

## GEOLOGICAL SEQUENCE IN THE VICINITY OF LA SALLE AS REVEALED BY RECENT DRILLING.

GILBERT H. CADY.

Within the last two months the State Geological Survey has received the drilling samples from two new wells in the vicinity of La Salle that penetrate strata to the depth of from 1,200 to 1,500 feet. The presentation of the records or logs resulting from the study of these two sets of samples, and their interpretation, is the first purpose of this discussion. There were also available for comparison the records of several wells in the vicinity of La Salle, some quite recently drilled, and others dating back before 1890. Of some of the latter, the drilling samples have been studied by Dr. J. A. Udden, and the results of his

study appear either in the detailed cross-section of northern Illinois prepared for the Report of the Illinois Board of World's Fair Commissioners or in his correspondence with the Director of the State Geological Survey. Following the interpretation of the new logs, a comparative study of the records of a number of the wells in the vicinity will be undertaken. In conclusion, as a summary of the data presented, and in order that a broad application to conditions in the State may be made, a revision of the Udden cross-section from Rock Island to the east side of the State will be presented and discussed.

#### PRESENTATION AND INTERPRETATION OF LOGS.

In way of preparation for the discussion and interpretation of the two new logs, a general understanding of the geological sequence in northern Illinois and of the structure in the vicinity of La Salle is necessary.

The northern Illinois section, summarized by R. S. Blatchley in his paper on Illinois Oil Resources in Bulletin No. 16, State Geological Survey, page 60, is in brief as follows:

|                                  | Feet.   |
|----------------------------------|---------|
| Coal measures .....              | 575     |
| Devonian                         |         |
| Sweetland Creek shale .....      | 40      |
| Iowan Hamilton limestone .....   | 150     |
| Silurian. Niagara dolomite ..... | 335-388 |
| Ordovician                       |         |
| Maquoketa shale .....            | 68-250  |
| Galena-Trenton .....             | 300-440 |
| St. Peter sandstone .....        | 150-275 |
| Lower Magnesian limestone .....  | 450-811 |

Unconformities exist between all the divisions, except between the St. Peter sandstone and Trenton limestone, and possibly even locally there.

On page 28 of the same volume, G. H. Cox describes the rocks of the Lower Magnesian formation and separates it into the following members:

|                              | Feet.   |
|------------------------------|---------|
| Shakopee dolomite .....      | 40      |
| New Richmond sandstone ..... | 15-130  |
| Oneota dolomite .....        | 200-225 |

The Lower Magnesian rests on the Potsdam formation of the Cambrian.

The Pennsylvanian of northern Illinois is separated into three members: the McLeansboro, Carbondale and Pottsville forma-

tions. The Pottsville lies below No. 2 coal. It is characterized by silicious, micaceous, gray or reddish shales, and sandstones which are often micaceous. Occasionally there occurs a thin bed of coal in the formation. In the main it is non-calcareous. The texture and color, together with the lack of calcareous material, are important criteria of discrimination.

The Sweetland Creek shale, a dark colored shale, at least its lowest part, is often colored brownish by an abundance of fossils known as *Sporangites huronense*, supposed to be the spores of some paleozoic tree. These are readily distinguishable, and render the correlation of a shale containing them very accurate. The Hamilton limestone is a light gray, pure calcareous limestone, not a dolomite. Considerable hesitancy should be shown in correlating any dolomite with the Hamilton.

The Niagara limestone is generally a dolomite of very fine texture, usually of a light color, and sometimes characterized by layers of flint. In certain places the Niagara limestone is known to contain calcareous layers.

The Maquoketa shale is very variable in lithological character, but bluish-gray shale with some streaks or beds of limestone and black carbonaceous shale is the usual occurrence. The relationship of the overlying and underlying formations are the readiest means of identification.

The Galena-Trenton formations are dolomite in the upper part, the lower sixty or 100 feet of Trenton, however, being usually more calcareous. The upper part is usually of a characteristic brownish-buff color, due to a large percentage of iron present. The Trenton is often bluish. Both formations are often quite flinty; this is especially true of the Galena and the lower or quarry beds of the Trenton.

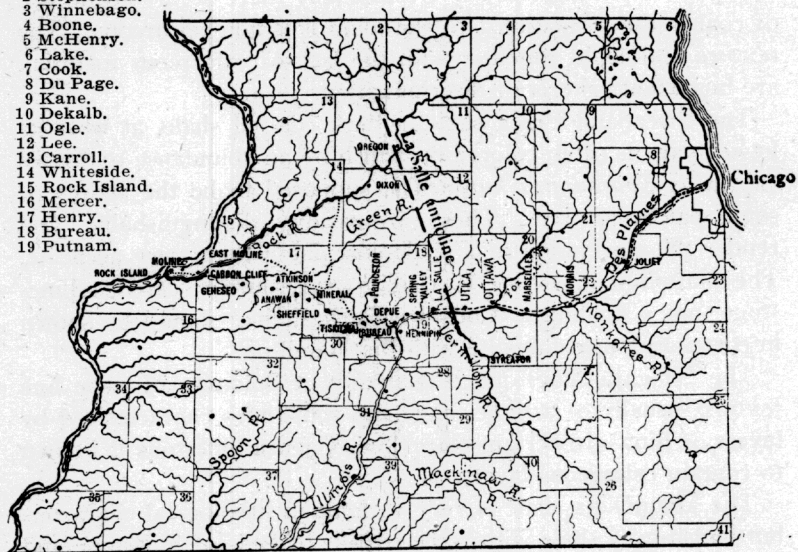
The St. Peter sandstone is characteristically a pure, soft white sandstone, the individual grains being all quartz and of a rather large size. Its purity, color and softness are almost unfailing criteria for identification.

The Lower Magnesian limestone, or Shakopee dolomite, is a white flinty dolomite, often having beds of fine laminated hydraulic limestone. It sometimes contains silicious concretions. The upper part in contact with St. Peter sandstone is usually marked by the occurrence of oölitic flint. The beds lower than the Shakopee dolomite are nowhere exposed in Illinois, and their local characteristics are not known.

The structural feature to be emphasized in the northern part

## List of Counties

- No.  
 1 Jo Daviess.  
 2 Stephenson.  
 3 Winnebago.  
 4 Boone.  
 5 McHenry.  
 6 Lake.  
 7 Cook.  
 8 Du Page.  
 9 Kane.  
 10 DeKalb.  
 11 Ogle.  
 12 Lee.  
 13 Carroll.  
 14 Whiteside.  
 15 Rock Island.  
 16 Mercer.  
 17 Henry.  
 18 Bureau.  
 19 Putnam.



- No.  
 20 LaSalle.  
 21 Kendall.  
 22 Grundy.  
 23 Will.  
 24 Kankakee.  
 25 Iroquois.  
 26 Ford.  
 27 Livingston.  
 28 Marshall.  
 29 Woodford.  
 30 Stark.  
 31 Peoria.  
 32 Knox.  
 33 Warren.  
 34 Henderson.  
 35 Hancock.  
 36 McDonough.  
 37 Fulton.  
 38 Mason.  
 39 Tazewell.  
 40 McLean.  
 41 Vermillion.

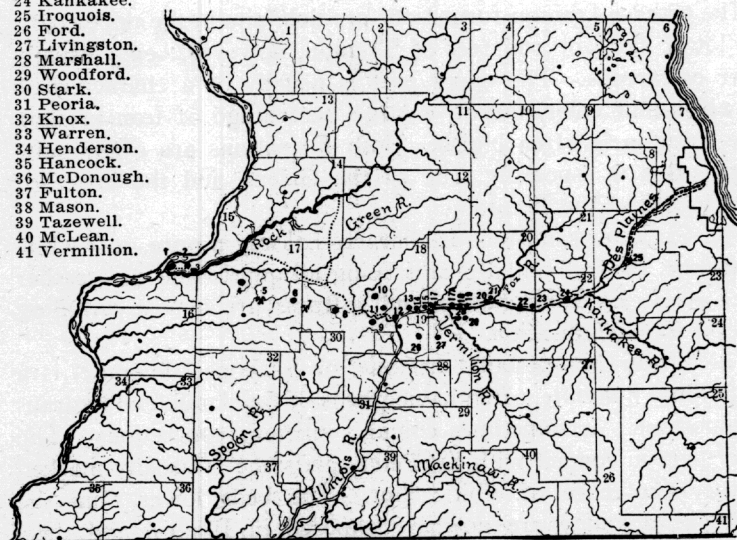


Plate I. Maps of Northern Illinois showing locations of towns and drill holes between Rock Island and Joliet.



of the State relative to the region of our investigation is the La Salle anticline. Its position is indicated on the map. (Plate I.) Its character has been discussed so frequently that it has become familiar. The fold is more in the nature of a monocline than an anticline, the west side being thrown down along the axis of disturbance and the east side thrown up. The details of the structure at La Salle will be shown by the cross-section.

The two new logs to be presented are from wells located in the lowest part of the trough west of the anticline.

Log of well No. 16, at the Western Clock Works in Peru, is as follows, continuing from the base of coal No. 2, or the third-vein coal, as it is locally known. This log is diagrammatically shown on the chart.

|  |                           |
|--|---------------------------|
| Fireclay .....                             | 5 feet                    |
| Sandstone .....                            | 30 "                      |
| Gray shale, dark, indications of coal..... | 70, base 500 feet deep    |
| White calcareous sandstone.....            | 15 feet                   |
| Hard red shale.....                        | 3 "                       |
| Gray and green shale.....                  | 30 "                      |
| Hard red shale.....                        | 3 "                       |
| Green and gray shale.....                  | 85-90 ft., bottom 650 ft. |
| White dolomite .....                       | 36 feet                   |
| Brown .....                                | 8 "                       |
| Light gray dolomite.....                   | 96 "                      |
| Buff dolomite .....                        | 15 "                      |
| Light gray dolomite.....                   | 23 "                      |
| Buff dolomite .....                        | 12 "                      |
| Light gray dolomite.....                   | 13 feet, bottom 853 feet  |
| Bluish gray dolomite.....                  | 70 feet                   |
| Brown shale .....                          | 10 "                      |
| Gray shale .....                           | 100 feet, bottom 1035     |
| Brown dolomite .....                       | 85 feet, bottom 1120      |

Log of well No. 27, at No. 5 mine of La Salle County Carbon Coal Co. Coal No. 2, or third-vein coal, at elevation of 135 A. T. depth 565 feet:

|  |                           |
|--|---------------------------|
| Gray shale .....                         | 125 feet                  |
| Fine sandstone .....                     | 40 "                      |
| Gray shale .....                         | 35 "                      |
| Sandstone .....                          | 10 "                      |
| Light gray shale.....                    | 25 "                      |
| Gray and green shale .....               | 25 feet, bottom 825 ft.   |
| White dolomite.....                      | 75 feet                   |
| Brownish dolomite .....                  | 25 "                      |
| Light gray dolomite.....                 | 25 "                      |
| White dolomite .....                     | 50 "                      |
| White, slightly calcareous dolomite..... | 25 "                      |
| White, chalky calcareous dolomite.....   | 25 "                      |
| Buff dolomite .....                      | 23 "                      |
| Gray dolomite .....                      | 20 "                      |
| Shale .....                              | 5 "                       |
| Blue and brown shale.....                | 145 "                     |
| Brown dolomite .....                     | 255 feet, bottom 1498 ft. |

the last 15 ft. somewhat calcareous.

It is apparent that the strata can be divided into four parts, lithologically. There is an upper division composed of shales and sandstones and possibly a little coal; the second division, consisting of lighter colored dolomites; the fourth, made up of light gray and bluish shales, with a little dark shale, and finally the brownish dolomite.

A detailed comparison of the first limestone of the two logs shows a little similarity throughout; both have a succession somewhat as follows: White dolomite at top, followed by brown dolomite, gray-white dolomite, then a thin buff dolomite, with the bottom a gray dolomite, so that there seems to be great safety in the correlation of these two limestones.

Having established the correlation of the upper limestone, the lower strata fall into order. Checking the lithological characteristics of the four divisions of this well with the character of strata outcropping in northern Illinois, previously described in this paper, it would appear that the upper limestone is probably Niagara limestone and that the Maquoketa shale and Galena-Trenton limestone lie below. The Hamilton limestone does not occur in these logs. The material composing the shale of the first group might be Devonian or Pottsville, but the absence of bituminous beds with *Sporangites* seems good proof that the upper Devonian or Sweetland Creek shale is here absent and that the strata all belong to the Pottsville.

To summarize: We have below No. 2 or third-vein coal 250 feet of Pottsville sediments, 200-250 feet of Niagara sediments, 145-180 feet of Maquoketa sediments, and as much as 300 feet of Galena-Trenton, neither well having certainly penetrated the horizon.

#### COMPARATIVE STUDY WITH OTHER RECORDS.

In the comparative study of the records just summarized with the records of other wells in this locality, wells Nos. 16, 31, 15, 14 and 13 will be included in the discussion. (See Plate II.)

These wells are for the most part located in a linear manner along the north bluff of the Illinois River, extending from La Salle to Bureau (See Plate I), and they will be considered in order from east to west.

Well No. 30, Illinois Zinc Co., about one-quarter mile west of well No. 16:

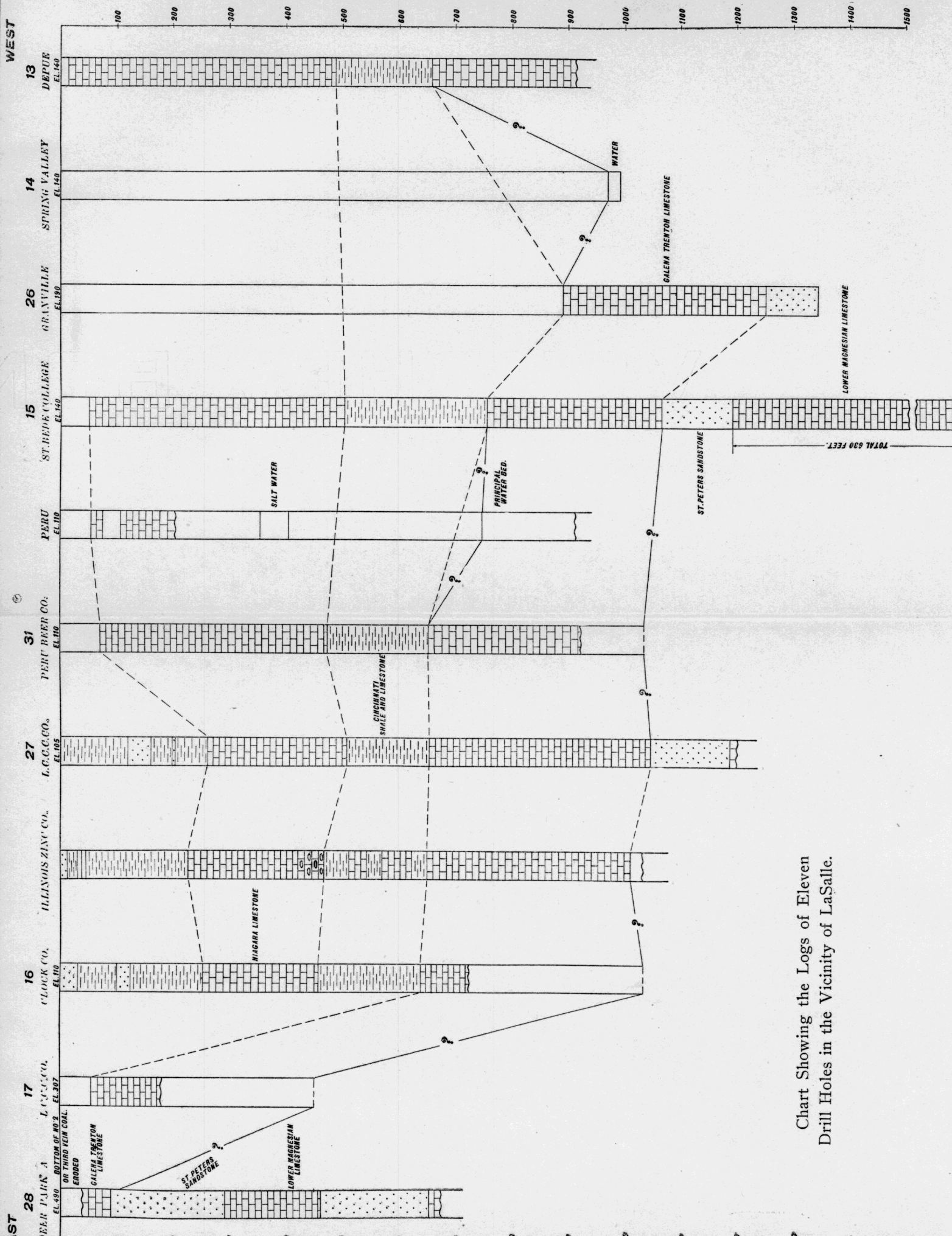
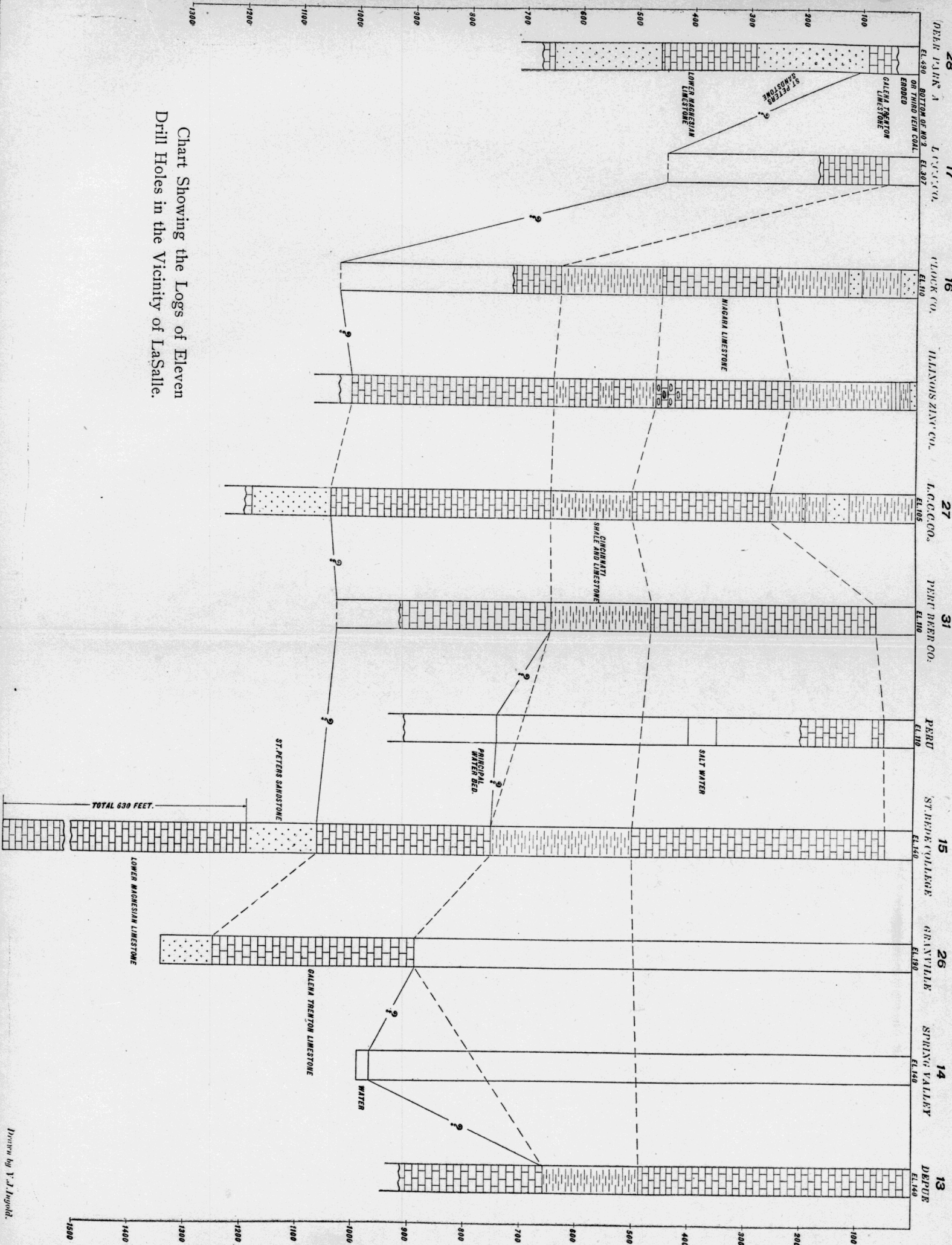


Chart Showing the Logs of Eleven Drill Holes in the Vicinity of LaSalle.



Chart Showing the Logs of Eleven  
Drill Holes in the Vicinity of LaSalle.





- (1) 200 feet of Pottsville.
- (2) 220 feet of Niagara.
- (3) 178 feet of Maquoketa.
- (4) 350 feet of Galena-Trenton limestone.

Well No. 31, Peru Beer Co., about one-quarter mile west of No. 30, shows:

- (1) 55-60 feet of Pottsville.
- (2) 400 feet of limestone and dolomite, the upper part is calcareous and possibly Devonian.
- (3) 180 feet of Maquoketa shale.
- (4) 170 feet of Galena-Trenton limestone.

Well No. 15, St. Bede College, one and one-half miles west of No. 31:

- (1) 50 feet of Pottsville.
- (2) 450 feet of dolomite, the upper part of which is possibly Devonian.
- (3) 250 feet of Maquoketa shale.
- (4) 308 feet of Galena-Trenton.
- (5) 130 feet of St. Peters.

At Spring Valley, well No. 14, water is obtained at a depth corresponding to that of the Galena-Trenton limestone, well No. 13.

Artesian well No. 2 of Mineral Point Zinc Co., at DePue, examined by Dr. J. A. Udden, and reported in correspondence to the Director of the State Geological Survey:

- (1) Pottsville, 10-20 feet.
- (2) Dolomites, 231 ft., white and cream colored. Dolomite different from usual Niagaran. No strong evidence to show that it is Devonian, hence placed in the Niagaran.  
Dolomitic limestone, white and straw colored, 243 feet.
- (3) Maquoketa shale, 170 feet.
- (4) Galena-Trenton, 258 feet.

On the chart showing several of the logs just described a number of interesting details are brought out. The most significant of these is the excessive and local thickness of the Pottsville sediments as shown in logs Nos. 16 and 27. The condition as shown by these records indicate that in Pottsville times there existed a deep depression probably lying parallel to the axis of the La Salle anticline, extending up from the south, but not present to the west, as is shown by the thinning out of the formation in that direction. The second noteworthy feature is the thinning of the Niagara limestone where the Pottsville is thickest. This seems to indicate that the depression or basin in which the Pottsville sediments were deposited was not due to down faulting or folding, but to extensive erosion in the Niagara and Devonian limestone. In pre-Pottsville times there apparently existed in the

vicinity of La Salle, within a distance of one-quarter of a mile relief as great as 200 feet. A third point brought out by the chart relates to the source of the water supply. It is seen that almost all the wells obtain water not from the St. Peter sandstone, but from the Galena-Trenton limestone, a condition which has not been generally recognized heretofore for this part of the State.

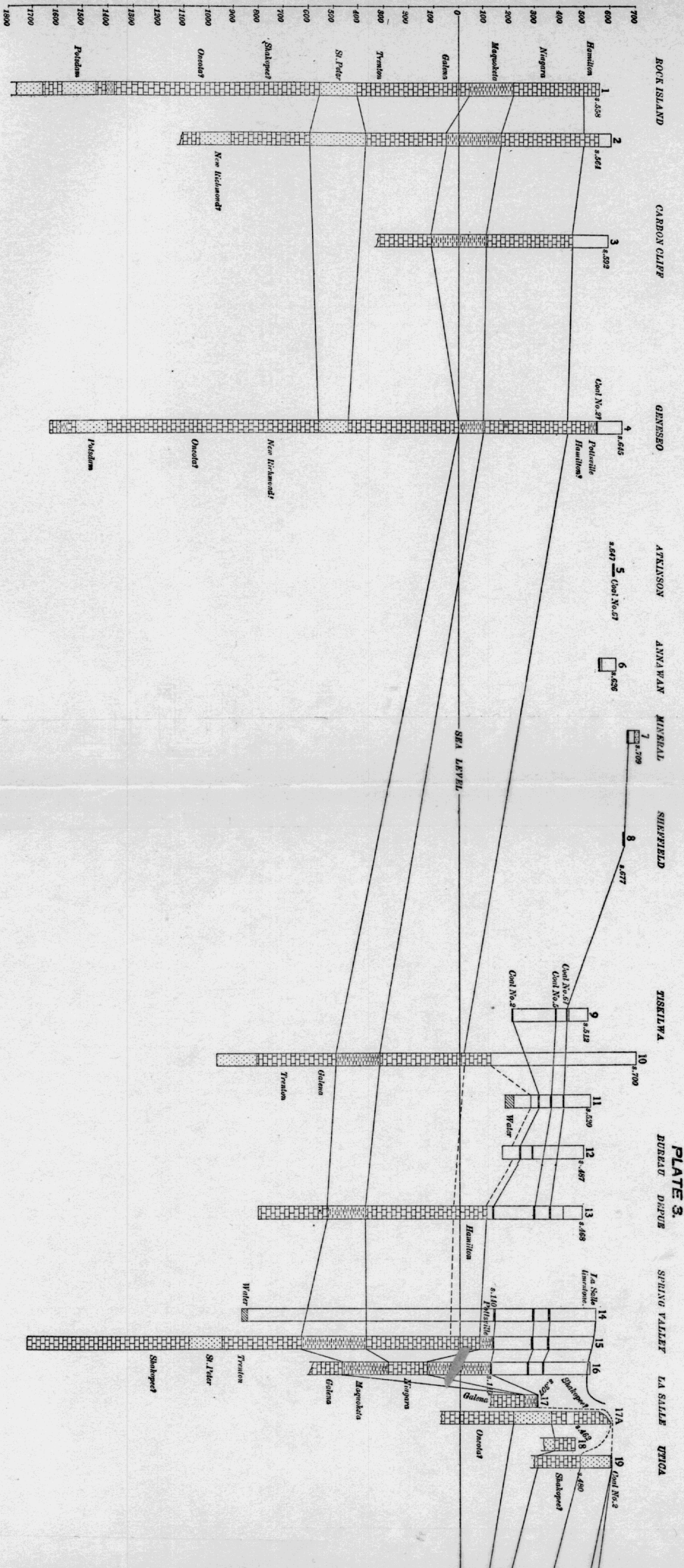
For the sake of comparison, the log of a well recently drilled at Deer Park, which lies on or just east of the anticline, appears as No. 28, plate II. The succession shown by this log is very different from that shown in the logs to the right. The upper limestone, of which only a part is left, is the Trenton limestone outcropping along the banks of the Vermilion River. Below this lies about 200 feet of St. Peter sandstone. This is followed by 180 feet of Lower Magnesian or Shakopee limestone. This lies above a rather massive sandstone of about 200 feet in thickness, probably the New Richmond sandstone. The well penetrates about twenty feet of limestone below the New Richmond.

A further reason for introducing this log is for the sake of showing the difference in the stratigraphic conditions on the two sides of the anticline, and the possibility of confusing the St. Peter sandstone and New Richmond sandstone. East of the anticline the upper sandstone is eroded in the Illinois River bottom about Utica, hence the lower sandstone is often reported as St. Peter. Furthermore, the record of this well shows us the character of strata that would probably be encountered in deeper drilling west of the fold.

#### PLATE III.

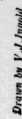
In order that the local condition existing in the vicinity of La Salle may be more clearly understood, a cross-section has been prepared, extending from Rock Island to Joliet, showing structural conditions in northern Illinois, and the stratigraphical conditions from the Lower Magnesian formation to the "Coal Measures." The source of the data shown on this chart is partly from published articles by Dr. Udden, including the World's Fair cross-section and the Rock Island section in the seventeenth Annual Report of the Federal Survey, and partly from data in the files of the State Survey.

To sum up briefly what it is desired to show by the chart: (1) The general occurrence of the same strata having somewhat the same thickness on the two sides of the anticline, so far as they



**PLATE 3.**





Cross Section from Rock Island to Joliet, Showing the Relation and Structure of the Hard Rocks.



have not been removed by erosion. It will be noticed, however, that the eastern Maquoketa is considerably thinner than the western. (2) The amount of the displacement of the La Salle anticline. The logs showing the full extent of this displacement are Nos. 15 and 17a. In both cases we have data on the bottom of St. Peter and top of the Lower Magnesian limestone. The Lower Magnesian limestone, as it is exposed in the bluff above well No. 17a, reaches practically to the base of the St. Peter sandstone, inasmuch as the top of the limestone contains the oölitic flints that mark the contact between the St. Peter and Lower Magnesian. The total displacement as indicated by these two wells is 1,500 feet. (3) The time and amount of the displacement. Inasmuch as coal veins are probably laid down on horizontal surfaces, and as coal No. 2, or third-vein, extends completely across the anticline in places, and, in fact, as the complete "Coal Measure" section near La Salle is affected by the disturbance, it seems unquestionable that the final folding is post-Pennsylvanian. The amount of this displacement is about 500 feet. As the coal beds dip slightly toward the fold on the west and away from it on the east, there has probably been movement on both sides.

The fact that there have been two movements shows in actual outcrop at Split Rock, near La Salle, and elsewhere along the anticline where the "Coal Measures" can be seen lying against the St. Peter sandstone. The former has a dip of twelve or fifteen degrees, the latter from twenty-five to thirty-five degrees.

The date of the fold seems to be determinable from a study of the contact of the Trenton-St. Peter formations and the Maquoketa-Galena formations east of the fold, as is shown by the cross-section (Plate III). The straight line marking the contact of the limestone and sandstone is a depositional surface and must have originally been flat. Therefore the uplift to the west ending in the anticlinal fold must have occurred in post-St. Peter time. Further attention is directed to the Trenton-Galena limestone east of the axis. It seems that in the well at Joliet, No. 25, the thickness of the Trenton-Galena is about normal, conforming with the condition west of the axis. It is thought that probably originally the limestone extended across the position of the fold. That this was the case seems probable because of its actual occurrence at present in places between the St. Peter sandstone and coal No. 2 near the axis of the anticline. The convergence of the lines of deposition of the Maquoketa on the Galena-Trenton and the Trenton on the St. Peter indicates a trunca-

tion of the limestone by erosion to a flat surface, upon which the shale was locally deposited. The convergence of these two lines of deposition seems reasonable proof that the age of the chief fold can be placed as post-Galena and pre-Maquoketa, or about contemporaneous with the formation of the Cincinnati arch. The displacement at the time amounted to about 1,000 feet.<sup>1</sup>

---