, crossing,	1495′
Corners—road north,	1535′
Johnson run branch, crossing,	1510′
Cross-roads to Lander's,	1600′
Summit—J. R. Gardner,	1610′
Cross-roads, school-house and church—average summit,	1655′
West township line,	1650′±

From A, south.

Summit—L. D. Phillips,	1605′
Stream crossing,	1590′
Summit—A. H. L. Phillips,	1800′
Stream crossing,	1600′
Corners—road west, (*B*,)	1740′
Forks by school-house, (forks 1 m. S. E. near township line, 1395′,)	1705′
Corners—road east,	1715′
Rhynd's run, crossing,	1495′
Summit near S. township line,	1770′

From B, west.

Summit—D. Porter,	1880′
Cross-roads—N. Putnam,	1860′
Rhynd's run, crossing,	1745′
Lander's and Jackson run road,	1820′

From Lander's, south towards Jackson run.

First corner south—G. H. Cramer, (*C*,)	1720′
Forks—H. Sweet, (*D*,)	1820′
Summit—J. W. Preston,	1900′
Corners—road east,	1820′
Summit—J. Miller,	1850′
Top of SS. outcrop—A. Anderson, (near S. line of township,)	1550′

From C, west.

Branch of Jackson run,	1665′
Corners—road south,	1735′

Mud run, crossing,	1620′
Summit,	1875′
Corners—O. & E. Kingsley, (turn north,)	1800′
" Mrs. Wilson, (turn west,)	1700′
Stream crossing,	1610′
Corners near west township line,	1705′

From D, southerly.

Summit—E. A. Sweet,	1840′
School-house,	1525′
Forks at south township line, (turn N. W.,)	1435′
School-house, 1 mile from west township line,	1480′
Corners near west line—A. P. Morris,	1470′

V. *Pine Grove township.*

Russellburg depot—D. A. V. RR.,	1238′

Going north-east.

Lane hotel,	1260′
S. P. Allen's house,	1440′
Eighmie deep well,	1395′
Corners—road south-west, (*A*,)	1420′
School-house,	1480′
Forks at township line, (turn north, see Farmington)	1490′
Corners ¾ mile south of State line, (turn east,)	1460′
Summit—T. Way,	1560′
" E. Vanman,	1490′
Conewango valley road—J. L. Arnold,	1290′
Corners ¾ mile south of (*A*,)	1725′

Rhind's Run road.

Corners near school-house and S. township line	1240′
Old drill hole—1 m. W. of Conewango,	1305′
Stream crossing, above well,	1305′
Stream crossing W. township line—J. M. Ruland,	1360′

Road from Russellburg toward Quaker Hill.

Corners—road north, (*B*,)	1260′
Old oil well near M. Adams',	1330′
Bridge over Akeley run—S. Vakeley,	1390′
Road in front of A. Randall's,	1820′
Road in front of T. Sheehan's, near township line,	2030′

From B, north-east.

Road at Niver well,	1710′
Summit—J. H. Fox,	1980′
" S. E. Rider,	2000′

School-house,	1970′
Small bridge near W. Sumners,	1790′
East line of township—O. C. Gage,	2090′

From Akeley Station, east.

RR. Station,	1241′
J. McCoy's gate,	1445′
T. McCoy—angle in road,	1455′
Bridge over Akeley run—H. E. Brown,	1485′
School-house,	1525′
Corners near east township line,	1875′
Road summit N. E. corner of township,	2125′

VI. *Spring Creek township.*

Spring Creek station—P. & E. RR.,	1392′

On State road, running north-easterly.

Cross-roads 1 m. from county line—McClay, (*A*,)	1620′
West Spring creek--road north, (*B*,)	1460′
Road south—to Titusville, (*C*,)	1460′
Road north—to Columbus, (*D*,)	1440′
Road S. E. (W. Jackson's, 1¼ m. S. E. of this 1750′,)	1420′
Big Brokenstraw—surface of water,	1360′
RR. crossing,	1392′
Cross-road at school-house,	1400′
Summit—J. W. Mallery,	1765′
" G. E. Eldred,	1800′
" F. J. Eldred,	1800′
Road N. W.—Blue Eye run road,	1550′
Summit--L. A. Brooks,	1830′
Miles' run,	1790′

From A, north-west.

Opposite E. L. Demings,	1840′
Summit in field to S. E.,	1880′
County line,	1870′

From B, north, towards Columbus.

Summit--Wm. Weed,	1730′
" D. Wright,	1760′
Intersection N. and S. road,	?
Summit—R. Seiver,	1790′
" N. of A. H. Olmstead's,	1780′
Road west,	1815′
Summit—H. Perkins,	1830′
Cross-roads in Columbus township,	1445′

From C, towards Titusville.

Summit—J. N. Clark,	1540′
" G. W. Nicholls,	1740′
School-house,	1660′
Road E, (H. J. Jewett's $\frac{3}{4}$ mile east 1765′,)	1655′
Summit—P. Wright,	1715′
" A. Pero,	1675′
Stream,	1585′
Cross-roads, (O. N. Hemingway $1\frac{1}{2}$ mile E. 1795′,)	1630′
Summit—E. B. Whaley,	1710′
Stream—East Branch,	1590′

From D, towards Columbus.

Summit—D. Gustin,	1800′
" B. Morten, highest point ridge,	1835′
" R. H. Fisher,	1810′
School-house,	1795′
At M. Bresky's,	1490′
Corners in Columbus township,	1405′

From Spring Creek Station, N. E.

Opposite J. Birch's,	1665′
Stream crossing,	1640′
Summit—A. S. Skinner,	1800′
Corners—School-house No. 3, Columbus township,	1630′

VII. Pittsfield township.

Pittsfield—P. & E. RR. depot,	1247′

On road from Pittsfield to Wrightsville.

Pittsfield corners,	1250′
Holcomb farm,	1320′
Old Payne oil well,	1325′
Young well,	1365′
Bridge over Little Brokenstraw,	1330′
Corners—road west, (*A*,)	1325′
Church near township line,	1340′

From A, north-west.

Road south—J. Wolf,	1410′
School-house,	1455′
Corners—(turn north-east,)	1460′
Opposite C. Errickson's,	1745′
Summit in field north-west,	1780′

On road in north-east part of township.

Nuttall's conglomerate—top,	1955′
Corners near base of conglomerate,	1910′

Summit—D. Haupin,	1805′
" W. Welden,	1830′
" L. M. Peterson,	1785′
" W. Wentworth,	1565′
Garland Depot P & E. RR.,	1309′
Garland hotel corners,	1295′
Church corners, 1 mile S. W. of village,	1320′
Hosmer run road W. township line,	1400′
Next road south at township line,	1790′
School-house on road to Grand Valley,	1360′
RR. crossing—1 mile from S. township line,	1400′

On Cole Hill road.

Summit—Mrs. Barber,	1825′
Forks at school-house,	1835′
Summit south—A. L. Palmer,	1840′
" D. Martin,	1840′
Stream,	1790′
Summit—N. F. Camp,	1840′
Forks—near south line,	1780′?

VIII. Brokenstraw township.

Youngsville depot P. & E. RR.,	1214′

Youngsville, north-east to Irvine run.

Youngsville corners,	1205′
Angle in road—W. A. Davis,	1230′
School-house,	1750′
Summit—S. Butts,	1760′
Forks of roads, (turn south-east,)	1745′
Summit—E. P. Kyler,	1750′
Base of flat pebble conglomerate by road,	1420′
Intersection Irvine run road,	1390′
Steam saw-mill,	1340′
Old oil well south of road,	1300′
Saw-mill,	1240′
RR. crossing E. of Irvineton,	1175′

Youngsville, north, up Indian run.

Road forks,	1255′
Road east—G. Norway,	1745
Summit—B. Davis,	1795′
Road forks—G. Sullivan, (turn south,)	1810′
School-house,	1810′
Summit—J. A. Akens,	1680′
Road west,	1600′

Youngsville, up Matthew's run.

First road west, (*A*,)	1300′
Forks near north line of township,	1425′

From A, to N. W. corner of township.

Summit—N. Olson,	1800′
Road west—near N. W. corner,	1845′

Youngsville, S. towards Tidioute; York Hill road.

Road east—to Sulphur Springs,	1780′
B. M. on Walnut near J. Andersons, (leveled,)	1796′
B. M. on rock near school-house,	1803′
Top of conglomerate—York hill,	1905′
Summit N. E. of R. York's,	1840′
Depression in ridge,	1745′
Summit,	1850′
Stream crossing,	1775′
Summit near S. E. corner township,	1825′

IX. Eldred township.

Grand Valley depot—D. A. V. RR.,	1341′
Hotel corners,	1380′
Cross-roads at school-house south of town, (turn E.,)	1440′
Summit—C. E. Emerson,	1710′
Stream crossing,	1640′
Summit,	1705′
South township line,	1500′?
School-house corners between Grand Valley and Newton,	1410′
Summit S. E. of same—D. McCune,	1700′
School-house near E. township line,	1700′

Grand Valley to Ezra Trim's, on Spring Creek road.

Road west, (*A*,)	1635′
C. H. Whaley's,	1695′
J. McIntyre's,	1685′
Middle Branch crossing,	1490′
School-house,	1510′
Summit—J. B. Brown,	1640′
" ¼ mile north,	1740′
West Branch crossing,	1525′
Forks of roads	1585′
Corners—(turn west,)	1805′
Spring creek road—E. Trim,	1770′

From A, west to Spring Creek road.

Middle Branch crossing,	1405′
Summit,	1615′

West Branch crossing, ... 1355′
School-house corners, Spring creek road, (turn N.,) . . . . 1725′
Stream, ... 1640′
" . . . . 1665′
White's oil well, ... 1610′
Ackerman well, (leveled,) . . . . 1673′
Summit—J. Cullen, ... 1695′
Stream, ... 1625′
Summit—A. S. Belknap, ... 1675′
Stream, ... 1605
Summit—A. Engle, ... 1690′
" J. Green, ... 1705′
West Branch crossing—Eagle, P. O., ... 1645′
Road east, ... 1745′
School-house and road west, ... 1770′
Road east—Trim's corners, ... 1770′

X. South-West township.

Enterprise corners, (water in Pine creek, 1240′,) . . . . 1255′
West Enterprise corners—W. B. Benedict, ... 1265′

On road from Enterprise to Grand Valley.

Bridge over Pine creek, ... 1250′
Forks—(turn north,) . . . . 1280′
Road east, (Grave-yard summit ¼ m. E., 1615′,) . . . . 1560′
Forks of roads, ... 1570′
Summit—G. M. Hunter, ... 1620′
School-house, ... 1610′
Road west—J. Wales, (*A*,) . . . . 1660′
Road east, ... 1600′
Knapp's oil well, ... 1585′
Summit—J. Stearns, ... 1660′
Stream, ... 1560′
Road east, (turn north,) . . . . 1660′
School-house, ¾ m. from township line, ... 1665′
Summit—A. Goodwill, ... 1610′
" S. H. Fisher, near north line, ... 1635′

From A, south-west.

Angle in road—H. A. Jamieson, ... 1610′
Summit, top of Olean conglomerate, ... 1630′
Summit—H. R. Bunce, ... 1620′
Corners—J. S. Campbell, (turn west,) . . . . 1550′
School-house, ... 1585′
Stream, ... 1535′
Summit, ... 1555′
Stream, ... 1520′
Bridge over Pine creek near S. W. corner of county, ... 1205′

From Enterprise E. to Scofield.

Forks—Grand Valley road,	1280′
Stream crossing,	1290′
Forks—Colarado road,	1355′
Summit, road south—T. Fleming,	1580′
Stream crossing,	1500′
Road south,	1645′
Gilson run crossing,	1480′
Scofield corners, (turn north,)	1555′
School-house,	1590′
Summit,	1615′
Gilson run crossing,	1475′
Summit—H. A. Barber,	1645′
Road west—to Colarado,	1665′

XI. Deerfield and Triumph townships.

On road from S. W. corner of Triumph township, N. and N. E.

Funk's corners,	1505′
Cross-roads—Mrs. Valentine, (turn left,) (*A*,)	1670′
Summit,	1690′
Summit—A. C. Clark,	1630′
Summit,	1720′
School-house, McGraws corners Triumph road, (*B*,)	1650′
Divide between Gordon run and Pine creek,	1545′
Summit—S. Thompson,	1665′
" W. Hartrup,	1710′
School-house corners Tidioute road, (*C*),	1700′
Summit—T. Culbertson,	1650′
Bridge over Tidioute creek,	1265′
Cross-roads—Tidioute to Grand Valley, (*D*,)	1275′
Summit—W. Wilson,	1730′
School-house cross-roads—J. H. Morrison (stream north of this 1550′ and summit beyond 1710′,)	1740′
Road north,	1685′
Summit,	1775′
Road south, (*E*)	1750′
Stream,	1520′
Summit—A. Bimber,	1840′
" J. D. Brown, (S. of road 1890′)	1845′
Road south, (*F*,)	1835′
Road east,	1770′
Summit—J. Conklin,	1750′
" Mrs. McGee,	1850′
Road west, near N. line of township,	1870′

From A, north-east to Tidioute.

Hunt's run crossing,	1545′
Summit—Gorman school-house,	1650′

West Hickory crossing,	1495′
Summit—Gorman,	1675′
School-house,	1640′
Corners—Fagundus road,	1660′
" Triumph road,	1610′
RR. depot at Tidioute—B. P. & W. RR.,	1113′

From A, south-east to Fagundus.

Summit,	1690′
Bridge over West Hickory,	1365′
Road forks,	1630′
School-house, Fagundus,	1665′
Summit, Fagundus,	1725′
B. M. at forks near county line, (leveled,)	1692′

From B, north-east to Triumph.

Summit,	1680′
School-house, Clapp farm,	1655′
Entrance to Clapp farm,	1665′
Summit,	1740′
Forks of road,	1725′
Road south—Triumph corners,	1690′

From C, south-easterly to Tidioute.

Stream crossing,	1655′
Summit—C. T. Crocker,	1715′
Depression,	1650′
Road north—Richardson,	1705′
School-house,	1710′
River Hill summit—Mrs. Campbell,	1710′

From D, south-east to Tidioute.

Oil well north of road,	1220′
School-house south of road,	1180′
Top Second Oil sand B in stream,	1150′
National Hotel, Tidioute,	1130′

From D, north-west towards Grand Valley.

Road north,	1290′
School-house,	1350′
Summit,	1530′
Summit—Thompson's,	1650′
Stream,	1540′
Summit—W. Barker,	1625′
Oil well S. of road,	1585′
School-house in Eldred township,	1700′

From E, southerly to Tidioute.

Summit—J. Burton,	1765′
Depression,	1665′

Summit—M. Dever,	1765′
" J. D. McCormick,	1695′
" R. McCormick,	1715′
Top of River hill,	1670′
Summit—J. N. Brown,	1320′
River level, east end of Tidioute,	1102′

From F, to the river.

Summit—(none higher,)	1875′
River hill, crook in road—D. H. McKean,	1720′
River road near Cobham Station,	1155′

XIII. Conewango township.

" Yankee Bush " road, going N. W. from Warren.

Warren—P. & E. depot,	1200′
School-house,	1805′
Road south—A. Gantz, (*A*,)	1860′
Haag's heirs,	1775′
Road north—B. Arnold,	1760′
Summit—Burying ground,	1900′
School-house,	1845′
Cross-roads—A. Babcock, (*B*,)	1800′
School-house,	1785′
Summit—V. M. Dalrimple,	1835′
W. Sturdevant,	1845′
G. Frantz,	1850′
Cross-roads—W. J. Dunham, (*C*,)	1820′
School-house, near N. township line,	1820′
Summit—Burying ground,	1830′

From A to the river.

Top conglomeritic sandstone—A. Grosz,	1540′
River road,	1205′

From B to the river.

At A. G. Weiler's,	1620′
At saw-mill,	1390′
River road,	1190′

From C to the river.

Forks of road, (turn south-east,) (*D*,)	1840′
Summit—D. Goss,	1850
School-house, road west,	1815′
Summit,	1820′
M. Schuler's,	1765′
P. Seigrist's, (summit in field, west 1810′,)	1755′
Top of pebbly sandstone outcrop near road,	1385′
River road,	1185′

From D to river.

First summit,	1840′
At J. H. Lee's,	1790′
School-house,	1775′
J. Keller's,	1590′
Water trough—C. Koalfral,	1535′
River road,	1195′

From North Warren, north-east, up Jackson run.

Depot at North Warren,	1221′
Road north—H. Lacy, (*E*,)	1300′
J. Thomas',	1305′
Miles' mill,	1355′
Road north, (oil well near 1375′,)	1370′
Corners—Jackson run P. O.,	1435′

From E, north to township line.

Forks of road, (*F*,)	1485′
Top of massive, fossiliferous sandstone—W. Smith,	1630′
School-house forks,	1760′
Summit near township line—J. Baker,	1770′

From F to Conewango creek.

Summit—J. O. Hoag,	1830′
Forks—M. Waters,	1600′
Top SS. outcrop north of this—M. Lanffer,	1660′
Junction with creek road,	1220′

XIV. Glade township.

From Conewango road to Gardner's rocks.

Corners by school-house,	1225′
Bridge—Hatch run,	1300′
At C. Koeblins,	1490′
At H. W. Gardner's,	1690′
Top of Gardner's rocks,	2030′

From Quaker Hill road E. of Snyder's summit, south.

Corners on Quaker Hill road,	1890′
M. Peterson's (Shenango shale summit S. E. 1920,)	1840′
Stream crossing,	1430′
Corners—turn west to Glade road,	1315′

Glade Run road to Quaker Hill.

Glade run school-house,	1215′
Glade run bridge,	1240′
Road south—S. Storum, (*A*,)	1300′
School-house and bridge,	1390′
Summit north of Cobham park,	1920′
B. M. at school-house—Quaker Hill road,	1925′

From A to Cobham Park, ridge road.

Turn in road—N. Storum,	1595′
L. Bauer,	1770′
Water trough—L. Bauer, (summit N. 1845′,)	1770′
Road summit, east,	1860′
Depression in ridge—Wood road to river,	1775′
Wood road, entrance to Cobham park,	1870′
Cobham park—level of mansion,	1890′

Quaker Hill road and river road.

For these levels, see Chapter I.

XV. Elk township.

Quaker Hill road to Corydon.

Cross-roads at M. E. and Lutheran churches,	2100′
(P. Lund's corner, ½ m. N. W. of this, 2120′.)	
Summit—H. Holman,	2075′
Road north, (*A*,)	2030′
Summit—S. Errickson,	2065′
Germany post-office—Mrs. Walling,	2085′
Road east, (stream crossing E. of this, 1820′,)	2100′
Church and road E., (Catholic Ch. corners E. 2090′,)	2100′
Road west,	2070′
School-house,	2070′
Depression—branch Cornplanter run,	2025′
Summit—W. I. Reeves,	2110′
J. Bennett,	2115′
Road west—burying-ground, (*B*,)	2105′
Summit—H. B. Lonsbury,	2060′
Road north,	2050′
Summit at river hill—M. Giltman,	2120′
Allegheny river at ferry,	1270′

From A, towards Pine Grove township.

At A. Engstrum's,	2050′
C. Holburg's,	2075′
E. Burkland's,	2020′

From B, west and north-west.

Forks—S. A. Lonsbury, (turn N. W.,) (*C*,)	2110′
Summit—A. Learn,	2170′
School-house forks—D. Hess, (Cemetery ½ m. W. 2155′,)	2170′
Summit—E. McKee,	2140′
J. Arnold,	2155′
Angle in road—J. Learn,	2175′
Top of escarpment of sub-Olean along the road,	2160′
North-west corner of township,	2125′

From C, west to township line.

Forks—road south-west,	2065′
Summit—J. Arnold,	1890′
Top sub-Olean at township line, (O. C. Gage,)	2090′

For other elevations see map of Quaker Hill coal basin.

XVI and XVII. Limestone and Watson townships.

Ridge road from Tidioute to Warren:

RR. depot at Tidioute,	1113′
Floor of bridge, south end,	1124′
Surface of water in Allegheny rivsr,	1098′
Junction of Economy road with Warren road, (leveled,)	1738′
Road S. E. to Shingle mill, (leveled,)	1739′
School-house and road to river,	1680′
Summit east,	1730′
Cross-roads—L. Bimber, (summit on road S. 1745′,)	1640′
Water-trough—S. Averill,	1710′
School-house,	1720′
Water-trough—F. Black,	1710′
Road to river,	1770′
Water-trough—J. Conroe,	1705′
Summit,	1795′
School-house and plank-road,	1805′
Corners—J. Miller, (*A*, as below,)	1785′
Summit, east,	1865′
" "	1885′
Road to Baxter's mills, south,	1820′
Wood road to Shaw Bros. & Green's well,	1915′
Summit—L. Snavely,	1930′
John Slater,	1910′
J. Rapp,	1920′
Church and burying-ground,	1900′
J. Conarrow, ½ m. from township line,	1915′

Cobham P. O. to Baxter's Mills and Cherry Grove.

Cobham post-office,	1140′
Corners—J. B. McKean, (turn S. E.)	1770′
Summit—P. J. Mickelson,	1785′
Next summit,	1790′
Corners—J. Miller, (*A*, as above,)	1785′
Top of sub-Olean escarpment E. of plank-road,	1725′
Base of Olean Conglomerate over it,	1760′
Bridge—West branch Hickory creek,	1555′
Summit on plank, between Rynd's and Baxter's mills,	1845′
Baxter's mills,	1665′±
At A. H. Baxter's gate,	1780′
Forks—road north to Warren,	1790′
Summit,	1840′
"	1870′
"	1970′
" near township line,	1920′

XVIII. Pleasant township.

Tidioute and Warren road, going north-east.

Summit—Mrs. Conarrow,	1915′
School-house cross-roads, (*A*,)	1885′
Summit ½ mile north-east,	1930′
Road south,	1780′
Crown of river hill and base of Olean conglomerate,	1760′
Top of rocks north of road,	1805′
Corners near school-house, mouth of Sill's run, (*B*,)	1220′

From A north-west to river.

Summit—T. Daily,	1890′
Top of coal knob north-east,	1935′
Road north-east,	1845′
School-house corners on river road, (*C*,)	1190′
Water in river—ferry to Irvineton,	1150′

From C along the river and over the ridge to Tionesta creek.

Bridge—branch of Lenhart's run,	1270′
Road summit opposite conglomerate cliff,	1375′
Top flat pebble conglomerate escarping towards the river,	1440′
Top of summit over it,	1510
Crossing of small stream east of above,	1325′
Bridge—Grunder's run,	1180′
Road south, (school-house ¼ m. up run, 1205′,)	1175′
Summit,	1410′
Bridge—Sill's run,	1215′
Corners near school-house, (*B* above,)	1220′
Road north—P. Hertzell,	1495′
Bend in road; fine pebble, irony, fossiliferous outcrop—Mrs. Knupp,	1645′
Summit,	1790′
Top sub-Olean in hill S. of road,	1820′
Corners—A. Siegrist, (turn south,)	1695′
Road east,	1840′
Summit—J. Dible,	1900′
Bridge—Morrisons run,	1570′
Summit—above Olean conglomerate,	1890′
Tionesta creek road, (turn west,)	1450′
Steam crossing,	1440′
School-house,	1455′
Creek bottom at entrance to saw-mill,	1430′

XIX, XX, XXI. Mead, Kinzua and Corydon townships.

The elevations given elsewhere of railroads, well-mouths and outcrops, must suffice for these townships. Other altitudes have been taken, but in the absence of roads and clearings, the points cannot be located definitely so as to be of any practical worth to the reader.

XXII. Cherry Grove township.

Road east, through center of township to Sheffield.

West line of township,	1910′
Road north—M. B. Dunham,	1920′
School-house,	1880′
Opposite C. Noble's,	1860′
Valley—branch of Minister run, lot 680,	1805′
Summit at Stafford wells,	1860′
Valley—J. Farnsworth,	1820′
Summit,	1890′
Stream crossing—Green well, lot 671,	1830′
Corners—school-house—pump station—"Vandergrift city," (*A*,)	1870′
Summit,	1890′
Valley—head of Lower Sheriff run,	1820′
Road south,	1890′
Corners—M. Farnsworth, (*B*,)	1915′
Summit by coal bank, turn in road,	1995′
House south of road—Horton & Co.,	1990′

From A, south to Forest county.

Long level at head of Fool's creek,	1915′
Valley and shanty,	1765′
Summit south,	1795′
Summit south,	1820′
Top Olean conglomerate,	1730′
Terrace,	1685′
Spring near county line,	1625′

From B, north towards Clarendon.

At M. Farnsworth's house,	1960′
Tip top rock back of house,	1980′
Arnot run crossing,	1770′
Summit,	1940′
Valley,	1840′
Summit,	1920′
Plank road corners, (*C*,)	1925′
Summit—iron tank west,	1955′
Railroad crossing,	1905′
Valley—level of Guffey well No. 1,	1880′
Summit,	1960′
Mahoopany well No. 1,	1910′
Average summit to township line,	1930′

From Garfield to Farnsworth switch.

Garfield—Jamestown house,	1935′
Plank road corners at Farnsworth, (*C* above,)	1925′
Bridge—large rock to right,	1560′
Saw-mill,	1500′
Summit of Tionesta hill,	1680′
Bridge over Tionesta creek,	1365′
Farnsworth switch,	1365′

XXIII. Sheffield township.

From Sheffield to Cherry Grove.

Sheffield depot—P. & E. RR.,	1344′
Culvert ascending the hill,	1670′
Summit just above large outcropping rocks,	1865′
Summit—M. Miley,	1975′
School-house,	1970′
Summit, (point of rocks just north 2000′,)	1965′
House before mentioned in Cherry Grove—Horton & Co.,	1990′

From Sheffield to Brookston.

Exposure of red rock and sandstone,	1340′
Bridge over Tionesta—Barnesville saw-mill,	1325′
At E. Barnes',	1350′
Road to Foxburg, (*B*,)	?
Bridge over Tionesta creek—Donaldson's,	1345′
Brookston, (Badger oil well, 1410′,)	1425′
Base of sub-Olean—Mr. Brooks' house,	1515′

From B towards Foxburg.

Summit on the road,	1755′
Top of sub-Olean—exposed by the road side,	1550′
Bridge at Henry's mill,	1290′

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WARREN COUNTY.

N. B.—*Figures marked * give the page at which full descriptions or records may be found.*

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