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BULLETIN No. 10.
Prepared in Co-operation with the State Water Survey

The Mineral Content of Illinois Waters

BY

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STATE GEOLOGICAL SURVEY,

UNIVERSITY OF ILLINOIS, Oct. 1, 1908.

Governor C. S. Deneen, Chairman, and Members of the Geological Commission:

GENTLEMEN—I submit herewith material for a report upon the mineral content of Illinois waters, and recommend that it be published as Bulletin 10. This report has been prepared in coöperation with the State Water Survey under the direction of Dr. Edward Bartow, director of that organization and consulting chemist in charge of water investigations for the Geological Survey. Dr. Bartow has personally prepared a number of chapters in the report. The tables of analyses have been compiled under his direction from the records of the State Water Survey. Dr. J. A. Udden of Augustana College and the State Geological Survey, has prepared a chapter on the geological classification of the waters of Illinois and Professor S. W. Parr, one on water for boilers and for other industrial uses. Dr. George Thomas Palmer, M. D., editor of the *Chicago Clinic and Pure Water Journal*, has prepared the chapter on the Medicinal Springs of Illinois. The Geological Survey is under great obligations to these gentlemen for their assistance, and particularly to Dr. Bartow for the cordial coöperation between the two surveys which he has made possible. This report will be published also by the State Water Survey, forming Bulletin 4 of the water survey series.

The report as a whole is to be considered as essentially preliminary and is designed to place in the hands of the citizens of the State accurate analyses of water from the different Geological horizons and Geographical districts. To aid in the use of these tables the brief special discussions already noted have been prepared. It is planned to follow this bulletin with special studies of the water resources of the particular areas so far as these resources are dependent upon geological conditions. One such report, the water resources of the East St. Louis district,[1] a brief preliminary statement regarding the water resources of the Springfield area,[2] and a paper on the artesian wells in Peoria and vicinity[3] have already been published. A general report upon the underground structure of the State as related to artesian and other waters is planned, and Dr. J. A. Udden is accumulating material for it.

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1 State Geol. Survey Bull. No. 5, Water Resources of the East St. Louis District; by Isaiah Bowman and C. A. Reeds.

2 Water Resources of the Springfield Quadrangle; by T. E. Savage, State Geol. Survey, Bull. 4, pp. 235-244.

3 Udden, J. A. Year Book for 1907. State Geol. Survey, Bull. No. 9, pp. 315-334.

In the meantime the services of the two Surveys have been frequently called into requisition by cities, towns, railways and manufacturers desiring to secure better or larger water supplies. In a number of instances it has been possible to make positive recommendations which have been followed with good results. In other cases our present data have proven too incomplete to permit of a certain answer to the questions raised. It is proposed to continue the work with a view to giving progressively better service as the records become more complete. It is believed that there are few, if any, more important lines of inquiry demanding attention. Questions of water supply are so important, not only as relates to the industrial activity of an area but also to the health of the people and even the very existence of a community, that they warrant much more exhaustive studies than are possible with the resources now available. It is to be hoped that more money may be made available for this work.

Very respectfully,

H. Foster Bain,

Director.

THE MINERAL CONTENT OF ILLINOIS WATERS

INTRODUCTION

[BY EDWARD BARTOW.]

HISTORICAL STATEMENT.

The State Water Survey of Illinois began the investigation of the waters of the State in 1895. While the Survey has laid special stress on the determination of the character of the waters from a sanitary standpoint, it has also often been called upon to make analyses of the mineral content to determine its character from a medicinal or commercial standpoint. In the various reports so far issued by the Survey only results of the sanitary investigations were published. It had been the intention to publish the results of the mineral analyses in a previous report[1] but this had to be postponed until the present time when, in co-operation with the Geological Survey, it has become possible. This Bulletin, primarily, contains the records of the analyses made to determine the composition of the mineral residue with reference to the value of the water for manufacturing and medicinal uses, but there are also included the sanitary analyses, wherever such analyses have been made.

Owing to lack of funds the Survey has not been able to do systematic collecting. The samples examined have been sent by parties who desired to know something of either the commercial or medicinal value of some special water. Though many times, when requested to make only the sanitary examination of a water, that could be considered as typical of a section of the State or of a geological stratum, the Survey has also made an examination of the mineral content. Since the foundation of the Survey in 1895 to December 31, 1905, though it has not been possible to collect samples systematically, 547 analyses have been made to determine the composition of the mineral residue. These waters have come from 269 cities and towns distributed over 90 counties, leaving only 12 counties from which no specimens have been analyzed.

The samples sent to the Survey have usually been sent with a request for information regarding the potability, medicinal value, the suitability for use in boilers, or the suitability for manufacturing purposes. In all

[1] "Chemical Survey of the Waters of Illinois," pp. 3 and 6.

cases a report has been made to the party sending the water, and when desired an opinion has been given with respect to its suitability for the special purpose designated by the sender. As a rule, when an opinion regarding the medicinal effect has been desired, the Survey has suggested that the report of the analysis be referred to a competent physician for an opinion. The special opinions concerning each water are not given in this report, but there are given briefly general interpretations of results from a sanitary, medicinal, and industrial standpoint.

The analyses have been arranged in alphabetical order according to the cities and towns. This arrangement will enable those wishing to know the composition of the mineral matters contained in waters from a certain city or town, to easily obtain the information desired, or to learn whether an analysis of the water in question has been made by the State Water Survey. We have also included in the report a county list, showing the number and location of the waters analyzed in each county, in order to facilitate the comparison of the waters of a given section. Again, we have arranged tables of distribution, showing the source of each sample; whether from river, spring, shallow well, or deep well in rock or in drift. This will facilitate comparison of waters of similar origin, or from similar geological horizons.

The methods of analysis published in this Bulletin have been used throughout the greater part of the existence of the Water Survey. While modifications have been made from time to time, in general, the methods given have been followed. Many of the methods are those recommended by the American Public Health Association. When such is not the case it is our purpose as soon as possible to adopt their recommendations, especially with reference to sanitary work.

The analyses were made under the direction of the late Professor A. W. Palmer, until his death in February, 1904. Professor S. W. Parr was director from February, 1904, to September, 1905, when the present director took charge of the work. The analyses have been made by members of the Water Survey staff and the initials accompanying each analysis indicate the analyst. The following men have done this analytical work for the Survey:

Perry Barker, Arthur Donaldson Emmett, Arthur Russell Johnston, David Klein, Justa Morris Lindgren, Albert LeRoy Marsh, Arthur William Palmer, Carleton Raymond Rose, Robert Watt Stark.

Mr. C. V. Miller has made many of the sanitary examinations.

Distribution of Waters Analyzed.

GEOGRAPHICAL.

The various samples of water which have been sent to the Water Survey since its foundation, aggregating a total number of 13,873 to December 31, 1905, have come from 590 towns in 100 counties. Since practically all of these waters have been sent to the laboratory by citizens or city officials such a distribution shows the widespread demand for the work. The samples, which have been analyzed to determine the composition of the mineral residue, aggregating a total number of 547, have been sent from 269 towns in 90 counties. This distribution seems remarkable since it has been possible for the State Water Survey to influence the points of collection only in a very small degree. The only counties from which no samples have been received for analysis of the mineral content are Carroll, Clay, Crawford, Cumberland, Edwards, Franklin, Grundy, Hamilton, Hardin, Massac, Monroe and Moultrie.

The following table shows the distribution of mineral analyses by counties and towns, and will serve as a guide for the comparison of the quality of water in certain sections of the country.

MINERAL ANALYSES BY COUNTIES.

ADAMS—
Camp Point,
Clayton,
Mendon,
Payson, (see Quincy),
Quincy.

ALEXANDER—
Cairo.

BOND—
Greenville.

BOONE—
Belvidere,

BROWN—
Mt. Sterling,
Ripley.

BUREAU—
Bureau,
La Moille,
Malden,
Marquette,
Milo,
Neponset,
Spring Valley,
Walnut.

CALHOUN—
Kampsville.

CASS—
Arenzville,
Ashland,
Chandlersville,

CHAMPAIGN—
Champaign,
Rantoul,
Tolono,
Urbana,

CHRISTIAN—
Assumption,
Pana,
Rosemond.

CLARK—
Marshall.

CLINTON—
Carlyle.

COLES—
Mattoon.

COOK—
Berwyn,
Chicago,
Evanston,
Forest Glen,
Hyde Park,
Kensington,
Maywood,
Morgan Park,
North Chicago,
Oak Park,
Palatine,
Riverside,
West Chicago,
Winnetka.

DEKALB—
DeKalb.

DEWITT—
Clinton,
DeWitt,
Farmer City.

DOUGLAS—
Newman,
Tuscola.

DUPAGE—
Elmhurst,
Glen Ellyn,
Hinsdale,
Warrenville,
Winfield.

EDGAR—
Chrisman,
Dudley,
Paris.

EFFINGHAM—
Altamont.

FAYETTE—
Vandalia.

FORD—
Paxton,
Piper City.

FULTON—
Astoria,
Canton,
Brereton,
Farmington,
Ipava,
Lewistown,
London Mills,
Vermont.

GALLATIN—
Omaha,
Shawneetown.

GREENE—
Carrollton.

HANCOCK—
Augusta,
Hamilton,
La Harpe,
Niota.

HENDERSON—
Oquawka,
Stronghurst.

HENRY—
Cambridge,
Geneseo,
Kewanee,
Woodhull.

IROQUOIS—
Ashkum,
Gilman,
Loda,
Onargo,
Sheldon.

JACKSON—
Carbondale,
Makanda,
Murphysboro,
Neunert.

JASPER—
Bell Air.

JEFFERSON—
Mt. Vernon.

JERSEY—
Grafton,
Jerseyville.

JO DAVIESS—
Apple River,
Stockton,
Warren,
Woodbine.

JOHNSON—
New Burnside.

KANE—
Aurora,
Batavia,
Carpentersville,
Dundee,
Elgin,
Montgomery,
South Elgin,
St. Charles.

KANKAKEE—
Grant Park,
Kankakee,
Momence,
St. Ann.

KENDALL—
Bristol Station,
Plano.

KNOX—
Abingdon,
Galesburg,
Knoxville,
Maquon.

LAKE—
Deerfield,
Everett,
Fort Hill,
Highland Park,
Lake Bluff,
Lake Forrest,
Libertyville,
Russell,
Waukegan.

LASALLE—
LaSalle,
Marseilles,
Ottawa,
Peru,
Streator,
Tonica,
Waltham.

LAWRENCE—
Sumner.

LEE—
Amboy,
Dixon,
Franklin Grove,
Paw Paw.

Mineral Analyses by Counties—Concluded.

LIVINGSTON—
Dwight,
Fairbury,
Flanagan,
Forest,
Manville,
Odell,
Pontiac.

LOGAN—
Atlanta,
Elkhart,
Mt. Pulaski.

MADISON—
Godfrey,
Highland,
Poag,
Alton,
Collinsville.

MACON—
Decatur.

MACOUPIN—
Staunton.

MARION—
Centralia,
Kell,
Kinmundy,
Omega,
Salem.

MARSHALL—
Wenona.

MASON—
Havana.

McDONOUGH—
Bushnell,
Chester,
Colchester,
Eldorado Twp.,
Tennessee,
Macomb.

McHENRY—
Algonquin,
Crystal Lake,
McHenry,
Woodstock.

McLEAN—
Bloomington,
Cooksville,
Downs,
Gridley,
Normal,
Lexington.

MENARD—
Petersburg,
Tallula.

MERCER—
Aledo.

MONTGOMERY—
Hillsboro.

MORGAN—
Jacksonville,
Markham,
Pisgah,
Waverly.

OGLE—
Byron,
Mt. Morris,
Oregon,
Polo,
Rochelle.

PEORIA—
Averyville,
Chillicothe,
Glasford,
Mapleton,
Peoria,
So. Bartonville.

PERRY—
Cutler,
DuQuoin,
Tamaora.

PIATT—
Atwood,
Bement,
Cerro Gordo.

PIKE—
Milton.

PULASKI—
Mound City,
Pulaski,
Villa Ridge.

PUTNAM—
Granville,
Hennepin.

RANDOLPH—
Menard,
Red Bud.

RICHLAND—
Claremont,
Olney,
Parkersburg.

ROCK ISLAND—
E. Moline,
Milan,
Rock Island,

SALINE—
Carrier's Mills,
Harrisburg,
Stone Fort.

SCHUYLER—
Camden,
Huntsville,
Rushville.

SANGAMON—
Springfield.

SCOTT—
Bluffs,
Brushy,
Winchester.

SHELBY—
Middlesworth,
Moweaqua,
Oconee,
Shelbyville.

ST. CLAIR—
Belleville,
E. St. Louis.

STARK—
Bradford,
Wyoming.

STEPHENSON—
Freeport,
Lena.

TAZEWELL—
Pekin.

UNION—
Alto Pass,
Cobden.

VERMILION—
Danville,
Hoopeston,
Hope,
Oakwood,
Sidell.

WABASH—
Keensburg.

WAYNE—
Cisne,
Fairfield.

WARREN—
Roseville.

WASHINGTON—
Richview.

WHITE—
CARMI—
Mill Shoals.

WHITESIDE—
Morrison,
Sterling.

WILL—
Joliet,
Peotone,
Plainfield,
Romeoville,
Wilmington.

WILLIAMSON—
Creal Springs.

WINNEBAGO—
Rockford.

WOODFORD—
Eureka,
Minonk,
Roanoke.

ACCORDING TO SOURCE.

The water supplies of Illinois are derived from three general sources:

1. Surface waters, including rivers, lakes and ponds.
2. Waters from shallow wells and springs.
3. Waters from deep wells.

In order to facilitate the comparison of waters from similar sources we have inserted tables classifying each water according to the character of its source:

Source of Water.	Number of Analyses Made.
Surface waters	32
Shallow wells and springs.	
Springs	131
Dug wells	47
Driven wells	10
Deep wells.	
Flowing wells in drift	16
Deep drift wells, not flowing	62
Deep wells in rock, flowing	68
Deep wells in rock, not flowing	191
Total	547

The number of samples of water of each division analyzed, does not represent in any way the relative amount of each class of water used in the State. Surface waters serve by far the greatest number of people, including as they do, Lake Michigan and the Mississippi river. In fact the majority of the cities containing more than 10,000 inhabitants, obtain their water supply, as a whole, or in part, from streams. Deep rock wells serve the next greatest number, followed by the deep drift wells.

TOWNS FROM WHICH SURFACE WATER HAS BEEN ANALYZED.

Apple River,	Aurora,	Averyville,	Belleville,
Cairo,	Champaign,	Chicago (2),	Danville,
East St. Louis,	Elgin,	Farmington,	Galesburg,
Grafton (2),	Havana (3),	Kankakee (3),	Kensington,
Lewistown,	Paris,	Pekin,	Peoria,
Rockford (3),	Rock Island,	So. Bartonville,	Streator.

TOWNS FROM WHICH WATER FROM SPRINGS HAS BEEN ANALYZED.

Abingdon (3),	Alto Pass,	Ashland,	Belleville,
Bloomington,	Canton,	Carlock,	Carlyle,
Carrollton (2),	Centralia (2),	Cerro Gordo,	Claremont (2),
Clinton (4),	Cobden (2),	Colchester,	Cooksville,
Creal Springs,	Crystal Lake,	Cutler,	Danville,
Decatur,	DeWitt,	Dixon,	DuQuoin,
Elgin (3),	Elkhart,	Elmhurst,	Fairbury,
Franklin Grove,	Freeport,	Galesburg,	Geneseo,
Glasford,	Godfrey,	Grafton,	Granville,
Hamilton,	Hoopeston,	Huntsville,	Jacksonville (8),
Kewanee,	Kinmundy,	Knoxville,	LaSalle (2),
Lewistown,	Lexington,	Libertyville,	London Mills,
Makanda (4),	Manville,	Maquon,	Markham,
Marquette,	Marshall,	Mattoon,	Menard,
Middlesworth (3),	Mill Shoals,	Mossville,	Mt. Vernon (2),
Murphysboro,	Niota,	Oconee (3),	Odell,
Ottawa (2),	Peoria (4),	Pisgah,	Plano,
Pulaski,	Quincy (2),	Ripley,	Rochelle (2),
Rock Island (2),	Rosemond,	Salem,	Shawneetown,
Sidell,	Springfield (2),	Sterling (3),	Sumner,
Tallula,	Tennessee,	Tolono,	Vandalia (6),
Waukegan,	Wilmington,	Winchester (2),	Wyoming.

TOWNS FROM WHICH WATER FROM DRIVEN WELLS LESS THAN 50 FEET DEEP HAS BEEN ANALYZED.

Carpentersville,	Chillicothe,	Herrin,	Lewistown,
Marshall,	Mt. Pulaski,	Russell,	Shelbyville.
Urbana (2),			

TOWNS FROM WHICH WATER FROM DUG WELLS HAS BEEN ANALYZED.

Assumption,	Bloomington,	Bushnell,	Camden,
Cerro Gordo,	Chrisman,	Clayton,	Creal Springs (3),
DuQuoin,	Farmington,	Forrest,	Grafton,
Greenville,	Gridley (2),	Hillsboro,	La Harpe,
LaMoille,	Macomb,	Mapleton,	Milton,
Morgan Park,	Mt. Vernon,	Neunert,	Olney,
Oquawka,	Pana,	Piper City (2),	Richview,
Springfield,	Urbana (2),	Villa Ridge,	Waverly.

TOWNS FROM WHICH WATER FROM FLOWING WELLS IN DRIFT HAS BEEN ANALYZED.

Ashland,	Bell Air,	Clinton,	Gilman (2),
Newman (2),	Lexington,	Libertyville (2),	McHenry,
Roanoke,	Oakwood,	Palatine,	Paris (2).

TOWNS FROM WHICH WATER FROM DEEP DRIFT WELLS HAS BEEN ANALYZED.

Algonquin,	Alton,	Atlanta (2),	Atwood (2),
Averyville,	Bluffs,	Bristol Station,	Champaign,
Clinton (2),	Collinsville,	Downs,	Dwight (2),
Eureka,	Everett,	E. St. Louis (2),	Farmer City,
Flanagan,	Fort Hill,	Havana (2),	Hennepin,
Hoopeston,	Hope,	Kinmundy,	Lock Haven,
Loda,	Macomb,	Marshall,	Mattoon (2),
Milo,	Normal (2),	Omega,	Onarga (4),
Paxton (3),	Peoria (6),	Poag,	Rantoul,
Rockford,	Strawn,	Tolono (2),	Urbana (4).

TOWNS FROM WHICH WATER FROM FLOWING WELLS IN ROCK HAS BEEN ANALYZED.

Algonquin,	Amboy,	Arenzville,	Aurora (3),
Batavia,	Belvidere,	Bristol Station,	Bureau,
Cairo (7),	Carbondale,	Carlyle,	East Moline,
Elgin (2),	Evanston,	Fairfield,	Gilman,
Hamilton,	Hennepin,	Highland Park (2)	Hillsboro,
Hyde Park,	Jacksonville (3),	Joliet,	Lake Forest,
LaSalle,	Lewistown,	Marseilles,	Milan,
Montgomery (3),	Mound City (4),	Oak Park,	Omaha,
Oregon,	Ottawa (3),	Palestine,	Paris,
Peoria (2),	Peru,	Petersburg,	Quincy (2),
Roanoke,	Rock Island,	So. Elgin,	Spring Valley.
Sterling (2),	Warrenville,		

TOWNS FROM WHICH WATER FROM DEEP WELLS IN ROCK HAS BEEN ANALYZED.

Abingdon,	Aledo,	Altamont (2),	Ashkum,
Astoria,	Aurora,	Batavia (2),	Belleville,
Bement,	Blackstone,	Bradford,	Brereton,
Berwyn,	Bushnell,	Byron (2),	Cambridge,
Brushy,	Canton,	Carbondale (2),	Carmi,
Camp Point,	Carrier Mills,	Carrollton (2),	Chandlersville (2),
Carpentersville,	Chrisman,	Cisne,	Collinsville (2),
Chicago (4),	DeKalb (2),	Dundee,	DuQuoin,
Deerfield,	Eldorado Twp.,	Elgin (2),	Everett,
Dwight,	Forest Glen (2),	Galesburg (3),	Gilman,
Fairfield,	Grant Park,	Harrisburg (7),	Highland,
Glen Ellyn,	Kampsville,	Ipava (2),	Jerseyville (2),
Hinsdale,	Kewanee (6),	Kankakee (4),	Keensburg,
Joliet (4),	La Moille,	Knoxville (3),	Lake Bluff (2),
Kell,	Marion (2),	Lena (2),	Macomb (3),
Lake Forest (4),	Momence,	Maywood,	Mendon,
Malden,	Mt. Sterling (3),	Morrison,	Moweaqua,
Minonk,	North Chicago,	Mt. Vernon,	Neponset,
Mt. Morris,	Paw Paw,	Odell,	Paris (2),
New Burnside,	Payson (see Quin-	Peoria (3),	Peotone,
Parkersburg,	cy),	Pontiac (2),	Quincy (3),
Plainfield,	Polo (2),	Robinson,	Rochelle,
Red Bed,	Riverside (2),	Roseville (2),	Rushville,
Rockford (3),	Romeoville,	Sheldon,	South Elgin (2),
Russell,	Shawneetown,	St. Charles (3),	Stockton,
Sparta,	Staunton,	Stronghurst,	Tamaroa,
Stone Fort (2),	Streator (6),	Vermont,	Waltham Twp.,
Tonica,	Tuscola (2),	West Chicago (2),	Wilmington,
Warren,	Wenona,	Woodbine (2),	Woodhull (2).
Winfield,	Winnetka,		
Woodstock,	Wyoming (3),		

GEOLOGICAL CLASSIFICATION OF THE WATERS OF ILLINOIS.

[By J. A. Udden.]

Source of the Ground Water.

Primarily the source of all the waters of the State is the rainfall in the Mississippi valley. For the northern part of the State this is equal to a layer nearly thirty-four inches in thickness, for the middle part of the State it is a little more than thirty-six and a half inches, and for the southern part of the State it is almost forty-one inches, averaging annually for the entire State, during the time it has been observed, 36.59 inches. A large part of this water is lost by evaporation, especially during the warmer months. Some twenty per cent of the total rainfall is drained away by the streams. The remainder enters the ground and slowly sinks, either to reappear on the surface as springs at other places, or to slowly seep under its own pressure in the direction of least resistance. The run off in the basin of the Illinois river is estimated at eight inches for the year. It can hardly be less than this for other parts of the State.

Recent Lowering of the Head of the Ground Water.

It is clear that great changes in the run-off have taken place since the first settling of this country more than fifty years ago. The drainage is at the present time more perfect, and hence much more prompt, than it was at the time when the original vegetation still covered the native prairies. This vegetation retained the water of the heavy showers during summer. At the present time such showers more frequently than before cause the gullies and creeks to overrun their banks. The best evidence of this greater run-off at the present day is to be seen in the recent deepening of many channels of the smaller streams, and in the universal appearance of gullies on upland slopes, which were originally even and smooth. The same change is also to be noted in the disappearance of shallow surface ponds, which in the days of the early settlements seldom failed to form on the level uplands during the months of greatest rainfall in the spring and early summer. Another cause for this change is the construction of drained wagon roads and drainage ditches made for the reclamation of lowlands. Whether the loss of water by evaporation has been increased or diminished by this same change incident to the immigration of the present inhabitants, it is difficult to say. On the one hand the cover afforded the ground by the native vegetation would appear to have retarded evaporation, but on the other hand this protection may have been counter-balanced by a still greater increase of evaporation from a luxurious foliage. On the whole, evaporation is probably greater now than before, and this increase is very likely greater in the southern part of the State than in the northern.

With an undoubted augmentation of the run-off and with a probable increase in the amount of water evaporated, the general lowering of the level of the ground water is easily accounted for. A sinking of this level is everywhere conspicuous. The first settlers on the prairies invariably found a sufficient quantity of water in shallow surface wells. Springs were everywhere more common than at the present day. With the lowering of the level of the ground water many of these springs have run dry. The shallow wells have mostly either been deepened or they have become useless, and at the present time the average depth of the country wells will exceed that of the wells of the early days by at least twenty feet.

The Water-Bearing Formations.

The water which enters the ground and seeps in the direction of least resistance enters the successive formations and sinks to unknown depths. Through the more pervious strata the percolation is most rapid. Even the most compact rocks allow some seeping, although it goes on at an exceedingly slow rate. In clays and shales the seeping proceeds so slowly that a sufficient quantity of water can never be obtained from these strata. Sandstone and some limestone allows the water a more free passage, and such strata furnish the waters in all of our deep wells. These rocks constitute our true water-bearing formations.

The Potsdam Sandstone.

The lowest formation furnishing water in this State is the Potsdam sandstone. This is a formation to the Cambrian age, and it underlies all the other sedimentary rocks of the State. The Potsdam sandstone does not come to the surface anywhere in this State, but it outcrops in the central part of Wisconsin, where it forms a crescent shaped area beginning on the Menominee river on the east, extending southward to Madison and Prairie Du Chien and from there northwest to the region of the St. Croix river. The average elevation of the land in this area of outcrop, is about 1,000 feet above the sea level, or a little more than 200 feet above the average elevation of the northern part of the State of Illinois. We may consider this region as the intake area of the Potsdam sandstone, for it is evident that the water yielded by the formation further south enters it in this territory and follows it under the ground in its course southward and downward. In the state of Wisconsin the Cambrian formation has a thickness of 1.000 feet, and it probably maintains this under the greater part of Illinois. The materials of which it is composed consist of sandstone and sandy shale, frequently of reddish color, and there are also some strata of calcareous rocks. In the well made at Lockport, the following section of strata belonging to this horizon has been observed, beginning at a depth of about 1,250 feet.

POTSDAM SANDSTONE AT LOCKPORT.

	Feet.
Sandstone	75
Sandy shale	220
Shale	35
Shale and red marl	230
Sandstone	51
Total	686

Another section was penetrated by a well made by the Joliet Steel Mills and this was as below:

SECTION OF THE POTSDAM ROCK IN THE WELL OF THE JOLIET STEEL MILL.

	Feet.
Sharp sandstone	175
Blue shale	50
Shaly limestone	125
Shale	230
Total	580

In the western part of the State this formation has been entered by some wells in Rock Island and at Aledo. In the Rock Island well, the Potsdam section was penetrated only to the depth of some 370 feet, and the section is given as follows:

SECTION OF THE POTSDAM ROCK IN THE MITCHELL & LYNDE WELL, ROCK ISLAND.

	Feet.
Compact sandstone and shale	30
Sandy limestone	35
Sandstone	130
Shaly limestone and shale	75
Sandstone	97
Total	367

The formation was entered at a depth of about 1940 feet.

From these figures it is clear that this formation dips to the south at the rate of about ten or twelve feet to the mile. In the southern half of the State it is practically out of reach, except for a small area in Calhoun and Jersey counties where, by an abrupt fold, it is brought nearer to the surface, and for a tract extending in a northwest-southeast direction through La Salle and Livingston counties where another fold elevates all the formations lying on the east side.

The head of the Potsdam water is higher than that of any other artesian flow in the region. Drillers usually figure that it will flow forty feet higher than the water from the St. Peter sandstone. But the head is not every where the same. It varies as much as 100 feet for different parts of the State. Even in limited areas slight variations are noted. Thus in the eastern part of the State, it rises to an elevation of 595 feet above the sea in the Consumers' Ice Company Well in Chicago, while in the Oak Park waterworks, it rises to 610 feet, and in the Riverside waterworks its head is reported as 596 feet. In the western part of the State, the head approaches a level of 650 feet at Geneseo, while in Catlin's well at Ottawa it rises to 705 feet. The elevation of the head at Minooka is 660 feet. It is believed that the head of this water in the wells of the western part of the State would reach a level of 700 feet, if the wells were properly cased, so as to prevent the Potsdam water from entering the overlying formations. The formation being deep as well as extensive, and having a large area of exposure to the north, its water contents far exceeds the capacity of the wells so far sunk into it.

The water is somewhat salty, but is pure enough for use in the northern part of the State. In the deeper wells the quantity of salt increases. For this reason some of the wells entering the formation do not extend very far into it. In one instance the deepening of a well 100 feet rendered the water undesirable on account of its increased saltiness. In this case the well was saved by shutting off the flow from the lower part, the yield from the unner part of the formation being sufficient for the purpose desired. It would thus appear that the saltiness increases with the depth in one and the same stratum, and this has been exnlained as being due to the specific gravity of the material dissolved.

The Lower Magnesian Limestone.

The Lower Magnesian limestone is the next higher horizon which has been found to yield water. Though this formation is known as a limestone, it is in some places to a considerable extent made up of sandy strata. It varies in thickness from about 400 feet in the eastern part of the State to 800 feet along the Mississippi river. The main area of outcrop of this formation is likewise in the state of Wisconsin, but it also has a small exposure on the Illinois river east of La Salle. In the eastern part of the State it is apparently replaced by considerable amounts of shaly material, with which are associated some sand and some calcareous layers, but in western wells it consists largely of limestone and sandstone and the latter yields considerable amounts of water. This difference in the composition of the formation is well illustrated by the following two sections:

Section of the Lower Magnesian Rocks in the Lockport Well.

	Feet.
Limestone	12
Red marl	33
Sandy limestone	20
Green shale	330
Total	395

Section of the Lower Magnesian Formation in the Well at Rock Island.

	Feet.
Limestone with some strata of sand	811

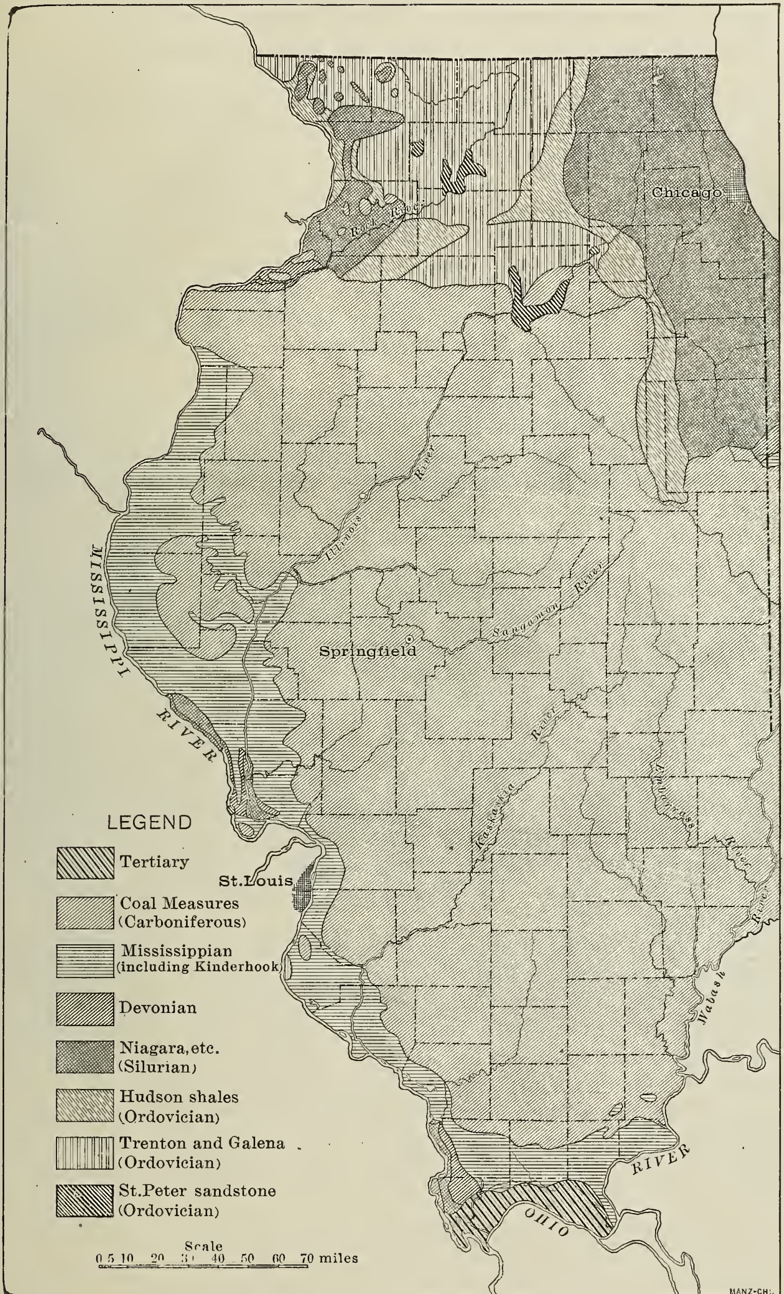
The water supplied by this limestone is as a rule more free from impurities than that of other deep waters in the State. It supplies a great number of the wells in the city of Ottawa and in the surrounding country. West of La Salle this formation lies at the depth of about 1800 feet, but it gradually rises toward the Mississippi. It contains no single well marked horizon of water, but the supply is irregularly distributed through its thickness in sandy strata. In the western part of the State where the formation consists mainly of lime, the flow is not very marked, and no wells have been made which rely upon its flow, except in the city of Princeton. The flow is nowhere very strong, and the quantity is more limited than that of either the Potsdam or the St. Peters sandstones.

The St. Peters Sandstone.

Owing to the moderate depth at which it can be reached, the St. Peters sandstone has been more often tapped by deep wells than any other rock in the State. This formation is not as thick as the water-bearing strata which have just been described, but its development is uniform, and geographically it is very extensive, underlying wide areas in Wisconsin, Indiana, Illinois, Minnesota, Iowa, and Missouri. It is a very pure sandstone, consisting of well rounded quartz grains, moderately coarse. For the most part it is destitute of any cement material between the grains, and this renders its texture open and gives it a great capacity for holding water, which is freely yielded when the rock is tapped. It overlies the Lower Magnesian limestone from which it is often separated by several feet of varicolored clays. In thickness it varies from 100 to more than 200 feet, as may be seen in the following records of wells made along the line across the State from Rock Island to Chicago.

Thickness of the St. Peters Sandstone in the Northern Part of the State.

	Feet.
Rock Island	145
Moline	216
Milan	195
East Moline	220
Geneseo	220
Princeton	116
LaSalle	175
Ottawa	130
Marseilles	200
Peddicord's well, near Marseilles	275
Seneca	220
Joliet	200
Lockport	210
Blue Island	115
Chicago Heights	200
Union Stock Yards	155
Goose Island	60



Geological map of Illinois. (After Leverett by courtesy of the U. S. Geological Survey.)

In the western part of the State, the St. Peters sandstone some times includes a shaly stratum near its middle portion, and in most places the formation is overlain by a dark clay which occasionally is slightly oily.

The principal intake area of this formation is in southern Wisconsin, in the southeast part of Minnesota, and in some limited localities in this State. It comes to the surface in the south central part of La Salle county in the Illinois river valley and in the valley of Rock river in Ogle county. Another small outcrop has been found on the Mississippi river in Calhoun county. At all of these points it has been elevated by the folding already spoken of as effecting the Lower Magnesian and the Potsdam formations. Elsewhere it is covered by later sediments, but its position and the depths at which it may be found bv drilling are fairly well known from explorations which have been made in the northern two-thirds of the State.

In his report[1] on the water resources in Illinois, Mr. Frank Leverett, presents a map in which the position of the St. Peters sandstone is indicated for the entire State. According to this map it lies mainly above the level of the sea in a triangular area extending from the northern boundary of the State and converging to a point near the center of Livingston county. Over this tract it is hence within a distance of about 800 feet below the surface of the ground, rising toward the north and northwest and sinking in the opposite direction. In the two or three tiers of counties which lie nearest the Mississippi river from Clinton, Ia., to Quincy, and in the country between the Illinois and the Mississippi south of this latter place, it lies mainly within 500 feet below the level of the sea, dipping to the southeast. It is hence encountered at depths of from 1200 to 1400 feet. In about the same position it is also found under a belt of land some fifty miles wide, extending from Highland Park past Chicago and Kankakee to Urbana, and in the proximity of the Mississippi and the Ohio rivers along the southern boundary of the State. Under the remaining large tract in the south and the south central part of the State the St. Peters sandstone probably lies more than 500 feet below the sea. Its actual position is less accurately known for this region.

The quality of the St. Peters water is good. In some wells it has been found to be somewhat sulphurous, probably from the presence of iron sulphides in the overlying shale, but it is usually not salty, except at some points in the southern part of the State. The supply is quite copious, but it has been noticed that in some places where many wells draw water from this source, its head has been slightly lowered.

The head of the water in the St. Peters sandstone approaches, on the Rock Island and Chicago section, 600 feet above sea level. But it varies considerably, and rises somewhat with an increasing elevation of the land, as may be seen from the following table:

[1] U. S. Geological Survey, 17th Annual Report, p. 2.

Head of the St. Peters Water.

	Feet.
Barry	625
Chicago, Stock Yards well	590
Chicago, Morgan Park water works	595
Chicago, Harvey water works	593
Galesburg	635
Lake Forest	700
Lemont	656
Marseilles	500
Mendota	700
Milan	634
Moline, paper mills	646
Moline, Prospect Park	636
East Moline	615
Rock Island, Atlantic brewery	647
Rock Island, Mitchell & Lynde	·644
Wilmington	586
Wilmington	600

At De Kalb the head of this water is considerably above that in the wells enumerated in the foregoing table, and it ranges from 772 to 844 feet above the sea. At Elgin the St. Peter water rises to 740 feet.

The Trenton-Galena Formation.

Many wells have been made which draw their water from some part of the 400 feet of limestone overlying the St. Peters sandstone. Usually this water is found in a horizon at about 250 feet above the St. Peters sandstone, but in many instances it has been reached as much as one hundred feet higher up than this, and sometimes it is found considerably deeper than the middle of the formation. This water is not confined to any regular stratum but evidently follows joints and cavernous passages in the rock. The lower one hundred feet of the formation, which is usually spoken of as the Trenton limestone in a restricted sense, is a calcareous, thinly bedded, and somewhat clayey limestone, and it is not as open in texture as the upper part of the formation. This is nowhere known to have yielded any water. The water bearing rock, which is limited to the upper three hundred feet, is a magnesian limestone of more porous texture. Its flow is frequently as strong as that of the St. Peters water, and its head seems to be about the same. But this water is often found to be highly charged with hydrogen sulphide, and this circumstance sometimes renders it disagreeable to the taste and limits its use as a potable water.

Head of the Trenton-Galena Water.

	Feet.
Carbon Cliff	675
Chicago	690
Rock Island	645

As this water-bearing horizon lies above the St. Peters rock it is not always necessary to go down to the latter formation in order to secure a good well. This is especially true for the western part of the State, where it has been encountered at depths varying from five hundred to a thousand feet. As these two formations are conformable, the dip for both is the same, the upper rock following the lower in the folds and dips which have already been described.

The Niagara Limestone.

The Trenton-Galena limestone is overlain by the Cincinnati shale, which forms an impervious cover, confining the water below it. There are some sandy layers in this shale, but it is nowhere known to have furnished any water. It appears to be everywhere barren in this respect. It is in turn capped by the Niagara limestone, which is about 400 feet in thickness in the northern part of the State, and somewhat less than this farther south. The upper two hundred feet of this limestone is of a porous and open texture and frequently furnishes abundant water. It is exposed to the surface and underlies the drift in a crescentic belt on the east side of the Mississippi river from Jo Daviess county to the rapids above Rock Island. It also underlies the drift over a more extended belt in the northeast corner of the State, covering the greater part of McHenry county, all of Lake county, and extends along the west border of Lake Michigan as far as Kankakee river. Three small areas occur in the western part of Union and Alexander counties. In all of these localities wells measuring from fifty to two hundred feet are sunk into this limestone. The formation is probably continuous under most of that part of the State which is south of Green river, and it can be reached at depths varying from two hundred to one thousand feet, but it is not believed that many of the deep wells made in his region are supplied from this formation. At Carthage a water bed is reported at 750 feet, which probably belongs in the Niagara, and at Fort Màdison, Iowa it is reported at from 610 to 687 feet. At Hamilton, Hancock county, Illinois, it is reported at 653 feet. At Peru, Illinois in the Zinc Company well, it was found at the depth of 750 feet and furnished some water. The quality of the water from this horizon appears to be somewhat variable and is often too salty for general use. As the area of outcrop of this limestone occurs in regions which are no higher than the general level of the State, the head of this water is low and it flows only when tapped in the lowest valleys. But the yield is abundant and a great number of pumped wells take their supply from this formation where it is the country rock and lies at a small depth under the drift.

The Devonian Strata.

The Devonian rocks have a limited extent in this State, not fully known. They underlie at least a part of the rocks of the Carboniferous age and outcrop at the surface over an area which perhaps does not exceed 300 square miles in Rock Island, Calhoun, Union, and Alexander counties. The Devonian is unimportant as a water bearing formation, but it is believed to be the source of a flow which was encountered at a depth of 350 feet in a well at Beardstown.

The Mississippian or Lower Carboniferous Rocks.

The Mississippian or Lower Carboniferous rocks overlie the Devonian beds in the southern two-thirds of the State. They consist mostly of limestone with sandy strata and the latter are the chief source of water in this formation. But these water bearing strata have few places of outcrop at the surface and hence their intake area is very limited. Two wells at Redbud and one well at Sparta are reported to draw their supply from this source, but this rock must otherwise be regarded as of comparatively little importance so far as it has been explored for water.

The Coal Measures.

The fact that the southern two-thirds of the State are underlain by the Coal Measures is a most significant circumstance relative to the quality and quantity of our water supply. These deposits consist largely of shale with alternating limestones and sandstones and with seams of coal. The impervious shaly material probably makes up four-fifths of the entire formation, and for this reason much of the country underlain by the Coal Measures is unprofitable to the prospector for water. The limestones are mostly quite compact and impervious so as not to readily yield to the solvent action of the percolating water. Reliance must be placed on the sandstones only. But these are frequently associated with carbonaceous materials which are apt to contain impregnations of various mineral salts, such as sulphides of iron and of magnesia, in considerable abundance. In this way we find that whatever water can be secured from the sandstones of the Coal Measures cannot always be used for the purposes desired. The sandy strata are most frequently present in the lower two hundred feet of the formation. On the west side of the State these come to the surface in a belt which extends from Rock Island county to Union county, approaching the Mississippi to a varying distance of from ten to sixty miles. To the north and the east the border of the formation runs through Henry, Bureau, La Salle, Livingston, Ford, and Iroquois counties. The surface of the land within these belts has a lesser average elevation than the land over the greater part of the region which the formation covers. From this circumstance it will be clear that the conditions necessary for producing a flow from the included sandstones must be very exceptional. Such flowing wells are confined exclusively to the lowest valleys in the region. The well in the C. R. I. & P. depot at Bureau Junction is of this kind. Its waters contain a large amount of sulphate of magnesia, and this mineral is perceptible to the taste.

The Pleistocene Formations.

Except in the five counties of the southernmost part of the State and in JoDaviess county at the northwest, the drift is everywhere present, overlying the older rocks which we have already described. It has an average thickness of fifty feet but measures more than a hundred feet over an area of about one-third of the State. Most of the thick drift lies to the northwest of the center of the State. In parts of Bureau county it measures 400 feet. By far the greater number of wells draw their supply from the drift, and from an economic point of view the drift is by far the most important of all our water bearing formations.

For practical purposes we may consider the drift as consisting of three different parts: 1. Boulder clay. 2. Alluvial drift. 3. Loess. It is desirable to here present a brief description of the occurrence of water in each of these three kinds of drift.

Boulder Clay.—The boulder clay is quite generally known as "blue clay." Some well makers call it "hard pan," and others refer to it as "stony clay" or "pebbly clay." It consists of a compact mass of fine clay, with which are mixed grains of sand, pebbles, and larger fragments of rock. The latter are called boulders, and they give the clay its geological name. It is the least sorted of all formations, and we find in its mass the finest clay packed close together in the interstices among the coarser materials. It is hence very impervious to water, and no good wells can be made in the boulder clay if this does not contain any sandy strata. In regions where the boulder clay is heavy and where no sandy layers can be reached underneath, it is necessary to make the wells deep and wide in order to secure even a moderately large quantity of water from seepage. Sometimes open wells are made and set with brick, and from the bottoms of these wells tunnels are extended laterally into the clay, twenty to thirty feet in length, and these are also set with brick. By this tunneling a larger seepage surface is secured. In other localities where the boulders are not too frequent and where the boulder clay is somewhat less compact, wells are made by large augers, two feet in diameter, and afterward set with large tile.

But quite often the boulder clay contains strata of sand. In some localities these may be very extensive and are then usually the main reliance for a good water supply. Even when such layers are no more than one or two feet thick, they may furnish a large quantity of water. They vary in coarseness from very fine sand to gravel, and they may run their course in the boulder clay from a few rods to several miles. Many of them, no doubt, draw their supply of water from the boulder clay by seepage; while in other localities the more extensive strata apparently come up to the surface and are at least partly filled more directly by the rainfall. When water is abundant from such sandy strata wells are frequently bored and then cased with iron tubing or with tile.

As compared with other sediments the drift is exceedingly variable in its nature and texture. The sandy strata may be absent or present. In short distances they may change from coarse to fine material and as rapidly thin out or fail altogether, and they may rise or sink in the formation to which they belong. As a consequence, we find that the drift is a rather unreliable source of water. Because a successful well has been made at one point it can never with certainty be predicted that an equally good well can be made within a short distance from the successful well. The supply is apt to vary greatly in short distances. As a rule drift wells will not overflow. The height to which the water rises in a seepage well is presumably the level of the ground water. But in places where water is drawn from an extensive gravel or from some sandy stratum under the clay, it sometimes happens that flowing wells can be made. This is due to the existence of the usual artesian conditions. The water bearing sands have an intake area at a point where the level of the ground water lies higher than the curb of the flowing well. In every case such instances of artesian wells of the drift lie in regions where the topography of the drift has a considerable range of altitude. The artesian basins of this kind are always of a much more limited extent than similar basins in the older and more deep lying rocks.

The principal known occurrences of artesian drift wells in Illinois are as below:

1. In the valley of a tributary to Bureau creek about six miles southeast of Princeton, in Bureau county.
2. A small tract in the southwest corner of DeKalb county.
3. In the valley of the Kishwaukee river northwest of Sycamore, DeKalb county.
4. A small area a little south of the center of Lake county.
5. Two small areas in the west arm of Cook county, some eight or ten miles east of Elgin.
6. A tract in the center of Kendall county along the valley of a tributary to Fox river at Yorkville.
7. In the valley of the Big Vermilion in the southeast corner of Champaign county and in the northwestern part of Vermilion county.
9. A large area in Iroquois county, covering fully one-half of this county. lying mostly in the center but with arms extending into Indiana on the east, Kankakee county on the north, and Ford county on the west.

The quality of the water from the boulder clay varies with the nature of the drift. Generally it is hard water, containing considerable quantities of carbonates of lime, magnesia and iron.

Alluvium.—The alluvium deposits consist of gravels, sands and silt, which fill the bottoms that have been made by the present drainage of the country. These sands and gravels are always stratified and of a clean and open texture. The associated silts are somewhat more compact but invariably contain sandy layers at greater or less depth. The water held in the alluvial deposits may be regarded as being a part of the water of the streams. It often has the same head as the water in the open channel. Farthest out on the sides of the valleys it may be slightly higher. Almost everywhere on the so-called first and second bottoms of the larger streams, water can be obtained at no great depth from the sands of this drift. The supply is invariably abundant excepting in the smaller streams where it may run low in dry seasons. The most common way to reach the water on such lands is to make "driven wells." Their construction is cheap as well as easy. A screened point is attached to an iron pipe and this is driven down to a depth of from twenty to sixty feet, where the sand is reached. A pump is then attached to the upper end of this tube. The well maker must of course see to it that the valve of the pump is sufficiently far down to draw the water from the head below. Where the water does not rise within twenty-five feet of the surface it is then necessary to widen the well above, so as to allow the lowering of the suction valve to the requisite depth.

While the supply of water furnished by the river drift is usually as pure as the water of the boulder clay it is in some localities quite heavily charged with salts of iron. Some alluvial waters have a strongly chalybeate taste. When left to stand in open troughs the water from many of these wells becomes turbid from the oxidation of these salts. In other localities the water may have an oily taste, due to the presence of ancient vegetation. Owing to the ready flow of the ground water in these loose sands it is quite liable to be contaminated from surface seepage.

Loess.—In the southern and the western part of the State the uplands are everywhere covered by a deposit called "loess." This is somewhat like silt in texture, but it is much more open and porous than the common water silts. To well men it is usually known as "yellow clay" or, as in the southern part of the State, "white clay." It varies from five to forty feet in thickness and probably averages on most uplands where it occurs about twenty feet. Where the level of the upland is fairly flat, the loess is so porous as to permit the total rainfall to be absorbed and for some time stored. This is especially true of the region north and west of the Kaskaskia river. In the southern part of the State it is somewhat less porous and sheds more of the rainfall. The water which is thus absorbed slowly sinks, until it reaches the boulder clay under the loess. This is much less open in its texture and thus the water is held on its surface in the lower part of the loess. Before the original vegetation was destroyed seep springs could everywhere be found at the level of the junction of these two formations in the western part of the State. Even at the present time many such springs remain and the difference in the nature of the two formations is evident. During the rainy season many streams which come down from the upland loess and cut into the underlying boulder clay, show a greater quantity of water after they have reached the lower formation.

The water stored in the lower part of the loess was usually sufficient for the needs of the wells of the first settlers, and it was seldom necessary to go below this level in the loess region for a permanent water supply. Even now the supply may hold out on some of the flat uplands in the counties covered by this deposit. But probably more than half of all the wells which once relied upon this formation have gone dry, owing to the general lowering of the level of the ground water attendant upon the changes due to the coming of agriculture. The original surface of the boulder clay under the loess was not an even plain but must have had a somewhat diversified relief of its own, not always the same as that of the land today. Where the underground drainage following the upper surface of this old relief is favorable for the accumulation of water, these wells may be expected to remain permanent, but in situations where this drainage is less hemmed in, the wells have already in many cases become dry.

The lower part of the loess, in which the water occurs, frequently has a dark or blue color. Well makers sometimes call this dark base of the loess "sea mud," "Noah's garden," or "grandmother's garden." These names have been suggested by the fact that the water bearing stratum contains various remains of plants, such as logs, roots, branches and leaves of trees and other plants. Occasionally there is even an odor of decaying vegetation and there may be an oily scum on the water, which may also hold considerable quantities of minerals in solution. This water is most often obtained by making open wells sunk down into the top of the boulder clay. Such wells may stand for many years without falling in, even when not protected by curbing. This stability of the loess is due to absence of horizontal stratification and to the fact that all the joints which are found in this deposit, extend in a vertical direction.

Springs.

Geologically considered, springs may be referred to one or the other of two groups: 1. Springs issuing from the drift, and 2. Springs issuing from the bed rock. The drift springs are the most numerous. A great number of small springs issue from the base of the loess, as has already been explained. Other springs issue from sandy and gravelly strata, which lie in the boulder clay or beneath it. Some of these deeper springs of the drift are of considerable size and some of them are associated with Artesian conditions, the water coming from strata which may lie in part at greater depths than the mouth of the spring and in part above this level. These springs usually maintain during the year a very steady temperature of about forty-nine or fifty degrees Fahrenheit. Chemically the water of the drift springs is variable, owing to the great local differences in the nature of the drift.

Springs which issue from bed rock are mostly of shallow origin, as the strata lie practically in a horizontal position over the entire strata. They represent the outflow of water which has entered the drift and has sunk into the superficial layers of the bed rock, and which is following bedding planes and joints that lie above the valleys and drain into them. For this reason we find most of these springs in the southern part of the State, where the drift is thinnest and the valleys deepest and most numerous. They are also common in the limestone region in the driftless area in the northwest corner of the State. Springs with a deep underground source are believed to be few. In the absence of data on their temperature, indicating a deep origin, we may conclude that such springs must be confined to those limited tracts that exhibit violent folding of the bed rock. It has already been stated that such folded structure of the formations occurs in LaSalle, Calhoun, Jersey, Union and Alexander counties.

CLASSIFICATION OF WATERS ACCORDING TO PHYSICAL AND CHEMICAL PROPERTIES.

[By Edward Bartow.]

GENERAL.

When it is possible to determine the temperature, waters are sometimes classified accordingly as thermal or non-thermal. Dr. A. C. Peale[1] has suggested that springs having a temperature above 70° F., should be classified as thermal, those from 70° to 98° F., be called tepid or warm, and all above 98° F., should be called hot. This seems to us a very satisfactory method, but we are unable to thus classify the Illinois waters as no such data concerning them has been obtained.

Numerous authors have suggested various methods of classifying waters according to the chemical composition of the salts or gases which they contain. Some classification is certainly desirable. It is, however, difficult to find a classification which will answer the requirements of all interested parties. We have deemed it best in this work, to assign the waters to no special class, but to report the ions and the hypothetical combinations, so arranged, that any person who desires to compare similar waters, may easily do so. We submit an outline describing some of the most important classifications for reference.[2]

A GERMAN CLASSIFICATION.[3]

I.	Alkaline	Simple carbonated. Alkaline. Alkali and common salt.
II.	Glauber salt.	
III.	Iron	Pure. Alkaline and saline. Earthy and saline.
IV.	Common salt	Simple. Concentrated. With bromine.
V.	Epsom salts.	
VI.	Sulphur.	
VII.	Earthy and calcareous.	
VIII.	Indifferent.	

1 United States Geological Survey, Fourteenth Annual Report. p. 68.

2 Compare Crook, The Mineral Waters of the United States, New York, 1899, p. 28.

3 McPherson, John. The Baths and Wells of Europe. London, 1869, p. 94.

A FRENCH CLASSIFICATION.[1]

I.	Sulphur waters	With salts of sodium. With salts of lime.
II.	Chloride of sodium waters	Simple. With bicarbonates. Sulphureted.
III.	Bicarbonated waters	Bicarbonate of soda. Bicarbonate of lime. Mixed bicarbonates.
IV.	Sulphated waters	Sulphate of soda. Sulphate of lime. Sulphate of magnesium. Mixed sulphates.
V.	Ferruginous waters	Bicarbonated. Sulphated. With salts of manganese.

AN AMERICAN CLASSIFICATION.[2]
(Mixed chemical and therapeutical.)

I.	Alkaline waters	Pure. Acidulous (carbonic acid). Muriated (chloride of sodium).
II.	Saline	Pure. Alkaline. Iodo-bromated.
III.	Sulphur waters	Alkaline. Saline (chloride of sodium). Calcic.
IV.	Chalybeate	Pure. Alkaline. Saline (chloride of sodium). Calcic. Aluminous.
V.	Purgative waters	Epsom salt (sulphate of magnesium). Glauber salt (sulphate of soda). Alkaline.
VI.	Calcic waters	Limestone (carbonate of lime). Gypsum (sulphate of lime).
VII.	Thermal waters	Pure. Alkaline. Saline (chloride of sodium). Sulphur. Calcic.

AN ENGLISH CLASSIFICATION.[3]

I. Simple thermal waters.
II. Common salt or muriated waters.
III. Alkaline waters.
IV. Sulphated alkaline waters.
V. Iron or chalybeate waters.
VI. Arsenic waters.
VII. Sulphur waters.
VIII. Earthy or calcareous waters.

These classifications are faulty in that the various divisions are not sufficiently distinctive, and many waters could be placed in two or more classes.

The scheme of Dr. Albert C. Peale[4] overcomes this difficulty as no waters can fall into more than one of his main classes. Dr. Peale makes no provision for the difference in concentration of the various waters. Waters of the same relative composition but varying greatly in concentration are not distinguished.

1 Dictionaire des Eaux Minerales. Paris, 1860, Tome 1, page 403.
2 Walton's Mineral Springs of the United States and Canada, 1872, page 33.
3 Herman Weber, in Allbutt's System of Medicine, 1896, page 319.
4 United States Geological Survey, Fourteenth Annual Report, 1894, p. 66.

PEALE'S CLASSIFICATION.

Group A. Nonthermal. Group B. Thermal.

- Class I. Alkaline.
- Class II. Alkaline—Saline .... { Sulphated. Muriated.
- Class III. Saline .... { Sulphated. Muriated.
- Class IV. Acid .... { Sulphated. Muriated. Silicious .... { Sulphated. Muriated.

{ Sodic. Lithic. Potassic. Calcic. Magnesic. Chalybeate. Aluminous.

{ Nongaseous. Carbonated. Sulphureted. Azotized. Carbureted.

MODIFICATIONS OF PEALE'S CLASSIFICATION.

Crook[1] follows quite closely Peale's scheme, but substitutes a chalybeate group instead of the acid group and adds a class of neutral or indifferent waters, to distinguish that class of waters in which there is but a small amount of mineral matter.

Haywood[2] follows Peale very closely, making the method of classification more comprehensive by including more acids in his scheme.

HAYWOOD'S CLASSIFICATION.

Groups—Thermal. Nonthermal.

Class.	Subclass.		
I. Alkaline	Carbonated or bicarbonated. Borated. Silicated.	Sodic. Lithic. Potassic. Calcic. Magnesic. Ferruginous. Aluminic. Arsenic. Bromic. Iodic. Silicious. Boric.	Nongaseous. Carbondioxated. Sulphureted. Azotized. Carbureted. Oxygenated.
II. Alkaline—Saline	Sulphated. Muriated. Nitrated.		
III. Saline	Sulphated. Muriated. Nitrated.		
IV. Acid	Sulphated. Muriated.		

Blatchley[3] uses a modification of Peale's scheme leaving out the alkaline-saline class, substituting "chalybeate" for "acid," and adding a neutral indifferent group.

BAILEY'S CLASSIFICATION.

Bailey[4] suggests a grouping, based upon the predominant ions present as follows:

1. Chlorid group, or those in which chlorin ion (Cl) is the predominant one.

II. Sulfate group, or that in which there is a predominance of the sulfate ion.

III. The chlor-sulfate group, or waters which contain about equal amounts of sulphate and the chlorin ion.

IV. The carbonate group, or those in which the carbonate ions (CO^3) are abundant.

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1 Crook, Mineral Waters of the United States, p. 30.
2 Haywood U. S. Department of Agriculture, Bureau of Chemistry, Bull. No. 91.
3 Blatchley, 26th Annual Report of the State Geologist of Indiana, 1901, p. 15.
4 Bailey, University Geological Survey of Kansas, Vol. 7, p. 98.

V. The chlor-sulfo-carbonate group, or those containing considerable quantities of each of these ions.

VI. The sulfid group, or those waters that give off hydrogen sulfid, and are commonly called sulfur waters.

VII. The chalybeate or iron group. (This may also contain the few manganese waters).

VIII. The special group, or those waters containing some special substance, like lithium, borax, etc.

IX. The soft water group, or those waters that contain only small quantities of any mineral substances.

SWEITZER'S CLASSIFICATION.

Sweitzer[1] suggests a classification based on the presence of acids, iron or sulphur.

Schedule of Classification.

Class I. *Muriatic Waters.*
Waters containing, as their main constituents, sodium chloride or common salt.

a. First Group.
Waters containing, besides sodium chloride, also calcium chloride, magnesium chloride, calcium sulphate (magnesium sulphate absent).

b. Second Group.
Waters containing besides sodium chloride, also magnesium chloride, calcium sulphate (calcium chloride absent).

c. Third Group.
Waters containing besides sodium chloride, also magnesium sulphate, calcium sulphate (calcium and magnesium chloride absent).

Class II. *Alkaline Waters.*
Waters containing sodium carbonate or magnesium carbonate.

a. First Group.
Waters containing sodium carbonate with or without magnesium carbonate.

b. Second Group.
Waters containing magnesium carbonate only.

Class III. *Sulphatic Waters.*
Waters containing one or more sulphates as their main constituent.

a. First Group.
Waters containing sodium sulphate or Glauber's salt.

b. Second Group.
Waters containing magnesium sulphate or Epsom salts.

c. Third Group.
Waters containing ferrous sulphate, ferric sulphate, aluminum sulphate, either singly or together.

Class IV. *Chalybeate Waters.*
Waters containing as their most efficient constituent some ferrous carbonate.

a. First Group.
(Pure Chalybeate Waters), Waters containing ferrous carbonate, magnesium carbonate, sodium carbonate (magnesium sulphate and calcium sulphate absent).

b. Second Group.
(Saline Chalybeate Waters). Waters containing ferrous carbonate, magnesium carbonate, magnesium sulphate (sodium carbonate and calcium sulphate absent).

1 Sweitzer, Missouri Geological Survey, Vol. 3, p. 25.

c. Third Group.

(Semi-Chalybeate Waters). Waters containing ferrous carbonate, magnesium carbonate, magnesium sulphate, calcium sulphate. (This latter, as explained previously, involves the existence of ferrous sulphate).

Class V. *Sulphur Waters.*

This class might naturally be divided into three groups; waters containing sulphides only; waters containing sulphides and sulphydrates; and waters containing free sulphydric acid, sulphides and other thio-compounds.

CONCLUSIONS.

Of these classifications, the schemes of Peale or of Haywood seem the best. It is a question, however, whether it is not better to consider the amount of the constitutents reported in the analysis, rather than to try to indicate the kind of content by a class name. For example, two waters containing respectively, 250 and 2,000 parts per million of mineral matter of the same relative composition, if classified, would fall in the same division. The class name would not give the reader an adequate idea of the relative properties of the waters. Both might be classified as, "*carbonated, sodic, calcic, muriated, alkaline-saline.*" The former would be a very satisfactory water. The latter would be a water too hard for household uses, and would contain so much salt that it would be evident to the taste.

Another illustration of the difficulty of a classification according to the kind of content, is met with when we consider the purposes for which an analysis of the mineral content is made. The physician wishes to know the therapeutic or physiological action, for example, to know whether a water contains sulphates of sodium or magnesium. These two salts have a similar therapeutic effect and the classification "sulphatic," which would include waters containing either or both salts, would give the information desired.

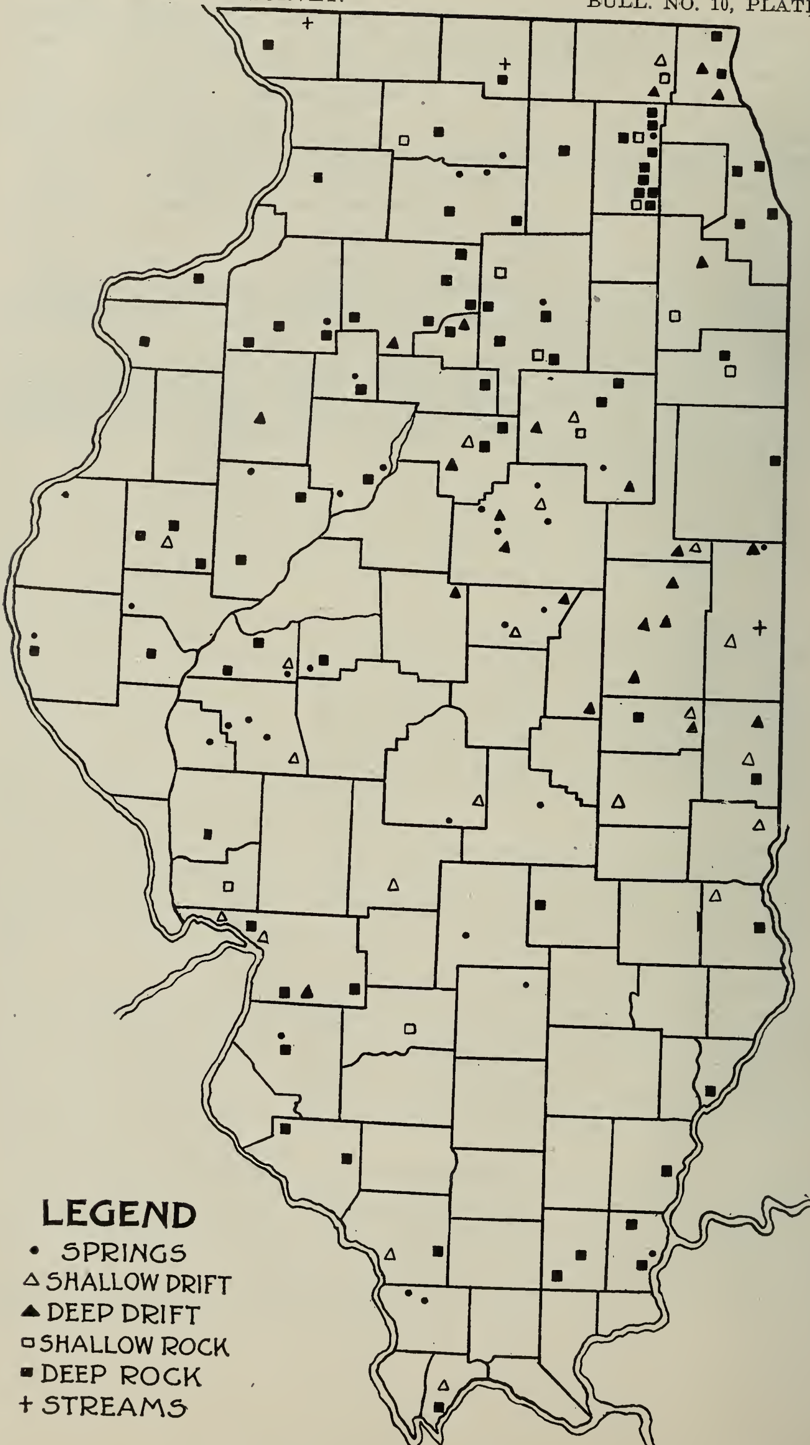
Such a classification does not suit the engineer or the chemist in charge of water softening. They must know the relative amount of the two salts, for the sodium sulphate would have little effect on a boiler, while the magnesium sulphate would be instrumental in forming a hard scale.

Our scheme of reporting "ions" and "hypothetical combinations," is helpful to all parties. The physician or the mineral water therapist can note the predominance of ions, the engineer can see how the acid and basic ions balance each other, and the manufacturer can by inspection, tell whether substances harmful to his business are present, whatever the need for the water, whether in the manufacture of starch, paints, dyes, or dairy products, etc.

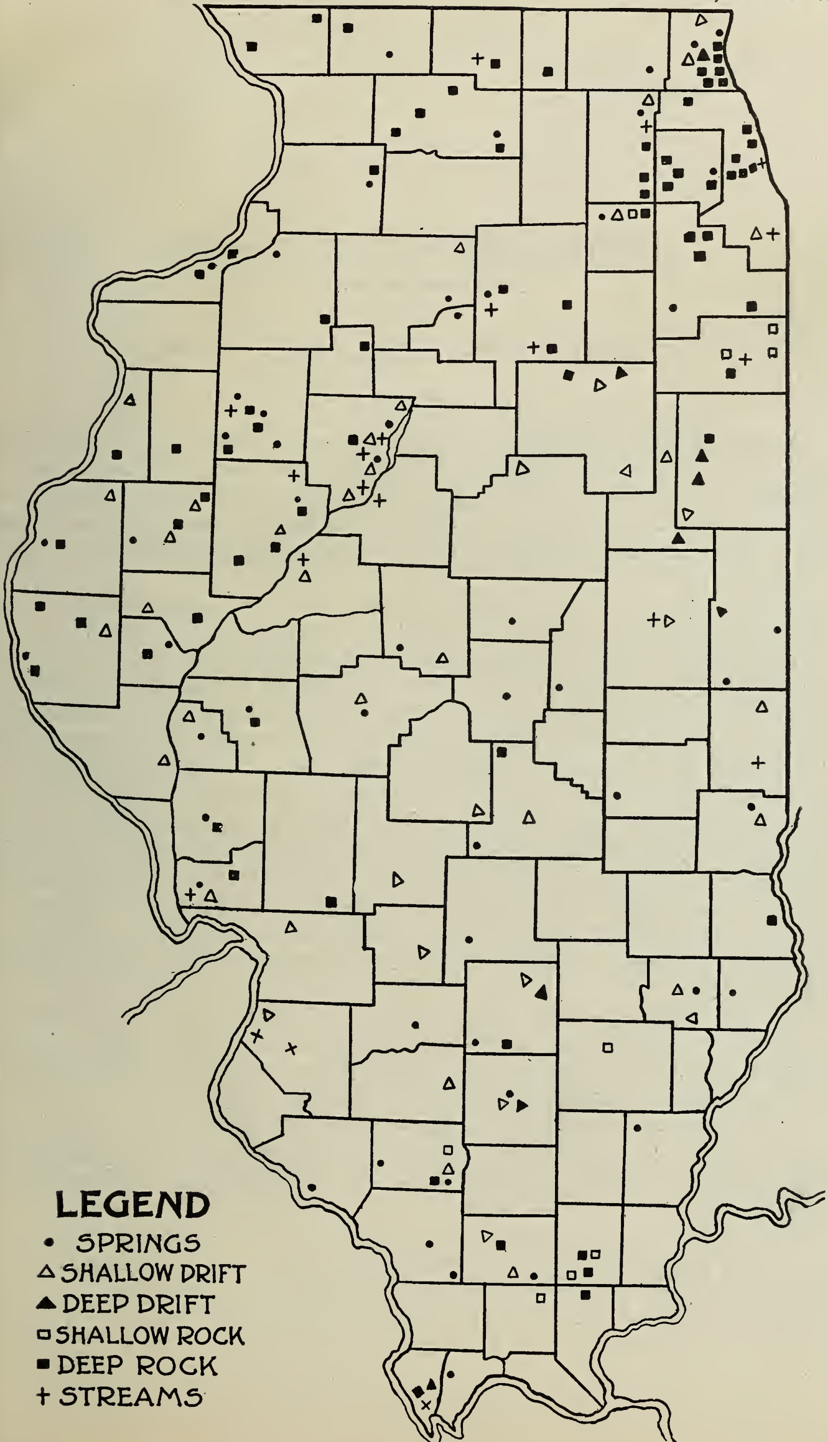
The division into hypothetical combinations is of especial use to the engineer. As the ions are set off against each other, an excess of nitrate and chlorine ions over the sodium ions, indicates corrosive properties in the water. When the nitrate, chlorine and sulphate ions exceed the sodium, a tendency to form a hard scale is indicated, as the sulphate is left to combine with the magnesium or calcium.

The character of treatment required, can also be determined from the hypothetical combinations; for example, when the nitrate, chlorine and sulphate ions exceed the sodium ions, magnesium sulphate will appear in the hypothetical combinations, and enough sodium hydroxide or carbonate must be added to react with it. When the sodium ions are in excess, it is shown by the appearance of sodium carbonate in the hypothetical combinations and, of course, no sodium carbonate or hydroxide are needed. The appearance of either magnesium sulphate or sodium carbonate in the hypothetical combinations, divides the waters of the State in two groups, that seem to us so important, that we have prepared two maps to illustrate their relative distribution throughout the State. The sodium carbonate waters are seen on Plate 2, and the magnesium sulphate waters on Plate 3.

In the chapter on Medicinal Springs of Illinois, Dr. Palmer has classified the springs mentioned, according to Peale's method. This is the only chapter in which a classification according to any of the outlines given, has been attemped.



Illinois waters containing sodium carbonate.



Illinois waters containing magnesium sulphate.

METHODS AND INTERPRETATIONS.

[By Edward Bartow.]

Methods of Analysis.

SANITARY.

As soon as the samples are received at the laboratory the cloth which covers the stopper is removed, the stopper and neck of the bottle is cleaned, the contents are thoroughly shaken in order to mix them completely and a little water is poured out in order to rinse off the neck and lip. The amounts required for the various determinations are then measured out.

Determinations of those constitutents which are most susceptible to change are started.

The sanitary determinations made are as follows:

Turbidity and Sediment.—The determinations of turbidity and sediment described in this report have been made by inspection. The terms "slight," "distinct," "decided," "much," and "very much" are used to indicate the degree of turbidity. The terms "very little," "little," "considerable," "much" and "very much," are used to roughly indicate the quantity of sediment. The methods recommended by the American Public Health Association,[1] have been recently adopted in this laboratory. By this method, turbidity is reported on the so-called silica scale. The numbers represent the equivalents of parts per million of finely divided silica in suspension. Artificial standards for comparison are used for turbidities below 100 and the electric turbidimeter for more turbid waters.

Color.—The color has been determined according to the Nessler scale. That is, the color has been compared to the tint developed in the Nessler standards. The figures correspond to the color formed in 50 c. c. of water by definite quantities of nitrogen as ammonia.

Odor.—After shaking the sample thoroughly the stopper is quickly removed and the odor noted. In the more recent samples we have used the method of reporting recommended by the American Public Health Association.[2]

1 Journal Infectious Diseases 1st supplement, p. 16.
2 Journal Infectious Diseases 1st supplement, p. 23.

In brief, this method describes the odor as

v—vegetable.
a—aromatic.
g—gassy.
f—fishy.
e—earthy.
m—Moldy.
M—musty.
d—disagreeable.
p—peaty.
s—sweetish.

and indicates the degrees of the odor bv figures 0-5 as follows:

Numerical value.	Term.	Approximate Definition.
0	None	No odor perceptible.
1	Very faint.....	An odor that would not be ordinarily detected by the average consumer, but that could be detected in the laboratory by an experienced observer.
2	Faint	An odor that the consumer might detect if his attention were called to it, but that would not otherwise attract attention.
3	Distinct	An odor that would be readily detected and that might cause the water to be regarded with disfavor.
4	Decided	An odor that would force itself upon the attention and might make the water unpalatable.
5	Very strong...	An odor of such intensity that the water would be absolutely unfit to drink. (A term to be used only in extreme cases.

Total Solids.—The total solids were determined by evaporating to dryness in a platinum dish upon a water bath a suitable quantity of the water (from 100 cubic centimeters to 1 liter.) The dish and contents are then placed in an air bath and kept at 180 degrees contigrade for one hour or until the weight is essentially constant.

Loss on Ignition.[1]—For the determination of "Loss on ignition" the device employed by the Massachusetts State Board of Health has been used. A platinum dish, which is somewhat larger than the one in which the total solids are contained, is heated to redness by a Bunsen flame, and the dish with the residue on evaporation is placed inside. The properly moderated temperature here attained is sufficient to bring the organic substances in the dish to a state of incandescence so that they are quite readily consumed. Usually, however, especially where very much organic matter is present, small particles of carbon are left in the residue and the contents of the dish remain dark in color. The temperature attained in this operation is sufficient to completely remove water from sulphates and to decompose the nitrates of calcium and magnesium. Thus even by this method the loss in weight resulting from the process cannot be looked upon as in any degree a definite or even an approximate measure of the quantity of organic matter present. The importance of the determination is largely limited to the general indications, i. e., the inferences which may be drawn from a blackening of the residue, the development of marked odors, or the evolution of colored fumes.

Chlorine.—In determining chlorine the ordinary process of titration with standard silver nitrate solution has been used. The standard solution is of such strength that one-tenth of a cubic centimeter represents

[1] This test was discontinued in October, 1903.

one part of chlorine in a million parts of water, when fifty cubic centimeters of the water are taken for the determination. Many of the waters with which we have had to deal contain so little chlorine that it was necessary to concentrate them. In such cases, whatever the quantity taken, the volume has been brought to fifty cubic centimeters for the determination.[1] Usually when more than 5 c. c. of the standard solution was required, less than 50 c. c. of the water was diluted to 50 c. c. with distilled water, or the chlorine was determined gravimetrically in a weighed portion of water. The indicator used is a potassium chromate solution, of which one cubic centimeter of five per cent strength is added to the liquid to be tested. The end point is in all cases determined by comparison with a blank test.

Oxygen Consumed.—One hundred cubic centimeters of the water are measured into an Erlenmeyer flask of two hundred and fifty cubic centimeters capacity. From two to five cubic centimeters according to the character of the water of pure concentrated sulphuric acid are added, followed by ten cubic centimeters of standard potassium permanganate solution. After mixing thoroughly the flask is placed in a shallow bath of boiling water, and heated continuously for thirty minutes. By this method the temperature within the flask is raised almost to that of the water in the bath itself which is kept boiling briskly. In this way any considerable concentration by evaporation of the water in the flask, as also "bumping," which frequently results in the loss of the sample, is entirely avoided. At the end of thirty minutes digestion, the flask is removed, and exactly ten cubic centimeters of the standard ammonium oxalate solution is added. When the solution has become perfectly colorless, the excess of oxalic acid solution which has just been added, is determined by titration to a faint pink with the standard potassium permanganate. As the ammonium oxalate solution and the permanganate solution are of equivalent strength, only the permanganate used in the titration is considered. The strength of the reagent is such that one cubic centimeter of potassium permanganate solution is equivalent to one part per million of oxygen consumed by the water when one hundred cubic centimeters of the water sample have been taken for the determination.

In some cases it happens that the ten cubic centimeters of potassium permanganate solution is all consumed in the oxidation of organic matters contained in the water. Another test is then made, in which, instead of ten cubic centimeters, twenty or more are employed, the procedure otherwise being the same as above.

Free and Albuminoid Ammonia.—In the determination of free or saline ammonia, round bottomed flasks of eight to nine hundred cubic centimeters capacity have been used. These are supported upon an asbestos ring and heated by direct application of the Bunsen flame. The flasks are connected to the condensers by means of pure gum stoppers and a modified form of Reidmair & Stutsen's safety bulb, as designed by Hop-

1 Sometimes in highly colored or muddy waters it has been found necessary to clarify with aluminum hydrate and filter before the titration was made.

kins. The condensers consist of aluminium[1] tubes of three-eighths of an internal diameter, with a cooling surface 20 inches in length. The tubes pass through a galvanized iron tank through which a constant current of cold water is kept flowing.

The apparatus is thoroughly steamed out, until free from ammonia, before each determination. Five hundred cubic centimeters of the water are used for the distillation. With waters containing little free ammonia, the collection of the distillate is made in four Nessler tubes of fifty cubic centimeters capacity in each of which the ammonia is determined by nesslerization. The boiling is conducted at such a rate that each tube is filled in from eight to ten minutes. In some of the river waters and in many of the deep well waters which have been examined there are very considerable quantities of free or saline ammonia. In such cases, the distillate is caught in flasks of two hundred cubic centimeters capacity. After diluting to the mark and thoroughly mixing, the amount of ammonia in an aliquot portion is determined by nesslerization.

Albuminoid Ammonia.—The residue after distillation of the free ammonia is used for the determination of the albuminoid ammonia. Fifty cubic centimeters of alkaline permanganate solution are added and the distillation proceeded with, at the same rate as for free ammonia. The alkaline permanganate solution is made by adding eight grams of potassium permanganate and 200 grams of sodium hydroxide to 1,300 cubic centimeters of water and concentrating to one liter.

The collection of the distillate is ordinarily made in Nessler tubes, but in some few cases, where much nitrogenous organic matter is present, the distillates have been caught in flasks as described above in the determination of free ammonia.

Nesslerization.—A standard ammonium chloride solution is made of such strength that one cubic centimeter shall contain ammonium chloride corresponding to one one-hundredth of a milligram of nitrogen. Standards for comparison in nesslerization are made from the standard ammonium chloride solution of the following strengths, i. e., the quantities of standard ammonium chloride solution diluted to 50 c. c. with water are: 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 cubic centimeters.

Nessler tubes of colorless glass, of fifty cubic centimeters capacity and 7¾ inches long to the mark are used.

In conducting the nesslerization, care is taken that the distillates and standards are all of the same temperature before adding the Nessler reagent. Commonly, distillates obtained in the afternoon are allowed to stand in a cool place until the next morning, before proceeding with the nesslerization. Twenty minutes are allowed for the development of the full color after the addition of the reagent, and the readings are taken within an hour.

A camera is used in making comparisons. It consists of a black wooden box which cuts out all side lights and which is capable of holding twenty-seven tubes at one time. The tubes are illuminated from the bottom

[1] In the earlier tests block tin tubes were used. Aluminium has been found to be very satisfactory.

by means of a mirror reflecting the light from the north, and the reading is made by means of another mirror placed above the tubes and so arranged as to bring the image direct to the eye of the observer. This apparatus has been in use in the laboratories of the University of Illinois for years, and has always given satisfactory results. In determining the color fifty cubic centimeters of water are placed in standard Nessler tubes and compared with the standard.

The results of the determinations of all nitrogenous constituents of waters are stated in parts per million of nitrogen.

Nitrogen as Nitrites.—The fifty cubic centimeters of water used in the determination of color may be used for this test. One cubic centimeter of an acid solution of naphthylamine hydrochloride (8 grams of naphthylamine, 8 cubic centimeters of strong hydrochloric acid, and 992 cubic centimeters of water) and one cubic centimeter of a saturated solution of sulphanilic acid, in water containing five per cent of strong hydrochloric acid are added to the water in a Nessler tube. At the same time standards are prepared by diluting in other Nessler tubes known quantities of a standard solution of sodium nitrite to fifty cubic centimeters and adding naphthylamine hydrochloride and sulphanilic acid in the same manner as the water to be examined.

The standard solution of sodium nitrite is prepared from pure silver nitrite by reaction with sodium chloride, and contains in one cubic centimeter the equivalent of .0005 milligrams of nitrogen. Usually standards are made containing 0.3, 0.6, 1.0, 1.5, 2.0 and 2.5, cubic centimeters of the standard solution.

Comparisons are made in not less than thirty minutes nor more than one hour after adding the reagent. Waters which are very turbid or deeply colored are clarified and decolorized by treatment with aluminium hydroxide before testing for nitrites.

Nitrogen as Nitrates.—Determination of nitrates is begun as soon as possible after the water is received. A modification of the aluminium reduction method is used. One hundred cubic centimeters of the water are treated with two cubic centimeters of a thirty-three per cent nitrogen free sodium hydroxide solution. The mixture is boiled rapidly until reduced to a volume of 15 or 20 cubic centimeters, to remove the free ammonia. The concentrated mixture is rinsed into a test tube of about 80 c. c. capacity and is diluted to about fifty cubic centimeters by the addition of nitrogen free water. A piece of sheet aluminum four inches long and one-quarter inch wide and weighing .5 grams is then introduced and the tube allowed to stand over night in a comparatively cool place. The reduction of the nitrates to ammonia is ordinarily completed in the morning when the examinations are continued. The solution with the strip of aluminium is rinsed into an 800 cubic centimeter Kjeldahl flask with 250 cubic centimeters of nitrogen free water. Two hundred cubic centimeters are distilled into a graduated flask and the free ammonia, produced by the reduction of nitrites and nitrates, is determined by nesslerizing an aliquot part of the distillate according to the method described under free and albuminoid ammonia. In calculating the nitrogen as nitrates, the nitrogen as nitrites is substracted from the total amount of nitrogen indicated by the Nessler test.

MINERAL.

Determinations.—In determining the mineral content in the waters of Illinois in the laboratory of the State Water Survey, the following determinations have been made in all waters analyzed.

[1]Pottassium	K
Sodium	Na
Magnesium	Mg
Calcium	Ca
[2]Aluminium	Al_2O_3
Iron	Fe
[2]Silicia or Silicious Matter	SiO_2 or SiO_2+
[3]Nitric Acid	NO_3
Hydrochloric Acid	Cl
Sulphuric Acid	SO_4

In a few cases the following determinations have been included:

Lithium	Li
Phosphoric Acid	PO_4
Manganese	Mn

The methods in use have been changed somewhat during the ten years covered by this report, but in general the methods employed are as follows:

Measure accurately two portions of the water to be examined using such amounts as will give a residue of from 400 to 600 milligrams. The necessary amount of water is determined from the "residue on evaporation," if made, or by comparing the water to be examined with analyses of water of similar origin. It is not usual to use more than a liter, even though the residue should be less than 400 milligrams. Acidify both parts with hydrochloric acid and evaporate to dryness in platinum dishes on the water bath.

Heat the residues in an air bath at 180 degrees for one hour, or until the mass is completely dry and brittle. Moisten throughout with a little concentrated hydrochloric acid. Add 30 to 40 cubic centimeters of pure distilled water; digest on the water bath for a minute, filter off the silicious matter on an ashless filter paper and wash completely.

Silicious Matter.—Ignite one portion only and weigh as silicious matter.

Silica.—Treat the silicious matter with hydrofluoric acid and determine the silica (SiO^2) by the loss of weight. Note—Calcium sulphate is frequently found in waters of the State and because it dissolves slowly it is necessary to be especially careful that none of it remains with the silica. If any is left it will be found after volatilizing the silica by means of hydrofluoric acid. It must then be dissolved in hydrochloric acid and added to the solution from which it, together with the silica, has been removed. It is possible that a little sulphate of barium or strontium may be found at this point. These would resist the solvent

1 When sodium and potassium are not separated the combination is considered as sodium and calculations made accordingly.
2 In some cases no separation has been made of iron and alumina, and these elements are reported as the sum of their oxides.
3 In most cases the silicious matter has been treated with hydrofluoric acid and the silica reported is the loss by such treatment.

action of the water and hydrochloric acid and might thus be separated from calcium sulphate. Use one filtrate from the silicious matter for the determination of iron, aluminium, (phosphoric acid), (barium), calcium and magnesium, and the other for sulphuric acid and the alkalies.

Iron, Aluminium and Phosphoric Acid.—To one filtrate from the silica add a little bromine water and boil for 10 or 15 minutes to insure complete oxidation of the iron present. Add 25 cubic centimeters of ammonium chloride solution, (or neutralize with ammonium hydroxide, and acidify with concentrated hydrochloric acid), then add a distinct but not great excess of ammonium hydroxide. Boil vigorously for 5 minutes, allow to settle, filter and wash thoroughly with hot water. Ignite and weigh as oxides of iron and aluminium and phosphates, ($Fe^2O^3 + Al^2O^3 + M^1{}_3PO_4$). Ordinarily the phosphoric acid is present in minute quantities and may be neglected.

Iron.—Fuse the weighed residue with 8 times its weight of potassium acid sulphate ($KHSO_4$), See Fres. I, page 660). Dissolve in water and dilute sulphuric acid. After reduction with sulpheretted hydrogen Fres. I, page 326), or by use of Jones' Reductor, determine iron volumetrically by potassium permanganate.

Aluminium.—Calculate to Ferric Oxide (Fe_2O_3) the iron found. Add the weight of the ferric oxide to the weight of the phosphate found and subtract the sum from the weight of the combined oxides of iron and aluminium and phosphates. The difference will be the weight of aluminium oxide (Al_2O_3).

Barium.—If barium is present it may be determined at this point in the usual manner by the addition of a few drops of sulphuric acid after acidifying the solution with hydrochloric acid. (Determinations of barium have not been made in these investigations).

Calcium.—Concentrate the filtrates and washings from the precipitated hydroxides of aluminium and iron to about 200 c. c. Make alkaline with ammonium hydroxide and add to the hot solution an excess of ammonium oxalate (See Fres. I, page 270.) Boil until the precipitate settles and the supernatant liquid is clear. Filter, ignite the washed precipitate of calcium oxalate in the Hempel furnace or in the blast lamp and weigh as calcium oxide. Calculate to calcium.

Magnesium.—Concentrate the filtrate and washings from the precipitated calcium oxalate to about 250 c. c. See that ammonium hydroxide is in slight excess. Add to the cool solution an excess of sodium ammonium hydrogen phosphate ($NaNH_4HPO_4$) stirring the solution, taking care to avoid touching the sides of the beaker with the stirring rod. Allow to stand 12 hours in a cool place, filter, wash with a solution of one part ammonium hydroxide, specific gravity 0.96. Dry, ignite and weigh as magnesium pyrophosphate ($Mg_2P_2O_7$).

Manganese.—Should manganese be present it would be found as manganese pyrophosphate ($Mn_2P_2O_7$) with the magnesium pyrophosphate ($Mg_2P_2O_7$). In the earlier analyses, manganese was determined according to Fresenius I, p. 294 by adding sodium acetate and an aqueous solution of bromine, exposing to a temperature of 50 to 70 degrees for a few hours, till the free bromine is all or nearly all expelled from the solution and filtering. The manganese thus precipitated as hydrated dioxide is liable to contain sodium salts. It should be washed carefully with hot water and may be converted by ignition directly into Mn_3O_4 and weighed. If the quantity is considerable, it is dissolved in hydrochloric acid and converted into some other suitable form for weighing.

Sulphuric Acid and the Alkalies.—Heat the other filtrate from the silicious matter to boiling and add an excess of a solution of barium chloride, a drop at a time, with constant stirring. Allow to remain in a warm place for at least thirty minutes, stirring at intervals. Filter, ignite, and weigh as barium sulphate, ($BaSO_4$). Compare Fresenius, I, p. 434.

Sodium and Potassium.—Evaporate the filtrate from the barium sulphate to dryness, add water, heat to boiling and treat the boiling solution with slight excess of alkali free barium hydroxide, $Ba(OH)_2$. Filter and add to the filtrate ammonium carbonate and ammonia. Filter off the precipitate so obtained, evaporate the filtrate to dryness in a platinum dish and ignite to drive off the ammonium salts. Repeat the operation as often as necessary to remove any magnesium that may remain, and after igniting weigh the alkali chlorides.

Potassium.—To separate the potassium chloride from the sodium chloride convert all into the double platinum salt by adding platinic chloride. Treat with 80 per cent alcohol. Filter, wash with alcohol and dry or filter. Dissolve the potassium platinic chloride thus obtained by washing the precipitate on the filter with boiling water. Evaporate to dryness, dry, weigh as potassium platinic chloride, and calculate as potassium.

Sodium.—Calculate the equivalent of potassium chloride and deduct from the weight of the combined chlorides of sodium and potassium. The difference is sodium chloride and is calculated to sodium.

Chlorides and Nitrates.—The methods used for mineral analysis are the same as used for the sanitary analysis. See pages 31 and 34.

METHOD OF REPORTING ANALYSES OF THE MINERAL CONTENT.

The results obtained in the analysis of the mineral content are expressed in ionic form. By ions we understand those parts of a salt an acid or a base in aqueous solution, which will conduct the electric current.

The results obtained are also expressed in hypothetical combinations of the ions. These, we believe, serve better than the ions to show the character of the water, because the combinations enable one to see at a glance the relative amounts of basic and acidic ions.

The method of calculation, in use for years in this laboratory, combines the acid and basic ions in the following order:

Basic.		Acidic.	
Potassium	K	Nitrous	NO_2
Sodium	Na	Nitric	NO_3
Ammonium	NH_4	Chlorine	Cl
Magnesium	Mg	Sulphuric	SO_4
Calcium	Ca	Residual bases to carbonic	CO_3
Iron	Fe		
Aluminium	Al		

Combinations of this character are of special importance when water treatment is under consideration. Should it be desired to combine the ions in any other order for the comparison of our analyses with the work of other analysts, such combinations can be made from the ions reported. The conversion table, showing the factors used in our calculations, will be of assistance in such work.

FACTORS FOR CALCULATING HYPOTHETICAL COMBINATIONS FROM IONS ACCORDING TO ATOMIC WEIGHTS OF 1905.

[By Edward Bartow and J. M. Lindgren.]

Basic.			Acidic.		
Ion.	Combination.	Factor.	Ion.	Combination.	Factor.
K	KNO_2	2.1760	NO_2	KNO_2	1.8504
K	KNO_3	2.5847	NO_2	$NaNO_2$	1.5007
K	KCl	1.9055	NO_2	$Mg(NO_2)_2$	1.2646
K	K_2SO_4	2.2268	NO_3	$LiNO_3$	1.1133
K	K_2CO_3	1.7663	NO_3	KNO_3	1.6310
K	K_3PO_4	1.8089	NO_3	$NaNO_3$	1.3715
Na	$NaNO_2$	2.9974	NO_3	NH_4NO_3	1.2913
Na	$NaNO_3$	3.6915	NO_3	$Mg(NO_3)_2$	1.1963
Na	NaCl	2.5380	NO_3	$Ca(NO_3)_2$	1.3232
Na	Na_2SO_4	3.0837	Cl	LiCl	1.1983
Na	Na_2CO_3	2.3015	Cl	KCl	2.1044
NH_4	NH_4Cl	2.9616	Cl	NaCl	1.6502
NH_4	$(NH_4)_2SO_4$	3.6577	Cl	NH_4Cl	1.5098
NH_4	$(NH_4)_2CO_3$	2.6600	Cl	$MgCl_2$	1.3436
Mg	$Mg(NO_3)_2$	6.0936	Cl	$CaCl_2$	1.5656
Mg	$MgCl_2$	3.9105	SO_4	Li_2SO_4	1.0732
Mg	$MgSO_4$	4.9434	SO_4	K_2SO_4	1.8151
Mg	$MgCO_3$	3.4631	SO_4	Na_2SO_4	1.4799
Ca	$CaSO_4$	3,3940	SO_4	$(NH_4)_2SO_4$	1.3758
Ca	$CaCO_3$	2.4963	SO_4	$MgSO_4$	1.2536
Fe	$FeSO_4$	2.7206	SO_4	$CaSO_4$	1.4174
Fe	$FeCO_3$	2.0734	SO_4	$FeSO_4$	1.5812
Al	$Al_2(SO_4)_3$	6.3170	SO_4	$Al_2(SO_4)_3$	1.1881
Al_2O_3	$Al_2(SO_4)_3$	3.3501	Parts per million	Grains per gallon	0.5833

INTERPRETATION OF RESULTS.

SANITARY WATER ANALYSIS.

The statement of chemical results is made in parts per million by weight. That is, in milligrams per liter. Since one liter of water weighs one million milligrams, these two expressions, "parts per million" and "milligrams per liter," are practically synonymous. On the scale of 100, one part per million is equivalent to one ten thousandth of one per cent (0.0001%). Should the data be desired in terms of grains per United States gallon of 231 cubic inches, multiply the parts per million by .058335.

There is so much variation in the character of water from the different sources in the State, that no general standard can be made. We have made an attempt to formulate standards for the waters from the various sources, as classified in this Bulletin.

Surface Waters.

With few exceptions it may be said that we should treat or filter all surface waters, in or bordering on the State, before using them for drinking purposes. Lake Michigan, alone, at a distance from the shore, furnishes a satisfactory water without treatment. A representative analysis of water from Lake Michigan, taken ten miles from the shore, is given by Adolph Gehrmann.[1] It is repeated in the table of suggested standards for the interpretation of sanitary water analyses. The characteristics of the water from any stream are not constant but vary with the seasons.

Turbidity.—The streams of the State invariably carry some matter in suspension. The turbidity should be less than 10 parts per million.

Color.—The color should not exceed .2 parts per million, Nessler standard.

Odor.—The odor should never be noticeable.

Residue on Evaporation.—The total residue on evaporation varies greatly as the suspended matter varies. The soluble matter varies from 137 parts per million in Lake Michigan, to 643 parts per million in a creek at Farmington. The residue should not exceed 300 parts per million.

Chlorine.—Chlorine varies from 1.5 parts per million in Lake Michigan, to 63 parts per million in the Illinois river at Havana, before the opening of the drainage canal. A filtered water may vary between these limits, but as a rule should not exceed 6.0 parts per million. The test for chlorine is of value in showing the relative amount of pollution that has entered a stream.

Consumed Oxygen.—Consumed oxygen should not exceed 5.0 parts per million.

Nitrogen as Free Ammonia.—Nitrogen as free ammonia varies from .002 in Lake Michigan, to 2.32 in the Illinois river at Kampsville, before the opening of the drainage canal. It should not exceed 0.05 parts per million.

Nitrogen as Albuminoid Ammonia.—Nitrogen as albuminoid ammonia varies from .08 in Lake Michigan to .528 in the Illinois river at Kampsville, but should not exceed 0.15 parts per million.

Nitrogen as Nitrites.—Nitrogen as nitrites should be absent.

1 Report of Streams Examination, Sanitary District of Chicago, Chicago, 1902, p. 18.

Nitrogen as Nitrates.—Nitrogen as nitrates should not exceed 0.5 parts per million.

Alkalinity.—Alkalinity varies with the season, and also varies according to the treatment in the filtered water. The raw water will vary from 115 to 400 parts per million, and the treated water from 80 to 300 parts per million.

Spring Waters.

Turbidity.—Spring waters when first issuing from the earth should have no turbidity. They sometimes become turbid on exposure to the air, owing to oxidation of the soluble iron salts and to the loss of carbon dioxide.

Color.—A spring water should have no color when it first issues from the earth. The oxidation of iron salts may produce a color.

Odor.—There should be no odor except in springs containing hydrogen sulphide.

Residue on Evaporation.—The total residue on evaporation varies from 200.8 parts per million, (11.71 grains per gallon) in a spring at Tolono, to 9188.3 parts per million, (536 grains per gallon) in a spring at Creal Springs. A good spring water for domestic use, should not have more than 500 parts per million.

Chlorine.—Chlorine varies from 0.7 parts per million to 2675.0 parts per million. In springs for general use it should not exceed 15 parts per million. For the distribution of chlorine in springs. See plate 4.

Consumed Oxygen.—Consumed oxygen should not exceed 2.0 parts per million.

Nitrogen as Free and Albuminoid Ammonia.—Nitrogen as free and albuminoid ammonia, except in springs where the water becomes turbid on exposure to the air, should not exceed 0.02 parts per million and 0.05 parts per million respectively.

Nitrogen as Nitrites.—Nitrogen as nitrites should be absent.

Nitrogen as Nitrates.—Nitrogen as nitrates should not exceed 2.0 parts per million.

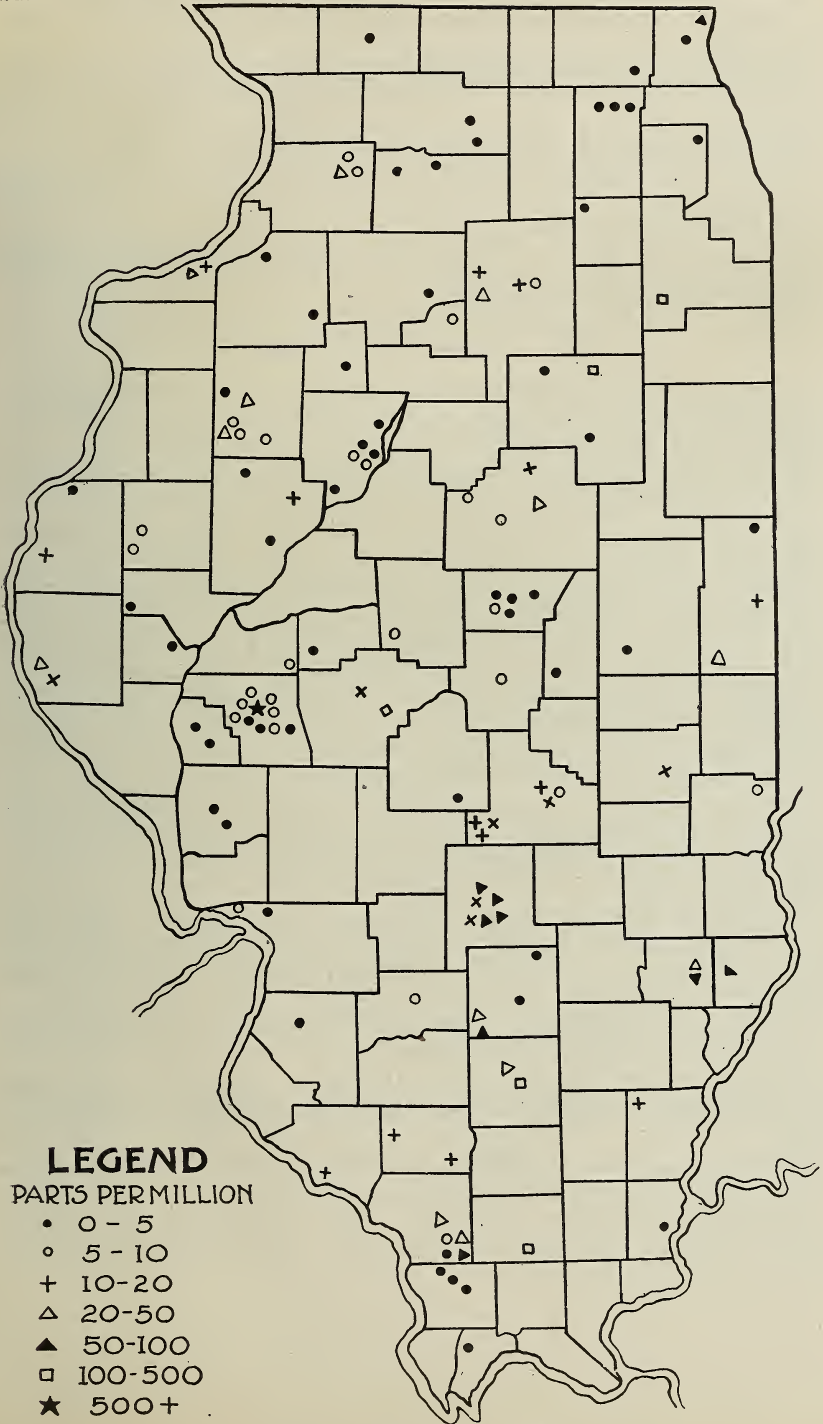
Alkalinity.—Alkalinity may vary from 150 to 500 parts per million. It should not exceed 300 parts per million.

Waters from Shallow Wells in the Drift.

These waters should be clear without color or odor.

Residue on Evaporation.—The total residue on evaporation varies from 160.5 parts per million, (9.36 grains per gallon) in a well at Poag, to 5331.27 parts per million, (311 grains per gallon) in a well at Creal Springs. The residue should not exceed 500 parts per million.

Chlorine.—Chlorine varies from .3 parts per million in a well at Pana, to 310 parts per million in a well at Bloomington. The majority of the waters reported are below 15 parts per million, an amount that should not be exceeded.



Chlorine in water of springs.

Consumed Oxygen.—Consumed oxygen should not exceed 2.0 parts per million.

Nitrogen as Free and Albuminoid Ammonia.—Nitrogen as free and albuminoid ammonia should not exceed 0.02 and 0.05 parts per million respectively.

Nitrogen as Nitrites.—Nitrogen as nitrites should be absent.

Nitrogen as Nitrates.—Nitrogen as nitrates should not exceed 2.0 parts per million.

Alkalinity.—Alkalinity varies from 200 to 500 parts per million, with exceptional cases above or below these limits. The alkalinity should not exceed 300 parts per million.

Waters From Deep Drift Wells.

Turbidity.—The well waters in the drift are clear when first drawn, but almost invariably become turbid on exposure to the air, due to oxidation of the iron salts, and to the loss of carbon dioxide.

Color.—These waters are colorless when first drawn, but may become colored on standing, owing to the oxidation of the iron salts.

Odor.—These waters are usually odorless, but hydrogen sulphide is sometimes found.

Residue on Evaporation.—The total residue on evaporation varies from 199 parts per million, (11.6 grains per gallon) in a well at Havana, to 2606 parts per million, (152 grains per gallon) in a well at Morgan Park. The residue should not exceed 500 parts per million. See plate 5.

Chlorine.—Chlorine varies from 1.0 parts per million in a well at Bradford, to 1,250 parts per million in a well at Hope. The majority of these wells are below 5.0 parts per million in chlorine, and a limit of 15.0 can easily be allowed. See plate 6.

Consumed Oxygen.—Consumed oxygen is variable as in the deep rock wells, and the same limits 5.0 parts per million in the presence of ferrous salts or hydrogen sulphide, and 2.0 parts per million in their absence, may be set.

Nitrogen as Free Ammonia.—Nitrogen as free ammonia varies from 0.3 parts per million in a well at Bristol, to 28.0 parts per million in a well at Marshall. Limits may be placed from 0.02 to 3.0 parts per million.

Nitrogen as Albuminoid Ammonia.—Nitrogen as albuminoid ammonia may reach 0.2 parts per million.

Nitrogen as Nitrites.—Nitrogen as nitrites are frequently found, and may go as high as 0.005 parts per million in waters containing ferrous salts.

Nitrogen as Nitrates.—Nitrogen as nitrates are present in small quantities, usually not exceeding 0.5 parts per million.

Alkalinity.—Alkalinity varies from 200 to 600 parts per million, sodium carbonate frequently being present. The alkalinity should not exceed 300 parts per million.

Waters from Deep Wells in Rock.

Turbidity.—These waters are clear when first drawn, but often become turbid on exposure to the air, due to the oxidation of the iron salts and to the loss of carbon dioxide.

Color.—These waters should be colorless when first drawn but may become colored on exposure to the air, due to the presence of salts of iron.

Odor.—There should be no odor except when hydrogen sulphide is present in occasional samples.

Residue on Evanoration.—The total residue on evaporation varies from 178 parts per million (10.39 grains per gallon) in a well at Hinsdale, to 44,587 parts per million (2,601 grains per gallon) in a well at Fairfield.

In general, it may be said, that the deep rock wells in the northern part of the State contain less residue on evaporation, whereas the deep wells further south are very highly mineralized. A limit of 500 parts per million of residue on evaporation can be used in the northern part of the State, but such a limit is too low for the rest of the State. See plate 7.

Chlorine.—Chlorine varies from 0.6 parts per million (.034 grains per gallon) in a well at Stockton and 0.5 parts per million (.029 grains per gallon) in a well at Amboy, to 11,000 parts per million (647.46 grains per gallon) in a well at Harrisburg. No absolute standard can be set for wells of this class. See plate 8.

Consumed Oxygen.—Consumed oxygen is quite variable. This is sometimes due to the presence of ferrous salts or hydrogen sulphide gas, in which case 5.0 parts per million would not be excessive. In the absence of these substances, consumed oxygen should not exceed 2.0 to 5.0 parts per million.

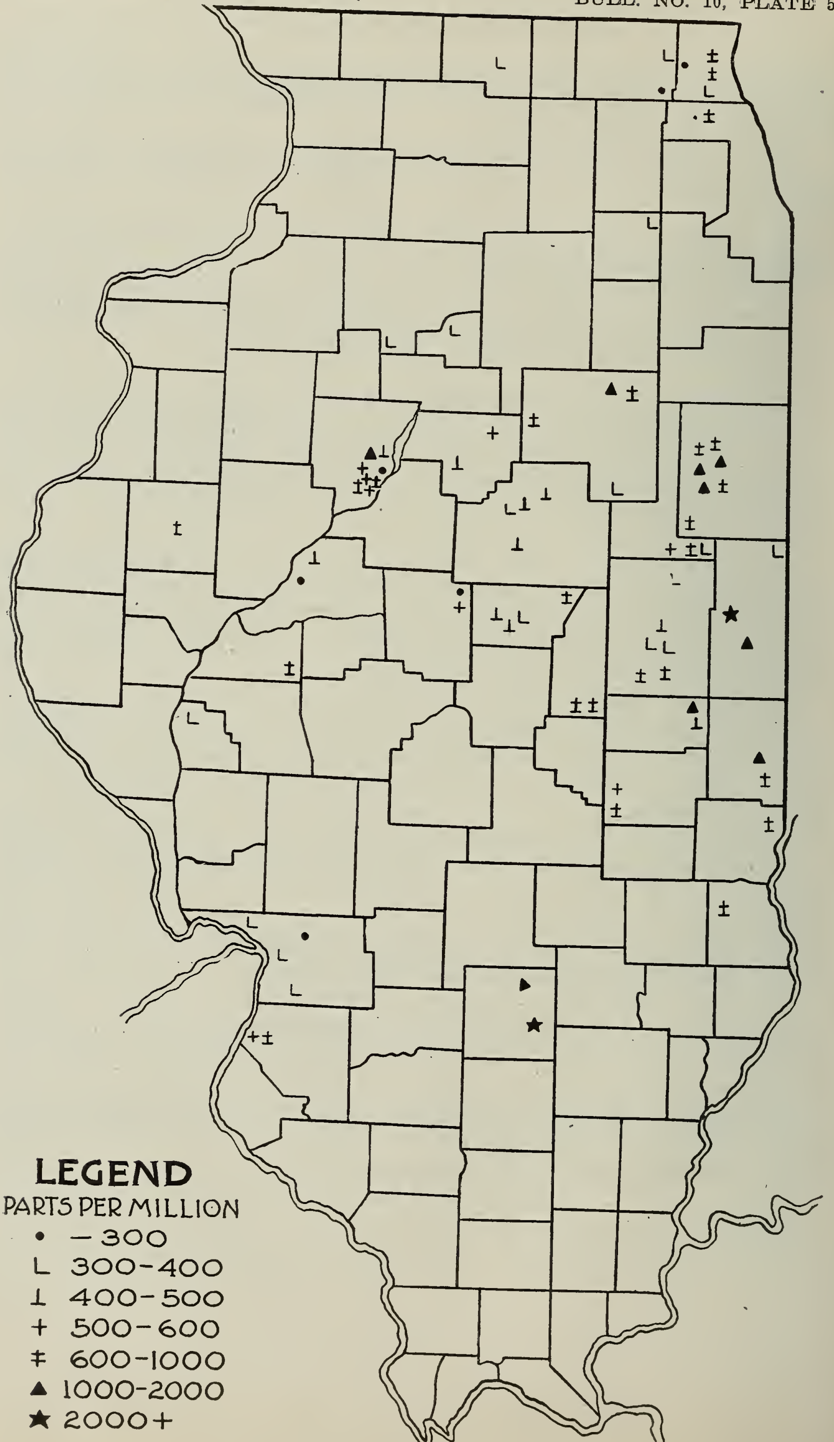
Nitrogen as Free Ammonia.—Nitrogen as free ammonia in waters containing iron salts may be as high as 3.0 parts per million. In the absence of iron salts, the free ammonia should not exceed 0.02 parts per million.

Nitrogen as Albuminoid Ammonia.—Nitrogen as albuminoid ammonia should not exceed 0.15 parts per million.

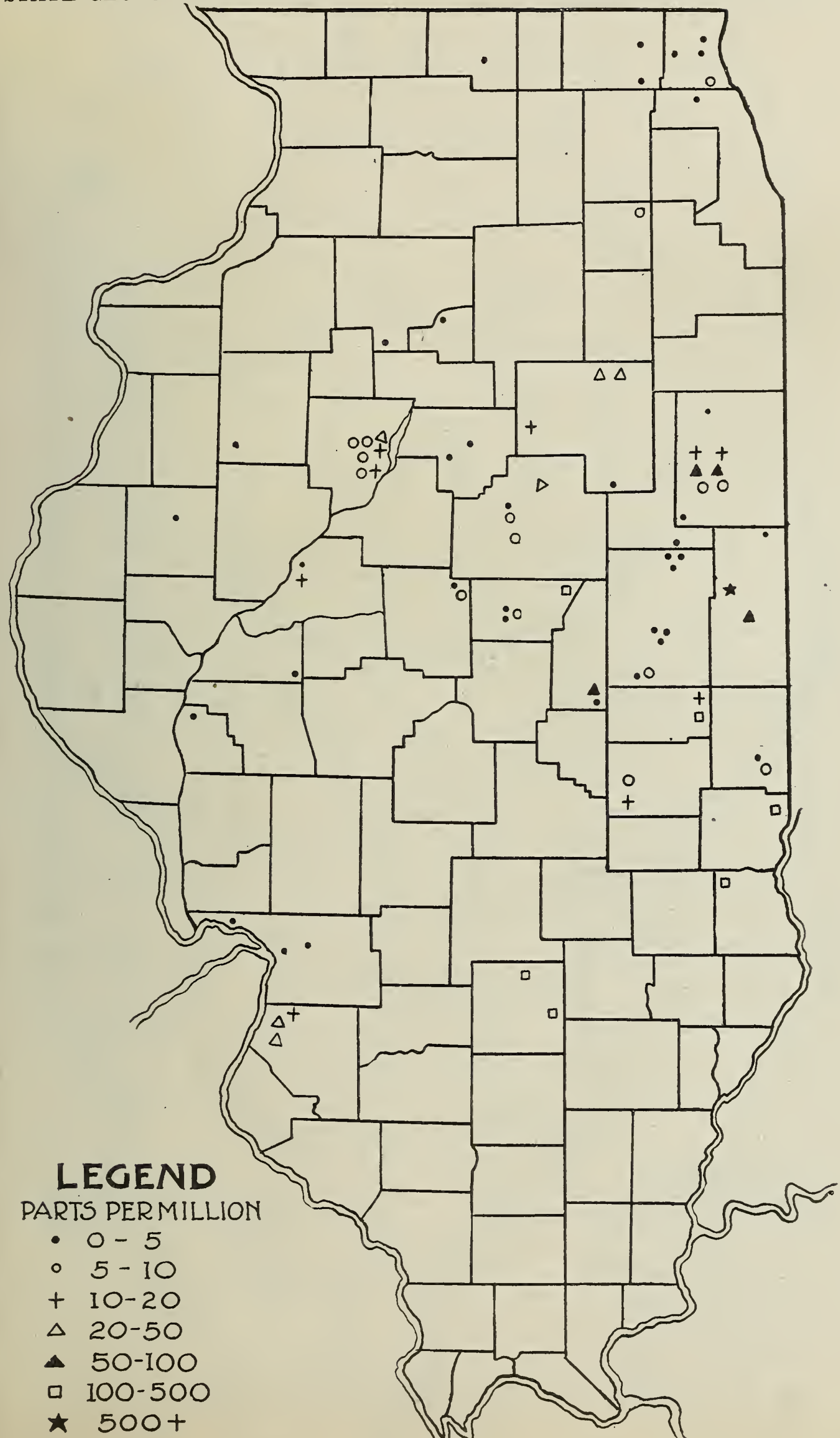
Nitrogen as Nitrites.—Nitrogen as nitrites should be absent except in the presence of iron salts, where the nitrates are reduced.

Nitrogen as Nitrates.—Nitrogen as nitrates should not exceed 0.5 parts per million.

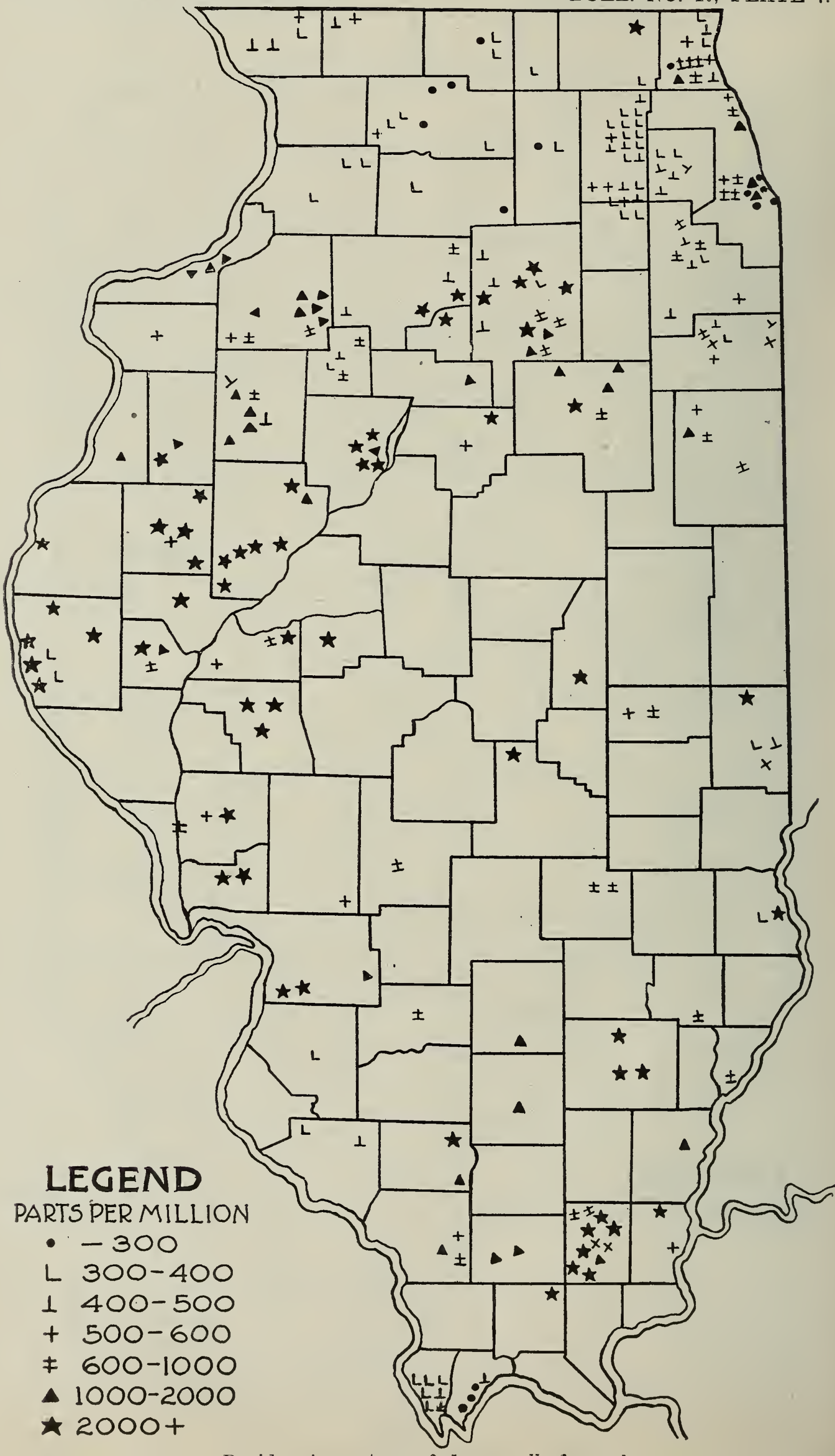
Alkalinity.—Alkalinity varies with the residue on evaporation between the limits 200 to 600 parts per million. In a water for domestic use, it should not exceed 300 parts per million.



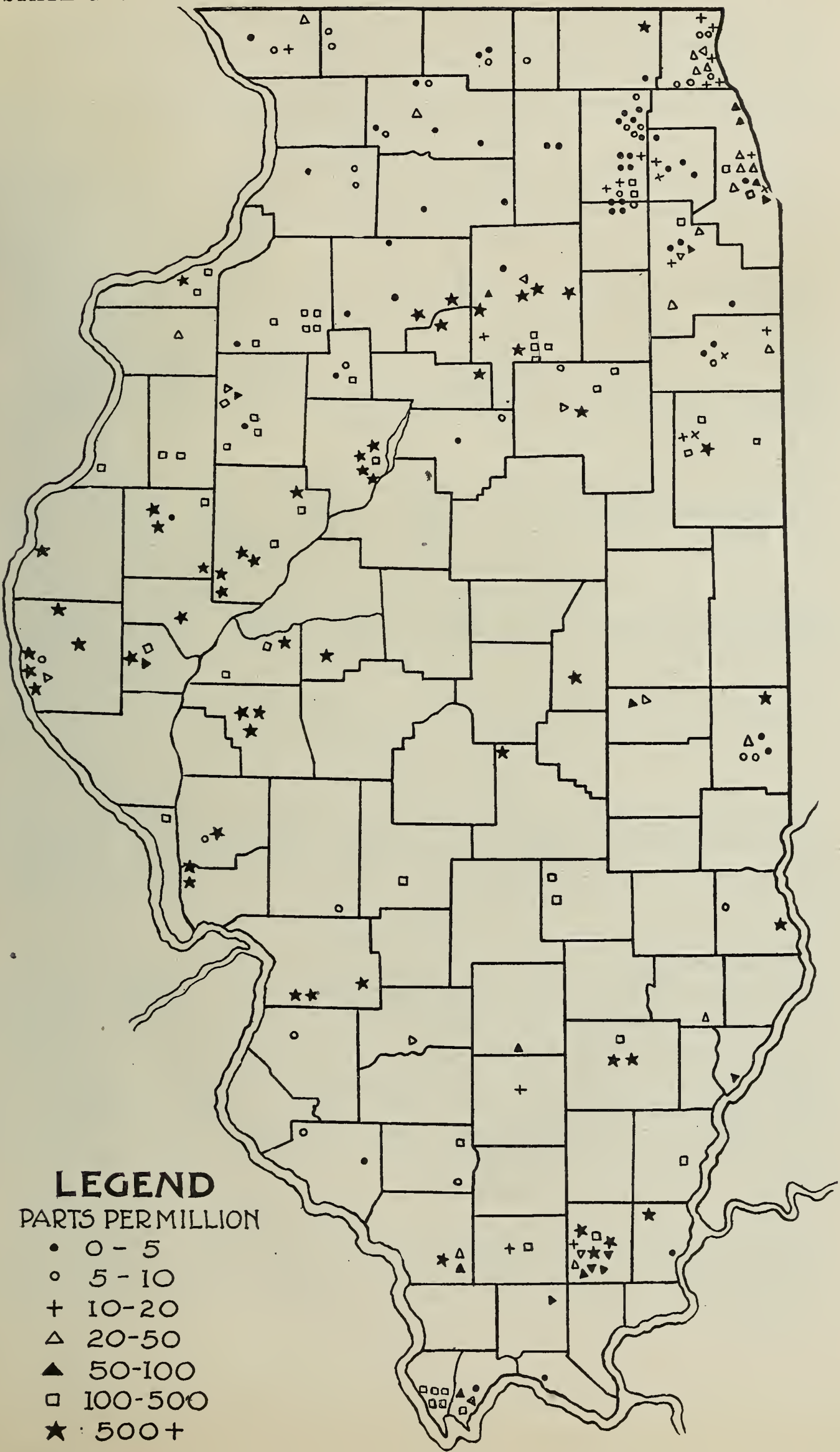
Residue in water of deep drift wells.



Chlorine in water of deep drift wells.



Residue in waters of deep wells in rock.



Chlorine in waters of deep wells in rock.

Summary.

The preceding observations are summarized in the following table:

SUGGESTED STANDARDS FOR INTERPRETATION OF RESULTS OF SANITARY WATER ANALYSIS.

		Lake Michigan[1].	Streams[2].......	Springs and shallow wells......	Deep drift wells.	Deep rock wells.
Turbidity		None	10.	[3]None	[3]None	[3]None ....
Color		None	.2	[3]None	[3]None	[3]None ....
Odor		None	None	None	None	None .....
Residue on evaporation		130.	300.	500.	500.	500.
Chlorine		5.5	6.	15.	15.	5.-100.
Oxygen consumed		1.6	5.	2.	2.-5.[4]	2.-5.[4]
Nitrogen as	Free ammonia	.00	.05	.02	.02-3.	.02-3.
	Albuminoid ammonia	.08	.15	.05	.20	.15
	Nitrites	.000	.000	.000	.005	.000
	Nitrates	.00	.5	2.00	.50	.5
Alkalinity		....	200.	300.	300.	300.
Bacteria per cubic centimeter		500	500	500	100	100
Colon bacillus in one c. c		Absent....	Absent....	Absent....	Absent....	Absent....

ANALYSES OF THE MINERAL CONTENT.

Surface Waters.

The analyses made include samples from only twenty-three towns and from fifteen different streams. No definite conclusions can be drawn from so small a number of analyses. We will be able to furnish better data from the series of analyses now under way under the coöperative agreement with the United States Geological Survey.

Residue on Evaporation.—We have given below the limits found in the few samples analyzed. We note that the smallest amount of solids is found in the water from Lake Michigan, the highest amounts were in samples from the Illinois river at Pekin taken before the opening of the Chicago drainage canal and from a creek at Farmington. The amount of solids range from 137.4 parts per million (7.97 grains per gallon) in Lake Michigan to 519.7 parts per million (29.87 grains per gallon) in the Illinois river at Pekin, and 643 parts per million (37.51 grains per gallon) in the Creek at Farmington.

1 Analyses of water ten miles from shore of Lake Michigan. Streams Examination Sanitary District of Chicago, p. 18.

2 This standard of purity is seldom found in the unfiltered water as all streams are more or less polluted.

3 None when drawn from wells. They may become turbid and develop color on standing.

4 Varies as the waters contain ferrous salts.

Potassium.—Very few separations of sodium and potassium in surface waters have been made.

Sodium.—The smallest amount of sodium 5.6 parts per million was found in Lake Michigan water at Chicago. The highest 62.8 parts per million in a creek at Farmington.

Magnesium.—The lowest magnesium content 5.9 parts per million was found in the Ohio river at Cairo, the highest 51.1 parts per million was in a creek at Farmington. The Illinois river at Havana and the Apple river at Apple river station had 41.5 and 41.2 parts per million, respectively.

Calcium.—The lowest calcium 15.8 parts per million was found in the Ohio river at Cairo, the highest, 107.1 parts per million, in 1900 in the Illinois river at Havana.

Iron.—The lowest iron content of the combined oxides of iron and aluminium, was found in Lake Michigan water, .7 parts per million, the highest, 64.7 parts per million in Kickapoo creek at South Bartonville.

Nitrates.—The lowest nitrates, .8 parts per million of NO_3 was found in Lake Michigan water, a creek at Rockford and Rock river at Rockford; the highest, 14.6 parts per million of NO_3 in the Illinois river at Pekin, due undoubtedly to sewage contamination.

Chlorine.—The lowest chlorine, 2.2 parts per million, was found in the Kankakee river at Kankakee, and the highest 14 to 63 parts per million in the Illinois river and 16.8 parts per million in the Calumet lake at Kensington.

Sulphates.—The lowest sulphates was found in the Apple river, 7.8 parts per million with Lake Michigan next with, 8.4 parts per million, the highest 112.4 parts per million in Calumet Lake.

Silica.—The lowest silica was found in Apple river, 1.8 parts per million, the highest in Kickapoo creek at South Bartonville, 176 parts per million. The high silica of the latter was probably due to suspended matter which was not removed by filtration.

Springs.

The 131 waters analyzed come from eighty-eight towns located in fifty-eight counties. The distribution is shown on plate 4. An inspection of the results show the following interesting items:

Residue on Evaporation.—The residue on evaporation varies from 178.4 parts per million (10.39 grains per gallon) in a spring at Makanda, Jackson county, to 12268 parts per million (713.07 grains per gallon) in a spring at Creal Springs in Williamson county. The majority of the springs contain from 15 to 35 grains per gallon of residue.

Potassium.—Potassium varies from 0.8 parts per million, in springs at Canton and London Mills, Fulton county, and Cobden, Union county, to 29.2 parts per million, in a spring at Cutler, Perry county. By far the greatest number of waters have less than five parts per million of potassium.

Sodium.—Sodium varies from 4.2 parts per million in a spring at Plano, Kendall county, to 1,963 parts per million in a spring at Jacksonville, Morgan county. A majority of the springs have less than fifteen parts per million of sodium.

Magnesium.—The magnesium varies from 8.2 parts per million in a spring at Salem, Marion county, to 591 parts per million in a spring at Claremont, Richland county. A majority of the springs contain more than twenty and less than fifty parts per million of magnesium.

Calcium.—The calcium varies from 17.0 parts per million in a spring in Salem, Marion county, and 17.3 parts per million in a spring at Jacksonville, Morgan county, to 1114. parts per million in a spring at Creal Springs in Williamson county. The majority of the springs contain from 75 to 100 parts per million of calcium.

Iron.—The iron varies from traces in several springs to 997. parts per million in a spring at Sidell, Vermilion county. A large majority of the springs examined contain less than 3.0 parts per million of iron.

Alumina.—The alumina varies from a trace or less than one part per million in several springs to 214. parts per million of Al_2O_3 in a spring at Abingdon, Knox county. A majority contain less than 3.0 parts per million.

Nitrates.—The nitrates vary from less than one part per million in many springs to 65.5 parts per million of NO_3 in a spring at Rock Island, Rock Island county. Most of the spring waters examined contain less than 5.0 parts per million.

Chlorine.—The chlorine varies from .7 parts per millian in a spring at Colchester, McDonough county to 2675. parts per million in a spring at Jacksonville, Morgan county. The majority of the waters contain less than ten parts per million. The variation is shown in plate 4.

Sulphates.—The sulphates vary from less than one part per million in several springs to 7,863 parts per million in a spring at Creal Springs, Williamson county. The amount of sulphates is very variable though about half of the springs have less than fifty parts per million.

Silica.—The silica varies from 4.5 parts per million of SiO_2 in a spring at Cerro Gordo in Piatt county to 68.4 parts per million of SiO_2 at Sidell, Vermilion county. A majority contain from fifteen to thirty parts per million of silica (SiO_2).

Ammonium.—The majority of the springs contain less than .1 parts per million of nitrogen as ammonia. Where they contain more than one part per million it has been considered in calculating the hypothetical combinations. A few springs have shown very noticeable amounts, viz.: Springs at Middlesworth, Shelby county; Plano, Kendall county; Pulaski, Pulaski county; Dudley, Edgar county.

Drift Wells.

We have included in this summary the water from all wells reported as having their sources in the drift, or in the alluvial soil of river bottoms.

Residue on Evaporation.—In the amount of mineral content we find more regularity than in the springs. The residue on evaporation varies from 161 parts per million (9.36 grains per gallon) in a 55 foot well at Poag, Madison county, to 5,349 parts per million (311.9 grains per gallon) in a 24 foot well at Creal Springs, Williamson county. The well at Creal Springs has the characteristics of the springs at that place and should almost be classed with springs. A bare majority of the wells of this class which were analyzed contain less than 500 parts per million (29.2 grains per gallon). If it were not for the fact that many of the waters examined have been sent in because of difficulty with the water in boilers, the relative number of the wells with less than 500 parts per million of residue would be greater. The location of the deep wells in drift and the amount of residue in each is shown on plate 5.

Potassium.—The potassium varies from 0.8 parts per million in a well fifty feet deep at Oquaqua in Henderson county to 102 parts per million in a well at Hope, Vermilion county. As is the case with springs an amount of potassium exceeding 5.0 parts per million is uncommon.

Sodium.—The sodium varies from 4.0 parts per million in a well at Bristol, Kendall county to 742 parts per million in a well at Hope, Vermilion county. The sodium is higher in the drift wells than in the springs. Only a small majority of the wells have less than 45 parts per million of sodium. This is probably due to the frequent occurrence of sodium carbonate waters in the deep drift wells.

Magnesium.—Magnesium varies from 4.3 parts per million in a well at Mt. Vernon, Jefferson county, to 511 parts per million in a well at Creal Springs, Williamson county. A majority contain more than 25 parts per million and less than 45 parts per million of magnesium.

Calcium.—Calcium varies from 18 parts per million in a well at Flanagan, Livingston county, to 604 parts per million in a well at Morgan Park, Cook county. A majority of the wells contain less than 80 parts per million of calcium.

Iron.—The iron varies from traces in several wells, to 11.0 parts per million in a well at Paris, Edgar county. The majority of the wells contain less than 2.0 parts per million, the deeper wells as a rule containing more of the iron.

Aluminium.—The aluminium varies from 0.3 parts per million in wells at Macomb, McDonough county, to 12 parts per million in a well at Urbana, Champaign county. A large proportion of the wells contain less than 1.5 parts per million.

Nitrates.—Nitrates vary from 0.1 parts per million of NO_3 in a well at Shelbyville, to 850 parts per million in a well at Bloomington. The majority of the wells contain less than 2.0 parts per million. Most of the deeper wells contain less than one part per million.

Chlorine.—Chlorine varies from .6 parts per million in a well at Clinton, DeWitt county, to 1,250 parts per million in a well at Hope, Vermilion county. A majority of all the wells have less than 15 parts per million. A majority of the deep wells contain less than five parts per million. (Plate 6.)

Sulphate.—The sulphate varies from 0.2 parts per million in a well at Ashland, Cass county, to 3,338 parts per million in a well at Creal Springs. This well is similar in character to the springs at Creal Springs, and contains an exceptionally large amount of sulphate. While the sulphate is very variable, the greater number of wells contain less than 50 parts per million. The majority of the deep drift waters contain less than 15 parts per million.

Silica.—The silica varies from 1.8 parts per million in a well at Peoria, to 75 parts per million in a well at Creal Springs. A large majority of all the drift wells contain between 15 and 25 parts per million.

Ammonium.—The majority of the shallow wells do not contain sufficient ammonium to make it necessary to consider it in the hypothetical combinations. Ammonium in the deeper wells reaches 41.1 parts per million of NH_4 in a well at Tolono, Champaign county, and a majority of the deeper wells contain more than 1.0 parts per million.

Deep Wells in Rock.

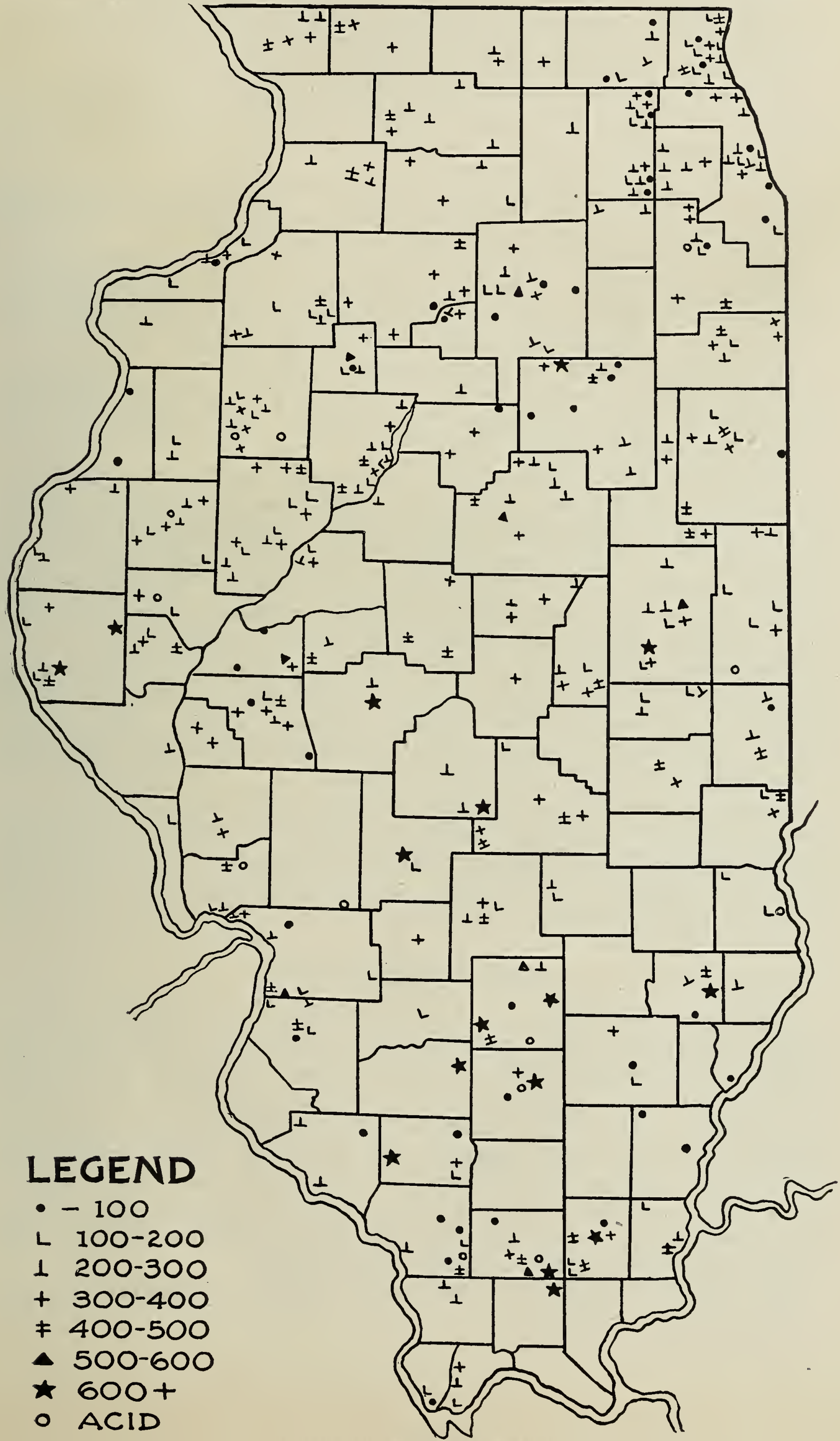
There have been examined 259 wells in rock, sixty-eight of which are reported to us as flowing wells. This distinction has no effect on the quality of the water, and therefore, in compiling our summaries, we have considered all of the deep rock wells to be in the same class. The large majority of the deep rock wells are in the northern part of the State, as indicated on plates 7 and 8.

Residue on Evaporation.—In the residue on evaporation we find a wide variation. From the 209 parts per million (12.13 grains per gallon) in a well 300 feet deep at Chicago, Cook county, it varies to the 44,600 parts per million (2,602 grains per gallon) in a well 825 feet deep at Fairfield in Wayne county. The residue in the deep wells in rock is lowest along the northern border of the State, and increases toward the south, reaching a maximum along a line drawn from Quincy to Ottawa. This is illustrated on plate 7.

Potassium.—The potassium varies from .7 parts per million in a well 174 feet deep at North Chicago, to 332.1 parts per million in a well 275 feet deep in Harrisburg, Saline county. The majority have less than 15 parts per million of potassium.

Sodium.—The sodium varies from 5.6 parts per million in a well 2,000 feet deep at Byron, Ogle county, to 13,548 parts per million in a well 825 feet deep at Fairfield, Wayne county. About one-half of the wells have less than 150 parts per million. One quarter have from 150 to 400 parts per million of sodium.

Magnesium.—The magnesium varies from 1.6 parts per million in a well 90 feet deep at Aurora, Kane county, to 598 parts per million in a well at New Burnside, Johnson county. A large majority have less than 60 parts per million, and only about one seventh of the wells contain more than 100 parts per million of magnesium.



Alkalinity of Illinois waters.

Calcium.—The calcium varies from 1.6 parts per million in a well 280 feet deep at Keensburg in Wabash county, to 1,203 parts per million in a well 900 feet deep in McHenry county. The majority of the wells contain from 60 to 150 parts per million of calcium.

Iron.—Iron varies from traces in many wells to 2,506 parts per million in a deep well at Kell in Marion county. A majority have less than 2.0 parts per million of iron.

Aluminium.—The aluminium varies from traces to 428 parts per million in a well at Kell, Marion county. The majority of the wells contain less than 2.0 parts per million of aluminium.

Silica.—While the silica varies from 2.4 parts per million of SiO_2 in a well at Stronghurst, Henderson county, to 95 parts per million in a well 1,395 feet deep at Bushnell, McDonough county, 80 per cent of the wells contain between 5 and 15 parts per million of SiO_2.

Nitrates.—Nitrogen as nitrates varies from less than .1 parts per million of NO_3 in several wells, to 93 parts per million of NO_3 in a well 250 feet deep at Winnetka, Cook county. The majority have less than 0.8 parts per million of NO_3.

Chlorine.—Chlorine varies from 0.5 parts per million in a well 2,100 feet deep at Amboy, Lee county, to 11,000 parts per million in a well 275 feet deep at Harrisburg, Saline county. About one-half of the wells have less than 50 parts per million. The relative distribution of the chlorine in deep wells in rock is shown on plate 8. Especially noticeable is the increase in the chlorine from the northern border of the State to a maximum along a line drawn from Quincy to Ottawa.

Sulphates.—Sulphates vary from 0.1 parts per million of SO_4 in a well 253 feet deep at Paris, Edgar county, to 2,119 parts per million in a well sixty-two feet deep at New Burnside, Johnson county. The majority of the wells have less than 50 parts per million, and about 40 per cent have less than 20 parts per million of SO_4.

Ammonium.—Only a very small number of the deep rock wells contain less than 0.1 parts per million of ammonium (NH_4). The largest amount observed, 15.9 parts per million, was found in a well 275 feet deep at Harrisburg, Saline county. The ammonium in most of the wells does not exceed one part per million.

GENERAL OBSERVATIONS.

It has been noted that the waters of the State may be divided into two classes, according as they contain sodium carbonate or magnesium sulphate, and the relative location of such waters has been shown on plates 2 and 3. We would further note that the large majority of the waters are alkaline. Only twelve contain enough nitrate, chlorine, and sulphate ions, to more than neutralize the potassium, sodium, ammonium, calcium, and magnesium, leaving some sulphate to unite with iron, to form ferrous sulphate. These waters, it may be noted, are from Abingdon, Camden, Creal Springs, Kell, McComb, Makanda, Maquon, Mt. Vernon, Palestine, Quincy, Sidell, and Staunton.

The relative alkalinity of the waters analyzed, including the acid waters is shown on plate 9.

Of interest to the engineer, is the fact that fifty-nine waters from forty-two towns, contain enough nitrate and chlorine ions to more than neuralize the potassium, sodium, and ammonium ions, so that magnesium chloride appears in the hypothetical combinations, indicating the possibility of corrosion when used in boilers.

BOILER WATERS.

[By S. W. Parr.]

When used for industrial purposes, water is chiefly modified as to its quality by the mineral constituents which are held in solution. This is particularly true in the case of waters which are to be used for steam generation in boilers. The constant removal of pure water in the form of steam leaves a solution of mineral matter more or less concentrated which may result in (a) the formation of scale, (b) the priming or foaming of the water, or (c) the corrosion of the plates and flues.

From an analysis, therefore, of the mineral constitutents we should be able to fairly judge as to the behavior of a water when used for steaming purposes.

Scale.

The formation of scale on the interior of a boiler produces a number of results more or less serious. Scale is a poor conductor of heat; on this account more fuel is required to produce a given result. The added expense from this cause has been estimated as follows.[1]

"A test of steaming efficiency was made at the University of Illinois, on a locomotive having a thickness of scale averaging one-eighth of an inch. After over-hauling and cleaning, a second test was made which showed a heat loss of 10.5 per cent due to the one-eighth of an inch scale.

This agrees closely with a comparison made previously on the same road. The performance sheets of one hundred and twenty locomotives were taken with reference to the consumption of coal for three months next preceding an overhauling and cleaning, and these results were compared with the coal consumption for the three months immediately following such a cleaning, with an average showing for the one hundred and twenty engines, of almost exactly 10 per cent in favor of the scale-free condition.

The annual fuel bill on one of the roads of the Middle West is approximately $1,500,000. Suppose half the locomotives on the system to be clean and working at their proper efficiency, and the other half possessed of the above average thickness of scale; 5 per cent additional cost for fuel would represent an annual tax of $75,000 due to this cause.

Duplicate this expense with another which would represent approximately the cost of overhauling and repairs, chargeable directly to the presence of scale, and we have a sum representing the annual interest at 5 per cent on an investment of $3,000,000. This takes no account of interest on the large number of continuously idle engines under repaid, nor of the cost of accidents or disasters due more or less directly to bad waters."

Aside from the loss of heat there are other serious possibilities. When thus protected from the cooling effect of the water the iron attains a

1 Journal American Chemical Society 28-640.

much higher temperature than would otherwise be the case, thus facilitating the absorption of oxygen and sulphur from the combustion chamber. Under the best possible conditions the deterioration of a fire-box is rapid enough. Overheating of the plates due to poor conductivity rapidly multiplies the rate of deterioration as the result of the change in chemical composition of the iron. The temperature may even reach a point where softening of the iron occurs, thus making possible the blowing out of the metal. Quite as serious a possibility is the cracking of the layer of scale over the parts thus highly heated whereby the water is suddenly admitted under conditions well suited to produce an explosion.

The constituents in solution which are classed as scale producers are silica, iron, aluminium, and salts of calcium and magnesium. The last two are commonly in the form of bicarbonates and sulphates, though they may occur as chlorides and still less frequently as nitrates. Because of the fact that the most common and most evident characteristic is shown by its scaling property, this feature has been of more use than any other to indicate the quality of boiler waters.

Probably the earliest and still perhaps the most frequently used method of classification is based on the hardness or quantity of soap required to precipitate the lime and other scaling constituents in order to bring the water to a "soft" condition. The degree of hardness may be determined, according to Clark's process, by use of a solution of soap reacting upon a solution of calcium chloride of such strength that each gallon should contain the equivalent of one grain of calcium carbonate. Each grain so held in solution is designated as a degree of hardness. But since the English imperial gallon differs from the American gallon, the Clark's scale of hardness differs correspondingly; that is, by the English standard, one degree of hardness is equivalent to one grain of calcium carbonate in 70,000 grains of water, and by the American standard, one degree of hardness is equivalent to one grain of calcium carbonate in 58,381 grains of water. The French and German standards differ again in that they are based on the decimal system, each degree of hardness representing so many parts per 100,000 of water, but it is to be noted that the German degree represents one part of CaO per 100,000 parts of water, while the French degree represents one part of $CaCO_3$ per 100,000 parts of water. It is coming to be a very common practice in this country to consider each part per million or 1 milligram (of $CaCO_3$) per liter as a degree of hardness, and this is more in accord with the method of reporting other data connected with water analysis. These methods of measuring the scaling properties of boiler water convey a somewhat vague and not altogether satisfactory conception of its character. They are based on the same equivalent; namely, that for lime or calcium carbonate, but are made to include all scale-forming ingredients, since they all react to form an insoluble soap. That is, while magnesium and iron unite with the soap solution in the same manner as the lime, they differ as to the relative proportions in which they unite. An application of this unit to the grading of waters is sometimes made for the purpose of designating the relative quality of a water. At a meeting of the American Association of Railway Chemists held at Buffalo, N. Y., May 24-25, 1887, the following schedule was adopted:

Water containing less than 15 grains per gallon of scale-forming ingredients (258 parts per million), good.
From 15 to 20 grains per gallon (258 to 344 parts per million), fair.
From 20 to 30 grains per gallon (344 to 515 parts per million), poor.
From 30 to 40 grains per gallon (515 to 697 parts per million), bad.
Over 40 grains per gallon (697 parts per million), very bad.

While this schedule may serve as a very fair index of the quality of many waters, there are others where such a test would be misleading. For example, it is hardly admissible to call a water "good" which has, say 15 grains to the gallon (258 parts per million) of scaling material when other constituents are present in sufficient quantity to cause foaming. A water cannot be both good and bad at the same time. Again, it is not impossible to have waters with from 15 to 20 grains to the gallon (258 to 344 parts per million) of incrusting matter present while other conditions exist which practically prevent the formation of scale. The diagnosis of a water for boiler use, therefore, is not altogether a simple proposition.

So far as the scaling ingredients alone are to be taken into account, two fundamental facts should be borne in mind; first, what proportion of the lime and magnesia is present as sulphate, and second, are alkaline bicarbonates present in sufficient quantity to precipitate the scaling ingredients in the form of sludge, and thus prevent the formation of scale.

Under the first heading it may be said that the presence of scaling ingredients in the form of calcium or magnesium sulphate is a certain index of a condition which will result in the formation of a hard, dense, cement-like scale. The carbonates of these elements may also be present in much larger amount, and if not accompanied by sulphates, the scale formed would be of a loose open texture, easy of removal in cleaning, but the presence of calcium sulphate exceeding two or three grains per gallon (35 to 50 parts per million) is sufficient to serve as a good cementing material in the production of a hard, flinty scale.

Under the second heading, that of water having an excess of free alkaline bicarbonates, attention is called to the wide distribution of these waters as may be seen by reference to plate 9. Very considerable areas are met with in Illinois, where, at a depth of from 100 to 200 feet this type of water is obtained which has almost an absence of sulphates, all the lime and magnesia are in the form of bicarbonates, and an amount of sodium bicarbonate is present ranging from 2 to 20 grains per gallon, (35 to 350 parts per million) quite sufficient upon the application of heat to throw all of the scale-forming ingredients out of solution.

At least one large area in Illinois has been developed where this water is found at a depth varying from 125 to 165 feet. With the University of Illinois as a center, it extends east and west approximately a total distance of 100 miles, and north and south about 40 miles. At other points, the same type is met with at varying depths from springs to deep rock wells. At Burnside, near Chicago, this same free alkali type occurs again at a depth of 400 feet. At Wenona, 100 miles southwest, it occurs at a depth of 800 feet, but with an additional constitutent of sodium chloride amounting to 80 grains per gallon (1,380 parts per million.) At Carbondale again, 300 miles south of Chicago, the same type is met with, having 15 grains (258 parts per million) of free sodium carbonate, no sulphate of lime, and 120 grains (206 parts per million) of salt per gallon. The depth is 850 feet.

It is readily seen that in use, with this type, the water in the boiler becomes more and more impregnated with free alkali. This very soon becomes a most active precipitating re-agent for the fresh incoming water, the result being that no scale but only sludge forms inside the boiler. Outside the boiler, in the feed water, e. g., this condition does not exist; indeed, the bicarbonate of lime present is in the best possible form for producing scale where only heat is applied, hence such waters scale badly in feed pipes as they approach the hot part of the boiler, as also in feed-water heaters and especially in heaters such as water-backs for household service.

The wide distribution of this type of water and its increasing use for industrial purposes makes any information as to its behavior desirable. Fifteen years ago such waters were so rarely met with as to be practically without recognition. Today they are of such common occurrence as to call for special consideration concerning their characteristics in practical service. When properly handled they have some features of exceptional advantage.

Occasional experiments have been conducted by the writer with a view to making use of that particular property of alkalinity, which results in accumulation of free soda-ash, and sodium hydroxide in the residual water left in the boiler from the continued generation of steam. This residual water, it will readily be seen, is the best possible form of solution for the chemical treatment of the incoming water. If the raw water is allowed to come directly into the boiler, there is set up at once this purifying reaction already mentioned, which results in the precipitation of the scaling ingredients within the generator in the form of sludge. To prevent this reaction within the boiler, and at the same time take advantage of the principle by providing for its operation on the outside, the following procedure was followed.

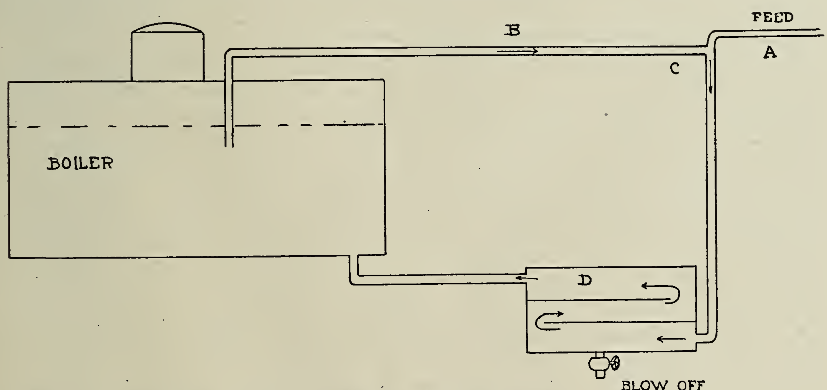


Fig. 1. Experimental Plant for study of boiler water.

The accompanying diagram shows an installation devised by the author and used at the Illinois Central roundhouse at Champaign, Illinois.

The method has been in operation for a number of years with decided advantage over conditions where the same water was fed directly into the boiler. The supply from the pump and feed water heater is forced through the pipe A. By introducing this current into the pipe as at C a jet action is produced which carries into the current the strongly alkaline water from the boiler, thereby reacting with the scale-forming material under the most favorable conditions of heat, etc., to produce complete precipitation of that material. A settling drum is provided, and the water which finally passes from it is free from scale forming material either dissolved or in the form of sludge.

Foaming.

One problem, and that often a serious one, presents itself in connection with this type of water, and that is the tendency to foam. A rather extensive series of tests, made in connection with a locomotive in heavy freight service on the Illinois Central, established the limit for alkaline salts of the sulphate and chloride sort as approximately fifty grains per gallon (860 parts per million); that is, when an ordinary engine tank filled with such water has been all discharged into the boiler, the resulting concentration, bringing the ratio up to three or four times the initial amount of alkali, affords a condition to promote foaming when extra stress of work, such as a heavy load, or greater speed, is imposed upon the engine. This tendency to foam is much enhanced by the presence of free alkali.

It will thus be seen that a consideration of the scaling ingredients alone can hardly be made without taking into account the foaming constitutents. It may be said in general, however, that where free sodium bicarbonate is not present, at least in quantity sufficient to precipitate all of the scale forming material, its character is fairly indicated by the tabulation already given as proposed by the Association of Railway Chemists.

As already stated, a water may be definitely considered as liable to foam in locomotive boilers if the quantity of alkaline salts approaches fifty grains to the gallon (860 parts per million) in amount. Stationary boilers, because of more uniformity of service and greater steam space, may not foam even with a much greater amount of alkali present. Other conditions, however, may greatly modify this assumption. It is altogether probable that if conditions could be maintained within the boiler whereby the water would be free from finely divided particles, the tendency to foam would be lessened if not entirely removed. The opposite condition is certain to exist in all cases where free sodium carbonate is present in the water. Its action is to precipitate the lime and other scaling ingredients immediately upon the entrance of fresh water to the boiler. Hence, under these conditions, foaming is likely to occur with much less alkaline salt present than fifty grains per gallon (860 parts per million). Especially is this the case where the waters are turbid from finely divided matter in suspension. It will sometimes happen that water from streams carrying this fine material will cause foaming where the alkaline salts with free sodium carbonate present will not amount altogether to more than 15 or 20 grains per gallon (258 to 344 parts per million.)

Corrosion.

Corrosion is ordinarily due to free acid accompanying the leachings from coal mine water, the iron pyrites upon oxidizing to ferric oxide liberating sulphuric acid. Magnesium chloride is almost equally corroding, and the nitrates of either magnesium or calcium are active in the same direction. These latter combinations rarely occur, and when found are associated with such large quantities of scaling material that the metal surfaces are kept well covered with protecting scale. However, it may be expected that, in such cases, pitting under the scale may occur due to the localized decomposition of the salts and the liberation of free acid. Gases dissolved in water may cause corrosion. This is often to be observed near the inlet of feed pipes where the dissolved oxygen or carbon dioxide of the incoming feed water furnish the conditions favorable to corrosion.

In general, the waters of the free alkali tvpe which are self purging have by that fact the conditions present which are most active in promoting foaming. By the same conditions, produced artificially by the usual methods of water treatment, either within or outside of the boiler, the chief difficulty encountered is the tendency to foam on the part of the water thus treated. It is not the purpose of this paper to discuss methods of water purification, but rather to present such facts as have a bearing upon the diagnosis of a boiler water, thus enabling one with a reasonable degree of certainty to foretell the probable behavior of the water when used for steaming purposes.

THE MEDICINAL SPRINGS OF ILLINOIS.

[By George Thomas Palmer, M. D.[1]]

Historical Statement.

Until within the past few years, the intelligent study of mineral water therapy, or "crounotherapy," as it is now generally termed, was left almost entirely to the medical men of the old world. The American mineral springs, which were discovered in considerable number early in our national history, received the more or less transitory attention and patronage of laymen and the passing notice of a few physicians, but were developed in such a way as to produce no dependable literature concerning their waters or their therapeutic uses. The majority of the watering places which sprang into prominence, laid their claims for favor on their facilities for social enjoyment, and, with the changes of fashion, they have fallen into decay. Such data as were accumulated concerning the medicinal value of their waters, were unsupported by competent medical observation and frequently bore the earmarks of commercial enterprise. Valuable mineral springs, which merited the serious attention of the better element of the medical profession, were advertised in the flamboyant style of the patent medicine vendor, and physicians turned from them with skepticism or with disgust.

During this same period, while the valuable medicinal waters of America have been denied the medical profession through unfortunate methods of promotion and through lack of real knowledge concerning them, the spas of the old world have maintained their place in European therapy and have drawn a not inconsiderable support from the patronage of the American people. In fact, in foreign countries, mineral water treatment has advanced hand in hand with other therapeutic measures, each year becoming more firmly established and more widely accepted through more careful observation of its efficiency, and this is made apparent through the fact that practically every European text-book or monograph, dealing with therapeutics or the practice of medicine, devotes a reasonable amount of space to the practical application of mineral waters.

The American medical profession have found it to their advantage to borrow extensively from European medical lore, English translations of European monographs finding a ready market in this country, and as a result of the study of such works, the well-read American physician has gained a fair idea of the value of the waters of Carlsbad, Vals, Vichy and other European watering places, although remaining entirely in

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ignorance of the therapeutic applicability of our American waters. It was, in all probability, the interest created by the writings of European medical authorities that prompted our recent awakening in our medicinal springs.

Although it had been contended, in times past, that practically every European water had one or more analogues in the United States, this fact does not seem to have been placed before our medical profession in concrete form until 1901, when Dr. Guy Hinsdale, then of Philadelphia, presented a paper on "Some Analogous European and American Mineral Springs,"[1] before the American Climatological Association. This paper was based upon the extensive investigations of the United States Government, carried out by Dr. A. C. Peale, of the U. S. Geological Survey,[2] and upon the work on "The Mineral Waters of the United States,[3] by Dr. James K. Crook, of New York. In his conclusions, Dr. Hinsdale pointed out that "we have in America the counterpart of nearly all of the springs of Europe," and, further, that we have some springs such as Europe has never seen. The comparative lists published by Dr. Hinsdale at that time, offered information which was indeed surprising to those who read them and who considered their significance. It was shown to that class of prosperous American physicians, of more or less European training, who had been accustomed to send their patients to the spas of the old world for treatment, that, in so doing, they had imposed unnecessary burdens of time and money upon their patrons; it was indicated, to the far sighted, that a day will come when, as in Europe, crounotherapy will be regarded as a part of the liberal education of every American physician, and it was demonstrated that we have at hand, in this country, ready for practical, therapeutic application, a wealth of natural resources. The work of Dr. Hinsdale further suggested that the extensive literature, collected throughout generations by competent European observers at the various spas, may, with slight modifications and allowances, be made applicable to analogous American waters and, hence, of the greatest practical value to the American physician.

Regardless of the revival of interest in our medicinal springs, manifested in the early part of the decade, there remained several practical obstacles to the immediate employment of American waters. First, the clinical data in regard to our various waters were not complete or accurate, while many of the water analyses were faulty if not absolutely worthless. Second, the knowledge of the members of the medical profession of the general principles of crounotherapy was exceedingly meagre, and American medical colleges showed no inclination to relieve the dearth of information. Third, only a small proportion of American springs had such facilities as would assure comfortable residence and the best of treatment to the sick and afflicted. Fourth, the better class of medical men had not seen it to their advantage, to take up their residence at the various springs, and very frequently the class of resident resort physicians was such as to inspire little or no confidence either on the part of the patient or his family physician.

1 Transactions of the American Climatological Association, Vol. XVII, p. 264.
2 Bull. No. 32. U. S. Geological Survey, 1886, Washington, D. C.
3 Lea Brothers & Co., Philadelphia, 1899.

During the past few years, however, the attitude of the American physician toward mineral water treatment has appreciably changed. American watering places have been developed and improved as never before known in the nation's history. Hotels, sanitaria and bathing establishments, easily comparable with those of European spas, have been erected at a large number of the spring resorts. The more recent text-books on the practice of medicine and practical therapeutics, have devoted more attention to crounotherapy than did any of the older works, while several important volumes,[1] devoted exclusively to mineral water and climatic treatment, have been brought forth in American editions. This altered attitude of our general medical literature and the increase in the special literature will better fit the physician to consider crounotherapy sanely and intelligently.

At the same time, a number of the most prominent of American physicians have taken up their residence at the well known springs and the therapeutic possibilities, as well as the limitations of the waters are being determined, by accurate observation. The conscientious work of Peale has rendered the interpretation of mineral water analyses, from a therapeutic standpoint, far more simple, while the United States Government, influenced, perhaps, by Peale and his associates of the United States Geological Survey, has assumed jurisdiction over several of the more important watering places, preserving to the nation these wonderful natural resources and giving assurance of the highest degree of protection to the sufferer who may go to these springs for treatment. Parenthetically, it may be stated, that this government control of mineral springs—which is in accord with the European method—gives promise of becoming the strongest factor in doing away with the quackery and charlatanry of our American resorts and of establishing American springs upon a dignified and substantial basis.

So obvious has been the growth of interest in the subject of our mineral springs, and so essential has it become that our medical profession be placed in possession of the real facts in regard to the therapeutic value of their waters, that Dr. Joseph D. Bryant, President of the American Medical Association, laid special stress upon the matter in his presidential address, delivered at Atlantic City, in June, 1907.[2] After referring at length to the necessity for honest and pure drugs—a matter of recognized vital importance to the profession—he said:

"But little less important than the preceding (honest and pure drugs) in some respects, would be the careful, scientific consideration of the therapeutic value of the abundant springs of our country. There is much, indeed, of special significance regarding their popular use which might well be garnered and put on a sound basis. A scientific coöperation with those in charge of certain baths possessed of traditional specific value might readily guide to improved conditions of significant importance to all those who seek relief. A country as rich as ours in these spontaneous endowments, can well afford, in proper ways, to court the attention and support of the afflicted to the decided advantage of all concerned."

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1 I refer to "The Therapeutics of Mineral Springs and Climates," by I. Burney Yeo, W. T. Keener & Co., Chicago, 1904; "Handbook of Climatic Treatment and Balneology," by Wm. R. Huggard, Macmillan & Co., New York and London, 1906; Solis-Cohen's System of Physiologic Therapeutics, Vol. IX, P. Blakiston's Son & Co., Philadelphia, 1902.

2 Journal of the American Medical Association, June 8, 1907, p. 1909.

The unreasoning apathy and indifference of past years is changing to active and serious interest and, as is usually the case, the interest is manifested first by those who stand highest, in the profession. The fact that the leaders in medicine—the writers of text books and the moulders of professional thought—are awakening to the importance of mineral water therapy, assures a period of active interest in the subject and that, in a not very distant future.

On the eve of this awakening of interest, a consideration of the mineral water resources of the State of Illinois is important and timely, especially since several of the mineral springs of the State have received recognition by writers of national reputation and in view of the fact that there are doubtless many waters fully as worthy of consideration. So far as I am aware, there has been no systematic attempt to collect the data on Illinois medicinal waters except that resulting in a report made before the Illinois State Medical Society,[1] in 1903. In preparing that report, I was compelled to rely almost entirely upon material already published and upon the "literature" published by the few companies that had developed springs in the State. Acting upon a suggestion made by Dr. I. N. Danforth, in his discussion of my report, I have continued the collection of material on Illinois springs until, at the present time, although my records are exceedingly defective, I am in the position to say that we have within the State many waters of unquestionable therapeutic value and the counterparts of many spas and springs which have gained wide repute.

The Mineral Springs of Illinois and Their Classification.

Beginning at the northern end of the State, we find, near Waukegan, in Lake county, the Glen Flora Spring, from which is obtained a water containing about 36.41 grains of mineral matter to the gallon (624 parts per million)—a water very similar in character to the waters of Waukesha, Wisconsin—a resort which is situated but a short distance north and west. This spring is classed by Peale and Hinsdale[1] as belonging to the alkaline calcic-magnesic (or "earthy water") group, 33.22 of the 36 grains of mineral matter being alkaline carbonates.

At Libertyville, in Lake county, is a spring which has been known by several names during its rather varied history. At one time it was called the Purix Spring, and at that time, a number of prominent Chicago physicians expressed confidence in its therapeutic efficiency and organized a company for its sale. So far as we are able to ascertain, the water is alkaline-calcic in character, probably not unlike the waters of the lower end of Wisconsin.

In the southern part of Lake county, near the village of Deerfield, is the Deerlick Spring, producing a light alkaline-saline water, containing 45 grains of mineral matter to the gallon (772 parts per million) of which 26.61 grains (456 parts per million) is sodium sulphate—a water very similar to the Piedmont White Sulphur Springs, of California, Doxtatter's mineral well, of New York, and the Healing Springs,

1 Solis-Cohen's System of Physiologic Therapeutics, Vol. IX, p. 320.

of Virginia. This water has been utilized medicinally to a very large extent, especially in Chicago, and has secured the approval of Drs. John B. Murphy, Joseph Zeisler, W. L. Noble and other physicians of prominence.

At Cary Station, in McHenry county are the ABANA MINERAL SPRINGS, which are not unlike the Salt Sulphur Springs, of West Virginia, and which are used commercially to a very considerable extent. The Abana mineral waters are saline-sulphated calcic-sodic-magnesic carbonated in character, having a total mineralization of 510.78 grains to the gallon, (8,740 parts per million), of which 410.13 grains (7,031 parts per million), are sulphates.

In Cook county there are but two springs reported as being used medicinally, and of these little reliable information can be obtained. The SYLVAN DELL SULPHO-MAGNESIAN SPRING is situated just outside the corporate limits of Chicago, and just north of Oak Park, while the other, the ALCYONE SPRING, is located at Western Springs, where its waters are utilized by a sanitarium.

Near the boundary between Kane and Kendall counties, are two springs of commercial importance—the MONTGOMERY MAGNESIA and the AURORA LITHIA SPRINGS. The waters of both these springs have been sold extensively in Chicago. The Montgomery Magnesia Spring affords an alkaline sodic water containing 38.92 grains of mineral matter to the gallon, (668 parts per million), of which a large part is made up of the carbonates of sodium. The water is very similar to that of the Bladen Springs of Alabama.

Near these springs, however, is another which gives considerable promise of therapeutic value. This is the MIN-NI-YAN SPRING, at Bristol, Kendall county—or, rather a group of springs of that name, giving forth water having an average mineralization of 24.91 grains to the gallon, (427 parts per million), alkaline-saline calcic-magnesic alumino-chalybeate, the water percolating through a large deposit of peat or mud which may be utilized, in time to come, for the peat or mud baths which have been employed so successfully at Carlsbad, and, in our own country, at Mudlavia, Indiana, LasVegas, New Mexico and at the Byron Springs of California.

A short distance from Elgin, in Kane county, is the ZONIAN SPRING, similar in the character of its water to the All Healing Spring, of North Carolina—that is, an alkaline calcic-magnesic water, containing 15.69 grains (269 parts per million) of mineral matter and 12.20 grains (209 parts per million) of alkaline carbonates.

It will be noted that all the foregoing springs, with the exception of DEER LICK, are light alkaline calcic-magnesic, similar in character and in therapeutic applicability to the well known waters of Waukesha, MIN-NI-YAN SPRING having the additional feature of mud or peat deposits.

At Ottawa, LaSalle county, we find a water which materially differs from those of northern Illinois, coming from the SANICULA SPRING. This water contains 170.77 grains (2,928 parts per million) of mineral matter to the gallon, 15.32 grains (263 parts per million) being alkaline carbonates and 139.64 grains (2,394 parts per million) of chlorides. This is an alkaline-saline-calcic-sodic muriated water which is said to be of considerable therapeutic value, and, while much weaker in mineral salts, is of the same general type as the waters of Saratoga.

In Rock Island county are three springs, which are said to have some local reputation, but of which little is really known. These are the ILLINOIS CITY ARTESIAN WELL, at Illinois City; the BLACK HAWK SPRING, at Rock Island, and the RENNA WELLS, at Andalusia.

The water of the AQUA VITAE SPRING, situated near Maquon, Knox county, has been classed by Peale as a sulphated acid water which is calcic-magnesic alumino-chalybeate. This water contains 2.57 grains (44 parts per million) of free sulphuric acid, 55.38 grains (950 parts per million) of iron salts, and 223 grains (3,830 parts per million) of sulphates, with a total mineralization of 258.04 grains (4,481 parts per million. This is a type of water which is unknown in Europe, the analysis of no spa water showing the presence of free acid. Similar to it are the Texas Sour Wells, the Oak Orchard Springs of New York, the Iowa Acid Spring of Iowa and Gaylord and Gulick's Mineral Spring of Pennsylvania.

A rather remarkable sulphated iron water, containing 69 grains (1,183 parts per million), of iron sulphate to the gallon, comes from the SCHUYLER COUNTY SPRING, located in Schuyler county—a water not unlike that of the Aqua Vitae Spring above described, except that it contains no free sulphuric acid—and one which is quite similar to the European spas of Alexisbad, Mitterbad and Parad.

Little is known of the RED AVON SPRING, situated at Avon, Fulton county.

The VERSAILLES SPRINGS, in Brown county, are very similar to the St. Moritz Spring of Switzerland, being calcic-magnesic alumino-chalybeate, with a total mineralization of 192.93 grains, (3,308 parts per million), of which 22.42 grains, (385 parts per million), are iron salts and 167.82 grains, (2,877 parts per million) sulphates. The American analogues of this spring are the Austin Springs of Tennessee, the Cresson Alum Spring of Pennsylvania, and the Eldorado Park Spring of Missouri.

The PERRY SPRINGS, of Pike county, at one time flourished as a summer resort with a hotel capable of accommodating 200 guests, which was crowded each season by visitors from Illinois and a number of surrounding states. One of the springs (No. 1), is alkaline calcic-magnesic in character, containing 38.24 grains (656 parts per million) of mineral matter of which 32.90 grains (564 parts per million) is made up of alkaline carbonates. This water is almost identical with the waters of Waukesha, Wisconsin, not only in the character but also in the amounts of mineral salts. It is consequently, very much like the waters in northern Illinois, first referred to in this paper. In addition to this alkaline spring, there are also at Perry Springs, sulphuretted and ferruginous springs which have attained a local reputation.

Information concerning the CARBURETTED SPRINGS, near Decatur, Macon county, is so meagre that it is of no significance.

The GREENUP or CUMBERLAND SPRINGS, at Greenup, Cumberland county, produce an alkaline-saline sodic water, containing 184.95 grains (3,171 parts per million) of mineral matter to the gallon, of which 113.31 grains (1,943 parts per million) are chlorides and 75.95 grains 1,302 parts per million) alkaline-carbonates. This water is quite similar to those of the Castalian, Glen Alpine and El Paso de Robles Springs of Caliornia, although the latter are thermal waters. Greenup has been developed, to a slight extent, as a resort, and the water has been used commercially.

In Madison county, near Grant Fork, is the DIAMOND SPRING, mentioned by Crook, but concerning which little seems to be known.

The SAILOR SPRINGS, in Clay county (two in number) have been used for resort purposes and are now visited annually by large numbers of people. Crook states that the waters have a local reputation for the treatment of certain digestive and urinary disturbances, but there is no accurate information obtainable.

The AMERICAN CARLSBAD SPRINGS, located at Nashville, Washington county, are badly named, the similarity to Carlsbad being slight. Peale[1] however, has selected this water as the type of the American analogues of the water of Pullna, Bohemia, it being a saline sodic-magnesic water, containing 258.90 grains (4,439 parts per million) of mineral matter with 222.50 grains (3,814 parts per million) of sulphates (chiefly magnesium sulphate) to the gallon.

At Mount Vernon, Jefferson county, are the GREEN LAWN SPRINGS, of which the WASHINGTON SPRING, affording an alkaline calcic-chalybeate water, is very similar to the waters of Massanetta Springs, Virginia, and the Stafford Mineral Springs of Mississippi.

The TIVOLI SPRING, at Chester, Randolph county, and the WESTERN SARATOGA SPRING, near Anna, Union county, are not developed and little is known concerning them.

A mineral spring resort, which promises much for the future, is CREAL SPRINGS, in Williamson county. This resort is well improved, the Ozark hotel and bath houses offering good accommodations, the sulphated chalybeate waters being used extensively in treatment.

The DIXON SPRINGS, near Grantsburg, Pope county, afford a sulphated chalybeate water, reputed to be of considerable value.

The ROSS MINERAL SPRINGS, of Saline county, are mentioned by Peale in his lists of sulphuretted springs.

We find on reviewing the foregoing data, that we have in Illinois more or less valuable types of some of the most important classes of mineral waters. That the character of the individual waters may be the more easily appreciated, the following table has been arranged to show the classification of the principal Illinois medicinal waters, the quantities of the salts contained in them and their American and European analogues, the data being given in grains per gallon and in parenthesis parts per million:

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1 Solis-Cohen's System of Physiologic Therapeutics, Vol. IX, p. 340.

ALKALINE WATERS.	Alkaline carbonates.	Total solids.
Sodic.		
Montgomery magnesia springs[1]	36.61 (627.)	38.92 (667.)
Bladen springs, Alabama	43.99 (754.)	48.88 (838.)
Calcic-Magnesic.		
Glen Flora springs[1]	33.22 (569.)	36.41 (624.)
Perry springs, (No. 1)[1]	32.90 (564.)	38.24 (656.)
White Rock spring, Waukesha, Wis	32.13 (551.)	37.06 (635.)
Zonian spring[1]	12.20 (209.)	15.69 (269.)
Eastman springs, Michigan	13.35 (229.)	13.57 (233.)

ALKALINE-SALINE WATERS. (Sulphated.)	Alkaline carbonates.	Sulphates.	Total solids.
Sodic-Magnesic.			
Deer Lick spring[1]	....	26.61 (456.)	45.00 (770.)
Piedmont white sulphur spring	22.85 (391.)	24.89 (427.)	62.61 (1073.)

ALKALINE-SALINE WATERS. (Chalybeate Sulphated.)	Iron salts.	Alkaline carbonates.	Sulphates.	Total solids.
Min-Ni-Yan spring[1]	5.80 (100.)	14.91 (256.)	3.62 (62.)	24.91 (427.)
Harbin springs, California	1.90 (32.5)	23.63 (405.)	11.36 (195.)	46.53 (798.)
Versailles spring[1]	22.42 (384.)	....	167.82 (2877.)	192.93 (3308.)
Cresson springs, Pa	44.64 (765.)	....	90.28 (1548.)	145.36 (2492.)
St. Moritz, Switzerland	2.39[2] (41.)	....	125.94 (2159.)	172.00 (2949.)
Schuyler county spring[1]	71.80[2] (1231)	....	....	....
Parad, Hungary	66.00[2] (1130)	....	....	....
Creal springs, Dixon springs [1] Iron sul	phate waters;	amounts not	known.	

ALKALINE-SALINE WATERS. (Muriated.)	Alkaline carbonates.	Chlorides.	Total solids.
Sodic.			
Cumberland mineral spring[1]	75.95 (1302)	113.31 (1943)	184.95 (3171)
Howard springs, California	45.56 (781)	111.15 (1906)	156.84 (2689)
Calcic-Sodic.			
Sanicula spring[1]	15.32 (263)	139.64 (2394)	170.77 (2928)
Saratoga (Excelsior) spring	124.34 (2132)	377.65 (6474)	514.75 (8825)

1 Denotes Illinois springs.
2 Iron sulphate.

SALINE WATERS. (Sulphated.)	Sodium sulphate.	Sulphates.	Total solids.
Sodic–Magnesic.			
American Carlsbad springs[1]	53.00 (910)	222.50 (3815)	259.90 (4456)
Pullna, Bohemia	990.40 (16979)	1794.29 (30761)	2010.46 (34467)
Calcic-Sodic-Magnesic.			
Abana mineral spring[1]	....	410.13 (7031)	510.78 (8757)
Salt sulphur spring, West Virginia	....	125.47 (2151)	150.28 (2577)

SULPHURIC ACID WATERS.	Sulphuric acid.	Iron salts.	Sulphates.	Total solids.
Calcic-Magnesic-Chalybeate.				
Aqua Vitae spring[1]	2.57 (44)	55.38 (949)	223.66 (3834)	258.04 (4424)
Pate sour well, Texas	1.32 (22)	69.19 1186)	167.60 (2873)	188.98 (3240)
Gaylord & Gulick's spring, Pa	5.64 (97)	31.65 (543)	76.98 (1320)	85.20 (1461)
Texas sour wells, Texas	7.26 (124)	7.58 (130)	248.84 (4266)	448.98 (7697)

MUD OR PEAT BATHS.

Min-Ni-Yan Spring.[1]
Austro-Hungary: Mehadia, Pystjan and Warasdin-Toeplitz.
France: Aix-les-Bains.
Italy: Acqui.
Sweden: Loka.
United States: Arrowhead Hot Springs, Byron Hot Springs, Byron Spring, El Paso de Robles, Hot Mud Springs, all of California; Mudlavia, in Indiana; Las Vegas Hot Springs, New Mexico.

THERAPEUTICS.

It must be borne in mind that the mineral water analysis is not, in itself, enough to base our conclusions of mineral water application upon. The classification of a water, based upon the published analysis, is exceedingly suggestive of its therapeutic applications, but our therapy is not well founded unless, in addition to the determination of the mineral salts contained in a water, we have some corroborative evidence in the form of clinical data.

If all analyses were correct—as unfortunately, they are not—classification together with a thorough understanding of the therapeutic indications of similar waters, would give us a sound working basis. In the present state of our knowledge of mineral waters, we must bring together all available evidence and, even then, our deductions may prove erroneous.

The following observations on the clinical or therapeutic uses of Illinois medicinal waters are based upon: (1) the analysis; (2) the clinical data obtainable concerning each water; (3) the therapeutic results obtained by using identical or similar waters.

Taking up first, the *alkaline sodic* waters, of which the Montgomery Magnesia Spring is a type, and which depend for their activity upon the sodium carbonates in them, we find first that Montgomery magnesia

1 Denotes Illinois springs.

water is already credited by eastern writers as being an excellent diuretic, especially applicable in rheumatism and the gouty diathesis. Clinical evidence concerning Bladen Springs, Alabama, which produces a water with almost an identical analysis, indicates that this type of water is of value in chronic indigestion, functional disease of the kidneys, diabetes and catarrhal conditions of the urinary tract. Kisch and Hinsdale[1] give, as the indications for a water of this type; gastric catarrh, catarrhal conditions of the respiratory tract, catarrhal conditions of the urinary bladder and of the biliary passages and catarrhal jaundice. In recommending waters of this class for chronic gastritis, these writers suggest that the water should be taken warm and that, instead of the large quantities usually taken in the morning, there should be small quantities at numerous times throughout the day.

The *alkaline calcic-magnesic* waters, of which there are several representatives in Illinois, are best known therapeutically through the wide experience with the waters of Waukesha, Wisconsin. These "earthy waters" are used in chronic cystitis, in nephritis, in tendency to formation of kidney or bladder stone, in bronchial catarrh with profuse secretions, in scrofula and rickets and in any of those conditions in which increased excretion is desired—in the so-called uric acid diathesis, gout, etc. In diabetes mellitus these waters have attained considerable reputation and there is not the slightest doubt but that their use is accompanied by good results. Wilcox, in his recent work on the treatment of disease, questions the advantage of the lighter mineral waters over any good drinking water, but he contends that the free use of water between meals is of importance in the treatment. He adds, incidentally, that the patient will drink the bottled spring waters, or the waters at the springs, more regularly and more systematically than the water at home. This would seem to be an admission that, in his experience, the diabetics using these waters have obtained better results than those not using them. Be this as it may, an exceedingly large number of competent physicians are satisfied that the calcic-magnesic carbonated waters are of distinct benefit to the diabetic and a prolonged residence at Waukesha inclines me to concur in this belief.

Of the *alkaline-saline sodic-magnesic sulphated* waters, Deer Lick is a type. Both in the use of this water and that of the Piedmont White Sulphur Springs of California—its American analogue—experience has taught that benefit may be expected in various digestive disorders, in anemia (particularly of auto-toxemic origin), in rheumatism and in functional disorders of the liver and kidneys. The water is regarded as tonic, markedly diuretic and slightly aperient.

The *alkaline-saline chalbybeate sulphated* waters, of which there are several worthy of note within the State, have very broad therapeutic indications—their therapeutic activity being due to the combination of the alkaline carbonates, the sulphates of magnesium and sodium and the iron salts. The more lightly mineralized waters of this group have been advocated in the treatment of stone of the kidney and, for many years it was erroneously contended that the beneficial effect was due to a direct

1 Solis-Cohen's System of Physiologic Therapeutics, Vol. IX.

solvent action upon the concretions. At the present time this view is not accepted. The benefit derived from the water comes from the marked diuretic action, from the flushing out of the kidneys preventing the formation of new concretions and expelling those of very small size.

These waters are of distinct advantage in chronic hyperemia of the liver, due to sedentary life and habitual constipation, especially when an anemic, toneless condition underlies the clinical manifestations. Kisch[1] advises these waters in diarrhoea, especially when caused by "increased or qualitatively altered secretion of bile."

The waters of this class frequently contain very considerable quantities of sulphuretted hydrogen gas—the so-called "sulphurous waters"—a class long recommended in the treatment of syphilis. It is quite true that the internal use of the saline sulphurous waters, and the frequent sulphurous baths, increase the elimination of the mercurials, either by stimulating the activity of the skin, the gastro-intestinal tract and the kidneys, or, as suggested by Kisch—by forming certain definite chemical combinations with the mercurial salts. However, the idea that the sulphurous waters are in any way specific in syphilis, or that, as formerly contended, they "render apparent latent syphilis and assure diagnosis," is entirely without foundation. In syphilis, the alkaline-saline or saline drinking cures, without sulphuretted hydrogen, will be found quite as effective as when the sulphuretted waters are used. So far, these remarks have been confined to the milder types of this group—of which Min-Ni-Yan is a type—a group which Hinsdale[1] believes may be relied upon for many of the beneficient results obtained from the waters of Franzenbad, Elster, Rohitsch and Bertrich.

Turning to the stronger iron sulphated waters—such as Versailles, Schuyler county, Creal and Dixon Springs, in Illinois—we find ample justification in the literature of Europe for the following conclusions: Such waters are tonic, and astringent and antiseptic or disinfectant to the digestive tract. In chronic diarrhoea and in chronic malarial cachexia they have been found of value, while certain observers feel justified in strongly recommending them in the after-treatment of gastric ulcer, particularly where there have been extensive and exhausting hemorrhages. In anemia—especially when due to conditions of auto-intoxication—these waters in small quantities internally, and used as baths, have been found of value, while in the scrofulous conditions associated with anemia, the results are especially gratifying. Kisch[2] speaks highly of the sulphated chalybeate waters for scrofulous girls at puberty "who do not exhibit erethistic conditions of the vascular system."

Another group of cases in which these waters have been used by certain European clinicians is that in which sexual neurasthenia prevails in the clinical picture, with impotence, pollutions and similar phenomena. In such cases, the baths have a nerve invigorating effect. Used internally, the waters should be taken in small quantity, that the bladder may not be overdistended, and they should be freed from their gases, to prevent undue irritation of the urinary tract.

1 Solis-Cohen's System of Physiologic Therapeutics, Vol. IX.
2 Loc. cit.

In anemia, associated with fatty heart, in the anemia following exhausting disease and in chlorosis, these waters have been frequently recommended, while the iron sulphate baths have been found beneficial in the nervous disorders of the heart. Some writers have claimed their use to be beneficial in exophthalmic goitre, especially when the springs have been so located as to offer advantages of favorable climate.

The *alkaline-saline muriated waters* of which there are two of considerable promise in Illinois, have long been recognized as therapeutically valuable by European observers. Perhaps the largest amount of clinical data has been collected in Ems, but at Saratoga Springs, in our own country, practical experience with this class of waters has been extensive. Used in the form of baths, this water has been of value in chronic muscular and articular rheumatism. In the drinking cures it has been employed in the treatment of chronic passive stasis, such as occurs in heart disease, pulmonary emphysema, general obesity and in drunkards, in blennorrhea of the urethra, in irritation from urinary calculi and in those conditions which bring about vesical hemorrhoids. Europeans favor the use of these waters in chronic enlargement of the spleen especially when due to syphilis, mercurial cachexia, scrofula or rickets.

While there is little or no clinical evidence bearing upon the subject in this country, several competent foreign observers, report good results from these waters in amyloid degeneration of the liver.

In catarrhal jaundice, where no profound changes have taken place the alkaline-saline-muriated waters may be employed at home with benefit; but, in the advanced cases, a sojourn at the springs is indicated.

In the chronic diarrhea of the emaciated and enfeebled, these waters have been employed with great benefit, especially in the presence of intestinal catarrh, but in such cases the water should be used judiciously and only small doses employed.

At Ems—which is a most important European source of this class of water—the results in the treatment of gastric catarrh, with hyperchlorhydria, flatulence and cardialgia have been most gratifying, as they have been in those cases of suspicious bronchial catarrh, where tuberculosis is suspected, but where the bacilli have not been demonstrated.

In gout, benefit is obtained by the internal use of these waters in combination with baths, through the counteracting of the underlying derangement of metabolism, the stimulation of elimination and the local symptomatic relief of joints, muscles and tendons.

Conditions of the urine, with uric acid sediment of moderate amount, yield readily to the proper use of these waters.

The American Carlsbad and the Abana Springs represent the *saline sulphated* or "bitter water" group of springs. Waters of this class depend chiefly for their activity upon the magnesium sulphate and sodium sulphate they contain. It is the purgative property of the former salt, with its stimulating effect upon the secretions of the intestinal canal, its influence in liquefying fecal matter and its pronounced stimulating effect upon the mucous membranes that renders it most effective. It must be borne in mind, however, that the stronger "bitter waters" must be used in very small quantities and that their use must not extend over a great length of time, else, in the opinion of many observers there will occur a reduction in the alubuminous constitutents of the body and impairment of the blood formation, while mild and severe degrees of gastric or intestinal catarrh may result. The Illinois waters of this type may be relied upon for satisfactory results, but, on account of the comparatively small quantities of salts contained in them, they may be taken with less concern, as to these unpleasant features.

No class of mineral waters has been used more extensively by both the medical profession and the people than this, and abundant clinical evidence supports the use of the waters in the following conditions: For the production of free catharsis; in small, repeated doses to overcome fecal impaction, to stimulate the elimination of waste products of bodily metabolism, in pleural and other serous effusions, enteritis and peritonitis to keep the bowels open, in the peculiar diarrhea due to impacted masses of feces in the colon, in acute febrile conditions and in atonic states, in the latter case, being used in association with a good ferruginous tonic. In chlorosis and anemia, dependent upon fecal impaction, this water is of especial value.

In disease of the kidneys, with general anasarca or ascites, such waters are of value, but should not be pushed to the extent of causing violent catharsis, inasmuch as profuse watery stools decrease the diuretic effect.

When we appreciate the great frequency of constipation and of faulty elimination, especially among those of sedentary life and liberal dietary habit, we find a logical reason for the beneficial effects in the use of the saline sulphated waters, even when employed in the absence of intelligent medical advice or supervision. The conditions dependent upon failure to eliminate waste products constitute a group of cases as ill-defined as it is broad, and it is unquestionably true that there is, in connection with well-defined pathologic states, frequently an element of auto-intoxication which, if eliminated, would render the original condition far more amenable to treatment.

European literature contains no reference to the *sulphated acid* waters and, on that account, the American waters of that class have been generally neglected in the past. Hinsdale[1] calls attention to these waters and to the fact that none of this type is to be found in Europe, but he says nothing of their therapeutic uses. Crook,[2] in describing waters of this class, states that they are used clinically and with considerable success as a tonic, alterative and astringent. Locally the waters are employed in conjunctivitis, pharyngitis and in leucorrhea. They have also been used in dyspepsia and intestinal disorders.

As previously stated, there is at least one deposit of mud within the State, through which mineral waters have percolated for many years, and mud of such character as to be readily utilized for *mud baths*. Such baths, properly applied, are extremely useful in relieving inflammatory diseases of the joints, various paralyses and neuralgia. The hot mud packs increase the activity of the skin, adding materially to the general process of elimination.

1 Solis-Cohen's System of Physiologic Therapeutics, Vol. IX.
2 Mineral Waters of the United States, Lea Brothers & Co., 1899.

In presenting these notes on the medicinal waters of Illinois and their indications in the treatment of disease, I desire to lay special stress upon one or two general considerations. First, it is not the belief of any physician who has intelligently studied mineral water therapy that crounotherapy will ever take the place of the rational use of drugs. It will never be more than a branch of general therapy. At the same time, however, we believe that this will constitute an important branch which will render our general methods of treatment far more effective.

In the address delivered by Dr. Bryant before the American Medical Association, quoted in an earlier part of this paper, attention is called to the significance of the extensive popular use of mineral waters and the necessity for prompt action in putting the subject on a sound basis. This can only be done by the members of the medical profession, and a certain amount of the labor will fall, not upon those who are specializing in this field and collecting data for general use, but upon the physicians residing in the vicinity of the individual springs.

We have pointed out that, in Illinois, we have types of the most important mineral springs. So far as comparison of analyses can take us, these waters are capable of employment in the treatment of a wide range of diseases. Clinical observation and intelligent clinical observation will be necessary to substantiate our hypotheses and deductions. It now remains for the medical men of Illinois to do their part and, if this part is done conscientiously and well, there is every reason to believe that, in the spa treatment of disease, which is destined to greater popularity in America, we shall not have to go beyond the boundaries of our own State for the proper resort treatment of our sick and afflicted.

ANALYSES OF

Town	Abingdon	Abingdon	Abingdon	Abingdon
County	Knox	Knox	Knox	Knox
Laboratory number	2287	9738	9739	9159
Date	May 30, 1897	Nov. 12, 1901	Nov. 12, 1901	July 6, 1901
Owner	J. J. Roger	R. Harshberger	R. Harshberger	S. T. Mosser
Depth	Spring	Spring	Spring	1355 feet
Strata		Rock	Rock	St. Peter's
Remarks				
Turbidity				Distinct
Color				.01
Odor				None

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue				1085.6
Loss on ignition				26.4
Chlorine				115.
Oxygen consumed				5.
Nitrogen as Free ammonia				1.472
Nitrogen as Alb. ammonia				.132
Nitrogen as Nitrites				.04
Nitrogen as Nitrates				.48
Potassium K	6.6	2.7	2.1	119.5
Sodium Na	40.1	13.5	14.3	230.7
Ammonium (NH_4)			.1	1.9
Magnesium Mg	25.	38.2	43.9	36.0
Calcium Ca	418.9	101.4	103.6	75.2
Ferrous Fe	166.9	2.4	2.3	.7
Aluminium Al	111.6	4.8	.9	1.8
Silica Si	23.1	12.2	12.2	7.9
Nitrate NO_3	.3	.7	.7	2.1
Chloride Cl	42.	6.6	6.2	115.0
Sulphate SO_4	1989.6	39.7	47.5	393.4

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.6	.03	1.1	.06	1.1	.06	3.5	.20
Potassium Chloride	12.1	.70	4.3	.25	3.2	.19	20.3	1.18
Potassium Sulphate								
Potassium Carbonate								
Sodium Chloride	59.8	3.48	7.6	.44	7.8	.46	173.7	10.07
Sodium Sulphate	53.8	3.13	32.5	1.90	34.6	2.02	500.8	29.05
Sodium Carbonate								
Ammonium Sulphate					.3	.02	6.9	.40
Ammonium Carbonate								
Magnesium Sulphate	124.2	7.24	22.2	1.29	26.9	1.57	62.4	3.62
Magnesium Carbonate			117.4	6.85	134.0	7.81	81.5	4.73
Calcium Sulphate	1,422.8	83.0						
Calcium Carbonate			253.4	14.78	259.0	15.08	187.8	10.89
Ferrous Sulphate	453.1	26.43						
Ferrous Carbonate			5.0	.29	4.8	.28	1.4	.08
Alumina			9.5	.55	1.7	.1	3.4	.2
Aluminium Sulphate	597.5	34.86						
Silica	49.2	2.87	26.4	1.54	26.0	1.52	16.8	.97
Suspended matter								
Total	2,773.1	161.74	479.4	27.95	499.4	29.11	1058.5	61.39
Analyst	C. R. R.		A. D. E.		A. D. E.		A. L. M.	

ILLINOIS WATERS.

	Aledo	Algonquin	Algonquin	Altamont	Altamont	Alton
	Mercer	McHenry	McHenry	Effingham	Effingham	Madison
	10597	3514	9373	4543	10168	2211
	Sept. 3, 1902	April 28, 1898	Sept. 13, 1901	Dec. 29, 1898	Jan. 6, 1902	May 12, 1897
	A. Calhoun	B. B. Stewart	J.M. Pyatts	A. P. Sy	J.K. Wal'ce	L.F. Schu'r
	280 feet	160 feet	80 feet	144 feet	137 feet	80 feet
	Limestone	Drift	Rock	Rock	Sandstone	......
	......	......	Flowing	......	......	......
	Decided	Slight	Distinct	Distinct	Decided	Distinct
	Yellow	.02	.4	.06	Yellow	Yellow
	None	None	None	.000	.000	None
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
	650.	294.	336.4	1026.8	1005.2	414.
	36 8	21.2	20.8	50.	18.4	56.8
	41.	2.5	1.	185.	341.	4.
	5.	3.7	4.1	13.	7.1	1.5
	1.2	.64	2.32	5.4	1.4	.4
	.032	.074	.088	.226	.096	.018
	.001	None	None	None	None	None
	18.0	.45	..do	.1	.24	.04
	7.8	6.0	4.8	11.5	9.5	1.6
	156.5	73.2	21.4	290.0	301.2	15.4
	1.5	.8	3.0	6.9	......	......
	23.5	11.6	13.2	30.0	27.0	35.7
	49.4	22.1	46.9	67.1	36.8	108.6
	1.2	.73	1.8	.5	2.9	5.6
	7.1	.8	32.1	.7	6.6	2.1
	3.0	6.5	24.2	9.	6.1	12.3
	.6	.2	......	.5	1.0	.2
	41.	2.5	1.0	185.0	341.0	4.
	89.	3.6	1.2	12.0	9.3	12.4

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
.9	.05	3.2	.19	......	......	.7	.04	1.7	.09	.3	.02	KNO_3
14.3	.84	5.2	.30	2.1	.12	21.4	1.24	17.0	.99	3.	.17	KCl
......	......	4.4	.26	2.2	.13	......	......	......	......	......	......	K_2SO_4
......	......	......	......	4.8	.28	......	......	......	......	......	......	K_2CO_3
56.6	3.31	......	......	......	......	288.1	16.80	549.5	32.05	4.2	.24	$NaCl$
131.7	7.68	1.7	.10	......	......	17.9	1.05	13.8	.80	18.6	1.08	Na_2SO_4
210.0	12.25	167.3	9.76	49.5	2.88	394.8	23.03	192.5	11.23	18.1	1.06	Na_2CO_3
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2SO_4$
4.1	.24	2.2	.13	8.0	.47	18.3	1.07	......	......	......	......	$(NH_4)_2CO_3$
......	......	......	......	......	......	......	......	......	......	......	......	$MgSO_4$
80.2	4.68	40.5	2.36	46.	2.68	104.4	6.09	94.1	5.49	117.4	6.85	$MgCO_3$
......	......	......	......	......	......	......	......	......	......	......	......	$CaSO_4$
123.6	7.21	55.2	3.22	117.2	6.85	166.2	9.69	91.8	5.36	272.0	15.86	$CaCO_3$
......	......	......	......	......	......	......	......	......	......	......	......	$FeSO_4$
2.6	.15	1.5	.09	3.7	.22	1.1	.06	6.1	.36	11.6	.67	$FeCO_3$
1.4	.08	.2	.01	61.1	3.57	1.4	.08	12.4	.72	4.	.23	Al_2O_3
......	......	......	......	......	......	......	......	......	......	......	......	$Al_2(SO_4)_3$
6.4	.37	12.2	.71	51.5	3.00	19.2	1.11	12.8	.75	26.1	1.52	SiO_2
38.9	2.27	......	......	......	......	......	......	......	......	......	......	......
670.7	39.13	293.6	17.13	346.1	20.20	1033.5	60.26	991.7	57.84	475.3	27.70	
A. D. E.		R. W. S.		A. D. E.		R. W. S.		A. D. E.		C. R. R.		

Analyses of Illinois

Town	Alto Pass	Amboy	Apple River	Arenzville
County	Union	Lee	Jo Daviess	Cass
Laboratory number	4589	2929	9831	60
Date	Jan. 7, 1899	Nov. 10, 1897	Nov. 1, 1901	Oct. 7, 1895
Owner	Will Turk	City supply	I. C. R. R.	J. F. Heffner.
Depth	Spring	2,100 feet	Stream	Artesian
Strata		Rock		
Capacity				
Remarks		Flowing		Flowing
Turbidity	Distinct	Distinct	Decided	
Color	.03	.7		
Odor	None	.000		
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	450.8	349.2		
Loss on ignition	18.8	33.2		
Chlorine	3.5	.5	5.4	
Oxygen consumed	2.5	2.7		
Nitrogen as Free ammonia	.012	.72		
Nitrogen as Alb. ammonia	.042	.018		
Nitrogen as Nitrites	.000	.000		
Nitrogen as Nitrates	.04	.5		
Potassium K	2.4	2.8		
Sodium Na	8.2	13.7	16.1	380.1
Ammonium (NH_4)		.9		
Magnesium Mg	19.5	34.9	41.2	2.9
Calcium Ca	79.2	86.3	54.9	7.9
Ferrous Fe	.2	1.6		2.7
Aluminium Al	.5	7.1		
Silica Si	5.9	6.5	.8	4.4
Nitrate NO_3	.17	2.2		
Chloride Cl	3.5	.5	5.4	114.
Sulphate SO_4	10.4	7.7	.9	9.4
Lithium Li	.02			

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.3	.02	3.6	.21				
Potassium Chloride	4.3	.25	1.1	.06			Trace	Trace
Potassium Sulphate			1.9	.11				
Potassium Carbonate								
Sodium Chloride	2.3	.13			8.9	.52	188.	10.96
Sodium Sulphate	15.4	.89	9.	.52	13.8	.81	14.	.82
Sodium Carbonate	5.5	.32	14.1	.82	20.3	1.19	696.	40.62
Ammonium Chloride								
Ammonium Carbonate			2.5	.14				
Magnesium Chloride								
Magnesium Sulphate								
Magnesium Carbonate	67.6	3.93	125.2	7.30	143.2	8.36	9.1	.53
Calcium Chlorde								
Calcium Sulphate								
Calcium Carbonate	197.8	11.53	212.6	12.39	137.2	8.00	19.7	1.15
Oxide of Iron and Alumimium					2.0	.12		
Ferrous Carbonate	.5	.03	3.2	.18			6.	.34
Alumina	.9	.05	1.9	.11				
Aluminium Sulphate								
Silica	12.6	.73	13.8	.80	1.8	.11	9.3	.54
Suspended matter					69.8	4.08		
Lithium Salts	Trace	Trace						
Total	307.2	17.88	388.9	22.64	397.0	23.19	942.1	54.96
Analyst	R. W. S.		R. W. S.		A. D. E.		A. W. P.	

Waters—Continued.

Ashkum......	Ashland	Ashland ...	Assumption..	Astoria	Atlanta.....
Iroquois......	Cass..........	Cass	Christian	Fulton.....	Logan . . .
9023	6123	7439	9198	3491	3718 ....
Mar. 6, 1901..	Oct. 19, ...	Apr. 30, 1900	July 22, 1901..	Apr. 22, 1898	June 22, 1898
H. G. Morel.	Silas Hexter.	H.S.Sav'ge	W. S. Walker	S. N. Flik'n	E.R.Mason
185	Spring	14 feet......	18 feet	1,650 feet...	147 feet ....
Rock	Clay	Sand.......	....	....	....
....	3 gal. per min.	....	....	....	....
....	Flowing	....	....	....	City sup'ly
Decided......	Distinct......	Decided ...	Decided......	Distinct....	Distinct....
Yellow.......	Yellow.......	Yellow.....	Red....	.03	.2
None	None	None	None	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
682.4	447.2	682.	350.	3,620.2	511.2
64.	16.4	43.	22.	66.0	18.8
295.	8.0	1.	26.	1,085.	4.8
9.2	4.4	14.	3.6	6.1	9.5
2.88	1.6	12.8	.288	.096	3.44
.048	.24	.416	.032	.018	.168
.018	.000	.004	.000	.08	.000
.022	.12	.2	.08	.79	.15
7.3	1.7	3.0	1.3	41.5	3.5
120.8	26.9	36.2	35.1	1,003.7	31.2
3.7	2.0	16.4	.3	....	4.4
43.1	43.1	49.4	25.3	59.4	43.1
44.3	106.4	135.3	60.6	139.1	97.1
5.4	2.3	10.4	8.5	1.1	3.8
1.3	.8	5.1	2.5	.2	.7
2.7	10.2	17.6	12.8	6.5	9.3
.09	.7	.9	.3	3.4	.7
295.	8.0	1.0	26.0	1,085.0	4.8
2.4	4.3	.2	6.3	1,039.4	18.1
....	....	....	....	....	....

Combinations.

Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	
.1	.01	.9	.05	1.5	.09	.6	.03	5.8	.33	1.1	.06	KNO_3..........
13.9	.81	2.7	.16	2.1	.12	2.1	.12	75.0	4.37	5.8	.33	KCl............
....	......	....	......	trace	......	....	......	......	......	......	......	K_2SO_4..........
....	......	....	......	2.3	.13	....	......	......	......	......	......	K_2CO_3..........
306.6	17.88	11.2	.65	......	......	41.2	2.39	1729.2	100.87	3.3	.16	NaCl..........
....	......	6.4	.37	......	......	9.4	.55	997.6	58.19	26.8	1.56	Na_2SO_4..........
....	......	47.2	2.75	83.4	4.86	13.5	.78	......	......	48.9	2.85	Na_2CO_3..........
11.0	.64	....	......	......	......	....	......	......	......	......	......	NH_4Cl..........
....	......	5.3	.31	43.6	2.54	.8	.05	......	......	11.7	.68	$(NH_4)_2CO_3$....
128.0	7.47	....	......	......	......	....	......	......	......	......	......	$MgCl_2$..........
3.0	.17	....	......	......	......	....	......	295.1	17.20	......	......	$MgSO_4$..........
34.0	1.98	150.1	8.75	175.3	10.22	88.2	5.12	......	......	150.1	8.75	$MgCO_3$..........
....	......	....	......	......	......	....	......	......	......	......	......	$CaCl_2$..........
....	......	....	......	......	......	....	......	182.8	10.65	......	......	$CaSO_4$..........
110.5	6.45	265.9	15.51	338.8	19.76	151.8	8.80	213.1	12.43	242.5	14.14	$CaCO_3$..........
....	......	....	......	......	......	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$.
11.2	.65	4.8	.28	21.6	1.25	21.1	1.22	2.3	.13	7.7	.45	$FeCO_3$..........
2.4	.14	1.5	.09	9.7	.56	4.8	.28	.4	.02	1.3	.07	Al_2O_3..........
....	......	....	......	......	......	....	......	......	......	......	......	$Al_2(SO_4)_3$......
5.8	.34	21.4	1.24	36.3	2.12	27.3	1.58	13.8	.80	19.8	1.15	SiO_2..........
....	......	....	......	......	......	....	......	......	......	......	......	....
....	......	....	......	......	......	....	......	......	......	......	......	....
626.5	36.54	517.4	30.16	714.6	41.62	360.8	20.92	3515.1	205.00	519.0	30.23	
A. R. J.		R. W. S.		R. W. S.		A. L. M.		R. W. S.		R. W. S.		

Analysis of Illinois

Town	Atlanta	Atwood	Atwood	Aurora
County	Logan	Piatt	Piatt	Kane
Laboratory number	3719	3164	10603	6584
Date	June 22, 1898	Jan. 12, 1898	Sept. 8, 1902	Dec. 25, 1899
Owner	E. R. Mason	Hanks & Helton	E. Moore	I. Prichard
Depth	147 ft	75 ft	108 ft	90 ft
Strata	Gravel	Clay	Sand	Rock
Capacity				2884 gal. day
Remarks	City supply			Flowing
Turbidity	Distinct	Distinct	Decided	Very slight
Color	.2	.4	Yellow	.01
Odor	.000	.000	.000	.000

	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.
Total residue	272.	874.4	609.2	539.2
Disolved				
Suspended				
Loss on ignition	34.	64.8	73.2	26.4
Disolved				
Suspended				
Chlorine	5.2	85.	2.8	7.
Oxygen consumed	7.5	13.	12.1	2.3
Nitrogen as — Free ammonia	3.52	.044	5.2	.264
Nitrogen as — Alb. ammonia	.152	.4	.246	.032
Nitrogen as				
Nitrogen as — Nitrites	.000	.5	.000	.000
Nitrogen as — Nitrates	.15	4.8	.04	.06
Potassium K	3.6		4.1	7.1
Sodium Na	32.1	75.6	51.7	220.5
Ammonium (NH_4)	4.5		6.7	.3
Magnesium Mg	45.7	71.0	50.8	1.6
Calcium Ca	93.9	117.9	109.5	3.3
Ferrous Fe	3.1		4.6	trace
Aluminium Al	1.3		1.0	.3
Silica Si	8.4	10.2	8.5	3.9
Nitrite NO_2		1.5		
Nitrate NO_3	.7	21.0		.2
Chloride Cl	5.2	85.	2.8	7.0
Sulphate SO_4	23.8	227.4	1.9	.2

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrite			3.0	.18				
Potassium Nitrate	1.1	.06	34.2	2.00			.4	.02
Potassium Chloride	6.0	.35	62.6	3.61	5.9	.34	13.4	.78
Potassium Sulphate					2.4	.14		
Sodium Nitrite								
Sodium Nitrate								
Sodium Chloride	4.1	.23	90.9	5.30			1.0	.06
Sodium Sulphate	35.3	2.06	13.3	.77	2.7	.16	.3	02
Sodium Carbonate	44.7	2.60			117.1	6.83	507.0	29.56
Ammonium Sulphate								
Ammonium Carbonate	11.9	.70			17.8	1.04	.8	.05
Magnesium Sulphate			272.9	15.90				
Magnesium Carbonate	159.2	9.29	55.8	3.26	176.8	10.32	5.5	.32
Calcium Sulphate								
Calcium Carbonate	234.6	13.68	294.5	17.15	273.6	15.96	8.2	.48
Oxide of Iron and Aluminium			17.0	.99				
Ferrous Carbonate	6.4	.37			1.0	.06	trace	
Alumina	2.4	.14			2.0	.12	.5	.03
Silica	17.8	1.04	21.3	1.24	18.0	1.05	8.3	.48
Silicious matter								
Suspended matter					50.3	2.94		
Total	523.5	30.52	865.6	50.44	667.6	38.96	545.4	31.80
Analyst	R. W. S.		R. W. S.		A. D. E.		R. W. S.	

Waters—Continued.

Aurora	Aurora	Aurora	Aurora	Averyville.	Averyville.
Kane	Kane	Kane	Kane	Peoria	Peoria
5198	9461	10724	12826	4885	2254
June 12, 1899.	Oct. 9, 1901	Oct. 28, 1902	Jan. 10, 1905	Apr. 3, 1899.	May 24, 1897
I. & C. S. Co.	W. R. Rees.	W. R. Rees	F. J. Co'ghlin	Ed. Crane.	D. H. Maury
1,457 ft.	2,000 ft. Fox r.	2,240 ft.	1,700 ft.	Illinois riv.	60 ft.
Sandstone	Rock	Rock	Rock	....	Gravel
....	....	....	....	....	....
....	Flowing	Flo. c. sup.	....	....	City sup.
Very slight.	Slight	Distinct	Little	Decided	None
.03	.03	3	.3	Muddy	.03
.000	.000	.000	.000	.000	.000
Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
384.	596.8	472.4	367.6	248.	428.
....	....	....	....	206.8	....
....	....	....	....	41.2	....
23.6	50.4	28.4	....	52.	37.2
....	....	....	....	42.	....
....	....	....	....	10.	....
12.5	143.	122.5	11.5	8.	27.
.6	4.	2.2	6.25	13.5	1.1
.72	.336	.016	.336	.56	.000
.012	.014	.028	.024	.48	.032
....	....	....	....	.304	....
....	....	....	....	.176	....
.000	.001	.000	.007	.02	.000
.16	.08	.14	.12	1.75	2.3
16.0	14.5	14.6	14.4	....	4.1
51.2	86.6	73.6	52.2	12.7	29.3
.9	.4	....	....	.7	....
22.0	11.1	15.4	21.5	8.6	12.1
55.2	68.3	66.2	54.0	38.4	109.3
.3	.4	.8	.8	....	....
.3	15.9	.4	.7	....	.8
4.9	3.4	2.9	3.	....	6.8
....	....	....	....	....	....
.7	.3	.6	.6	7.7	10.2
12.5	143.0	122.5	11.5	8.0	27.
49.5	32.5	31.0	57.7	39.6	71.7

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
....	....	....	....	....	....	....	....	....	....	....	....	KNO_2
1.1	.06	.6	.04	.9	.05	.9	.05	....	....	10.6	.61	KNO_3
26.2	1.53	27.4	1.60	27.3	1.60	25.2	1.47	....	....	....	....	KCl
4.2	.24	....	....	....	....	2.0	.12	....	....	....	....	K_2SO_4
....	....	....	....	....	....	....	....	....	....	....	....	$NaNO_2$
....	....	....	....	....	....	....	....	10.5	.61	5.0	.29	$NaNO_3$
....	....	214.5	12.51	181.7	10.60	....	....	13.2	.76	44.6	2.60	$NaCl$
69.9	4.07	7.1	.41	4.1	.24	83.8	4.89	14.6	.84	41.3	2.40	Na_2SO_4
65.8	3.84	....	....	....	....	57.6	3.36	....	....	....	....	Na_2CO_3
....	....	....	....	....	....	....	....	2.6	.15	....	....	$(NH_4)_2SO_4$
2.4	.14	....	....	....	....	....	....	....	....	....	....	$(NH_4)_2CO_3$
....	....	34.8	2.03	35.4	2 06	....	....	34.9	2.03	55.1	3.21	$MgSO_4$
76.6	4.46	13.9	.81	35.1	2.05	74.8	4.36	34.8	2.03	3.5	.20	$MgCO_3$
....	....	....	....	....	....	....	....	....	....	....	....	$CaSO_4$
137.8	8.03	170.7	9.96	165.	9.62	134.8	7.86	96.	5.59	272.9	15.91	$CaCO_3$
....	....	....	....	....	....	....	....	17.8	.45	0.8	.05	$Fe_2O_3+Al_2O_3$
.6	.03	.8	.05	1.6	.09	1.8	.11	....	....	....	....	$FeCO_3$
.6	.03	30.0	1.75	.8	.05	1.4	.08	....	....	....	....	Al_2O_3
10.5	.61	7.3	.43	6.2	.36	6.4	.37	....	....	14.4	.84	SiO_2
....	....	....	....	....	....	....	....	44.9	2.61	....	....	....
395.7	23.04	507.1	29.59	458.1	26.72	388.7	22.67	259.3	15.07	448.1	26.11	
R. W. S.		A. D. E.		P. B.		J. M. L.		R. W. S.		C. R. R.		

Analyses of Illinois

Town	Batavia	Batavia	Bell Air	Belleville	Belleville
County	Kane	Kane	Crawford	St. Clair	St. Clair
Laboratory number	6843	8936	12635	10805	10983
Date	Feb. 5, 1900	Jan. 2, 1901	Nov. 8, 1904	Dec. 17, 1902	Apr. 4, 1903
Owner	S. E. Keyes	J. D. Kell'r	C. Vaughn	W. Rens'w	F. Voel'gr.
Depth	219 feet	1250 feet	88 feet	Surf. water	Spring
Strata	Limestone	Rock	Sand		
Capacity			1 bbl. min'te		
Remarks		Flowing	Flowing		
Turbidity	Slight	Slight	Distinct	Decided	Decided
Color	.01	.01	.6	Muddy	Brown
Odor	.000	.000	.000	Mouldy	Vegetable.

	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
Total residue	453.6	326.8	632.4	371.6	704.
Loss on ignition	44.4	8.	....	58.4	56.4
Chlorine	3.5	5.	130.5	8.8	3.2
Oxygen consumed	.9	2.3	7.5	24.9	25.6
Nitrogen as Free ammonia	.56	.656	7.400	.072	2.8
Nitrogen as Alb. ammonia	.022	.042	.160	.72	.464
Nitrogen as Nitrites	.000	.000	.000	.000	.004
Nitrogen as Nitrates	.04	.16	.08	.2	.075
Potassium K	4.6	8.7	2.4	....	4.0
Sodium Na	11.6	27.8	164.2	228.7	28.4
Ammonium (NH_4)	.7	.84	9.5	....	3.6
Magnesium Mg	38.9	26.1	22.8	16.7	39.7
Calcium Ca	74.6	59.7	44.9	32.4	110.8
Ferrous Fe	.3	1.2	1.2	....	.9
Aluminium Al	.3	....	1.9	....	3.6
Silica Si	5.	2.6	4.2	5.	10.2
Nitrate NO_3	....	.7	....	.9	.3
Chloride Cl	3.5	5.	130.5	8.8	3.2
Sulphate SO_4	34.8	28.2	1.4	41.0	7.4

Hypothetical

	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.
Potassium Nitrate	......	......	1.1	.06	......	......	......	......	.6	.04
Potassium Chloride	7.3	.42	10.5	.61	4.6	.27	......	......	6.7	.39
Potassium Sulphate	1.7	.10	6.3	.36	......	......	......	......	.6	.04
Sodium Nitrate	......	......	......	......	......	......	1.3	.08	......	......
Sodium Chloride	......	......	......	......	211.7	12.35	14.5	.85	......	......
Sodium Sulphate	35.9	2.09	36.5	2.12	2.1	.12	51.8	3.03	10.7	.62
Sodium Carbonate	......	......	27.4	1.59	185.0	10.79	......	......	57.5	3.36
Ammonium Chloride	......	......	......	......	......	......	......	......	......	......
Ammonium Sulphate	2.6	.15	......	......	......	......	......	......	......	......
Ammonium Carbonate	......	......	2.2	.13	25.3	1.48	......	......	9.6	.56
Magnesium Chloride	......	......	......	......	......	......	......	......	......	......
Magnesium Sulphate	9.7	.56	......	......	......	......	7.5	.44	......	......
Magnesium Carbonate	128.7	7.50	90.9	5.27	79.2	4.62	53.1	3.10	138.2	8.06
Calcium Chloride	......	......	......	......	......	......	......	......	......	......
Calcium Sulphate	......	......	......	......	......	......	......	......	......	......
Calcium Carbohate	186.2	10.86	149.1	8.64	112.1	6.54	96.1	5.61	276.8	16.15
Oxide of Iron and Aluminium	......	......	......	......	......	......	2.2	.13	......	......
Ferrous Carbonate	.6	.03	2.4	.14	2.6	.15	......	......	1.9	.11
Alumina	.5	.03	......	......	3.6	.21	......	......	6.8	.40
Silica	10.6	.61	5.5	.32	8.9	.52	10.6	.62	21.8	1.28
Suspended matter	......	......	......	......	......	......	99.4	5.80	198.8	11.62
Total	383.8	22.35	331.9	19.24	635.1	37.05	336.5	19.66	730.0	42.63
Analyst	R. W. S.		A. R. J.		J. M. L.		P. B.		P. B.	

Waters—Continued.

Belleville ...	Belvidere ...	Bement ...	Berwyn ...	Blackstone ..	Bl'mgton..
St. Clair	Boone	Piatt	Cook	Livingston ..	McLean ...
10250	5977	10430	12159	10191	10772 ....
Feb. 8, 1902	Sept. 29, 1899.	May 30, 1902	Jun. 27, 1904	Jan. 18, 1902 .	Nov. 29, 1902
H. Kircher ..	A. J. Markl'y	B. Dy'rm'n	J.A.O'bri'n	G.E.Powell .	A. D. Loar.
425 feet	1920 feet	206 feet	1570 feet ...	128 feet	Spring.....
Rock	Rock, Pots'm	Rock	....	Sandstone...	....
....	....	....	....	....	....
....	Flo. city sup.	....	City sup...	....	....
Slight........	Slight........	Decided ...	Clear	Clear	....
.2	.02	Yellow	None	Green	....
.000	.000	.000	.000	H_2S..........	H_2S........
Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000c.c.
384.	336.	4510.8	730.8	1845.	601.6
45.6	60.	330.	....	145.2	129.6
9.	7.	2450.	84.	7.	6.
2.	1.1	25.1	1.7	40.1	39.2
.336	.3	4.6	.162	1.28	1.28
.032	.028	.206	.056	.12	.064
.000	.009	.000	.060	.000	.000
.08	.4	.2	.14	.84	.48
....	2.7	23.2	23.7	8.6	4.0
139.1	8.0	1393.8	79.9	159.3	40.1
....	.4	5.9	....	....	2.7
3.5	33.8	67.4	39.4	113.7	79.2
3.8	77.4	129.7	102.1	205.3	65.3
....	.15	....	....	2.6	.4
....	.16	....	....	29.9	.6
4.2	4.8	5.5	14.4	73.	6.3
.3	1.6	.9	2.4	3.7	2.2
9.0	7.	2450.	83.5	7.0	6.
5.5	11.6	1 7	239.7	420.4	37.3

Combinations.

Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	
....	......	2.6	.15	1.5	.09	1.0	.06	6.	.35	3.6	.21	KNO_3 ....
....	......	3.3	.19	43.3	2.53	44.2	2.57	12.	.70	4.9	.29	KCl ....
....	......	....	......	......	......	......	......	....	......	......	......	K_2SO_4 ....
.5	.03	....	......	......	......	......	......	....	......	......	......	$NaNO_3$ ....
15.0	.87	8.9	.52	3543.	206.68	103.0	6.01	2.1	.12	6.1	.36	NaCl............
8.2	.48	13.9	.81	......	......	121.1	7.6	488.9	28.52	55.2	3.22	Na_2SO_4..........
286.6	16.71	....	......	......	......	......	......	....	......	46.5	2.71	Na_2CO_3 ....
....	......	....	......	17.5	1.02	......	......	....	......	......	......	NH_4Cl..........
....	......	1.4	.08	......	......	......	......	....	......	......	......	$(NH_4)_2SO_4$.....
....	......	....	......	......	......	......	......	....	......	7.2	.42	$(NH_4(_2CO_3$ ....
....	......	....	......	265.1	15.47	......	......	....	......	......	......	$MgCl_2$ ....
....	......	1.5	.09	......	......	182.4	10.63	112.5	6.57	......	......	$MgSO_4$ ....
12.2	.71	116.5	6.80	......	......	9.7	.56	316.9	18.48	275.5	16.07	$MgCO_3$..........
....	......	....	......	141.9	8.28	......	......	....	......	......	......	$CaCl_2$ ....
....	......	....	......	2.4	.14	......	......	....	......	......	......	$CaSO_4$ ....
8.9	.52	193.4	11.28	194.7	11.35	256.8	14.98	512.9	29.92	163.2	9.52	$CaCO_3$..........
.6	.03	....	......	2.4	.14	2.5	.14	....	......	......	......	$Fe_2O_3+Al_2O_3$.
....	......	.3	.02	......	......	......	......	5.5	.32	.8	.05	$FeCO_3$..........
....	......	.3	.02	......	......	......	......	56.4	3.29	1.2	.07	Al_2O_3..........
9.0	.52	10.3	.59	11.8	.69	14.4	.84	15.6	.92	13.4	.78	SiO_2 ....
....	......	....	......	48.0	2.80	......	......	....	......	......	......	....
341.	19.87	352.4	20.55	4271.6	249.19	735.1	42.85	1528.8	89.19	577.6	33.70	
A. D. E.		R. W. S.		A. D. E.		A. D. E.		P. B.		P. B.		

Analyses of Illinois

Town	Bloomington	Bluffs	Bradford	Brereton
County	McLean	Scott	Stark	Fulton
Laboratory number	2461	13570	5517	13710
Date	July 19, 1897	Sept. 19, 1905	July 26, 1899	Oct. 30, 1905
Owner	N. Read	Ven. Cons. Co.	C. E. Prouty	Mon Coal Co.
Depth	43 feet	69 feet	2050 feet	948 feet
Strata	Drift	Drift	Sandstone	Rock
Capacity				
Remarks				
Turbidity	Slight	Decided	Distinct	Clear
Color	.2	Yellow	.05	.000
Odor	.000	.000	.000	.000

		Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c' c.	Milligrams per 1,000 c. c.
Total residue		2,802.	355.	1,404.	2,791.
Loss on ignition		268.		39.6	
Chlorine		310.	2.40	495.	1,100.0
Oxygen consumed		5.3	2.0	3.8	9.6
Nitrogen as	Free ammonia	.008	.016	1.6	.960
	Alb. ammonia	.154	.038	.034	.040
	Nitrites	.06	.000	.000	.013
	Nitrates	192.	.08	.04	.16
Potassium		3.0	1.6	12.3	17.9
Sodium Na		147.3	7.7	394.2	1,016.2
Ammonium (NH_4)				2.	
Magnesium Mg		168.1	35.2	67.4	14.8
Calcium Ca		421.9	82.4	74.5	30.9
Ferrous Fe		2.1	2.9	2.0	.5
Aluminium Al		.4	1.2	2.0	.3
Silica Si		7.8	8.8	7.7	2.0
Nitrate NO_3		849.6	.3	.17	.7
Chloride Cl		310.	2.4	495.0	1,100.
Sulphate SO_4		478.8	16.8	233.5	339.4

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	7.7	.45	.6	.04	.3	.02	1.1	.06
Potassium Chloride			2.7	.16	23.2	1.35	33.4	1.95
Sodium Nitrate	544.3	31.75						
Sodium Chloride			1.8	.11	797.6	46.52	1,788.8	104.35
Sodium Sulphate			21.5	1.26	248.2	14.48	502.1	29.29
Sodium Carbonate							340.6	19.87
Ammonium Sulphate					7 3	.42		
Ammonium Carbonate								
Magnesium Nitrate	535 6	31.24						
Magnesium Chloride	318.0	18.55						
Magnesium Sulphate			2.9	.17	76.0	4.43		
Magnesium Carbonate			120.5	7.03	181.6	10.59	51.7	3.02
Calcium Chloride	597.8	34.87						
Calcium Sulphate	678.3	39.56						
Calcium Carbonate	16.8	.98	206.1	12.03	186.1	10.85	77.2	4.50
Ferrous Carbonate	5.4	.31	6.0	.35	4.2	.24	1.1	.06
Alumina	.7	.04	2.3	.13	3.8	.22	.6	.04
Silica	16.5	.96	18.7	1 09	16.3	.95	4.4	.26
Total	2,721.1	158.71	383.1	22.37	1,544.6	90.07	2,801.	163.4
Analyst	R. W. S.		J. M. L.		R. W. S.		J. M. L.	

Waters—Continued.

Bristol Sta...	Bristol Sta...	Bristol Sta.	Brushy	Bureau	Bushnell ..
Kendall	Kendall	Kendall ...	Saline	Bureau.....	McDon'gh
5518	5519	5520	13400	9099	2625 ....
July 29, 1899.	July 29, 1899.	July 29, 1899	July 31, 1905.	May 2, 1901	Sept. 1, 1897
I. Prichard...	I. Pritchard..	I. Prichard.	I. Hutchins'n	John Crain	E.N. Arm'g
117 feet	16 feet........	18 feet......	211 feet.......	300 feet.....	45 feet......
Rock	White sand..	Rock	Rock	Rock	Sand.......
....	....	1 gal. a min	....	....	....
....	....	Flowing...	....	Flowing...	....
Decided	Decided	Decided ...	Clear	Clear	Slight......
.3	.5	1.	.000	.000	.10
.000	.000	.000	.000	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
335.6	374.4	319.2	1,456.8	2,093.2	636.8
55.6	52.6	41.6	....	14.	32.8
3.8	5.6	4.6	267.5	790.	13.0
3.8	3.7	3.80	2.55	8.2	1.6
.192	.224	.2	1.600	.784	.336
.05	.04	.04	.056	.008	.056
.000	.000	.000	.000	.002	.020
.08	.04	.04	.120	.078	1.20
2.1	2.7	1.8	8.8	2.9	1.2
7.8	5.6	4.0	344.1	757.9	22.7
.2	.3	.25	2.1	1.0	....
15.5	35.2	29.6	52.1	6.9	49.7
74.9	80.3	71.8	104.5	7.9	125.4
2.2	3.2	4.9	1.3	1.5	1.0
.6	1.0	1.0	3.6	1.3	3.6
7.52	8.8	7.9	10.1	.9	11.8
.3	.2	.2	....	.3	5.3
3.6	5.4	4.6	267.5	790.	13.
17.5	39.7	35.2	381.0	170.4	166.9

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
.6	.03	.3	.02	.3	.02	....	......	.5	.03	3.2	.19	KNO_3 ....
3.5	.20	5.0	.30	3.4	.20	16.8	.98	5.1	.29	......	......	$K\,Cl$ ....
....	......	....	......	......	......	....	......	......	......	4.6	.26	$Na\,NO_3$ ....
3.3	.19	5.1	.30	4.9	.28	428.2	24.98	1301.1	75.46	21.4	1.46	$Na\,Cl$ ....
20.1	1.17	11.2	.65	6.6	.38	542.0	31.61	252.0	14.60	40.3	2.35	$Na_2\,SO_4$ ....
....	......	....	......	......	......	....	......	207.7	12.04	......	......	$Na_2\,CO_3$ ....
.7	.04	1.1	.06	.9	.05	7.7	.45	......	......	......	......	$(NH_4)_2\,SO_4$....
....	......	....	......	......	......	....	......	2.6	.15	......	......	$(NH_4)_2\,CO_3$....
....	......	....	......	......	......	....	......	......	......	......	......	$Mg\,NO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Mg\,Cl_2$ ....
4.3	.25	39.3	2.29	37.5	2.19	10.1	.59	......	......	174.5	10.18	$Mg\,SO_4$ ....
51.0	2.97	95.1	5.54	76.6	4.46	174.1	10.16	24.1	1.40	48.6	2.83	$Mg\,CO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Ca\,Cl_2$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Ca\,SO_4$..........
187.1	10.91	200.9	11.71	179.3	10.45	261.1	15.23	19.6	1.12	313.2	18.26	$Ca\,CO_3$..........
4.5	.26	6.6	.38	10.1	.58	2.7	.16	3.2	.18	2.4	.13	$Fe\,CO_3$.. ......
1.2	.07	1.9	.11	1.9	.11	6.9	.40	2.5	.14	6.9	.40	$Al_2\,O_3$ ....
16.0	.93	18.8	1.10	16.8	.97	21.6	1.26	4.0	.23	25.0	1.46	$Si\,O_2$............
292.3	17.02	385.3	22.46	338.3	19.69	1,471.2	85.82	1822.4	105.64	640.07	37.52	

R. W. S.	R. W. S.	R. W. S.	J. M. L.	A. R. J.	R. W. S.

Analysis of Illinois

Town	Bushnell	Byron	Byron	Cairo
County	McDonough	Ogle	Ogle	Alexander
Laboratory	3570	9074	9235	4879
Date	May 12, 1898	Apr. 13, 1901	July 29, 1901	Mar. 29, 1899
Owner	J. H. Johnson	W. I. Caldwell	W. L. Campb'll	W. Halliday
Depth	1351 feet	2000 feet	2000 feet	Ohio river
Strata	Sandstone	Rock	Rock	
Capacity				
Remarks	City supply	City supply	City supply	City supply
Turbidity	Distinct	Very slight	Very slight	Decided
Color	.04	.02	.01	F.10
Odor	.000	.000	.000	.000

	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per. 1000 c. c.	Milligrams per 1000 c. c.
Total residue	2,042.	276.8	277.2	542.
Dissolved				94.
Suspended				448.
Loss on ignition	48.	51.2	28.8	36.
Dissolved				16.
Suspended				20.
Chlorine	392.	4.2	6.	3.2
Oxygen consumed	5.6	1.9	1.2	15.2
Nitrogen as. Free ammonia	1.36	.048	.032	.026
Nitrogen as. Alb. ammonia	.022	.034	.024	.4
Nitrogen as. Nitrites	.000	.000	.000	.018
Nitrogen as. Nitrates	.25	.08	.12	.8
Potassium K	26.1	4.9	5.6	
Sodium Na	475.6	6.3	5.6	7.9
Ammonium (NH_4)	1 55	.06		
Magnesium Mg	49.6	36.2	33.4	8.0
Calcium Ca	112.0	54.4	57.1	19.0
Ferrous Fe	3.8	.3		
Aluminium Al	9.4	.16		
Silica Si	44.7	4.2	2.3	
Nitrate NO_3	1.1	.3	.6	3.4
Chloride Cl	392.00	4.1	6.0	3.2
Sulphate SO_4	680.8	13.4	13.3	15.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Lithium Chloride								
Potassium Nitrate	1.8	.10	6	.03	.9	.05		
Potassium Chloride	48.5	2.83	8.6	.50	10.0	.58		
Potassium Sulphate			.4	.02				
Sodium Nitrate							4.5	.26
Sodium Chloride	608.0	35.46			2.1	.12	5.3	.30
Sodium Sulphate	729.2	42.53	19.5	1.13	14.9	.87	14.6	.85
Ammonium Chloride								
Ammonium Sulphate	6.0	.35						
Ammonium Carbonate			.2	.01				
Magnesium Chloride								
Magnesium Sulphate	228.0	13.29			4.0	.23	7.3	.42
Magnesium Carbonate	16.4	.95	125.8	7.30	112.8	6.57	21.4	1.23
Calcium Chloride								
Calcium Sulphate								
Calcium Carbonate	279.8	16.32	135.9	7.88	142.9	8.33	47.4	2.75
Oxide of Iron and Aluminium					3.8	.22	23.6	1.38
Ferrous Carbonate	8.0	.46	.6	.03				
Alumina	17.8	1.04	.3	.02				
Silica	13.2	.77	9.0	.52	5.0	.29	7.3	4.20
Clay and Silicious Matter							103.5	6.03
Total	1,956.6	114.1	300.9	17.44	296.4	17.26	234.9	17.42
Analyst	R. W. S.		A. L. M.		A. D. E.		R. W. S.	

Waters—Continued.

Cairo	Cairo	Cairo	Cairo	Cairo	Cairo ......
Alexander ..	Alexander ..	Alexander.	Alexander ..	Alexander.	Alexander.
3168	3597	3693	3694	3695	4880.........
Jan. 17, 1898..	May 19, 1898..	June15, 1898	June 15, 1898.	June 15, '98.	Mar. 29, 1899
E. Halliday..	W. Halliday.	J.S.R'ard'n	J. S. Reardon	J. S. R'rd'n	W.P. H'd'y
824 feet.......	806 feet.......	1040 feet....	840 feet.......	824 feet.....	811 feet.....
Rock	....	Rock	Sandstone....	Sandstone .	Flint bould
....	....	70 gal. pr m	350 gal. per m	70 gal. min.	....
Flowing	Flowing.....	Flowing...	Flowing	Flowing...	Fowing....
Distinct	Slight	None	None	None	Distinct....
.15	.02	..do	..do	..do	.03
.000	.000	..do	..do	..do	.000
Milligrams per 1,000 c. c.	Milligrams per 1.000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
347.2	453.6	350.8	444.	358.4	350.8
......	......	......	......	......	......
......	......	......	......	......	......
14.8	52.8	26.4	37.6	19.2	26.
......	......	......	......	......	......
......	......	......	......	......	......
111.	161.	118.	158.	134.	117.
2.	1.5	1.4	1.3	1.4	1.1
.41	.36	.36	.28	.32	.28
.01	.02	.006	.008	.008	.01
.000	.000	.000	.000	.000	.000
.5	.3	.05	.05	.05	.1
8.4	8.6	8.7	11,1	7.2	......
68.4	83.3	58.9	81.3	56.1	71.4
.5	.46	.5	.4	.4	.3
12.8	13.8	13.	14.	12.9	12.7
45.4	52.9	46.1	52.9	45.1	44.4
.28	.35	.7	.42	.49	......
.45	.2	.3	.16	.3	......
4.	4.7	4.1	4.9	3 05	......
2.2	1.3	.2	.2	.2	.4
111.	161.	118.0	158.	134.	117.0
17.3	16.1	17.6	17.4	17.4	18.2

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
......	......	.5	.03	......	......	......	......	......	......	......	......	Li Cl............
3 6	.21	2.2	.13	.4	.02	.4	.02	.4	.02	......	......	KNO_3........
13.3	.78	14.7	.86	16.3	.94	20.7	1.20	13.4	.77	......	......	K Cl............
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4..........
......	......	......	......	......	......	......	......	......	......	.6	.03	$Na\ NO_3$ ....
172.5	10.05	211.7	12.34	149.6	8.72	206.6	12.04	142.5	8.30	181.1	10.56	Na Cl ....
1.9	.11	......	......	......	......	......	......	......	......	......	......	$Na_2\ SO_4$ ....
......	......	1.4	.08	1.5	.08	1.2	.07	1.2	.07	.9	.05	$NH_4\ Cl$ ....
1.9	.11	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2\ SO_4$....
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2\ CO_3$....
......	......	54.4	3.17	24.7	1.44	29.4	1.71	50.8	1.95	8.8	.51	$Mg\ Cl_2$ ....
18.2	1.06	......	......	22.0	1.28	21.7	1.26	......	......	22.8	1.33	$Mg\ SO_4$ ....
31.8	1.85	......	......	8.2	.47	7.5	.43	......	......	20.5	1.18	$Mg\ CO_3$ ....
......	......	13.5	.78	......	......	......	......	19.8	1.14	......	......	$Ca\ Cl_2$ ....
......	......	22.8	1.32	......	......	......	......	24.6	1.43	......	......	$Ca\ SO_4$ ....
113.4	6.61	103.3	6.02	115.2	6.71	132.1	7.70	76.9	4.48	110.8	6.45	$Ca\ CO_3$........
......	......	......	......	......	......	......	......	......	......	1.9	.11	$Fe_2\ O_3 + Al_2\ O_3$
.6	.03	.7	.04	1.5	.08	.8	.04	1.0	.05	......	......	$Fe\ CO_3$........
.8	.05	.4	.02	.6	.03	.3	.02	.6	.03	......	......	$Al_2\ O_3$ ....
8.4	.50	10.0	.58	8.8	.51	10.4	.60	6.5	.37	6.4	.37	$Si\ O_2$...........
......	......	......	......	......	......	......	......	......	......	......	......	
366.4	21.36	435.6	25.38	348.8	20.28	431.1	25.09	337.7	19.61	353.8	20.59	
R. W. S.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Cairo	Cambridge	Camden	Camp Point
County	Alexander	Henry	Schuyler	Adams
Laboratory number	8817	2102	10539	6638
Date	Nov. 26, 1900	April 9, 1897	Aug. 6, 1902	Jan. 8, 1900
Owner	E. W. Halliday	E. D. Richarson	B. Taggert	H. Henry
Depth	811	1345 feet	28 feet	1006 feet
Strata	Flint pebbles	St. Peters		St. Peters
Remarks	Flowing	City supply		
Turbidity		Distinct	Decided	Distinct
Color		.2	Yellow	.30
Odor		.000	.000	Oily

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	372.	1036.	3684.8	6000.8
Loss on ignition	9.2	25.6	268.4	102.
Chlorine	135.	161.	6.	2650.
Oxygen consumed	2.2	1.9	8.1	8.1
Nitrogen as. Free ammonia	.032	1.4	.92	2.2
Nitrogen as. Alb. ammonia	.042	.016	.104	.016
Nitrogen as. Nitrites	.000	.015	.005	.001
Nitrogen as. Nitrates	.08	.176	1.115	.12
Lithium Li				0.8
Potassium K	9.8	13.5		18.3
Sodium Na	66.6	292.5	69.3	1793.5
Ammonium (NH_4)	.04		1.2	2.8
Magnesium Mg	13.9	19.7	75.6	105.8
Calcium Ca	51.5	42.0	734.8	230.9
Ferrous Fe	.8	.50	5.1	1.4
Aluminium Al	Trace	1.6	2.9	1.5
Silica Si	4.8	4.5	11.8	1.5
Nitrate NO_3	.3	.8	4.9	.6
Chloride Cl	135.	161.	5.9	2650.
Sulphate SO_4	17.1	353.8	2476.3	1046.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Lithium Chloride							4.8	.28
Potassium Nitrate	.6	.03	1.3	.07				
Potassium Chloride	18.2	1.05	24.9	1.45			34.9	2.03
Sodium Nitrate					6.8	.40		
Sodium Chloride	169.4	9.82	265.7	15.50	9.7	.56	4333.2	253.40
Sodium Sulphate			524.0	30.56	196.5	11.46	273.1	15.96
Sodium Carbonate			49.0	2.86				
Ammonium Chloride	.1	.01						
Ammonium Sulphate					4.4	.26	10.2	.59
Ammonium Carbonate								
Magnesium Chloride	31.6	1.83						
Magnesium Sulphate	21.4	1.24			375.6	21.91	526.2	30.69
Magnesium Carbonate	13.	.75	68.6	4.00				
Calcium Sulphate					2348.0	136.97	586.8	34.22
Calcium Carbonate	128.6	7.46	104.9	6.11			108.4	6.32
Oxide of iron and aluminium								
Ferrous Sulphate					13.9	.81		
Ferrous Carbonate	1.8	.10	1.	.06			2.9	.17
Alumina			3.2	.18			2.8	.16
Aluminium Sulphate					18.7	1.09		
Silica	10.3	.59	9.6	.56	25.2	1.47	3.2	.19
Sulphuric acid					290.9	16.97		
Suspended matter					33.4	1.94		
Total	395.0	22.88	1052.1	61.35	3323.1	193.84	5886.5	344.0

Analyst	A. R. J.	C. R. R.	P. B.	R. W. S.

Waters—Continued.

Canton	Canton	Carbondale	Carbondale	Carbondale	Carlock
Fulton	Fulton	Jackson	Jackson	Jackson	McLean
5607	3912	1985	7430	9068	6147
Aug. 10, 1899.	Aug. 3, 1898	Mar. 10, 1897	April 26, 1900.	Apr. 17, 1901	Oct. 23, 1899
W. Sh'l'nb'gr	Same	H. Lauder.	Lighting Co.	H. Munger	A. D. Loar
Spring	2,500 feet	...	260 feet	380 feet	Spring
Sand	St. Peters	Rock	Rock	Sandstone	...
...	City supply	Flowing	...	City sup'ly	...
Slight	Slight	None	Decided	Slight	Distinct
.01	.04	.01	Muddy	.01	.10
.000	.000	.000	.000	.000	H_2S
Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
386.8	1581.6	598.	805.2	1863.6	627.6
72.4	13.2	5.6	33.2	43.2	110.4
12.	245.	88.	45.	825.	7.4
.9	2.2	1.6	13.1	6.7	8.
.001	1.2	.234	3.6	.624	1.12
.016	.014	.014	.136	.044	.116
.000	.012	.000	.000	.000	.000
4.8	.12	.2	.12	.12	.08
...	...	...	...	...	...
.8	25.3	4.3	3.2	4.8	3.8
11 6	338.9	242.0	82.4	658.8	32.1
...	1.6	...	4.6	.8	1.4
47.8	38 6	1.8	30.1	9.0	81.0
97.6	95.9	2.9	57.2	24.4	79.2
.1	.8	...	1.6	.9	.5
.9	1.7	...	.4	.8	.9
12.3	11.4	2.2	6.3	3.9	7.1
21.2	.6	.8	.6	.5	.3
12.	245.0	88.0	45.	825.	7 4
20.2	649.6	44.4	4.3	33.8	50.5

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
...	...	...	...	4.6	.27	...	...	...	...	...	...	Li Cl
2.1	.12	.9	.05	1.4	.08	.9	.05	.8	.04	.5	.03	KNO_3
...	...	47.7	2.78	7.1	.41	5.4	.31	8.5	.49	7.0	.40	K Cl
27.4	1.59	...	...	...	...	...	...	...	...	...	...	$Na NO_3$
10.7	.62	366.3	21.36	139.6	8.14	70.0	4.08	1353.0	78.47	6.6	.38	Na Cl
...	...	601.1	35.06	64.4	3.75	6.4	.37	50.0	2.90	74.7	4.36	$Na_2 SO_4$
...	...	...	...	382.7	22.33	121.6	7.09	254.1	14.74	12.1	.70	$Na_2 CO_3$
...	...	...	...	...	...	...	...	...	...	...	...	$NH_4 Cl$
...	...	5.8	.33	...	...	...	...	...	...	...	...	$(NH_4)_2 SO_4$
...	...	...	...	...	...	12.2	.71	2.1	.12	3.7	.21	$(NH_4)_2 CO_3$
7.5	.44	...	...	...	...	...	...	...	...	...	...	$Mg Cl_2$
25.2	1.46	192.0	11.19	...	...	...	...	...	...	...	...	$Mg SO_4$
142 2	8.29	...	...	6.1	.30	105.8	6.17	34.8	2.02	281.8	16.43	$Mg CO_3$
...	...	121.2	7.70	...	...	...	...	...	...	...	...	$Ca SO_4$
243.9	14.23	149.4	8.70	7.3	.42	142.8	8.33	61.1	3.54	197.8	11.53	$Ca CO_3$
...	...	...	...	.8	.05	...	...	...	...	...	...	$Fe_2 O_3 + Al_2O_3$
...	...	...	...	...	...	...	...	...	...	...	...	$Fe SO_4$
.3	.02	1.6	.09	...	...	.3	.02	1.9	.11	.9	.05	$Fe CO_3$
1.7	.09	3.2	.18	...	...	.8	.05	1.6	.09	1.8	.10	$Al_2 O_3$
...	...	...	...	...	...	...	...	...	...	...	...	$Al_2 (SO_4)_3$
26,2	1.53	24.4	1.42	6.0	.35	13.4	.78	8.4	.49	15.2	.88	$Si O_2$
...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	
487.2	28.39	1513.6	88.86	620.1	36.16	479.6	27.96	1776.3	103.01	602.1	35.07	
R. W. S.		R. W. S.		C. R. R.		R. W. S.		A. R. J.		R. W. S.		

Analyses of Illinois

Town	Carlyle	Carlyle	Carmi	Carpent'rsville
County	Clinton	Clinton	White	Kane
Laboratory number	12387	8692	10637	8950
Date	Aug. 25, 1904	Oct. 22, 1900	Sept. 23, 1902	Jan. 15, 1901
Owner	Louis Becker	H. G. Weber	B. S. Crebs	E. Hendricks
Depth	Spring	24 feet	315 feet	22 feet
Strata	Sand	Rock	Sandstone	Sand, gravel
Remarks		Flowing		
Turbidity	Decided	Very slight	Distinct	Decided
Color	Muddy	.01	Muddy	Yellow
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	662.0	408.4	1,757.6	1,094.
Loss on ignition		44.	22.8	54.8
Chlorine	6.8	33.	400.	1.9
Oxygen consumed	3.4	1.8	7.8	2.7
Nitrogen as. Free ammonia	.056	.28	.4	.042
Nitrogen as. Alb. ammonia	.134	.046	.184	.03
Nitrogen as. Nitrites	.050	Trace	.000	.001
Nitrogen as. Nitrates	1 59	.28	.04	.119
Potassium K	3 7	3.7	13.9	4.3
Sodium Na	83.4	74.8	671.1	12.2
Ammonium (NH_4)		.4	.5	.05
Magnesium Mg	30.1	16.2	4.8	102.8
Calcium Ca	61.8	40.3	2.4	178.4
Ferrous Fe	1.5	1.7	.8	3.4
Aluminium Al	.6	.6	1.8	
Silica Si	5.3	5.2	3.4	10.8
Nitrate NO_3	7.	1.1	.2	.5
Chloride Cl	6.8	1.8	400.	1.9
Sulphate SO_4	316.6	78.2	12.2	495.3

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	5.1	.30	1.9	.11	.4	.02	.9	.05
Potassium Chloride			3.8	.22	26.3	1.54	4.	.23
Potassium Sulphate			2.2	.13			4.2	.24
Sodium Nitrate	1.6	.09						
Sodium Chloride	11.2	.65			639.4	37.30		
Sodium Sulphate	242.3	14.13	113.9	6.60	18.1	1.06	37.5	2.17
Sodium Carbonate			87.2	5.05	962.	56.12		
Ammonium Sulphate								
Ammonium Carbonate			1.	.06	1.3	.08	.1	.01
Magnesium Sulphate	150.0	8.75					49.9	2.90
Magnesium Carbonate			56.7	3.29	16.8	.98	322.9	18.73
Calcium Sulphate	46.6	2.73					606.1	35.15
Calcium Carbonate	120.0	7.00	102.5	5.94	6.1	.36		
Oxide of Iron and Aluminium								
Ferrous Carbonate	.3	.02	3.5	.21	1.6	.09	7.1	.41
Alumina	1.2	.07	1.2	.07	3.4	.20		
Silica	11.2	.65	11.	.64	7.2	.42	22.8	1.32
Suspended matter					41.	2.39		
Total	589.5	34.39	384.9	22.32	1,723.6	100.56	1,055.5	61.21
Analyst	J. M. L.		A. R. J.		A. D. E.		A. R. J.	

Waters—Continued.

Carp'nte'sv'e	Carrier's M'ls	Carrollton..	Carrollton ...	Carrollton..	Carrollton..
Kane	Saline	Greene	Greene	Greene	Greene ....
11715	10605	10535	10767	12422	3513 ....
Dec. 31, 1903.	Sept. 8, 1902..	Aug. 4, 1902	Nov. 24, 1902	Sept. 9, 1904	Apr. 28, 1898
A. D. Smith.	A. V. Tuller.	E.A. T'nh'l	G. W. Ross..	G. W. Ross	F. Sinsab'g
300 feet.......	150 feet.......	Spring	Spring.......	203 feet	1,400 feet ..
....	Rock & coal.	....	....	Limestone	St. Peter's .
....	....	City sup'ly	City supply.	....	City sup'ly
Clear	Slight........	Clear	Distinct......	Decided ...	Distinct....
.000	.000	.000	Muddy	Red........	.03
Soured	.000	.000	Vinegar	H_2S........	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
415.2	4,994.	339.6	342.	567.2	3,160.
....	47.2	27.6	60.	....	64.
9.1	2,800.	3.8	4.8	....	1,335.
2.6	17.4	1.8	9.5	11.5	6.4
.362	2.96	.024	.06	.200	1.4
.038	.044	.028	.152	.316	.026
.032	.001	.000	.004	.000	.000
1.2	.18	3.36	2.396	.08	.4
....	14.6	2.0	8.4	2.1	46.1
127.6	1,863.6	9.2	10.5	39.8	904.2
.5	3.8	....	.1	....	1.7
6.6	21.8	28.1	27.7	52.0	58.1
12.2	38.9	83.1	73.4	79.0	139.8
....	1.2	.8	.4	17.5	1.5
....	2.9	.5	.7	7.7	.6
3.2	2.8	3.3	5.9	4.1	4.2
.2	.8	15.0	13.0	.3	1.7
10 0	2,800.	3.8	4.8	5.7	1,335.
11.0	1.9	11.7	16.5	1.5	487.2

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
....	......	1.3	.08	5.2	.30	21.2	1.24	.6	.04	2.9	.17	KNO_3 ....
....	......	26.9	1.57	......	......	.3	.02	3.5	.20	86.0	5.02	KCl ....
....	......	....	......	......	......	....	......	......	......	......	......	K_2SO_4 ....
.3	.02	....	......	16.1	.94	....	......	......	......	......	......	$NaNO_3$ ....
16.5	.96	4,598.9	268.28	6.3	.37	7.6	.44	6.6	.39	2132.5	124.40	$NaCl$ ....
16.3	.95	2.8	.16	7.3	.43	23.1	1.35	2.3	.13	201.3	11.74	Na_2SO_4 ....
266.8	15.57	123.3	7.19	......	......	....	......	84.0	4.90	......	......	Na_2CO_3........
....	......	....	......	......	......	.4	.02	......	......	6.6	.38	$(NH_4)_2SO_4$ ....
1.3	.08	10.1	.59	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$....
....	......	....	......	8.7	.51	.9	.05	......	......	288.6	16.83	$MgSO_4$.........
22.9	1.33	76.0	4.43	92.0	5 37	92.2	5.38	181.0	10.56	......	......	$MgCO_3$ ....
....	......	....	......	......	......	....	......	......	......	162.0	9.45	$CaSO_4$..........
30.4	1.77	97.2	5.67	207.9	12.13	183.4	10.70	197.3	11.51	228.4	13.32	$CaCO_3$ ....
1.8	.11	....	......	......	......	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$ ..
....	......	2.6	.15	1.6	.09	.8	.05	36.2	2.11	3.0	.17	$FeCO_3$.........
....	......	5.4	.32	1.0	.05	1.4	.08	14.5	.85	1.2	.07	Al_2O_3 ....
6.8	.40	6.0	.35	7.2	.42	12.5	.73	8.8	.51	9.0	.52	SiO_2............
....	......	....	......	......	......	....	......	......	......	......	......	....
363.1	21.19	4,950.5	288.79	353.1	20.61	343.8	20.06	534.8	31.20	3121.5	182.07	
P. B.		A. D. E.		P. B.		P. B.		J. M. L.		R. W. S.		

Analyses of Illinois

Town	Centralia	Centralia	Cerro Gordo	Cerro Gordo
County	Marion	Marion	Piatt	Piatt
Laboratory number	9123	11148	3974	9028
Date	May 30, 1901	June 14. 1903	Aug. 22, 1898	Mar. 13, 1901
Owner	A. H. Rainey	C. Schnuckle	W. O. Peck	J. Miller
Depth	Spring	Spring	Spring	24 feet
Strata	Sand	Red Clay	....	....
Turbidity	Distinct	Distinct	Slight	Slight
Color	.1	.1	.01	.02
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	3,809.2	7,830.4	326.8	968.4
Loss on ignition	414.	874.4	30.8	130.
Chlorine	36.	91.	2.8	53.5
Oxygen consumed	3.6	4.2	1.	4.1
Nitrogen as Free ammonia	.022	.022	.000	.032
Nitrogen as Alb. ammonia	.084	.09	.018	.098
Nitrogen as Nitrites	.000	.00	.000	.000
Nitrogen as Nitrates	.08	.72	.5	45.
Potassium K	3.2	....	1.8	....
Sodium Na	321.6	694.1	5.9	....
Ammonium (NH_4)	....	....	....	....
Magnesium Mg	250.1	740.0	26.3	65.9
Calcium Ca	456.4	473.2	79.3	151.4
Ferrous Fe	2.2	....	.11	....
Aluminium Al	2.1	....	1.6	....
Silica Si	9.	....	2.1	....
Nitrate NO_3	.3	.3	.2	51.7
Chloride Cl	36.	91.	2.8	53.5
Sulphate SO_4	2,019.9	4,939.2	11.3	287.3

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.6	.03	....	....	3.5	.20	....	....
Potassium Chloride	5.5	.32	....	....	.9	.05	....	....
Sodium Nitrate	....	....	4.4	.27	....	....	....	....
Sodium Chloride	55.0	3.19	150.1	8.75	3.9	.23	....	....
Sodium Sulphate	925.2	53.66	1955.4	114.06	13.3	.77	....	....
Sodium Carbonate	....	....	....	....	....	....	....	....
Ammonium carbonate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	....	....
Magnesium Sulphate	1244.4	72.18	3,678.0	214.55	2.8	.16	....	....
Magnesium Carbonate	....	....	....	....	89.6	5.22	229.3	13.30
Calcium Sulphate	565.3	32.79	956.2	55.78	....	....	407.3	23.62
Calcium Carbonate	724.6	42.03	479.1	27.95	198.2	11.56	78.6	4.55
Oxide of Iron and Aluminium	....	....	14.0	.82	....	....	....	....
Ferrous Carbonate	4.5	.26	....	....	.2	.01	....	....
Alumina	4.0	.23	....	....	3.1	.18	....	....
Silica	19.4	1.13	20.0	1.16	4.5	.26	....	....
Total	3,548.5	205.82	7,257.2	423.34	320.0	18.65	715.2	41.47
Analyst	A. L. M.		R. W. S.		R. W. S.		A. R. J.	

Waters—Continued.

Champaign..	Champaign..	Chandlerv.	Chandlerv' le	Chicago....	Chicago....
Champaign..	Champaign..	Cass.......	Cass..........	Cook	Cook ......
10987	6613	9100	9428	5370	9103 ....
Apr. 27, 1903..	Jan. 4, 1900..	May 6, 1901.	Oct. 2, 1901 ..	Aug. 4, 1899	May 10, 1901
I. C. R. R....	C. B. Hatch..	Ira Read ..	Ira Read.....	I. C. R. R..	W. Rens'w
Boneyard ...	176 feet.......	215 feet.....	304 feet	Lake Mich.	Lake Mich.
....	Drift..........	....	Sandstone ...	....	....
Slight........	Distinct	V. Slight...	Slight........	....	Slight......
.1	.30	....	.02	....	.01
Mouldy	.000	.000	.000	....	Gassy......
Milligrams per 1,000 c. c.	Milligrams per 1.000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
391.6	376.4	866.4	3,291.2	....	144.8
47.6	46.4	18.	11.2	....	17.6
12.	2.3	144.	1,655.	....	4.2
6.4	5.7	4.3	9.	....	4.7
.016	3.6	.608	1.76	....	.018
.096	.094	.06	.036	....	.128
.27	.000	.000	.000	....	.004
5.33	.12	.16	.12	.56	.236
....	2.7	7.3	11.3	....	....
10.4	36,9	332.9	1,263.9	5.6	8.3
....	....	.8	2.3	....	.05
48.5	31.7	4.8	9.0	11.7	10.9
71.1	58.9	2 9	17.0	36.2	28.2
....	1.2	.15	.6	....	....
....	.5	.3	.4	....	....
4.3	8.1	4.7	3.8	6.7	1.9
23.7	.6	.7	.6	2.4	1.0
12.	2.3	144.	1,655.	4.8	4.2
75.1	.2	2.4	1.2	12.0	10.0

Combinations.

Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	
....	......	.9	.05	1.1	.06	.9	.05	......	......	......	......	KNO_3 ....
....	......	4.4	.25	6.9	.40	20.9	1.21	......	......	......	......	KCl. ....
32.4	1.89	....	......	......	......	....	......	3.3	.19	1.4	.08	$NaNO_3$ ....
4.5	.26	.3	.02	231.7	13.44	2,714.3	158.30	7.9	.46	6.9	.40	NaCl.............
....	......	.3	.02	3 5	.20	1.8	.11	5.0	.29	16.0	.93	Na_2SO_4.........
....	......	84.6	4.93	554.5	32.16	450.4	26.26	......	......	......	......	Na_2CO_3.........
....	......	12.2	.71	.8	.04	....	......	......	......	......	......	$(NH_4)_2CO_3$.....
12.5	.73	....	......	......	......	....	......	......	......	......	......	$MgCl_2$..........
93.9	5.48	....	......	......	......	....	......	10.8	.65	......	......	$MgSO_4$ ....
22.5	1.31	109.7	6.39	16.8	.97	34.4	2.00	33.2	1.93	38.0	2.20	$MgCO_3$.........
....	......	....	......	......	......	....	......	......	......	......	......	$CaSO_4$ ....
177.7	10.37	147.1	8.57	7.1	.41	42.5	2.48	90.5	5.28	70.3	4.08	$CaCO_3$..........
3.6	.21	....	......	......	......	....	......	5.0	.29	.7	.04	$Fe_2O_3 + Al_2O_3$.
....	......	2.4	.14	.3	.01	1.3	.08	......	......	......	......	$FeCO_3$..........
....	......	.9	.05	,6	.03	.8	.05	......	......	......	......	Al_2O_3 ....
9.1	.53	17.2	1.00	10.0	.58	8.0	.47	14.2	.83	4 1	.24	SiO_2............
356.2	20.78	379.1	22.08	833.2	48.30	3,275.3	191.01	169.9	9.92	137.4	7.97	
P. B.		R. W. S.		A. R. J.		A. D. E.		R. W. S.		A. R. J.		

Analyses of Illinois

Town	Chicago	Chicago	Chicago	Chicago
County	Cook	Cook	Cook	Cook
Laboratory number	5575	10363	6219	7877
Date	Aug. 7, 1899	Apr. 23, 1902	Oct 30, 1899	July 4, 1900
Owner	F. Sturges	A. V. Lee	W. Peterson	W. Vernon
Depth	250 feet	300 feet	1173 feet	3,000 feet
Strata	Limestone	Limestone (?)	Rock	....
Remarks	....	....	....	....
Turbidity	Slight	Distinct	Distinct	Slight
Color	.01	Milky	.05	.03
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	252.4	202.4	1.120.8	1,143.6
Loss on ignition	44.	17.6	47.2	62.8
Chlorine	27.5	16.	63.5	83.
Oxygen consumed	3.3	4.3	1.3	.7
Nitrogen as Free ammonia	42.4	.24	.52	.024
Nitrogen as Alb. ammonia	.022	.034	.034	.056
Nitrogen as Nitrites	.000	.000	.000	.07
Nitrogen as Nitrates	.16	.09	.16	.4
Potassium K	3.8	6.0	20.4	19.4
Sodium Na	49.1	42.1	87.0	103.5
Ammonium (NH_4)	.5	.2	.7	....
Magnesium Mg	14.5	8.9	44.4	33.1
Calcium Ca	23.1	17.4	184.8	180.0
Ferrous Fe	.15	2	4.0	....
Aluminium Al	.5	.6	.8	....
Silica Si	13.7	3.3	7.3	4.3
Nitrate NO_3	.7	.3	.7	1.7
Chloride Cl	27.5	16.	63.5	83.0
Sulphate SO_4	6.6	30.3	503.2	516.2

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.1	.06	.5	.03	1.1	.06	2.8	.16
Potassium Chloride	6.5	.38	11.1	.64	38.2	2.23	35.0	2.04
Sodium Nitrate	....	....	....	....	....	....	....	....
Sodium Chloride	40.2	2.34	17.6	1.02	74.6	4.34	109.3	6.37
Sodium Sulphate	9.8	.57	44.9	2.61	177.9	10.38	186.6	10.88
Sodium Carbonate	69.4	4.04	48.2	2.81	....	....	....	....
Ammonium Sulphate	....	....	....	....	2.5	.14	....	....
Ammonium Carbonate	1.3	.07	.7	.04	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	....	....
Magnesium Sulphate	....	....	....	....	220.8	12.88	164.1	9.57
Magnesium Carbonate	50.6	2.94	31.1	1.81	....	....	....	....
Calcium Sulphate	....	....	....	....	289 8	16.90	366.7	21.39
Calcium Carbonate	57.7	3.36	43.4	2.53	248.7	14.50	180.3	10.52
Oxide of Iron and Aluminium	....	....	....	....	....	....	1.4	.08
Ferrous Carbonate	.3	.02	.5	.03	8.4	.49	....	....
Alumina	.9	.05	1.1	.06	1.6	.09	....	....
Silica	29.2	1.70	7.1	.41	15.6	.90	9.2	.54
Suspended matter	....	....	2.5	.14	....	....	....	....
Total	267.	15.53	208.7	12.13	1.079 2	62.91	1,055.4	61.55
Analyst	R. W. S.		A. D. E.		R. W. S.		R. W. S.	

Waters—Continued.

Chillicothe...	Chrisman....	Chrisman ..	Cisne	Claremo'nt	Claremo'nt
Peoria	Edgar........	Edgar......	Wayne	Richland ..	Richland ..
3569	10701	10702	11749..........	5037	5038.........
May 11, 1898..	Oct. 13, 1902..	Nov. 11, 1902	Jan. 14, 1904..	May 14, 1899	May 14, 1899
J. S. Bailey..	A. G. Tucker	A. G. Tuck'r	S. P. Etter...	G. Mowrer.	G. Mowrer.
42 feet........	140 feet.......	17 feet......	80 feet	Spring.....	Spring.....
Sand	Shale	Sand	....	Grav. & S'd	....
City supply..	City supply..	City s'pply	....	....	....
Slight........	Decided	Slight......	Slight........	Slight......	Distinct....
Yellow	Muddy	.1	F. O.........	....	....
.000	Musty	Musty	.000	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c c.	Milligrams per 1,000 c.c.
426.4	2,287.6	596.4	3,095.2	3,936.	6,857.2
30.4	48.8	95.2	....	297.6	729.2
13.	567.5	42.	215.	36.	81.
5.	6 2	3.9	4.5	5.8	2.9
.048	1.6	.026	.012	.04	1.51
.048	.576	.11	.04	.15	.072
.000	.000	.2	.006	.008	.000
5 6	.16	.44	28.00	1.4	.12
5.0	....	....	7.3	7.6	11.3
10.6	588.8	11.3	305.5	125.6	484.9
....	2.1	....	.012	....	1.9
55.1	8.7	45.5	187.1	294.3	605.3
81.2	15.4	116.1	308.8	591.2	522.3
.14	....	....	5.0	....	6.2
1.8	....	....	1.3	1.5	2.7
6.3	3.9	3.2	8.1	8.3	8.3
24.8	.7	1.9	32.1	6.2	.6
13.	567.5	42.	215.	36.	81.
75.4	4.1	156.3	1,442.4	2,385.6	3,996.8

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	
12.9	.75	......	......	......	....	18.9	1.10	10.1	.58	.9	.05	KNO_3 ....
....	......	......	......	......	....	....	......	7.1	.41	20.9	1.21	K Cl ....
23.2	1.42	.9	.05	2.7	.16	27.2	1.59	......	......	......	......	Na NO_3 ....
11.1	.64	937.2	54.67	42.1	2.46	354.8	20.68	53.7	3.13	117.0	6.45	Na Cl. ....
....	......	6.	.35	......	....	489.4	28.53	322.4	18.81	1353.8	78.96	Na_2 SO_4 ....
....	......	343.5	20.03	......	....	....	......	......	......	......	......	Na_2 CO_3.........
....	......	......	......	......	....	.0	.00	......	......	6.9	.40	$(NH_4)_2$ SO_4....
....	......	5.6	.33	......	....	....	......	......	......	......	......	$(NH_4)_2$ CO_3....
16.9	.98	......	......	22.1	1.39	....	......	......	......	......	......	Mg Cl_2..........
94 4	5.50	......	......	194.1	11.52	930.0	54.25	1462.8	85.33	3008.4	175.49	Mg SO_4.........
41.1	2.39	30.2	1.76	......	....	....	......	......	......	......	......	Mg CO_3 ....
....	......	......	......	1.5	.09	521.4	30.40	1413.0	82.43	949.2	55.37	Ca SO_4.........
202.9	11.82	38.6	2.66	290.2	16.93	388.1	22.63	438.9	25.60	607.7	35.41	Ca CO_3 ....
....	......	6.8	.40	3.4	.20	....	......	......	......	......	......	$Fe_2O_3 + Al_2O_3$.
.3	.02	......	......	......	....	10.4	.61	......	......	12.9	.75	Fe CO_3..........
3.4	.20	......	......	......	....	2 4	.14	2.8	.16	5.2	.30	Al_2 O_3 ....
13.3	.77	8.4	.49	6 9	.40	17.2	1.00	17.6	1.02	17.6	1.02	Si O_2............
....	......	839.2	48.96	7.9	.46	....	......	......	......	......	......	
419.5	21.63	2216.4	129.7	570.9	33.31	2755.8	160.69	3728.4	217.47	6099.9	355.51	

R. W. S.	P. B.	P. B.	D. K.	R. W. S.	R. W. S.

Analyses of Illinois

Town	Clayton	Clinton	Clinton	Clinton
County	Adams	DeWitt	DeWitt	DeWitt
Laboratory number	11795	2694	8976	9327
Date	Feb. 7, 1904	Sept. 20, 1897	Aug. 1900	Aug. 27, 1901
Owner	G. Anderson	J. Ziegler	I. C. R. R.	D. T. Gay
Depth	54 ft.	Spring	Spring	Spring
Strata	Clay and sand.	....	....	....
Capacity	....	900 gal. per hr.	....	....
Remarks	....	....	....	City supply
Turbidity	....	Distinct	....	Distinct
Color	....	.4	....	.4
Odor	....	.000	....	.000

	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.
Total residue	2512.8	323.6	....	312.4
Loss on Ignition	....	21.6	....	29.2
Chlorine	25.5	1.4	.8	1.2
Oxygen Consumed	3.4	3.	....	3.1
Nitrogen as Free ammonia	.038	1.	....	.704
Nitrogen as Alb. ammonia	.07	.104	....	.112
Nitrogen as Nitrites	.000	.000	....	.000
Nitrogen as Nitrates	4.	.05	4.	.16
Potassium K	4.5	1.9	....	2.5
Sodium Na	82.7	8.9	23.6	8.9
Ammonium (NH_4)	....	1.28	....	.1
Magnesium Mg	214.0	86.3	40.4	33.8
Calcium Ca	304.9	101.7	87.9	51.6
Ferrous Fe	1.1	2.9	....	2.6
Aluminium Al	29.8	.4	....	.7
Silica Si	11.	9.1	9.3	10.2
Manganese Mn	....	....	....	....
Nitrate NO_3	4.6	.2	17.7	.7
Chloride Cl	25.5	1.4	.8	1.2
Sulphate SO_4	1086.0	.8	.2	2.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	7.5	.44	.4	.02	....	....	1.1	.06
Potassium Chloride	3.0	.17	2.9	.16	....	....	2.5	.15
Potassium Sulphate	....	....	1.5	.08	....	....	1.7	.10
Potassium Carbonate	....	....	1.0	.06	....	....	....	....
Sodium Nitrate	....	....	20.5	1.20	24.2	1.40	....	....
Sodium Chloride	39.8	2.32	....	....	1.3	.08	....	....
Sodium Sulphate	206.8	12.06	....	....	.4	.02	2.5	.15
Sodium Carbonate	....	....	....	....	37.8	2.19	18.6	1.18
Ammonium Carbonate	....	....	3.4	.19	....	....	.3	.02
Magnesium Nitrate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	....	....
Magnesium Sulphate	1066.2	62.16	....	....	....	....	....	....
Magnesium Carbonate	....	....	30.3	1.77	140.7	8.16	117.6	6.84
Calcium Sulphate	136.5	7.96	....	....	....	....	....	....
Calcium Carbonate	661.5	38.57	254.0	14.81	219.6	12.74	136.8	7.98
Oxide of Iron and Aluminium	....	....	....	....	5.0	.29	....	....
Ferrous Carbonate	2.3	.13	6.1	.35	....	....	5.5	.32
Alumina	56.2	3.27	.8	.05	....	....	1.4	.08
Silica	35.0	2 04	19.3	1.13	19.8	1.15	21.8	1.27
Manganese Carbonate	....	....	....	....	....	....	....	....
Total	2214.8	129.12	340.2	19.82	448.8	26.03	309.8	18.15
Analyst	D. K.		C. R. R.		A. L. M.		A. D. E.	

Waters—Continued.

Clinton......	Clinton......	Clinton....	Clinton......	Cobden....	Cobden....
DeWitt......	DeWitt......	DeWitt....	DeWitt......	Union	Union .....
9330	4674	Aug. 1900..	8978	8910	8911 ....
Aug. 27, 1901.	Feb. 2, 1899...	8977	Aug. 1900....	Dec. 21, 1900	Dec. 21, 1900
D. T. Gay ...	J. E. Moffatt	I. C. R. R..	I. C. R. R....	F. B. Hines	F. B. Hines
Spring.......	20 ft..........	78 ft........	78 ft...........	Spring.....	Spring.....
....	Gravel.......	....	....	....	....
....	....	....	....	....	....
....	Flo., c. sup..	....	....	....	....
Clear........	Distinct	....	....	Decided ...	Slight......
.000	.6	....	....	Yellow	.01
.000	.000	....	....	.000	.000
Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.
4393.6	414.8	....	....	350.4	288.4
76.	56.	....	....	16.8	4.
10.	2.3	1.4	.6	2.6	3.2
1.4	1.6	....	....	7.3	1.4
.04	.64	....	....	2.4	.012
.064	.026	....	....	.176	.026
.05	.000	....	....	.004	.000
8.75	.1	1.08	3.8	.076	.12
5.6	2.1	....	....	.8	....
7.6	8.9	15.1	24.0	10.7	7.1
....	.8	....	....	3.1	.01
43.7	41 7	33.7	39.8	14.5	19.8
83.9	94.7	82.0	73.3	77.6	77.6
.9	.3	....	....	....	1.4
2.1	.4	....	....	1.1	.14
9.6	8.4	6.9	10.	14.6	11.3
....	....	....	....	53.4	....
8.75	.5	4.8	16.9	.3	.5
10.	2.3	1.4	.6	2.6	3.2
21.1	11.3	1.6	2.2	5.3	10.0

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
14.6	.86	.7	.04	......	......	......	......	.5	.03	......	......	KNO_3 ....
......	......	3.5	.20	......	......	......	......	1.3	.07	......	......	KCl............
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4........
......	......	......	......	......	......	......	......	......	......	......	......	K_2CO_3.........
28.0	1.63	......	......	6.6	.38	23.1	1.34	......	......	.7	.04	$NaNO_3$ ....
......	......	1.1	.06	2.3	.13	1.0	.06	3.3	.19	5.3	.30	$NaCl$............
......	......	16.7	.97	2.3	.13	3.2	.19	7.8	.45	14.9	.86	Na_2SO_4.........
......	......	7.2	.42	27.0	1.57	37.8	2.19	15 5	.90	......	......	Na_2CO_3 ....
......	......	2.1	.12	......	......	......	......	8.2	.47	......	......	$(NH_4)_2CO_3$ ....
11.5	.67	......	......	......	......	......	......	......	......	......	......	$Mg(NO_3)_2$ .....
13.4	.79	......	......	......	......	......	......	......	......	......	......	$MgCl_2$ ....
26.4	1.54	......	......	......	......	......	......	......	......	......	......	$MgSO_4$ ....
115.3	6.72	143.6	8.38	117.2	6.80	138.6	8.04	50.4	2.92	68.9	3.99	$MgCO_3$ ....
......	......	......	......	......	......	......	......	......	......	......	......	$CaSO_4$ ....
207.9	12.12	236.4	13.79	204.3	11.85	183 2	10.63	193.7	11.23	194.3	11.27	$CaCO_3$..........
......	......	......	......	8.0	.46	5.2	.30	......	......	......	......	$Fe_2O_3+Al_2O_3$..
1.9	.11	.6	.03	......	......	......	......	......	......	2.9	.17	$FeCO_3$..........
4.0	.23	.7	.04	......	......	......	......	2.	.11	.3	.01	Al_2O_3..........
20.4	1.19	17.9	1.04	14.7	.85	21.4	1.24	31.	1.80	24.0	1.39	SiO_2...........
......	......	......	......	......	......	......	......	111.8	6.48	......	......	$MnCO_3$.........
443.4	25.86	430.5	25.09	382.4	22.17	413.5	23.99	425.5	24.65	311.3	18.03	
A. D. E.		R. W. S.		A. L. M.		A. L. M.		A. R. J.		A. R. J.		

Analyses of Illinois

Town	Colchester	Collinsville	Collinsville	Collinsville
County	McDonough	Madison	Madison	Madison
Laboratory number	8756	4271	4280	10753
Date	Nov. 7, 1900	Oct. 26, 1898	Oct. 26, 1898	Nov. 10, 1902
Owner	E. Belshaw	J. R. Wadsw'th	Same	S. E. Simpson
Depth	Spring	601 feet	706 feet	90 Feet
Strata	Yellow clay	Rock	Rock	Sand
Capacity	60 gal. per hr	......	......	......
Turbidity	Distinct	Distinct	Slight	Distinct
Color	Cloudy	.03	.03	.4
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	287.2	2608.8	2544.8	329.2
Loss on ignition	14.	26.	30.	36.4
Chlorine	.7	865.	680.	10.25
Oxygen consumed	2.2	4.7	3.3	1.3
Nitrogen as. Free ammonia	.1	.024	1.	.048
Nitrogen as. Alb. ammonia	.05	.044	.03	.04
Nitrogen as. Nitrites	.005	.215	.21	.000
Nitrogen as. Nitrates	.195	.4	.4	.16
Lithium Li	......	......	......	......
Potassium K	3.0	27.9	18.9	2.2
Sodium Na	17.7	830.4	883.8	38.2
Ammonium (NH_4)	.1	......	1.3	.1
Magnesium Mg	19.2	17.9	19.7	27.9
Calcium Ca	52.2	38.8	31.7	74.2
Ferrous Fe	2.0	2.5	1.5	1.2
Aluminium Al	.5	4.3	.6	1.0
Silica Si	8.7	24.1	3.3	9.5
Nitrites NO_2	......	......	......	......
Nitrate NO_3	.8	1.7	.6	.7
Chloride Cl	.7	865.	680.	10.3
Sulphate SO_4	1.4	450.4	505.4	16.9

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Lithium Sulphate	......	......	......	......	......	......	......	......
Potassium Nitrite	......	......	1.1	.06	1.1	.06	......	......
Potassium Nitrate	1.3	.07	3.8	.22	2.8	.16	1.1	.06
Potassium Chloride	1.5	.09	48.6	2.83	33.1	1.92	3.3	.19
Potassium Sulphate	2.6	.14	......	......	......	......	......	......
Potassium Carbonate	1.0	.05	......	......	......	......	......	......
Sodium Nitrate	......	......	......	......	......	......	......	......
Sodium Chloride	......	......	1,387.3	80.92	1,094.7	63.85	14.4	.86
Sodium Sulphate	......	......	666.3	38.87	747.6	43.60	25.0	1.46
Sodium Carbonate	40.7	2.36	158.2	9.23	485.8	28.34	56.2	3.28
Ammonium Sulphate	......	......	......	......	......	......	......	......
Ammonium Carbonate	.2	.01	......	......	3.4	.20	.3	.02
Magnesium Chloride	......	......	......	......	......	......	......	......
Magnesium Sulphate	......	......	......	......	......	......	......	......
Magnesium Carbonate	66.8	3.87	62.2	3.62	68.5	3.99	97.2	5.67
Calcium Sulphate	......	......	......	......	......	......	......	......
Calcium Carbonate	130.0	7.54	97.1	5.65	79.7	4.64	185.4	10.82
Ferrous Sulphate	......	......	......	......	......	......	......	......
Ferrous Carbonate	4.2	.24	5.1	.30	3.2	.18	2.6	.15
Alumina	1.0	.05	8.2	.48	1.2	.07	1.9	.11
Aluminium Sulphate	......	......	......	......	......	......	......	......
Silica	18.4	1.07	51.4	3.00	7.0	.40	20.3	1.19
Total	267.7	15.49	2,489.3	145.18	2,528.1	147.41	407.7	23.81
Sulphuric Acid	......	......	......	......	......	......	......	......
Analyst	A. R. J.		R. W. S.		R. W. S.		P. B.	

Waters—Continued.

Cooksville ..	CrealSprings	Creal Spr..	CrealSprings	Creal Spr..	Crystal Lk.
McLean	Williamson .	Williams'n	Williamson .	Williams'n	McHenry..
8729	9032	4106	9238	9919	11391 ....
Oct. 30,1900...	March 15,1901	Sept.21,1898	Aug. 1,1901..	Nov.29,1901	Sept.21,1903
W. H. Porter	W.P.Schney	W.Suth'l'd.	J. Renner ...	J.McRav'n	G.Prickett.
Spring.......	Spring.......	24 feet......	9 feet..... ...	25 feet......	Spring.....
Gravel.......	....	Sand........	Clay	Clay	Sand & g'vl
....					
....	Very slight..	Slight......	Slight........	Slight......	Decided....
....	.6	.03	.02	.04	.4
....	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
429.2	12,190.4	6,074.8	4,549.6	1,126.8	339.6
32.4	1,330.	74.	547.2	192.8	46.0
20.5	123.	171.	166.	33.	3.8
8.9	7.1	4 2	5.9	2.5	1.8
3.8	8.	.34	.032	.016	.112
.608	.176	.108	.128	.086	.028
.000	.01	.125	.06	.003	.000
.08	2.87	.3	33.94	1.557	.120
....	....	.06	....	....	....
5.3	14.6	20.7	9.6	5.8	4.0
75.0	26.3	509.5	582.9	135.8	20.1
4.9	10.3	.4	....	....	....
26.3	510.6	487.5	187.3	90.9	32.6
49.4	1,114.3	456.4	584.9	129.5	100.1
3.7	6.3	.4	2.2	1.9	2.2
1.2	214.2	1.1	.6	5.5	2.3
4.	9.4	8.7	36.1	12.3	5.9
....	....	.3	....	....	....
.3	18.5	1.3	150.3	6.9	.5
20.5	123.	171.	166.	33.	3.8
2.2	7,863.6	3,338.4	2,185.2	301.8	190.1

Combinations.

Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	
....	......	....	......	.4	.02	....	......	......	......	......	......	Li_2SO_4.........
....	......	....	......	.7	.04	....	......	......	......	......	......	KNO_2 ....
.6	.03	29.9	1.83	2.0	.11	24.9	1.45	2.9	.17	.8	.05	KNO_3 ....
9.5	.55	7.3	.42	37.4	2.17	....	......	8.9	.52	7.	.41	K Cl ....
....	......	....	......	......	......	....	......	......	......	......	......	K_2SO_4 ....
....	......	....	......	......	......	....	......	......	......	......	......	K_2CO_3 ....
....	......	....	......	......	......	185.1	10.80	......	......	......	......	$NaNO_3$ ....
28.	1.62	66.8	3.87	252.5	14.72	273.9	15.98	47.5	2.77	.8	.05	Na Cl ....
3.2	.18	....	......	1265.7	73.83	1,324.4	77.26	360.9	21.05	61.1	3.57	Na_2SO_4 ....
144.7	8.39	....	......	......	......	....	......	......	......	......	......	Na_2CO_3.........
....	......	37.7	2.18	1.5	.09	....	......	......	......	......	......	$(NH_4)_2SO_4$ ....
13.	.74	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$....
....	......	107.0	6.20	......	......	....	......	......	......	......	......	$MgCl_2$ ....
....	......	2,388.0	138.50	2432.1	141.34	931.2	54.32	72.5	4.25	162.	, .45	$MgSO_4$ ....
91.6	5.31	....	......	......	......	....	......	265.4	15.49	......	......	$MgCO_3$ ....
....	......	3,741.6	218.01	76[illegible]	44.87	2,036.2	60.44	......	......	27.4	1.60	$CaSO_4$ ....
123.6	7.17	....	......	574.3	33.50	700 0	40.83	142.4	8.31	230.	13.42	$CaCO_3$ ....
....	......	18.8	1.09	......	......	....	......	......	......	......	......	$FeSO_4$ ....
7.5	.43	....	......	.8	.04	4.5	.26	3.9	.23	4.5	.26	$FeCO_3$ ....
2.2	.13	....	......	2.0	.11	1.2	.07	10.4	.60	4.3	.25	Al_2O_3 ....
....	......	1,348.9	78.23	......	......	....	......	......	......	......	......	$Al_2(SO_4)_3$.......
8.6	.50	20.0	1.16	18.4	1.07	75.2	4.39	26.2	1.53	12.6	.74	SiO_2...........
432.5	25.05	10,017.0	581.78	5349.2	311.91	4,556.6	265.80	941.0	54.02	510.5	29.80	
....	......	2,251.	131.29	......	......	....	......	......	......	......	......	
A. R. J.		A. R. J.		R. W. S.		A. D. E.		A. D. E.		P. B.		

Analyses of Illinois

Town	Cutler	Danville	Danville.	Decatur
County	Perry	Vermilion	Vermilion	Macon
Laboratory number	9991	10713	11892	6072
Date	Dec. 6, 1901	Nov. 8, 1902	Mar. 22, 1904	Oct. 14, 1899
Owner	P. Feaman	G. A. Damon	Mrs. L. Rust	M. T. Holt
Depth	Spring	River	Spring	5 foot spring
Strata	...	...	...	...
Remarks	...	...	...	...
Turbidity	Distinct	Distinct	Decided	Slight
Color	Yellow	Muddy	Yellow	.01
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1,000 c. c.
Total residue	7084.	368.4	406.	442.8
Loss on ignition	814.	53.2	...	32.4
Chlorine	11.	2.8	10.	9.
Oxygen consumed	7.4	5.6	1.8	1.1
Nitrogen as — Free ammonia	.64	.024	.432	.02
Nitrogen as — Alb. ammonia	.336	.188	.02	.048
Nitrogen as — Nitrites	.007	.042	.00	.005
Nitrogen as — Nitrates	.313	.918	.08	1.92
Potassium K	29.2	...	10.1	1.9
Sodium Na	796.4	24.3	7.1	12.8
Ammonium (NH_4)	...	...	.6	...
Magnesium Mg	447.1	23.8	40.5	44.2
Calcium Ca	437.8	46.9	92.8	93.8
Ferrous Fe	1.4	...	4.1	.15
Aluminium Al	5.0	...	2.5	.4
Silica Si	8.7	7.	6.9	7.7
Nitrate NO_3	1.4	.4	.3	8.5
Chloride Cl	11.	2.8	9.7	9.
Sulphate SO_4	3846.5	31.5	44.5	72.0

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	2.2	.12	...	...	.6	.03	4.9	.28
Potassium Chloride	2.3	.13	...	...	18.9	1.10	...	...
Potassium Sulphate	60.5	3.53	...	...	...	...	...	...
Sodium Nitrate	...	...	5.5	.32	...	...	7.5	.44
Sodium Chloride	...	...	4.6	.27	1.2	.07	14.8	.86
Sodium Sulphate	2457.2	143.34	46.7	2.72	20.6	1.20	15.3	.89
Sodium Carbonate	...	...	13.5	.79	...	...	...	...
Ammonium Sulphate	...	...	...	...	2.0	.01	...	...
Ammonium Carbonate	...	...	...	...	...	...	...	...
Magnesium Sulphate	2222.4	129.67	...	...	21.6	1.26	77.1	4.49
Magnesium Carbonate	...	...	82.7	4.82	125.8	7.34	99.7	5.81
Calcium Sulphate	530.2	30.93	...	...	...	...	...	...
Calcium Carbonate	704.2	41.08	117.1	6.83	231.8	13.52	234.3	13.67
Oxide of Iron and Aluminium	...	...	4.3	.25	...	...	...	...
Ferrous Carbonate	2.9	.17	...	...	8.5	.49	.3	.02
Alumina	9.4	.55	...	...	4.8	.28	.8	.05
Silica	18.6	1.09	14 8	.87	14.6	.85	16.3	.95
Suspended matter	...	...	34.1	1.99	...	...	...	...
Total	6009.9	350.61	323.3	18.86	450.4	26.15	471.	27.46
Analyst	A. D. E.		P. B.		D. K.		R. W. S.	

Waters—Continued.

Deerfield....	Dekalb	Dekalb	De Witt......	Dixon	Downs ....
Lake.........	Dekalb	Dekalb	De Witt......	Lee	McLean ...
446	3463-4	3462	10033	10906	12316 ....
Jan. 28, 1896 .	Apr. 15, 1898 .	Apr. 18, 1898	Dec. 10, 1901 .	Mar. 2, 1903.	Aug. 8, 1904
R. B. Chase .	L. B. Merr'n.	L. B. Merr'n	Chas. Gleen.	C. Hughes	Miss L. Bkr.
140 feet	841 feet	890 feet	Spring.......	Spring	127 feet ....
Rock	Salt Peter (?)	Salt Peter..	....	....	Drift ....
....	City supply .	City sup...	....	....	....
....	Distinct	Slight......	Distinct	Clear	Decided ...
....	.5	.02	Yellow	.000	Yellow ....
....	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
....	334.4	296.4	432.	284.	486.
....	17.2	24.	36.4	6.	....
....	.9	.9	2.4	2.8	.9
....	3.3	2.8	7.2	2.	9.0
....	.6	.08	10.	.016	9.40
....	.048	.044	.352	.048	.308
....	.000	.012	.003	.000	.00
....	.16	.25	.077	1.6	.16
11.1	3.0	4.1	3.3	6.9	3.0
126.6	29.7	23.0	19.9	5.3	22.5
....	1.	....	....	....	12.
41.2	23.3	26.5	38.7	35.5	43.5
73.3	56.5	49.4	96.3	78.8	94.8
.5	.49	.8	5.0	1.2	6.1
....	.8	.7	5.6	.6	5.5
13.1	6.7	3.3	10.5	7.5	10.5
.7	.7	1.1	.3	.7	.7
11.4	.9	.9	2.4	2.8	.9
306.9	2.9	4.1	11.5	9.9	2.5

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
....	......	1.1	.06	1.8	.10	.6	.04	11.4	.66	1.1	.06	KNO_3..........
21.3	1.24	1.9	.11	1.9	.11	5.0	.29	5.9	.34	1.9	.11	KCl............
....	......	3.6	.21	5.5	.32	.9	.05	3.2	.19	3.5	.20	K_2SO_4..........
.9	.05	....	......	......	......	....	......	......	......	......	......	$NaNO_3$.........
2.1	.13	....	......	......	......	....	......	......	......	......	......	$NaCl$...........
387.5	22.61	1.3	.08	1.6	.09	16.3	.95	12.3	.72	.9	.05	Na_2SO_4........
....	......	67.3	3.93	52.8	3.08	29.4	1.71	3.3	.19	51.1	2.98	Na_2CO_3........
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2SO_4$....
....	......	1.9	.11	......	......	....	......	......	......	31.9	1.86	$(NH_4)_2CO_3$....
56.3	3.29	....	......	......	......	....	......	......	......	......	......	$MgSO_4$.........
104.	6.1	81.0	4.72	92.4	5.39	134.8	7.86	123.7	7.22	151.2	8.82	$MgCO_3$........
....	......	....	......	......	......	....	......	......	......	......	......	$CaSO_4$.........
183.	10.68	141.2	8.23	123.5	7.20	240.8	14.05	196.9	11.48	236.6	13.80	$CaCO_3$.........
....	......	....	......	......	......	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$.
1.2	.07	1.0	.06	1.8	.10	10.3	.60	2.6	.15	12.7	.74	$FeCO_3$.........
....	......	.2	.01	.1	.01	10.6	.62	1.1	.06	10.4	.61	Al_2O_3.........
14.3	.84	14.3	.83	7.1	.41	22.4	1.30	16.	.93	22.4	1.31	SiO_2...........
....	......	....	......	......	......	....	......	......	......	......	......	....
770.6	45.01	314.8	18.35	288.5	16.81	471.1	27.47	376.4	21.94	523.7	30.54	
A. W. P.		R. W. S.		R. W. S.		A. D. E.		P. B.		J. M. L.		

Analyses of Illinois

Town	Dundee	Duquoin	Duquoin	Duquoin
County	Kane	Perry	Perry	Perry
Laboratory number	8958	12038	12037	12039
Date	Jan. 18, 1901	May 10, 1904	May 10, 1904	May 10, 1904
Owner	H. Browning	L. D. Skinner	L. D. Skinner	L. D. Skinner
Depth	250 feet	Spring	30 feet	108 feet
Strata	Rock		Sand	Rock
Remarks				
Turbidity	Decided	Slight	Decided	Decided
Color	Yellow	Muddy	Muddy	Red
Odor	Oil	Pungent	.000	Peculiar

	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
Total residue	406.4	3,909.2	962.4	1,489.2
Dissolved				1,098.0
Suspended				391.2
Loss on ignition	17.2			
Chlorine	1.4	15.5	74.	9.
Oxygen consumed	11.	4.5	3.6	8.25
Nitrogen as. Free ammonia	10.4	.186	.114	.112
Nitrogen as. Alb. ammonia	.17	.186	.098	.160
Nitrogen as. Dissolved				.08
Nitrogen as. Suspended				.08
Nitrogen as. Nitrites	.003	.003	.010	.008
Nitrogen as. Nitrates	.117	.12	.31	.072
Potassium K	3.8			
Sodium Na	29.4	296.0	178.7	144.0
Ammonium (NH_4)	13.4			
Magnesium Mg	37.2	244.2	33.6	40.9
Calcium Ca	73.1	352.1	102.1	128.8
Ferrous Fe	5.3			
Aluminium Al	5.			
Silica Si	6.6	5.7	8.2	11.6
Nitrate NO_3	.5	.6	1.4	
Chloride Cl	1.4	15.5	74.	9.
Sulphate SO_4	1.1	2,112.4	311.4	552.0

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.8	.04						
Potassium Chloride	2.9	.17						
Potassium Sulphate	1.9	.11						
Potassium Carbonate	1.5	.08						
Sodium Nitrate			.8	.05	1.9	.11		
Sodium Chloride			25.6	1.49	122.1	7.12	14.8	.86
Sodium Sulphate			881.6	51.42	401.9	23.42	426.4	24.87
Sodium Carbonate	67.7	3.92						
Ammonium Chloride								
Ammonium Sulphate								
Ammonium Carbonate	35.6	2.06						
Magnesium Sulphate			1,213.8	70.80	50.1	2.92	203.4	11.87
Magnesium Carbonate	129.3	7.50			81.7	4.76		
Calcium Sulphate			773.2	45.10			143.1	8.35
Calcium Carbonate	182.8	10.60	311.4	18.16	255.0	14.87	216.6	12.63
Oxide of Iron and Aluminium								
Ferrous Carbonate	10.9	.63						
Alumina	.9	.05						
Silica	14.	.81	12.2	.71	17.5	1.02	24.8	1.45
Suspended matter								
Total	448.3	25.97	3,218.6	187.73	929.9	54.22	1,029.1	60 03
Analyst	A. R. J.		J. M. L.		J. M. L.		J. M. L.	

Waters—Continued.

Dwight......	Dwight......	Dwight....	E. Moline...	E.St.Louis.	E.St.Louis.
Livingston ..	Livingston...	Livingst'n.	Rock Island.	St.Clair....	St Clair ...
12894	12895	9929	13589	11800	11801 ....
Feb. 7, 1905..	Feb. 7, 1905..	Nov.30,1901	Sept. 23. 1905.	Feb. 9,1904.	Feb. 9,1904.
L. E. Keeley	L. E. Keeley	Jas. Eyer..	W Vanderv't	M.R.Tha'r.	M.R.Tha'r.
135 feet	135 feet	220 feet	1,450 feet	90 feet	Miss. River
Gravel.......	Gravel.......	Rock	Rock........	Sand.......	....
City supply.	12894 treated.	....	Flowing.....	....	....
Distinct	Distinct	V. Slight...	V. Slight	....	....
Yellow	Whitish	.02	.000	....	....
.000	.000	.000	.000	....	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
1,156.4	974.4	1,099.6	1,060.	680.4	196.
....	....	....	....	....	....
....	....	....	....	....	....
....	....	29.6	....	....	....
35.	38.0	175.	317.5	43.5	5.8
5.3	4.45	4.9	7.25	3.7	9.3
2.08	2.08	2.16	1.680	.656	.448
.126	.120	.054	.034	.054	.192
....	....	....	....	....	....
....	....	....	....	....	....
.000	.050	.00	.000	.003	.008
.44	.345	.16	.08	.077	.672
4.7	5.1	8.5	9.9	....	....
149.	238.1	307.3	268.8	59.2	23.2
2.7	2.7	2.8	....	.8	.448
50.9	26.3	31.5	26.6	42.1	13.0
128.7	19.1	51.9	61.9	138.4	35.9
2.2	....	.6	1.8	....	....
1.7	....	.3	1.1	....	....
3.9	3.4	4.9	4.2	16.9	6.2
1.9	1.5	.7	.3	....	.8
35.	38.	175.	317.5	43.5	5.8
549.4	547.3	316.6	223.3	102.7	45.6

Combinations.

Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	
3.2	.17	2.4	.14	1.1	.06	.6	.04	......	......	......	......	KNO_3 ....
6.7	.39	8.1	.47	18.5	1.08	18.2	1.06	......	......	......	......	KCl.............
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4..........
......	......	......	......	......	......	......	......	......	......	......	......	K_2CO_3 ....
......	......	......	......	8.3	.48	......	......	......	......	......	......	NH_4Cl...........
......	......	......	......	......	......	......	......	......	......	1.1	.06	$NaNO_3$...........
52.5	3.06	56.4	3.29	265.1	15.47	508.7	29.68	71.8	4.19	9.6	.56	$NaCl$.............
397.3	23.18	665.2	38.80	468.6	27.33	212.1	12.37	94.7	5.52	59.3	3.46	Na_2SO_4..........
......	......	......	......	117.8	6.88	......	......	......	......	......	......	Na_2CO_3 ....
......	......	......	......	8.3	.48	......	......	......	......	......	......	K_2CO_3..........
9.9	.58	9.9	.58	......	......	......	......	2.4	.14	1.6	.09	$(NH_4)_2SO_4$.......
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$.......
252.9	14.75	113.1	6.60	......	......	99.9	5.83	46.8	2.73	10.8	.63	$MgSO_4$ ....
......	......	12.2	.71	109.6	6.39	22.7	1.32	113.4	6.61	30.0	1.75	$MgCO_3$ ....
101.1	5.89	......	......	......	......	......	......	......	......	......	......	$CaSO_4$ ....
247.1	14.41	47.9	2.79	129.7	7.57	154.7	9.02	345.9	20.07	89.8	5.24	$CaCO_3$ ....
......	......	2.2	.13	......	......	......	......	43.1	2.51	11.7	.68	$Fe_2O_3+Al_2O_3$..
4.5	.26	......	......	1.2	.07	3.7	.22	......	......	......	......	$FeCO_3$...........
3.2	.17	......	......	.6	.04	2.0	,12	......	......	......	......	Al_2O_3 ....
8.2	.48	7.2	.42	10.4	.60	9.0	.53	28.8	1.68	13.2	.77	SiO_2............
......	......	48.3	2.80	......	......	......	......	......	......	......	......	....
1,086.6	63.34	972.9	56.73	1139.2	66.45	1031.6	60.19	746.9	43.45	227.1	13.24	
J. M. L.		J. M. L.		A. D. E.		J. M. L.		D. K.		D. K.		

Analyses of Illinois

Town	East St. Louis	Eldorado Twp.	Elgin	Elgin
County	St. Clair	McDonough	Kane	Kane
Laboratory number	11666	9125	13784	11168
Date	Dec. 9, 1903	June 3, 1901	Dec. 4, 1905	July 1, 1903
Owner	C. Hagedorn	H. Leighty	R. R. Parkin	A. Loomis
Depth	80 feet	731 feet	Fox river	Spring
Strata	Gravel	Rock		
Remarks				
Turbidity	Decided	Distinct	Little	Distinct
Color	Yellow	.2	Yellow	.3
Odor	.000	.000	Earthy	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	554.0	3,911.6	333.	321.6
Loss on ignition		32 4		36.4
Chlorine	28.8	2,070.	2.5	2.2
Oxygen consumed	4.	9.4	8.3	2.5
Nitrogen as — Free ammonia	.656	1.72	.116	.28
Nitrogen as — Alb. ammonia	.082	.054	.352	.036
Nitrogen as — Nitrites	.012	.000	.004	.000
Nitrogen as — Nitrates	.308	.1	.40	.000
Alkalinity			264.0	
Potassium K		10.8	4.1	1.1
Sodium Na	30.7	1,464.2	6.5	7.3
Ammonium (NH_4)	.8	2 2		.4
Magnesium Mg	29.9	15.4	35.3	33.4
Calcium Ca	176.1	34.0	66.7	62.2
Ferrous Fe		1.9	.5	1.6
Aluminium Al		2.1	1.2	2.5
Silica Si	11.5	5.7	5.2	7.2
Nitrate NO_3	1.4	.5	1.7	
Chloride Cl	28.8	2,070.	2.5	2.2
Sulphate SO_4	64.1	.8	35.5	8.3

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate			.7	.04	2.8	.16		
Potassium Chloride			20.1	1.17	5.9	.34	2.1	.12
Potassium Sulphate								
Potassium Carbonate								
Sodium Nitrate	1.9	.11						
Sodium Chloride	49.5	2.89	3,395.5	196.94			2.2	.13
Sodium Sulphate	34.6	2.02	1.1	.06	19.9	1.15	12.3	.72
Sodium Carbonate			295.1	17.12			5.6	.33
Ammonium Sulphate	2.9	.17						
Ammonium Carbonate			5.9	.34			1.1	.06
Magnesium Sulphate	48.3	2.82			27.6	1.62		
Magnesium Carbonate	70.4	4.10	53.8	3.12	103.5	6.03	116.1	6.78
Calcium Carbonate	441.	25.72	85.0	4.93	166.6	9.72	155.4	9.07
Oxide of Iron and Aluminium	23.2	1.35						
Ferrous Carbonate			3.9	.23	1.1	.06	3.4	.20
Alumina			4.0	.23	2.2	.13	4.8	.28
Silica	24.4	1.42	12.2	.71	11.1	.65	15.3	.90
Total	696.2	40.6	3,877.3	224.89	340.7	19.86	318.3	18.59

Analyst	P. B.	A. L. M.	J. M. L.	P. B.

Waters—Continued.

Elgin	Elgin	Elgin	Elgin	Elgin	Elgin ......
Kane	Kane	Kane	Kane	Kane	Kane ......
12022	12024	8872	8748	12909	13785 ....
May 5, 1904..	May 5. 1904 ..	May 6, 1900.	Nov. 6, 1900..	Feb. 11, 1905	Dec. 4, 1905
G. B. Royer.	G. B. Royer.	W. M. Anr's	R. R. Parkin.	R. R. Parkin	R. R. Parkin
Spring	Spring	93 feet	1,100 feet	1,300 feet ..	2,000 feet ..
....	....	Rock	St. Peter.....	St. Peter...	Rock ......
....	....	Flowing ...	Flowing	....	....
Slight........	Very slight..	Decided ...	Distinct......	Consid'ble.	Decided ...
.000	2.	.35	.01	.4	.4
.000	.000	.000	.000	.000	Putrid .....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
332.4	329.2	328.8	353.6	365.0	376.
....	....	22.4	14.8	....	....
2.6	1.9	1.7	5.8	4.7	3.5
2.8	3.2	2.8	2.1	2.65	4.0
.038	.688	1.12	.736	1.840	1.080
.060	.064	.052	.068	.056	.192
.000	.002	.008	.000	.000	.000
.12	.078	.08	.08	.120	.24
....	....	....	....	....	323.4
....	9.0	9.1	18.0	7.0	10.5
4.3	7.7	32.9	48.0	46.8	24.3
....	.9	1.4	.9	....	1.4
36.2	30.1	34 0	21.1	33.1	27.5
69.5	66.1	58.9	50.6	48.9	65.9
.4	1.5	1.9	.7	.7	.5
.8	3.8	....	.1	1.2	1.3
7.3	8.3	6.6	4.0	3.9	4.7
.5	3.4	.3	.3	.6	1.
2.6	1.9	1.7	5.8	4.7	3.5
66.2	10.1	4.6	16.7	15.9	8.1

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
....	......	5.6	.33	.6	.03	.5	.03	.9	.05	1.7	.10	KNO_3 ....
....	......	4.0	.23	3.6	.20	12.2	.71	9.9	.58	7.4	.43	$K Cl$ ....
....	......	10.5	.61	8.3	.48	25.5	1.48	3.3	.19	12.2	.71	$K_2 SO_4$ ....
....	......	......	......	5.9	.34	......	......	......	......	......	......	$K_2 CO_3$ ....
.8	.05	......	......	......	......	......	......	......	......	......	......	$Na NO_3$ ....
4.3	.25	......	......	......	......	......	......	......	......	......	......	$Na Cl$ ....
8.0	.47	6.4	.37	......	......	3.9	.22	20.9	1.22	2.1	.12	$Na_2 SO_4$ ....
....	......	13.0	.76	75.9	4.40	107.7	6.24	92.3	5.38	54.5	3.18	$Na_2 CO_3$ ....
....	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2 SO_4$....
....	......	2.3	.13	3.7	.21	2 4	.14	......	......	3.7	.22	$(NH_4)_2 CO_3$....
76.2	4.44	......	......	......	......	......	......	......	......	......	......	$Mg SO_4$.........
72.7	4.24	104.8	6.11	118.4	6.87	73.5	4.26	80.6	4.70	95.6	5.58	$Mg CO_3$ ....
173.5	10.12	165.0	9.62	147.1	8.53	127.5	7.39	122.3	7.13	164.7	9.60	$Ca CO_3$ ....
....	......	......	......	......	......	......	......	......	......	......	......	$Fe_2 O_3 + Al_2 O_3$
.8	.05	3.0	.17	3.9	.23	1.5	.08	1.4	.08	1.0	.06	$Fe CO_3$ ....
1.6	.09	7 2	.42	......	......	.2	.01	2.2	.13	2.5	.15	$Al_2 O_3$..........
15.6	.90	17.7	1.03	14.	.81	8.5	.49	8.3	.48	10.0	.58	$Si O_2$............
353.5	20.61	339.5	19.78	381.4	22.10	363.4	21.05	342.1	19.94	355.4	20.73	
J. M. L.		J. M. L.		A. R. J.		A. R. J.		J. M. L.		J. M. L.		

Analyses of Illinois

Town	Elkhart	Elmhurst	Eureka	Evanston
County	Logan	DuPage	Woodford	Cook
Laboratory number	13420	4349	4172	2927
Date	Aug. 6, 1905	Nov. 8, 1898	Oct. 4, 1898	Nov. 10, 1897
Owner	J. Oglesby	A. H. Fisher	C. H. Radford	J. Jones
Depth	Spring	Spring	102 feet	1602 feet
Strata			Sand	Limestone
Remarks				Flowing
Turbidity	Clear	Slight	Distinct	Slight
Color	.000	.1	.4	.03
Odor	.000	Musty	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	489.6	472.	432.	1178.8
Loss on Ignition		38.	48.0	34.
Chlorine	9.8	.8	3.2	96.
Oxygen consumed	1.6	2.	3.	3.
Nitrogen as Free ammonia	.040	.03	.88	.64
Nitrogen as Alb. ammonia	.044	.048	.062	.016
Nitrogen as Nitrites	.000	.000	.000	.000
Nitrogen as Nitrates	1.88	.35	.2	.4
Potassium K	1.9	2.8	3.4	31.9
Sodium Na	9.0	11.7	23.0	132.3
Ammonium (NH_4)			1.1	
Magnesium Mg	57.2	40.4	42.1	47.5
Calcium Ca	112.7	97.2	89.1	175.7
Ferrous Fe	.3	.6	1.3	
Aluminium Al	2.6	1.7	1.2	
Silica Si	9.1	2.2	12.7	3.5
Nitrate NO_3	.8	1.5	.9	1.7
Chloride Cl	10.0	.8	3.2	96.0
Sulphate SO_4	15.3	93.2	15.0	537.2

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	4.9	.29	2.4	.14	1.5	.09	2.8	.17
Potassium Chloride			1.7	.10	5.4	.31	59 0	3.44
Potassium Sulphate			2.1	.12				
Sodium Nitrate	7.4	.43						
Sodium Chloride	16.5	.96			1.1	.06	111.7	6.52
Sodium Sulphate	1.6	.09	35.9	2.09	22.2	1.29	283.9	16.56
Sodium Carbonate					35.4	2.06		
Ammonium Chloride								
Ammonium Sulphate								
Ammonium Carbonate					2.9	.17	2.2	.17
Magnesium Chloride								
Magnesium Sulphate	17.9	1.04	85.0	4.96			236.3	13.79
Magnesium Carbonate	186.3	10.87	81.0	4.72	146.6	8.54		
Calcium Chloride								
Calcium Sulphate							222.6	12.98
Calcium Carbonate	281.1	16.40	242.8	14.16	222.7	13.00	275.5	16.07
Oxide of Iron and Aluminium							1.0	.06
Ferrous Carbonate	0.6	.04	1.3	.07	2.7	.16		
Alumina	5.0	.29	3.2	.18	2.2	.13		
Silica	19.3	1.13	4.6	.27	26.1	1.52	7.4	.43
Suspended matter								
Total	540.6	31.54	460.0	26.81	468.8	27.33	1,202.5	70.19
Analyst	J. M. L.		R. W. S.		R. W. S.		C. R. R.	

Waters—Continued.

Everett	Everett	Fairbury	Fairfield	Fairfield	Farmer C'y
Lake	Lake	Livingston	Wayne	Wayne	De Witt
4134	13693	10529	10920	10921	3686
Sept. 26, 1898	Oct. 23, 1905	July 31, 1902	March 3, 1903	Mar. 3, 1903	June 14, 1898
J. O'Con'or	J. A. Seyl	G. Y. McD'l	J. M. Rapp	J. M. Rapp	J. D. Ge'rh't
177 feet	143 feet	Spring	1050 feet	825 feet	175 feet
White Clay	Rock	......	Sandstone	......	Gravel
......	......	......	Flowing	......	......
Distinct	Decided	Slight	Decided	Decided	Slight
Whitish	.2	.6	Muddy	Muddy	.08
H_2S	H_2S	Musty	.000	Mouldy	.000
Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
420.	1052.	416.8	42696.8	44517.6	719.6
48.	......	69.2	1254.4	2494.8	30.4
9.	7.0	2.7	24000.	25500.	118.
1.8	39 6	3.95	134.	102.	11.
.36	1.440	2.8	10.8	8.8	3.2
.06	.066	.132	.32	.554	.208
.000	.000	.000	.000	.009	.000
.2	.40	.08	.64	.151	.2
4.6	9.1	2.5	107.0	113.5	6.5
75.8	37.6	30.4	13527.5	13548.5	185.3
.5	1.85	3.6	13.6	11.	4.1
34.3	129.8	42.9	270.5	331.8	24.4
27 7	119.9	75.8	584.9	693.9	58.6
.15	.4	1.2	......	......	1.9
.6	.7	.8	......	......	.4
13.4	15.9	6.3	.9	6.9	7.1
.9	1.7	.3	2.7	.6	.9
9.	7.0	2.7	24000.	25500.	118.
66.6	419.6	7.4	1.2	11.7	2.4

Combinations.

Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	
1.5	.09	2.8	.16	.6	.04	4.7	.26	.9	.05	1.5	.08	KNO_3
7.8	.45	1.5	.09	4.3	.25	201.	11.73	216.	12.60	11.2	.65	KCl
......	......	16.1	.91	......	......	......	......	......	......	......	......	K_2SO_4
......	......	......	......	......	......	......	......	......	......	......	......	$NaNO_3$
8.7	.51	......	......	1.2	.07	34386.	2005.90	34439.3	2009.01	185.7	10.83	NaCl
98.5	5.74	114.7	6.69	11.0	.64	......	......	......	......	3.5	.20	Na_2SO_4
93.4	5.44	......	......	60.5	3.53	......	......	......	......	255.1	15.14	Na_2CO_3
......	......	......	......	......	......	40.4	2.35	32.7	1.91	......	......	$(NH_4)Cl$
......	......	6.8	.40	......	......	......	......	......	......	......	......	$(NH_4)_2SO_4$
1.3	.07	......	......	9.6	.56	......	......	......	......	10.9	.63	$(NH_4)_2CO_3$
......	......	......	......	......	......	1064.5	62.09	1305.8	76.18	......	......	$MgCl_2$
......	......	410.4	23.94	......	......	......	......	......	......	......	......	$MgSO_4$
119.3	6.96	164.2	9.58	149.3	8.71	......	......	......	......	85.0	4.95	$MgCO_3$
......	......	......	......	......	......	1486.1	86.70	1912.8	111.59	......	......	$CaCl_2$
......	......	......	......	......	......	1.7	.10	17.	.99	......	......	$CaSO_4$
69.1	4.02	299.7	17.49	189.3	11.04	121.3	7.08	10.	.58	146.4	8.53	$CaCO_3$
......	......	......	......	......	......	19.5	1.14	17.6	1.03	......	......	$Fe_2O_3+Al_2O_3$
.3	.02	.8	.05	2.4	.14	......	......	......	......	3.9	.22	$FeCO_3$
1.1	.06	1.4	.08	1.6	.09	......	......	......	......	.7	.04	Al_2O_3
28.6	1.66	33.8	1.98	13.4	.78	1.9	.11	14.6	.86	15.1	.87	SiO_2
......	......	......	......	......	......	754.9	44.04	6634.8	387.03	......	......	......
429.6	25.02	1052.2	61.37	443.2	25.85	38082.0	2221.5	44601.5	2601.84	719.0	42.41	
R. W. S.		J. M. L.		P. B.		P. B.		P. B.		R. W. S.		

Analyses of Illinois

Town	Farmington	Farmington	Flanagan	Forest Glen
County	Fulton	Fulton	Livingston	Cook
Laboratory number	11635	11636	10804	11767
Date	Nov. 25, 1903	Nov. 25, 1903	Dec. 17, 1902	Jan. 23, 1904
Owner	Maplew'd C.C.	Maplew'd C.C.	H. Oathout	Brant & Noe
Depth	....	....	156 feet	100 feet
Strata	....	Creek	Gravel	Rock and sand.
Turbidity	Decided	Distinct	Slight	Decided
Color	Yellow	Yellow	.4	Muddy
Odor	.0	Vegetable	Musty	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	559.6	662.	610.4	288.8
Loss on ignition	....	....	35.2	....
Chlorine	2.0	12.8	15.	27.
Oxygen consumed	1.9	5.5	6.1	5.3
Nitrogen as. Free ammonia	.640	.204	2.	.198
Nitrogen as. Alb. ammonia	.020	.160	.118	.088
Nitrogen as. Nitrites	.000	.015	.000	.003
Nitrogen as. Nitrates	.08	1.105	.16	.24
Potassium K	....	....	11.6	....
Sodium Na	18.2	62.8	181.2	60.1
Ammonium (NH_4)	.8	.3	2.6	....
Magnesium Mg	44.4	51.1	12.3	9.9
Calcium Ca	129.3	93.8	17.7	29.3
Ferrous Fe	....	....	.7	....
Aluminium Al	....	....	1.2	....
Silica	6.9	5.1	6.6	5.6
Nitrate NO_3	.3	4.9	.7	.3
Chloride Cl	2.0	12.8	15.	27.
Sulphate SO_4	99.0	180.8	92.2	38.8

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	....	....	....	....	1.1	.06	....	....
Potassium Chloride	....	....	....	....	21.4	1.25	....	....
Potassium Sulphate	....	....	....	....	....	....	....	....
Sodium Nitrate	.5	.03	6.8	.40	....	....	.4	.02
Sodium Chloride	3.3	.19	21.1	1.23	7.9	.46	44.6	2.60
Sodium Sulphate	51.5	3.01	162.4	9.47	136.5	7.96	57.6	3.36
Sodium Carbonate	....	....	....	....	308.3	17.98	54.7	3.19
Ammonium Sulphate	2.9	.17	1.1	.06	....	....	....	....
Ammonium Carbonate	....	....	....	....	6.9	.40	....	....
Magnesium Nitrate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	....	....
Magnesium Sulphate	62.6	3.66	87.8	5.13	....	....	....	....
Magnesium Carbonate	110.5	6.45	116.3	6.79	43.3	2.53	34.4	2.00
Calcium Sulphate	....	....	....	....	....	....	....	....
Calcium Carbonate	323.1	18.85	234.3	13.67	44.1	2.57	71.8	4.18
Oxide of Iron and Aluminium	5.2	.30	2.2	.13	....	....	6.0	.35
Ferrous Carbonate	....	....	....	....	1.5	.09	....	....
Alumina	....	....	....	....	1.1	.06	....	....
Silica	14.7	.86	10.8	.63	14.1	.83	11.9	1.02
Suspended matter	....	....	....	....	....	....	....	....
Total	574.3	33.52	642.8	37.51	586.2	34.19	281.4	16.72
Analyst	P. B.		P. B.		P. B.		D. K.	

Waters—Continued.

Forest Glen.	Forrest	Fort Hill...	Franklin Gr..	Freeport ..	Galesburg..
Cook	Livingston ..	Lake.......	Lee	Stephenson	Knox ......
11768	2453	4178	4147	4203	11980 ....
Jan. 23, 1904..	July 15, 1897..	Oct. 5, 1898.	Sept. 30, 1898.	Oct. 10, 1898	Apr. 25, 1904
Brant & Noe.	E.N. Armst'g	G. Stanford	Dr. A. Grim..	Jenks Bros.	W.B.McK.
100 feet	31 feet.........	154 feet.....	Spring	Spring.....	Brook......
Rock & sand	Grav. & sand	Drift.........	....	....	....
Decided	Distinct......	Decided ...	Distinct......	Distinct....	....
Muddy	.3	.03	.05	.03	....
.003	.000	.000	.000	.000	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
288.8	436.	282.4	296.4	255.2	433.2
....	26.	25.6	37.2	54.	....
39.	12.	2.3	1.	4.	7.4
4.6	2.	3.5	1.3	1,4	9.1
.178	.4	.44	.096	.066	.090
.076	.044	.088	.018	.072	.128
.034	.000	.000	.000	.000	.060
.286	.2	.2	.05	.4	9.94
....	....	3.7	1.6	4 2	....
55.3	11.6	50.0	8.5	4.0	11.1
....	....	.6	....	....	....
15.6	36.5	17.2	13.0	38.1	29.9
30.1	80.2	23.6	99.2	77.6	68.5
....	....	.3	.5	.16	....
....	....	.4	.8	.6	....
4.7	8.	7.3	5.1	5.8	3.3
.3	.9	.9	.2	1.7	43.9
39.	12.	2.3	1.	4.	7.4
33.6	52.8	75.2	4.8	24.4	61.8

Combinations.

Parts per million...	Grains per U.S. gal.	Parts per million...	Grains per U.S. gal.	Parts per million...	Grains per U.S. gal.	Parts per million...	Grains per U.S. gal.	Parts per millson...	Grains per U.S. gal.	Parts per million...	Grains per U.S. gal.	
....	......	....	......	1.5	.09	.4	.02	2.8	.16	......	......	KNO_3 ....
....	......	....	......	4.8	.28	2.1	.12	5.8	.34	......	......	KCl ....
....	......	....	......	1.3	.07	.7	.04	......	......	......	......	K_2SO_4 ....
.5	.03	1.2	.07	......	......	....	......	......	......	40.9	2.38	$NaNO_3$..........
64.4	3.75	19.8	1.15	......	......	....	......	2.0	.12	......	......	$NaCl$ ....
....49.7	2.90	10.8	.63	110.2	6.42	6.5	.38	10.1	.58	......	......	Na_2SO_4 ....
37.1	2.16	....	......	32.8	1.90	14.7	.85	......	......	......	......	Na_2CO_3........
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2SO_4$....
....	......	....	......	1.6	.09	....	......	......	......	......	......	$(NH_4)_2CO_3$....
....	......	....	......	......	......	....	......	......	......	16.5	.96	$Mg(NO_3)_2$.....
....	......	....	......	......	......	....	......	......	......	9.9	.58	$MgCl_2$.........
....	......	86.7	5.05	......	......	....	......	22.0	1.28	77.3	4.51	$MgSO_4$.........
54.4	3.17	68.1	3.96	59.8	3.49	45.1	2.62	117.4	6.85	29.7	1.73	$MgCO_3$ ....
....	......	8.6	.50	......	......	....	......	......	......	......	......	$CaSO_4$.........
75.2	4.38	189.3	11.04	58.9	3.43	246.6	14.38	193.9	11.31	171.3	9.99	$CaCO_3$.... ....
5.8	.34	4.4	.25	......	......	....	......	......	......	2.7	.16	$Fe_2O_3 + Al_2O_3$.
....	......	....	......	.6	.03	1.1	.06	3.4	.20	......	......	$FeCO_3$.........
....	......	....	......	.7	.04	1.5	.09	1.1	.07	......	......	Al_2O_3 ....
10.0	.58	17.1	.99	15.5	.90	10.8	.62	12.3	.70	7.1	.41	SiO_2...........
....	......	....	......	......	......	....	......	......	......	81.9	4.77	
297.1	17.31	406.	23.64	287.7	16.74	329.5	19.18	370.8	21.61	437.3	25.49	
D. K.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Galesburg	Galesburg	Galesburg	Galesburg
County	Knox	Knox	Knox	Knox
Laboratory number	2780	11981	11982	6500
Date	Oct. 11, 1897	April 25, 1904	April 25, 1904	Dec. 11, 1899
Owner	C. Isaacson	W.B.McKinl'y	W.B.McKinl'y	D. W. Aldrich.
Depth	Spring			1500 feet
Strata	Sand			Rock
Remarks		City water	City water	City water
Turbidity	Distinct			Slight
Color	.3			.03
Odor	.000			.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	348.8	454.8	963.2	1454.8
Loss on ignition	22.8			38.4
Chlorine	3.5	25.	66.5	157.5
Oxygen consumed	3.2	4.1	3.5	1.9
Nitrogen as Free ammonia	.078	1.600	.320	.56
Nitrogen as Alb. ammonia	.106	.078	.046	.03
Nitrogen as Nitrites	.019	.001	.100	.09
Nitrogen as Nitrates	4.25	.08	.38	.64
Potassium K	1.5			18.5
Sodium Na	20.3	22.6	130.8	344.4
Ammonium (NH_4)		2.	.5	.7
Magnesium Mg	27.1	37.3	47.1	38.6
Calcium Ca	39.2	97.8	130.1	83.2
Ferrous Fe	3.1			.42
Aluminium Al	2.9			.4
Silica Si	21.	6.4	5.8	4.9
Nitrate NO_3	18.8	.3	1.7	2.7
Chloride Cl	3.5	25.	66.5	157.5
Sulphate SO_4	38.7	30.4	361.6	664.4

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	3.9	.22					4.5	.26
Potassium Chloride							32.0	1.86
Sodium Nitrate	22.5	1.31	.5	.03	2.3	.13		
Sodium Chloride	5.8	.33	41.3	2.40	109.7	6.40	234.3	13.67
Sodium Sulphate	36.9	2.15	19.2	1.12	267.2	15.58	778.1	45.39
Sodium Carbonate								
Ammonium Sulphate			7.50	.44	1.7	.10	2.6	.15
Magnesium Sulphate	17.3	1.00	9.40	.55	224.7	13.10	171.0	9.98
Magnesium Carbonate	82.3	4.79	123.2	7.18	6.5	.38	14.5	.85
Calcium Sulphate								
Calcium Carbonate	98.0	5.72	244.5	14.25	325.8	18.99	207.8	12.11
Oxide of Iron and Aluminium			9.5	.55	6.8	.40		
Ferrous Carbonate	6.4	.37					.9	.05
Alumina	5.5	.31					.8	.04
Silica	43.2	2.51	13.7	.80	12.3	.71	10.4	.60
Total	321.8	18.71	468.8	27.32	957.0	55.79	1456.9	84.96
Analyst	R. W. S.		D. K.		D. K.		R. W. S.	

Waters—Continued.

Geneseo	Gilman	Gilman.....	Gilman	Gilman	Glassford ..
Henry	Iroquois	Iroquois ...	Iroquois	Iroquois ...	Peoria .....
9171	4987	4988	4989	5375	2533 ....
July 26, 1901..	May 3, 1899...	May 3, 1899.	May 3, 1899...	Aug. 14, 1899	Ap. 6, 1897..
A. Martin....	Am. Ex. Co.	Am. Ex. Ag	Am. Ex. Co.	I. C. R. R...	E. Arms'ng
Spring	150 feet	113 feet....	1746 feet	1800 feet....	Spring.....
....	Sand.........	Sand	Rock	Rock	....
....	Flowing.....	Flowing...	....	....	Gravel.....
Distinct......	Decided	Decided ...	Decided	....	Slight......
....	Yellow	Yellow	Yellow	....	.03
....	.000	.000	.000	....	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
396.8	912.8	919.6	1748.4	....	427.2
32.4	61.6	70.4	54.4	....	20.4
4.6	19.9	17.3	751.	....	4.0
5.6	2.2	2.2	4.6	....	3.1
.088	1.12	1.04	.8	....	.101
.178	.034	.046	.056	....	.036
.001	.000	.000	.000	....	.000
.039	.05	.05	.05	.76	.24
1.7	5.0	5.1	31.5	....	....
8.1	72.4	72.9	504.2	154.1	13.3
.1	1.4	1.3	1.	....	....
32.7	54.7	56.4	43.2	53.3	45.6
76.9	137.4	141.0	96.2	112.6	97.9
.8	.5	.6	.6	....	....
3.1	.9	.5	1.4	....	....
23.5	....	6.2	2.7	17.8	12.3
.17	.2	.2	.2	3.3	1.0
4.6	19.9	17.3	751.	147.5	4.
38.6	335.4	368.8	192.0	383.6	9.7

Combinations.

Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	
.3	.02	.4	.02	.4	.02	.4	.02	......	......	......	......	KNO_3 ....
3.2	.19	9.2	.54	9.5	.55	59.9	3.49	......	......	......	......	KCl.............
....	......	....	......	......	......	....	......	4.6	.27	1.4	.08	$NaNO_3$ ....
5.1	.30	25.5	1.48	21.1	1.22	1190.7	69.46	128.8	7.51	6.6	.38	$NaCl$ ....
18.8	1.09	192.6	11.23	199.2	11.61	109.9	6.41	177.0	9.94	14.40	.84	Na_2SO_4 ....
....	......	....	......	......	......	....	......	......	......	13.10	.76	Na_2CO_3.........
.4	.02	5.1	.30	4.7	.27	3.6	.21	......	......	......	......	$(NH_4)_2SO_4$ ....
15.6	.90	252.0	14.69	280.2	16.33	143.8	8.38	264.6	15.44	......	......	$MgSO_4$.........
103.3	5.99	14.1	.82	......	......	49.8	2.90	......	......	158.5	9.24	$MgCO_3$ ....
....	......	....	......	9.2	.54	....	......	74.3	4.33	......	......	$CaSO_4$..........
192.1	11.14	343.4	20.02	345.3	20.14	235.0	13.71	226.6	13.21	244.4	14.24	$CaCO_3$ ....
....	......	....	......	......	......	....	......	7.2	.42	3.2	.18	$Fe_2O_3 + Al_2O_3$
1.6	.09	1.0	.05	1.2	.07	1.3	.07	......	......	......	......	$FeCO_3$ ....
5.8	.34	1.7	.10	1.0	.05	2.6	.15	......	......	......	......	Al_2O_3 ....
50.0	2.90	14.4	.83	13.2	.77	5.8	.34	36.2	2.11	26.3	1.52	SiO_2............
396.2	22.98	859.4	50.08	885.	51.57	1802.8	105.14	919.3	53.23	467.9	27.24	
A. L. M.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Glen Ellyn	Godfrey	Grafton	Grafton
County	DuPage	Madison	Jersey	Jersey
Laboratory number	10587	13565	5288	5289
Date	Aug. 27, 1902	Sept. 18, 1905	June 23, 1899	June 23, 1899
Owner	W. J. Catlin	E. M. Caldwell	A. W. Palmer.	A. W. Palmer.
Depth	310 feet	Spring	Illinois River	Illinois River
Strata	Rock	.....	.....	.....
Turbidity	Slight	Decided	Decided	Decided
Color	.4	Muddy	Muddy	Muddy
Odor	Musty	.000	.000	.000

	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c. c.
Total residue	375.2	427.	332.	345.6
Dissolved	.....	.....	320.4	306.
Suspended	.....	.....	11.6	39.6
Loss on ignition	34.4	.....	48.	40.
Dissolved	.....	.....	40.	34.4
Suspended	.....	.....	8.	5.6
Chlorine	1.3	4.8	8.6	18.5
Oxygen consumed	1.9	2.0	11.1	12.2
Nitrogen as. Free ammonia	.624	.338	.064	.064
Nitrogen as. Alb. ammonia	.032	.054	.352	.352
Nitrogen as. Dissolved	.....	.....	.288	.256
Nitrogen as. Suspended	.....	.....	.064	.096
Nitrogen as. Nitrites	.001	.000	.022	.017
Nitrogen as. Nitrates	.08	.04	1.12	1.12
Potassium K	3.3	2.8	3.1	3.2
Sodium Na	25.8	24.7	9.3	9.6
Ammonium (NH_4)	.8	.....	.....	.....
Magnesium Mg	29.4	31.2	22.7	22.9
Calcium Ca	68.6	92.0	53.2	53.1
Ferrous Fe	1.1	2.0	.3	.5
Aluminium Al	1.9	1.2	.6	1.5
Silica Si	7.4	11.1	6.	6.3
Phosphorus PO_4	.....	.....	.8	.8
Nitrate NO_3	.3	.2	4.9	4.9
Chloride Cl	1.3	4.8	8.6	8.5
Sulphate SO_4	56.2	21.9	30.3	30.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.6	.04	.4	.02	5.4	.31	5.6	.33
Potassium Chloride	2.7	.16	5.1	.30	.....	.....	.....	.....
Potassium Sulphate	3.7	.22	.....	.....	.....	.....	.....	.....
Sodium Nitrate	.....	.....	.....	.....	2.2	.13	2.0	.11
Sodium Chloride	.....	.....	4.0	.23	14.2	.83	14.0	.82
Sodium Sulphate	79.7	4.65	32.5	1.90	9.6	.56	11.0	.64
Sodium Carbonate	.....	.....	29.1	1.70	.....	.....	.....	.....
Ammonium Sulphate	.5	.03	.....	.....	.....	.....	.....	.....
Ammonium Carbonate	1.7	.10	.....	.....	.....	.....	.....	.....
Magnesium Sulphate	.....	.....	.....	.....	31.3	1.82	28.9	1.68
Magnesium Carbonate	102.5	5.95	109.0	6.36	57.1	3.32	59.6	3.47
Calcium Sulphate	.....	.....	.....	.....	.....	.....	.....	.....
Calcium Carbonate	171.3	10.0	229.9	13.41	133.0	7.75	132.7	7.73
Oxide of Iron and Aluminum	.....	.....	.....	.....	.....	.....	.....	.....
Ferrous Carbonate	2.3	.13	4.2	.25	.6	.03	1.0	.06
Alumina	3.5	.20	2.3	.13	1.2	.07	2.8	.16
Silica	15 8	.92	23.8	1.39	12.8	.75	13.3	.78
Potassium Phosphate	.....	.....	.....	.....	1.8	.10	1.8	.10
Total	384.3	22.40	440.3	25 69	269.2	15.67	272.7	15.88
Analyst	A. D. E.		J. M. L.		R. W. S.		R. W. S.	

Waters—Continued.

Grafton	Grafton	Grant Park	Granville	Greenville.	Gridley
Jersey	Jersey	Kankakee	Putnam	Bond	McLean
5286	5287	12652	10857	3948	2452
June 24, 1899.	June 24, 1899.	Nov. 12, 1904	Jan. 22, 1903	Aug. 13, 1898	July 16, 1897
M. M. Scheff	W. Kirkp't'k	W. S. Curtis	J. Hershey	C. E. D'vs'n	E. N. A'm'g
Spring	30 feet	78 feet	Spring	40 feet	56 feet
Rock	Gravel	Rock		Sand	S. and grav
Distinct	Slight	Decided	Distinct	Slight	Distinct
.03	.01	Yellow	.4	.02	.1
.000	.000	.000	.000	.000	.000
Milligrams per 1000 c. c.	Milligrams per 1000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
272.	306.8	492.4	520.8	554.8	654.
11.2	19.6		82.4	71.2	16.
9.	5.2	10.8	5.2	24.	9.
1.4	1.	1.7	3.1	1.1	4.1
.002	.001	.352	.144	.004	1.04
.05	.024	.026	.088	.01	.110
.000	.000	.001	.002	.000	.032
.2	1.16	.16	.16	.8	.9
2.2	2.7		2.0	1.9	
11.6	7.3	12.8	9.4	27.8	43.9
			.2		1.37
20.8	24.9	43.3	55.1	40.8	46.7
75.4	89.0	120.2	95.8	111.0	87.2
.15	.3	2.8	1.7	.2	
.7	.6	2.3	2.0	1.1	
8.2	9.6	8.7	6.3	13.6	8.6
.9	5.2	.7	.7	3.6	4.0
9	5.2	10.8	5.2	24.	9.
15.3	29.5	73.9	101.1	77.1	191.2

Combinations.

Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	
1.5	.09	6.8	.39			1.1	.06	4.9	.28			KNO_3
3.2	.19					3.	.18					KCl
												K_2SO_4
		1.4	.08	.9	.05			.8	.05	5.5	.31	$NaNO_3$
12.4	.72	8.4	.49	18.1	1.06	6.3	.37	39.6	2.30	14.8	.86	$NaCl$
20.8	1.20	11.2	.64	16.7	.97	21.3	1.25	37.1	2.16	113.1	6.59	Na_2SO_4
												Na_2CO_3
						.7	.04			4.9	.28	$(NH_4)_2SO_4$
												$(NH_4)_2CO_3$
1.6	.09	27.4	1.59	78.3	4.57	107.9	6.29	65.1	3.79	139.8	8.16	$MgSO_4$
71.0	4.14	67.6	3.94	96.0	5.60	115.9	6.76	96.4	5.62	64.0	3.73	$MgCO_3$
												$CaSO_4$
188.4	10.99	222.3	12.96	300.3	17.52	239.3	13.96	277.3	16.17	216.6	12.70	$CaCO_3$
										2.3	.13	$Fe_2O_3+Al_2O_3$
.3	.02	.6	.04	5.8	.34	3.5	.20	.5	.03			$FeCO_3$
1.3	.07	1.2	.07	4.3	.25	3.7	.22	2.0	.11			Al_2O_3
17.5	1.02	20.5	1.19	18.4	1.05	13.5	.79	28.8	1.68	18.4	1.07	SiO_2
												K_3PO_4
318.	18.53	367.4	21.39	538.8	31.41	516.2	30.12	552.5	32.19	580.4	33.83	
R. W. S.		R. W. S.		J. M. L.		P. B.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Gridley	Hamilton	Hamilton	Harrisburg
County	McLean	Hancock	Hancock	Saline
Laboratory number	2636	12924	13093	4024
Date	Aug. 7, 1897	Feb. 21, 1905	Apr. 20, 1905	Sept. 1, 1898
Owner	E. N. Armstng	H. Brown	J. W. Dewitt	Geo. Burnett
Depth	50 feet	Spring	700 feet	275 feet
Strata	Coarse sand	Limestone	Flowing	Rock
Turbidity	Distinct	Clear	Clear	Slight
Color	.2	Very little	.000	.02
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	551.6	338.8	3610.8	18287.2
Loss on ignition	21.6	....	....	372.
Chlorine	3.7	11.5	592.5	11000.
Oxygen consumed	2.4	1.25	7.75	1.
Nitrogen as — Free ammonia	1.36	.024	1.760	12.4
Nitrogen as — Alb. ammonia	.062	.066	.030	.052
Nitrogen as — Nitrites	.000	.000	.000	.000
Nitrogen as — Nitrates	6.0	6.8	.100	.05
Lithium Li	....	....	....	1.
Potassium K	4.5	3.2	28.8	332.1
Sodium Na	54.6	9.0	863.0	641.9
Ammonium (NH_4)	....	....	....	15.9
Magnesium Mg	41.0	22.8	84.8	139.4
Calcium Ca	90.1	83.5	143.2	201.3
Ferrous Fe	2.3	....	.8	.8
Aluminium Al	.6	....	6.2	5.5
Silica Si	9.2	9.3	.9	2.3
Nitrate NO_3	26,5	30.1	....	.2
Chloride Cl	3.7	11.5	592.5	11000.
Sulphate SO_4	162.6	228.0	1526.1	14.5

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	11.6	.68	8.2	.47	....	....	.4	.02
Potassium Chloride	....	....	....	....	55.0	3.21	633.7	36.96
Sodium Nitrate	26.7	1.56	33.2	1.94	....	....	....	....
Sodium Chloride	6.1	.36	....	....	934.4	54.51	16318.8	951.94
Sodium Sulphate	138.6	8.08	....	....	1521.9	88.78	....	....
Sodium Carbonate	....	....	....	....	....	....	....	....
Ammonium Chloride	....	....	....	....	....	....	47.2	2.75
Ammonium Sulphate	....	....	....	....	....	....	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	15.4	.90	....	....	558.6	32.58
Magnesium Sulphate	86.1	5.03	28.5	1.66	421.5	24.59	....	....
Magnesium Carbonate	82.6	4.82	45.8	2.67	....	....	....	....
Calcium Chloride	....	....	....	....	....	....	541.3	31.57
Calcium Sulphate	....	....	....	....	227.0	13.24	....	....
Calcium Carbonate	225.0	13.12	208.6	12.17	191.0	11.14	15.2	.88
Oxide of Iron and Aluminium	....	....	2.2	.13	....	....	....	....
Ferrous Carbonate	4.8	.28	....	....	1.8	.11	1.6	.09
Alumina	1.2	.07	....	....	11.6	.68	10.4	.60
Silica	19.5	1.14	19.7	1.15	2.0	.12	4.8	.28
Lithia	....	....	....	....	....	....	4.4	.25
Total	602.2	35.14	361.6	21.09	3366.2	196.38	18136.4	1057.92
Analyst	R. W. S.		J. M. L.		J. M. L.		R. W. S.	

Waters—Continued.

	Harrisburg ..	Harrisburg ..	Harrisburg	Harrisburg ..	Harrisburg	Harrisburg
	Saline	Saline	Saline	Saline	Saline	Saline ......
	4025	4026	4027	9225	9228	9229 ....
	Sept. 1, 1898..	Sept. 1, 1898..	Sept. 1, 1898	July 29, 1901..	July 29, 1901	July 29, 1901
	Geo. Burnett	Geo. Burnett	Geo. Burn't	H. S. Andsn.	Wm. Chois.	Wm. Chois.
	275 feet.......	275 feet	100 feet	104 feet	94 feet	210 feet ....
	Limestone ..	Limst. & coal	C'l, lm'st, rk	Rock	Sandstone.	Lmst. & s'd.
	Slight........	Slight........	Distinct	Decided	Slight......	Slight......
	.02	.03	.4	Yellow	.01	.01
	.000	.000	.000	.000	.000	Musty .....
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c	Milligrams per 1,000c.c.
	793.6	3644.	2664.	2007.2	2964 8	774.8
	10.8	170.	172.	120.8	230.	11.8
	90.	1640.	12.	22.	50.	78.
	2.1	7.5	1.9	4.3	3.7	4.
	.64	2.56	.4	.4	.064	.448
	.058	.048	.024	.048	.056	.108
	.03	.000	.000	.000	.034	.026
	.05	.2	.05	.08	.286	.134
	....	....	....	....	....	....
	13.7	58.1	9.0	3.0	3.7	2.7
	305.7	1080.1	77.2	35.0	148.9	304.1
	.8	3.3	.5	.5	.1	.6
	5.9	90.2	109.2	101.9	91.9	8.6
	7.1	131.4	357.4	351.5	547.4	8.7
	1.5	1.0	7.6	9.0	.5	....
	.3	1.7	.8	3.2	1.4	....
	4.8	3.1	23.	31.0	11.7	5.7
	.2	.9	.2	.3	1.3	.6
	90.	1640.	12.	22.	50.	78.
	8.6	224.4	154.05	962.4	1431.0	16.3

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
.4	.02	1.5	.08	.4	.02	.6	.03	2.0	.12	1.0	.06	KNO_3 ....
25.8	1.50	109.8	6.40	16.8	1.00	5.2	.30	5.5	.32	4.4	.26	KCl ....
....	......	....	......	......	......	....	......	......	......	......	......	$NaNO_3$ ....
128.0	7.47	2616.5	152.63	6.6	.38	32.1	1.86	78.1	4.53	12.5	.73	$NaCl$ ....
12.8	.77	158.9	9.27	230.1	13.42	92.0	5.34	364.6	22.15	24.1	1.40	Na_2SO_4 ....
578.7	33.75	....	......	......	......	....	......	......	......	671.2	39.14	Na_2CO_3 ....
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)Cl$ ....
....	......	12.1	.70	1.8	.10	1.8	.10	.4	.02	......	......	$(NH_4)_2SO_4$ .....
2.1	.12	....	......	......	......	....	......	......	......	1.4	.08	$(NH_4)_2CO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$MgCl_2$ ....
....	......	133.8	7.80	542.7	31.65	506.7	29.39	456.6	26.48	......	......	$MgSO_4$ ....
20.6	1.20	220.0	12.83	......	......	....	......	......	......	29.8	1.74	$MgCO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$CaCl_2$ ....
....	......	....	......	1175.2	68.55	700.1	40,61	1146.0	65.47	......	......	$CaSO_4$ ....
17.8	1.04	328.2	19.15	28.6	1.66	363.4	21.08	524.8	30.44	21.8	1.27	$CaCO_3$ ....
....	......	....	......	......	......	....	......	......	......	2.6	.15	$Fe_2O_3+Al_2O_3$.
3.0	.17	2.1	.12	15.7	.91	18.7	1.08	1.0	.06	......	......	$FeCO_3$ ....
.6	.03	3.2	.18	1.6	.09	6.0	.35	2.6	.15	......	......	Al_2O_3 ....
10.3	.59	6.6	.38	47.2	2.75	64.2	3.72	25.0	1.45	12.2	.72	SiO_2 ....
....	......	....	......	......	......	....	......	......	......	......	......	....
800.1	46.66	3592.7	209.54	2066.7	120.53	1790.8	103.86	2606.6	151.19	781.	45.55	
R. W. S.		R. W. S.		R. W. S.		A. L. M.		A. L. M.		A. D. E.		

Analyses of Illinois

Town	Havana	Havana	Havana	Havana
County	Mason	Mason	Mason	Mason
Laboratory No	2882	4297-8	7539-40	2455
Date	Nov. 1, 1897	Nov. 1, 1898	Aug. 25, 1900	June 30, 1897
Owner	M. Newberry	Same	Chas. Logue	C. A. Kofoid
Depth	Illinois R	Illinois R	Illinois R	52 feet
Strata				Sand
Remarks				
Turbidity	Decided	Decided	Decided	Distinct
Color	Muddy	Muddy	Muddy	Yellow
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	384.8	444.	298.0	450.
Dissolved	362.4	370.8	251.2	
Suspended	22.4	73.2	46.8	
Loss on ignition	30.	30.	36.8	42.
Dissolved	27.6	28.	25.2	
Suspended	2.4	2.	11.6	
Chlorine	63.	29.	14.0	18.
Oxygen consumed	12.1	7.4	11.4	5.4
Nitrogen as: Free ammonia	1.32	2.08	1.28	1.76
Nitrogen as: Alb. ammonia	.48	.4	.416	.118
Nitrogen as: Dissolved	1.32	.24	.32	
Nitrogen as: Suspended	.16	.16	.096	
Nitrogen as: Nitrites	1.	.04	.04	.000
Nitrogen as: Nitrates	.7	.35	.6	.064
Alkalinity				
Lithium Li		.01		
Potassium K	6.9	4.6	3.5	2.1
Sodium Na	45.8	26.3	14.9	20.4
Ammonium (NH_4)	1.7	2.8	.6	
Magnesium Mg	27.6	28.9	41.5	19.0
Calcium Ca	56.0	60.0	107.1	69.5
Ferrous Fe	1.5	.15	3.2	1.2
Aluminium Al	4.8	.9	3.7	7.8
Silica Si	12.5	14.8	13.	8.8
Nitrate NO_3	3.1	1.5	3.7	21.7
Chloride Cl	63.	28.9	14.	18.
Sulphate SO_4	42.	52.8	43.5	77.1
Phosphorus PO_4	2.5	1.1		
Manganese Mn			.5	

Waters—Continued.

Havana......	Hennepin...	Hennepin.	Herrin.......	Hi'hl'd P'k	Hi'hl'd P'k
Mason.......	Putnam	Putnam....	Williamson .	Lake.......	Lake.......
3752..........	3761..........	3826.........	13732.........	5609.........	6103.........
June 28,1898.	July 23,1898..	July 15,1898	Nov. 8,1905..	Aug.10,1899	Oct. 17,1899
C. A.Kofoid.	J. H. Seaton.	J.M.Sto'ff'r	C.&C. C'lCo.	W. Tillm'n	R. Tillman
75 feet........	800 feet.......	105 feet.....	20 feet........	135 feet.....	168 feet.....
Sand........	St. Peter.....	Sand&g'v'l	Drift.........	Shell rock..	G'vl & s'nd
City supply..	Flowing.....	....	....	Flowing...	Flowing...
Slight........	Slight........	Slight......	Decided.....	Slight......	Slight......
.02	.03	.02	.8	.01	.02
.000	Sour.........	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
191.2	2920.4	344.4	1022.	420.8	570.4
....	....	....	....	....	....
....	....	....	....	....	....
16.	14.	20.	....	41.6	22.
....	....	....	....	....	....
....	....	....	....	....	....
2.2	1200.	3.	2.4	14.	11.
1.3	6.	1.3	7.0	1.6	1.6
.001	.826	.000	.096	29.	.474
.008	.032	.01	.204	.022	.036
....	....	....	....	....	....
....	....	....	....	....	....
.002	.000	.000	.006	.000	.000
.55	.2	.5	.08	.16	.01
....	....	....	168.4	....	....
....	....	....	....	....	....
1.2	26.9	1.7	12.5	2.6	2.7
4.9	1092.4	12.1	117.4	76.7	72.7
....	1.	....	....	.4	.6
14.0	6.9	30.0	44.6	24.2	45.8
39.5	143.4	71.6	96.9	33.8	49.3
.3	.3	....	4.3	Trace......	.3
.3	.5	....	2.8	.7	.4
13.3	3.3	9.0	19.1	6.7	8.
2.4	.9	2.2	.3	.7	....
2.2	1200.	3.	2.4	14.	11.
20.9	199.2	17.7	575.4	188.5	276.9
....	....	....	....	....	....
....	....	....	....	....	....

Hypothetical

Town	Havana		Havana		Havana		Havana	
Laboratory No	2882		4297-8		7539-40		2455	
	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrite	6.1	.35	....	....	....	....	....	....
Potassium Nitrate	5.1	.29	2.4	.14	6.0	.35	5.4	.31
Potassium Chloride	3.7	.22	4.4	.25	2.2	.13	....	....
Potassium Sulphate	....	....	....	....	....	....	....	....
Sodium Nitrate	....	....	....	....	....	....	25.2	1.46
Sodium Chloride	100.9	5.88	44.2	2.57	21.4	1.24	29.7	1.73
Sodium Sulphate	17.4	1.03	27.5	1.60	20.1	1.16	5.8	.34
Sodium Carbonate	....	....	....	....	....	....	....	....
Ammonium Sulphate	6.2	.36	10.2	.59	2.2	.13	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Sulphate	31.0	1.8	33.4	1.94	35.5	2.07	91.6	5.33
Magnesium Carbonate	74.0	4.32	77.3	4.51	69.7	4.06	3.0	.17
Calcium Sulphate	....	....	....	....	....	....	....	....
Calcium Carbonate	137.8	8.03	150.3	8.77	267.5	15.60	173.6	10.11
Oxide of Iron and Aluminium	....	....	....	....	....	....	....	....
Ferrous Carbonate	3.2	.18	.3	.02	6.6	.38	2.6	.15
Alumina	9.0	.52	1.7	.10	7.	.40	14.7	.86
Silica	26.1	1.51	31.6	1.83	27.6	1.60	18.7	1.09
Lithium	....	....	Trace..	Trace..	....	....	....	....
Potassium Phosphate	....	....	2.4	.14	....	....	....	....
Total	420.8	24.49	385.7	22.46	466.5	27.16	370.3	21.55
Manganese Peroxide	....	....	....	....	.7	.04	....	....
Analyst	R. W. S.		R. W. S.		R. W. S.		R. W. S.	

Combinations.

Havana 3752		Hennepin 3761		Hennepin 3826		Herrin 13732		Hi'hl'd P'k 5609		Hi'hl'd P'k 6103		
Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
......	......	......	......	......	......	......	......	......	......	......	......	KNO_2
3.2	.18	1.5	.08	3.5	.20	.6	.04	1.1	.06	......	......	KNO_3
......	......	50.2	2.92	.6	.03	5.0	.29	4.1	.24	5.1	.30	$K Cl$
......	......	......	......	......	......	21.5	1.26	......	......	......	......	$K_2 SO_4$
.6	.03	......	......	......	......	......	......	......	......	......	......	$Na NO_3$
3.6	.21	1938.2	113.05	4.4	.25	......	......	19.8	1.15	14.2	.83	$Na Cl$
10.3	.59	294.6	17.18	26.3	1.53	362.1	21.12	213.0	12.42	207.0	12.07	$Na_2 SO_4$
......	......	540.2	31.50	4.2	.24	......	......	......	......	......	......	$Na_2 CO_3$
......	......	......	......	......	......	......	......	1.5	.09	2.2	.13	$(NH_4)_2 SO_4$
......	......	2.6	.15	......	......	......	......	......	......	......	......	$(NH_4)_2 CO_3$
17.4	1.01	......	......	......	......	221.7	12.93	46.6	2.71	169.3	9.87	$Mg SO_4$
36.5	2.13	24.1	1.40	104.4	6.08	......	......	51.4	2.99	40.9	2.38	$Mg CO_3$
......	......	......	......	......	......	200.4	11.69	......	......	......	......	$Ca SO_4$
98.6	5.74	36.8	2.15	178.9	10.43	94.8	5.53	84.5	4.93	123.2	7.18	$Ca CO_3$
......	......	......	......	4.3	.25	......	......	......	......	......	......	$Fe_2 O_3 + Al_2 O_3$
.6	.03	.6	.03	......	......	9.0	.52	......	......	.6	.03	$Fe CO_3$
.6	.03	1.0	.06	......	......	5.2	.30	1.4	.08	.7	.04	$Al_2 O_3$
28.4	1.66	7.2	.42	19.1	1.10	40.6	2.37	14.2	.82	17.1	.99	$Si O_2$
......	......	......	......	......	......	......	......	......	......	......	......	Li
......	......	......	......	......	......	......	......	......	......	......	......	$K_3 PO_4$
199.8	11.60	2897.	168.94	345.7	20.11	960.9	56.05	437.6	25.49	580.3	33.82	
......	......	......	......	......	......	......	......	......	......	......	......	$Mn O_2$
R. W. S.		R. W. S.		R. W. S.		J. M. L.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Highland	Hillsboro	Hillsboro	Hinsdale
County	Madison	Montgomery	Montgomery	Du Page
Laboratory number	13677	5707	2132	11047
Date	Oct. 18, 1905	Apr. 23, 1899	Apr. 21, 1897	May 7, 1903
Owner	H. Brew'ng Co.	S. Canady	Dr. Moyer	P. Rudnick
Depth	246 feet	39 feet	85 feet	173 feet
Strata	Rock			Lime stone
Capacity			7 gal. per hour.	
Remarks			Flowing	
Turbidity	Distinct	Slight	Distinct	Decided
Color	.4	.01	.15	Cloudy
Odor	Oily	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	1670.	4943.6	951.6	491.2
Loss on igniton		505.6	34.	44.4
Chlorine	665.0	162.	312.	.85
Oxygen consumed	5.7	1.9	9.	2.7
Nitrogen as. Free ammonia	.640	.002	3.44	.6
Nitrogen as. Alb. ammonia	.084	.07	.14	.028
Nitrogen as. Nitrites	.008	.000	.000	.001
Nitrogen as. Nitrates	.20	30.4	.04	.08
Potassium	8.7	.9	4.0	2.7
Sodium Na	624.9	369.9	319.1	17.7
Ammonium (NH_4)				.8
Magnesium Mg	13.2	405.0	17.6	42.0
Calcium Ca	27.3	503.5	30.0	89.8
Ferrous Fe	1.1	.5		2.0
Aluminium Al	2.3	.8		1.9
Silica	13.4	10.7	6.2	7,5
Nitrate NO_3	.9	134.5	.17	.3
Chloride Cl	665.	162.	312.0	.85
Sulphate SO_4	64.4	2580.0	.4	67.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.5	.09	2.4	.14	.3	.02	.6	.04
Potassium Chloride	15.5	.89			7.4	.43	1.7	.10
Porassium Sulphate							3.5	.20
Sodium Nitrate			182.4	10.64				
Sodium Chloride	1085.0	63.29	267.0	15.58	508.9	29.68		
Sodium Sulphate	95.3	5.56	665.0	38.53	.6	.03	52.9	3.08
Sodium Carbonate	385.2	22.47			272.8	15.91		
Ammonium Chloride								
Ammonium Sulphate							2.9	.17
Ammonium Carbonate								
Magnesium Chloride								
Magnesium Sulphate			2013.0	117.42			34.8	2.03
Magnesium Carbonate	46.0	2.68			61.3	3.57	121.8	7.11
Calcium Sulphate			736.8	42.97				
Calcium Carbonate	68.2	3.98	716.1	41.77	75.	4.36	224.3	13.08
Oxide of Iron and Aluminium					2.3	.13		
Ferrous Carbonate	2.3	.13	1.1	.06			4.2	.25
Alumina	4.3	.25	1.6	.09			3.5	.20
Silica	28.6	1.67	22.8	1.32	13.1	.76	16.	.93
Suspended matter							7.2	.42
Totals	1731.9	101.01	4608.2	268.52	941.7	54.89	473.4	27.61
Analyst	J. M. L.		R. W. S.		C. R. R.		P. B.	

Waters—Continued.

Hoopston ...	Hoopston ...	Hope	Huntsville...	Hyde Park	Ipava .....
Vermilion ...	Vermilion ...	Vermilion .	Schuyler	Cook.......	Fulton.....
10916	13588	9769	3481	10385	10433 ....
Mar. 3, 1903...	Sept. 25, 1905.	Nov. 1, 1901	Apr. 19, 1898.	May 19, 1902	June 23, 1902
A. Honeyw'll	Mrs. Rodm'n	Ludwig....	L. F. King..	Mathews...	C. Marshall
....	106 feet	107 feet	....	288 feet	1,088 feet...
Spring	Drift	Drift.........	Quicksand ..	Rock.........	Lime stone
....	....	....	....	....	....
....	....	....	....	Flowing ...	....
Slight........	Decided	V. Slight...	Decided	V. Slight...	V. Decided
.000	Yellow.......	.01	.03	.000	Yellow.....
.000	Putrid........	.000	.000	.00	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
344.8	379.0	2114.	344.	182.4	2322.
34.8	....	43.6	28.	9.6	47.2
1.2	1.2	1250.	5.	16.	535.
1.9	2.75	9.9	1.6	1.4	17.
.252	.752	1.4	.184	.16	1.12
.022	.040	.13	.032	.042	.016
.000	.000	.001	.000	.000	.000
.16	.08	.12	.6	.11	.1
2.7	4.1	102.3	2.8	5.1	23.2
11.1	48.8	741.6	27.0	41.9	752.4
.3	....	1.8	.23	.2	1.4
35.2	13.8	31.0	34.3	6.3	54.0
81.0	72.9	72.8	84.0	12.4	121.7
.6	.15	.3	.9	.3	....
.4	.8	.7	....	.7	....
7.7	6.5	3.8	11.2	4.3	4.2
.7	.3	.6	2.7	.5	.5
1.2	1.2	1250.	5.	16.	535.
23.7	10.4	54.9	18.4	12.0	758.1

Combinations.

Parts per million..	Grains per U. S. gal.	Parts per million..	Grains per U. S. gal.	Parts per million..	Grains per U. S. gal.	Parts per million..	Grains per U. S. gal.	Parts per million..	Grains per U. S. gal.	Parts per million..	Grains per U. S. gal.	
1.1	.06	.6	.04	.9	.05	4.3	.25	.7	.04	.7	.04	KNO_3...........
2.5	.15	2.5	.15	194.6	11.35	1.7	.10	9.4	.55	43.9	2.56	KCl ....
2.2	.13	5.7	.33	......	......	....	......	......	......	......	......	K_2SO_4 ....
....	......	....	......	......	......	....	......	......	......	......	......	$NaNO_3$...........
....	......	....	......	1885.1	109.97	6.9	.40	19.1	1.12	848.3	49.48	NaCl ....
33.4	1.95	10.8	.63	......	......	27.3	1.59	17.8	1.04	674.9	39.37	Na_2SO_4 ....
5.1	.30	104.5	6.09	......	......	35.4	2.06	66.2	3.86	......	......	Na_2CO_3..........
....	......	....	......	5.3	.31	....	......	......	......	......	......	NH_4Cl...........
....	......	....	......	......	......	....	......	......	......	5.1	.30	$(NH_4)_2SO_4$ .....
.8	.05	....	......	......	......	.6	.04	......	......	......	......	$(NH_4)_2CO_3$.....
....	......	....	......	83.4	4.86	....	......	......	......	......	......	$MgCl_2$ ....
....	......	....	......	48.9	2.85	....	......	......	......	268.2	15.64	$MgSO_4$..........
122.6	7.15	48.1	2.81	......	......	119.5	6.97	22.5	1.31	......	......	$MgCO_3$ ....
....	......	....	......	22.4	1.30	....	......	......	......	118.5	6.92	$CaSO_4$ ....
202.5	11.82	182.2	10.63	165.4	9.65	269.8	12.24	31.1	1.82	217.	12.65	$CaCO_3$ ....
....	......	....	......	......	......	....	......	......	......	1.8	.11	$Fe_2O_3+Al_2O_3$..
1.3	.08	.3	.02	.6	.04	2.0	.11	.6	.03	......	......	$FeCO_3$..........
.7	.04	1.5	.09	1.4	.08	....	......	1.3	.08	......	......	Al_2O_3 ....
16.4	.95	13.8	.81	8.0	.47	22.2	1.29	9.2	.54	9.	.53	SiO_2 ....
....	......	....	......	......	......	....	......	......	......	22.6	1.32	....
388.6	22.68	370.	21.6	2416.	140.93	429.7	14.55	177.9	10.39	2210.	128.92	
P. B.		J. M. L.		A. D. E.		R. W. S.		A. D. E.		A. D. E.		

Analyses of Illinois

Town	Ipava	Jacksonville	Jacksonville	Jacksonville
County	Fulton	Morgan	Morgan	Morgan
Laboratory number	10489	3726	3970	5107
Date	June 30, 1902	July 23, 1898	Aug. 18,	May 25, 1899
Owner	W. T. Branson	S. Dunlap	D. Seligman	W. McLa'ghlin
Depth	768 feet	Spring	Spring	Spring
Strata	Rock		Sand	
Remarks				Same as 3970
Turbidity	Slight		Slight	.000
Color	.05		.02	.01
Odor	.000	Vinegar	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	4060.	339.6	374.8	416.8
Loss on ignition	26.	29.2	54.	38.4
Chlorine	2075.	6.0	9.	10.2
Oxygen consumed	7.1	1.3	2.	1.8
Nitrogen as. Free ammonia	1.4	.136	.134	.02
Nitrogen as. Alb. ammonia	.064	.04	.052	.02
Nitrogen as. Nitrites	.005	.000	.005	.015
Nitrogen as. Nitrates	.795	.2	1.	3.2
Potassium	19.3	1.5	1.2	2.8
Sodium Na	1515.7	10.2	11.5	9.6
Ammonium (NH_4)	1.8	.2		
Magnesium Mg	20.3	32.3	29.9	37.6
Calcium Ca	37.7	78.0	70.7	89.9
Ferrous Fe	.9	.8	.07	Trace
Aluminium Al	.6	.3	1.7	.4
Silica Si	3.4	5.9	4.1	11.2
Nitrate NO_3	.4	.9	4.4	14.1
Chloride Cl	2075.	6.	9.	10.2
Sulphate SO_4	1.3	24.4	14.8	8.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	5.8	.34	1.5	.09	3.2	.18	7.3	.42
Potassium Chloride	32.3	1.9	1.7	.10				
Potassium Sulphate								
Sodium Nitrate					3 3	.19	13.2	.77
Sodium Chloride	3398.3	198.2	8.6	.50	14.8	.86	15.3	.89
Sodium Sulphate	1.9	.11	21.3	1.24	14.9	.87		
Sodium Caabonate	410.5	23.93						
Ammonium Nitrate								
Ammonium Sulphate			.5	.03				
Ammonium Carbonate	4.8	.28						
Magnesium Nitrate								
Magnesium Chloride							.9	.05
Magnesium Sulphate			12 1	.70	6.0	.35	10.8	.63
Magnesium Carbonate	70.6	4.11	103.9	6.06	99.7	5.81	122.6	7.15
Calcium Sulphate								
Calcium Carbonate	94.3	5.49	194.8	11.36	175.2	10.21	224.6	13.10
Ferrous Carbonate	1.9	.11	1.6	.09	.1	.08		
Alumina	1.2	.07	.5	.03	3.1	.18	.7	.04
Silica	7 2	.42	12.5	.73	8.7	.51	23.1	1.34
Total	4028.8	234.96	359.	20.93	329.0	19.24	418.5	24.39
Analyst	P. B.		R. W. S.		R. W. S.		R. W. S.	

Waters—Continued.

Jacksonville.	Jacksonville.	Jacks'nv'le	Jacksonville.	Jacks'nv'le	Jacks'nv'le
Morgan......	Morgan......	Morgan....	Morgan......	Morgan....	Morgan....
7811	8985	9218	10734	11924	3712 ....
June 29, 1900	Feb. 6, 1901..	Aug. 9, 1901	Nov. 1, 1902..	Mar. 31, 1904	June 21, 1898
O. K. Taylor	Wm. Carson.	Hy. Ricks.	S. Dunlap ...	E. Tichner.	H.S.Uph'm
Spring.......	Spring.......	Spring.....	Spring.......	Spring.....	3110 feet....
....	Gravel.......	....	....	Gravel.....	Rock ......
....	....	....	....	....	Flowing...
Slight........	Very slight..	Decided ...	Slight........	Slight.......	Distinct....
Turbid.......	.01	.02	.3	.2	.02
Musty.......	.000	.000	Putrid.......	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
344.4	397.2	5102.4	344.4	441.6	2466.
37.6	27.2	18.	39.6	....	10.4
4.	4.8	2675.	6.	6.0	1000.
3.3	2.5	18.4	2.7	1.4	4.6
.152	.024	1.68	.13	.024	1.2
.072	.05	.154	.166	.052	.022
.000	.000	.000	.000	.000	.000
.28	7.	.16	.16	.08	.5
2.8	3.2	4.6	1.5	7.5	32.7
39.8	6.1	1963.5	11.1	37.1	678.6
.2	.03	2.2	.2	....	1.5
31.3	22.6	11.1	33.4	46.7	45.4
28.2	80.6	17.3	79.6	96.1	123.0
2.6	....	.5	1.2	3.1	2.6
2.2	....	1.8	.9	5.8	1.3
15.5	8.4	7.8	7.	4.7	6.
1.3	31.0	.7	.7	.3	2.2
4.	4.8	2675.	6.	6.	1000.
12.9	10.1	.8	24.4	53.5	439.7

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
2.	.12	8.3	.48	1.1	.06	1 1	.06	.6	.03	3.5	.20	KNO_3 ....
4.	.24	....	......	7.9	.46	2.1	.12	12.6	.73	59.9	3.50	$K Cl$ ....
....	......	....	......	......	......	....	......	1.5	.09	......	......	$K_2 SO_4$ ....
....	......	22.5	1.30	......	......	....	......	......	......	......	......	$Na NO_3$ ....
3.5	.20	....	......	4402.1	255.32	8.3	.48	......	......	1601.0	93.38	$Na Cl$...........
19.2	1.12	....	......	1.2	.07	24.3	1.42	77.9	4.54	150.4	8.77	$Na_2 SO_4$ ....
74.4	4.35	....	......	532.5	30.89	....	......	27.4	1.59	......	......	$Na_2 CO_3$........
.1	.01	.13	.01	......	......	....	......	......	......	......	......	$(NH_4) NO_3$ ....
....	......	....	......	......	......	.7	.04	......	......	5.5	.30	$(NH_4)_2 SO_4$ ....
....	......	....	......	5.9	.34	....	......	......	......	......	......	$(NH_4)_2 CO_3$....
.5	.02	10.4	.60	......	......	....	......	......	......	......	......	$Mg (NO_3)_2$ .....
....	......	6.4	.37	......	......	....	......	......	......	......	......	$Mg Cl_2$ ....
....	......	....	......	......	......	9.5	.55	......	......	225.9	13.17	$Mg SO_4$ ....
108.8	6.36	68.6	3.98	38.4	2.23	109.4	6.38	162.5	9.47	......	......	$Mg CO_3$ ....
....	......	14.3	.83	......	......	....	......	......	......	217.6	12.69	$Ca SO_4$..........
159.6	9.33	191.0	11 08	43.2	2.51	199.	11.61	240.0	14.00	147.5	8.59	$Ca CO_3$ ....
5.5	.32	....	......	1.0	.05	2.4	.14	6.4	.37	5.3	.30	$Fe CO_3$.........
4.1	.24	....	......	3.3	.19	1.7	.10	10.8	.63	2.4	.14	$Al_2 O_3$ ....
31.2	1.82	17.8	1.03	16.5	.96	14.9	.87	10.0	.58	12.8	.75	$Si O_2$............
412.8	24.12	339.4	19.68	5053.1	293.08	373.4	21.77	549.7	32.03	2431.8	141.79	
A. R. J.		A. R. J.		A. L. M.		P. B.		D. K.		R. W. S.		

Analyses of Illinois

Town	Jacksonville	Jacksonville	Jerseyville	Jerseyville
County	Morgan	Morgan	Jersey	Jersey
Laboratory number	3713	11888	10192	3750
Date	June 21, 1898	Mar. 19, 1904	June 21, 1902	June 27, 1898
Owner	H. S. Upham	F. Sibert	J. J. Miller	Wm. Pittman
Depth	3,028 feet	3,100 feet	40 feet	1,468 feet
Strata	St. Peter	St. Peter	Rock	St. Peter
Remarks	Flowing	Flowing	....	City supply
Turbidity	Distinct	Distinct	....	Slight
Color	.02	.4	....	.01
Odor	.000	.000	....	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	2,520.	2,482.4	3,019.6	2,624.4
Loss on ignition	36.	....	83.2	30.8
Chlorine	1,000.	961.5	1.195.	1,070.
Oxygen consumed	5.4	8.3	8.2	6.5
Nitrogen as. Free ammonia	1.2	.64	.112	1.08
Nitrogen as. Alb. ammonia	.016	.024	.118	.02
Nitrogen as. Nitrites	.000	.024	.95	.024
Nitrogen as. Nitrates	.6	.096	7.85	.15
Potassium K	33.3	232.5	....	34.1
Sodium Na	698.8	510.7	785.5	719.5
Ammonium (NH_4)	1.5	.8	....	1.4
Magnesium Mg	44.5	43.6	66.0	49.4
Calcium Ca	120.1	128.9	189.3	110.1
Ferrous Fe	1.0	1.2	....	1.2
Aluminium Al	.8	8.1	....	9.1
Silica Si	6.5	4.	10.4	4.6
Nitrate NO_3	2.6	.5	34.7	.7
Chloride Cl	1,000.	961.5	119.5	1,070,0
Sulphate SO_4	435.3	335.5	467.0	412.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per m llion	Grains per U. S. gal.
Potassium Nitrate	4.3	.25	.7	.04	....	....	1.1	.06
Potassium Chloride	60.4	3.52	443.3	25.86	....	....	64.0	3.73
Sodium Nitrate	....	....	....	....	47.5	2.77	....	....
Sodium Chloride	1,600.5	93.36	1.237.8	72.22	196.2	11.44	1,713.1	99.92
Sodium Sulphate	213.2	12.43	73.5	4.28	690.7	40.29	140,6	8.19
Sodium carbonate	....	....	....	....	1,086.5	63.38	....	....
Ammonium Sulphate	5.5	.30	3.0	.18	....	....	5.1	.29
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Sulphate	221.4	12.91	219.6	12.81	....	....	250.5	14.61
Magnesium Carbonate	....	....	....	....	229.7	13.40	....	....
Calcium Sulphate	156.1	9.10	153.0	8.77	....	....	160.8	9.37
Calcium Carbonate	186.1	10.85	209.6	12.23	472.9	27.59	156.8	9.14
Oxide of Iron and Aluminium	....	....	....	....	3.0	.18	....	....
Ferrous Carbonate	2.1	.12	2.6	.15	....	....	2.6	.15
Alumina	1.6	.09	15.2	.88	....	....	1.8	.10
Silica	13.7	.80	8.0	.47	22.2	1.29	9.8	.57
Total	2,464.9	143.73	2,366 3	137.89	2,748.7	160.34	2,506.2	146.13
Analyst	R. W. S.		D. K.		A. D. E.		R. S. W.	

Waters—Continued.

Joliet........	Joliet........	Joliet.......	Joliet........	Joliet.......	Kampsv'e..
Will.........	Will..........	Will........	Will..........	Will........	Calhoun ...
4246...........	9342...........	9352.........	10103..........	11376........	12234........
Oct. 24, 1898..	Aug. 30, 1901.	Sept. 5, 1901	Dec. 16, 1901..	Sept. 17, 1903	July 11, 1904
M. W. Cush'g	H. Pipenbri'k	H. Alex'd'r	Chas. Kahn..	L. Moore..	J. F. Ghor'y
637 feet.......	235 feet.......	115 feet.....	1,100 feet.....	108 feet.....	232 feet.....
Rock.........	Rock.........	Limestone.	St. Peter.....	....	L. & soapst
Flowing.....	....	....	....	....	....
Distinct......	Very slight..	Very slight	Distinct......	Slight......	Decided....
.1	.01	.02	.03	.1	2.
.000	.000	.000	.000	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
840.	462.8	....	500.8	434.0	624.0
74.	50.4	....	81.6	142.0	....
54.	4.	....	20.	2.4	103.5
4.2	1.6	....	1.6	2.8	4.
.24	.096	....	.008	.12	.144
.106	.018	....	.022	.036	.136
.07	.001	....	.000	.090	.000
.7	.36	....	1.	.95	.240
17.8	5.0	5.1	8.8	....	29.2
48 2	19.7	32.7	22.6	32.7	133.5
.3	....	....	....	.2	....
67.9	17.9	61.4	15.1	39.2	15.8
126.7	76.9	127.0	83.2	85.1	52.2
1.0	.3	.2	1.5	....	3.1
.5	39.5	1.7	34.4	....	1.7
7.	4.2	4.7	3.7	6.9	6.5
3.1	1.6	.6	4.5	4.3	1.0
54.0	4.0	30.0	20.0	2.4	103.5
274.6	76 0	146.0	165.3	33.7	26.7

Combinations.

Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	
5.	.29	2.6	.15	.9	.05	7.3	.43	......	......	1.7	.09	KNO_3 ....
31.7	1.84	7.6	.44	9.0	.53	11.4	.66	......	......	54.5	3.18	$K\,Cl$ ....
....	......	....	......	......	......	....	......	5.8	.34	......	......	$Na\,NO_3$.........
64.1	3 73	.7	.04	42.4	2.47	24.1	1.41	4.	.23	127.9	7.46	$Na\,Cl$..........
71.0	4.14	64.8	3.78	49.2	2.87	40.5	2.36	49.9	2.91	39.6	2.31	$Na_2\,SO_4$ ....
....	......	....	......	......	......	....	......	38.	2.22	161.9	9.44	$Na_2\,CO_3$.........
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2\,SO_4$ ....
....	......	....	......	......	......	....	......	.5	.03	......	......	$(NH_4)_2\,CO_3$....
283,3	16.53	40.4	2.35	141.0	8.22	75.0	4.37	......	......	......	......	$Mg\,SO_4$. ....
33.2	2.22	33.8	1.98	114.9	6.71	....	......	136.3	7.95	55.0	3.21	$Mg\,CO_3$ ....
....	......	....	......	......	......	187.0	10.91	......	......	......	......	$Ca\,SO_4$..........
316.6	18.46	192.2	11.21	317.4	18.51	70.2	4.09	212 7	12.41	130.4	7.61	$Ca\,CO_3$ ....
....	......	....	......	......	......	....	......	2.3	.13	......	......	$Fe_2O_3 + Al_2\,O_3$.
2.1	.12	.6	.04	.5	.03	3.2	.19	......	......	6.4	.37	$Fe\,CO_3$.........
1.0	.06	74.6	4.36	3.2	.19	64.8	3.78	......	......	2.2	.13	$Al_2\,O_3$ ....
14.9	.87	9.0	.53	10.1	.59	7.8	.45	14.6	.18	13.9	.81	$Si\,O_2$............
827.9	48.26	426.3	24.88	688.6	40.17	491.3	28.65	464.1	27.08	593.5	34.61	

R. W. S.	A. D. E.	A. D. E.	A. D. E.	P. B.	J. M. L.

Analyses of Illinois

Town	Kankakee	Kankakee	Kankakee	Kankakee
County	Kankakee	Kankakee	Kankakee	Kankakee
Laboratory number	3946	3947	5373	7262
Date	Aug. 11, 1898	Aug. 11, 1898	Aug. 14, 1899	April 5, 1900
Owner	W. H. Martin	W. H. Martin	I. C. R. R.	E. V. Vining
Depth	River	River	River	68 feet
Strata				Limestone
Remarks	City supply Filtered	City supply Filt'd & boiled		
Turbidity	Distinct	Distinct		Slight
Color	.06	.06		.04
Odor	.000	.000		.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	248.	170.8		441.6
Loss on ignition	15.2	14.		50.8
Chlorine	3.4	3.3		14.5
Oxygen consumed	6.2	5.2		2.
Nitrogen as Free ammonia	.038	.082		.048
Nitrogen as Alb. ammonia	.3	.28		.048
Nitrogen as Nitrites	.001	.013		.000
Nitrogen as Nitrates	.25	.25	.88	.16
Lithium Li				
Potassium				3.4
Sodium Na	9.1	6.9	11.9	12.8
Ammonium (NH_4)				
Magnesium Mg	13.6	7.7	13.5	40.6
Calcium Ca	46.5	48.1	40.0	88.7
Ferrous Fe				1.00
Aluminium Al				.4
Silica Si	4.9	3.1	14.4	6.3
Nitrate NO_3	1.1	1.1	3.9	.7
Chloride Cl	3.4	3.3	2.2	14.5
Sulphate SO_4	37.6	34.6	39.7	110.8

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per U. S. gal.	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate							1.1	.06
Potassium Chloride							5.7	.33
Potassium Sulphate								
Sodium Nitrate	1.5	.08	1.5	.08	5.3	.31		
Sodium Chloride	5.6	.33	5.4	.31	3.6	,21	19.4	1.13
Sodium Sulphate	20.1	1.17	13.5	.78	14.4	.84	15.8	.92
Sodium Carbonate								
Ammonium Sulphate								
Ammonium Carbonate								
Magnesium Sulphate	30.1	1.75	31.9	1.86	37.6	2.19	125.2	7.30
Magnesium Carbonate	51.4	2.99	35.9	2.09	20.6	1.19	53.8	3,14
Calcium Sulphate								
Calcium Carbonate	125.4	7.30	71.6	4.17	100.0	5.83	221.6	12.92
Oxide of Iron and Aluminium	1.7	.09	2.6	.15	4.7	.27		
Ferrous Sulphate								
Ferrous Carbonate							2.1	.12
Alumina							.8	.05
Aluminium Sulphate								
Silica	10.5	.61	6.6	.38	30.6	1.78	13.5	.79
Lithium Nitrate								
Total	246.3	14.32	169.0	9.82	216.8	12.62	459.0	26.76
Sulphuric acid								
Analyst	R. W. S.		R. W. S.		R. W. S.		R. W. S.	

Waters—Continued.

Kankakee ...	Kankakee .	Kankakee .	Keensburg ..	Kell	Kensingt'n
Kankakee ...	Kankakee .	Kankakee .	Wabash	Marion	Cook ......
7787	9766	10912	4387	11856	5371 ....
Aug. 23, 1900.	Nov. 14, 1901	Mar. 4, 1903.	Nov. 18, 1898.	Mar. 9, 1904...	Aug. 14, 1899
F. Swannell.	W.E.Scoby	C H.Risser	W. Stein.....	Kell & My's	I. C. R. R..
1,000 feet	125 feet.....	78 feet......	280 feet	Deep	Calumet L.
St.P.& Tr't'n	Rock	Rock	Sandstone ...	Rock	....
....	....	....	....	....	....
....	....	....	....	....	....
Very slight..	Slight......	Distinct	Slight........	Decided......	....
....	.04	.3	.02	Reddish	....
Clayey	.000	.000	.000	....	....
Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c. c.	Milligrams per 1,000c.c.
331.2	594.4	576.	954.	17055.6	....
26.	85.2	80.6	8.0	....	....
3.5	7.	1.7	92.	....	....
1.1	1.5	1.8	1.6	33.9	....
.012	.32	.088	.36	19.2	....
.024	.02	.028	.012	.64	....
.001	.002	.000	.000	.003	....
.12	.158	.08	.15	1.52	.2
....	....	....	.8	....	....
2.3	6.3	9.5	8.2	....	....
7.1	22.7	18.7	387.1	182.6	18.3
....	.4	1.1	.5	24.7	....
36.1	40.9	72.2	1.2	117.1	30.8
77.9	113.0	97.5	1.6	450.3	57.7
1.5	3.1	2.5	.4	2506.6	....
.9	45.6	1.1	.4	428.2	....
2.8	8.1	9.9	5.6	....	9.4
.6	.7	.3	.7	.7	.9
3.5	7.	1.7	92.	62.	16.8
40.1	77.0	31.4	.4	10362.0	134.8

Combinations.

Parts per million ...	Grains per U. S. gal..	Parts per U. S. gal..	Grains per U. S. gal..	Parts per million ...	Grains per U. S. gal..	Parts per million ...	Grains per U. S. gal..	Parts per million ...	Grains per million ...	Parts per million ...	Grains per U. S. gal..	
.9	.05	1.1	.06	.6	.04	....	......	....	......	......	......	K N O_3 ....
3.8	.22	11.3	.66	3.6	.21	15.7	.91	....	......	......	......	K Cl ....
....	......	......	......	16.3	.95	....	......	....	......	......	......	K_2 SO_4 ,.........
....	......	......	......	......	......	....	......	9.3	.54	1.3	.07	Na NO_3 ....
2.8	.16	2.8	.16	......	......	139.2	8.11	102.3	5.96	27.7	1.61	Na Cl ....
6.0	.35	66.6	3.89	33.2	1.94	.5	.03	431.4	25.15	22.2	1.29	Na_2 SO_4 ....
9.4	.55	......	......	18.3	1.07	766.4	44.70	....	......	......	......	Na_2 CO_3........
....	......	1.5	.08	......	......	....	......	90.4	5.27	......	......	$(NH_4)_2$ SO_4....
....	......	......	......	2.9	.17	1.3	.07	....	......	......	......	$(NH_4)_2$ CO_3....
....	......	38.7	2.26	......	......	....	......	582.0	33.94	149.8	8.74	Mg SO_4.........
125.6	7.33	115.5	6.74	251.2	14.65	4.2	.24	....	......	2.3	.13	Mg CO_3 ....
....	......	......	......	......	......	....	......	1530.3	89.27	......	......	Ca SO_4..........
194.6	11.35	282.5	16.48	243.6	14.21	3.8	.22	....	......	143.6	8.38	Ca CO_3 ....
....	......	......	......	......	......	....	......	....	......	3.0	.17	Fe_2 O_3 + Al_2 O_3
....	......	......	......	......	......	....	......	6802.6	396.83	......	......	Fe SO_4..........
3.2	.18	6.4	.37	5.6	.33	.8	.05	1581.7	92.26	......	......	Fe CO_3..........
1.8	.10	86.0	5.02	2.	.12	.8	.05	....	......	......	......	Al_2 O_3 ....
....	......	......	......	......	......	....	......	2697.9	157.38	......	......	Al_2 $(SO_4)_3$......
6.	.35	17.2	1.00	20.4	1.19	11.9	.69	44.0	2.57	20.8	1.21	Si O_2............
....	......	......	......	......	......	.8	.05	....	......	......	......	Li NO_3 ....
354.1	20.64	629.6	36.72	597.7	34.88	945.4	55.12	15453.6	901.43	370.7	22.60	
....	......	......	......	......	......	....	......	1581.7	92.26	......	......	
R. W. S.		A. D. E.		P. B.		R. W. S.		D. K..		R. W. S.		

Analyses of Illinois

Town	Kewanee	Kewanee	Kewanee	Kewanee
County	Henry	Henry	Henry	Henry
Laboratory number	2411	3390	3391	12416
Date	Sept. 15, 1897	Mar. 24, 1898	Mar. 24, 1898	Sept. 7, 1904
Owner	W. E. Sanford.	W. E. Sanford.	W. E. Sanford.	K. Boiler Co.
Depth	Spring	1480 feet	1440 feet	1400 feet
Strata	...	St. Peter	St. Peter	St. Peter
Capacity	...	4,500 gal. per hr	9,000 gal. per hr	...
Remarks	...	City supply	...	Cased to Tr'tn.
Turbidity	Slight	Distinct	Slight	...
Color	.03	.4	.06	...
Odor	.000	.000	Oily	...

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	500.	1284.	1428.4	1162.4
Loss on ignition	34.	23.6	18.	...
Chlorine	2.	400.	485.	335.
Oxygen consumed	1.7	4.2	4 2	3.5
Nitrogen as Free ammonia	.53	1.48	1.52	1.00
Nitrogen as Alb. ammonia	.09	.026	.022	.102
Nitrogen as Nitrites	.000	.000	.03	.160
Nitrogen as Nitrates	.07	.75	.75	.32
Potassium K	2.2	18.9	20.7	...
Sodium Na	37.6	365.9	394.0	343.4
Ammonium (NH_4)	.68	1.9	1.95	1.2
Magnesium Mg	49.4	25.3	28.8	25.6
Calcium Ca	122.1	65.1	78.3	49.0
Ferrous Fe	5.7	1.2	.6	...
Aluminium Al	12.2	...	.11	...
Silica Si	11.6	3.9	4.3	7.2
Nitrate NO_3	.3	.3	.3	1.4
Chloride Cl	2.	400.	485.	335.
Sulphate SO_4	30.5	256.9	251.0	258.0
Lithium Li	...	...	...	...

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.5	.03	5.4	.31	5.4	.31	...	...
Potassium Chloride	3.8	.22	32.3	1.88	35.5	2.07	...	...
Sodium Nitrate	...	...	...	...	...	...	1.9	.11
Sodium Chloride	.3	.02	633 9	36.97	771.4	44.99	552.8	32.24
Sodium Sulphate	45.2	2.64	360.9	21.05	279.5	16 53	380.8	22.22
Sodium Carbonate	52.8	3.07	...	...	...	...	...	...
Ammonium Sulphate	...	...	6 9	.40	7.1	.42	.8	.05
Ammonium Carbonate	1.8	.10	...	...	...	...	2.7	.16
Magnesium Nitrate	...	...	...	...	...	...	...	...
Magnesium Chloride	...	...	...	...	...	...	...	...
Magnesium Sulphate	...	...	11.7	.68	71.2	4.15	...	...
Magnesium Carbonate	175.4	10.22	79.8	4.64	50.4	2.94	89.3	5.21
Calcium Sulphate	...	...	...	...	...	...	...	...
Calcium Carbonate	303.9	17.73	162.7	9.48	195.5	11.40	122.5	7.15
Oxide of Iron and Aluminium	...	...	...	...	...	...	4.8	.28
Ferrous Carbonate	11.8	.70	2.5	.14	1.2	.07	...	...
Alumina	2.3	.13	...	...	.2	.01	...	...
Silica	24.6	1.43	8.4	.49	9.1	.53	15.4	.90
Lithium Nitrate	...	...	...	...	...	...	...	...
Total	622.4	36.29	1304.5	76.04	1426.5	83.42	1171.0	68.32
Analyst	R. W. S.		R. W. S.		R. W. S.		J. M. L.	

Waters—Continued.

Kewanee....	Kewanee....	Kewanee..	Kinmundy..	Kinm'ndy.	Knoxville.
Henry	Henry	Henry	Marion	Marion	Knox .....
12417	12418	12971	8678	4376	7182 ....
Sept. 7, 1904..	Sept. 7, 1904..	Mar. 10, 1905	Oct. 19, 1900..	Nov. 17, 1898	Mar. 8, 1900.
K. Boiler Co.	K. Boiler Co.	E. S. Gal'sh	F. J. Ninider	H. Sch'ndr	Dr. L. Be'kr
1000 feet......	1479 feet......	1500 feet....	Spring	87 feet......	Spring.....
Sandstone ...	St. Peter.....	St. Peter...	....	Quicksand.	....
....	....	....	....	....	....
....	City supply .	....	....	....	....
....	....	Decided...	....	Slight	Slight .....
....	....	.2	....	.02	.01
....	....	Earthy.....	....	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
765.6	1362.0	1125.6	457.6	1818.	720.
....	....	....	20.0	192.0	60.8
47.5	457.5	310.	2.8	303.	48.
2.5	3.	3.8	1.5	3.2	1.4
1.00	1.40	.400	.368	.006	.002
.070	.036	.076	.012	.09	.03
.010	.000	.021	Trace	.012	.045
.07	.12	.499	.52	13.5	13.
....	....	12·6	2.3	6.8	3.0
222.2	352.3	269.6	69.0	255.9	17.6
1.2	1.7	....	.5	....	....
25.4	27.3	35.1	26.6	91.6	62.9
30.7	79.1	78.9	72.3	185.1	143.4
....	....	1.9	2.2	.5	.2
....	....	2.8	2.5	.5	.5
3.6	6.1	5.7	9.4	18.	4.4
.3	.6	2.2	2.3	62.0	58.5
47.5	457.5	310.	2.8	303.	48.
138.3	256.4	237.6	56.6	405.3	139.2
....	....	....	....	.1	....

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
......	......	......	......	3.6	.21	3.7	.21	17.6	1.02	7.7	.45	KNO_3 ....
......	......	......	......	21.4	1.25	1.6	.09	......	......	......	......	K Cl ....
.5	.03	.8	.05	......	......	......	......	69.1	4.02	65.0	3.79	$Na NO_3$..........
78.4	4.57	754.9	44.04	494.7	28.86	3.3	.19	498.3	29.06	......	......	Na Cl ....
204.7	11.94	169.9	9.91	231.3	13.49	83.8	4.86	127.1	7.41	......	......	$Na_2 SO_4$ ....
287.6	16.78	......	......	......	......	93.7	5.43	......	......	......	......	$Na_2 CO_3$ ....
......	......	6.2	.36	......	......	......	......	......	......	......	......	$(NH_4)_2SO_4$.....
3.2	.19	......	......	......	......	1·3	.07	......	......	......	......	$(NH_4)_2CO_3$ ....
......	......	......	......	......	......	......	......	......	......	6.4	.37	$Mg (NO_3)_2$ .....
......	......	......	......	......	......	......	......	......	......	64.2	3.74	$Mg Cl_2$ ....
......	......	135.9	7.93	101.6	5.93	......	......	399.0	23.27	174.0	10.15	$Mg SO_4$ ....
88.4	5.16	......	......	51.0	2.98	92.4	5.36	39.5	2.30	36.7	2.14	$Mg CO_3$ ....
......	......	40.1	2.34	......	......	......	......	......	......	......	......	$Ca SO_4$ ....
76.8	4.48	168.0	9.80	206.1	12.02	181.8	10.54	462.5	26.97	358.2	20.90	$Ca CO_3$ ....
3.2	.19	4.4	.26	......	......	......	......	......	......	......	......	$Fe_2O_3 + Al_2 O_3$.
......	......	......	......	4.0	.23	4.5	.26	1.0	.06	.5	.03	$Fe CO_3$ ....
......	......	......	......	5.2	.30	4.8	.28	1.0	.06	1.0	.06	$Al_2 O_3$ ....
7.6	.44	13.0	.76	12.2	.71	20.0	1.16	38.4	2.23	9.4	.55	$Si O_2$..........
......	......	......	......	......	......	......	......	.9	.05	......	......	$Li NO_3$ ....
750.4	43.78	1293.2	75.45	1131.1	65.98	490.9	28.45	1654.4	96.45	723.1	42.18	
J. M. L.		J. M. L.		J. M. L.		A. R. J.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Knoxville	Knoxville	Knoxville	LaHarpe
County	Knox	Knox	Knox	Hancock
Laboratory number	1701	8732	10521	2624
Date	Dec. 5, 1896	Nov. 2, 1900	July 28, 1902	Sept. 1, 1897
Owner	H. J. Charles	John Cook	W. J. Simpson	E. N. Armstr'g
Depth	1350 feet	130 feet	1255 feet	52 feet
Strata	St. Peter	China clay	Limestone	Sand
Remarks			City supply	
Turbidity		Slight	Clear	Slight
Color		.01	Clear	.02
Odor		.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue		435.6	1175.6	332.4
Loss on Ignition		39.6	44.8	19.2
Chlorine		2.2	188.	11.0
Oxygen consumed		1.1	5.5	1.6
Nitrogen as. Free ammonia		3.84	1.44	.140
Nitrogen as. Alb. ammonia		.036	.04	.042
Nitrogen as. Nitrites		.004	.008	.006
Nitrogen as. Nitrates		.396	.072	.20
Potassium K.	18.6	6.0	12.3	1.0
Sodium Na	414.0	22.0	293.7	13.0
Ammonium (NH_4)	1.33	4.9	1.8	
Magnesium Mg	25.8	44.4	27.3	28.8
Calcium Ca	57.6	73.3	63.1	74.3
Ferrous Fe	5.0	2.5	2.9	1.5
Aluminium Al	3.2	8.8	1.3	1.1
Slica Si	26.3	7.3	4.9	7.8
Nitrate NO_3	.4	1.7	.3	.9
Chloride Cl	191.	2.2	188.	11.
Sulphate SO_4	394.5	18.0	398.6	60.9

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.7	.04	2.8	.16	.6	.03	1.4	.82
Potassium Chloride	34.9	2.03	4.6	.26	23.0	1.34	.9	.05
Potassium Sulphate			5.5	.32				
Potassium Carbonate								
Sodium Chloride	287.7	16.79			292.2	17.05	17.4	.43
Sodium Sulphate	550.7	32.06	22.2	1.29	551.2	32.15	19.0	1.10
Sodium Carbonate			34.2	1.98				
Ammonium Sulphate					6.6	.38		
Ammonium Carbonate	7.1	.41	13.0	.75				
Magnesium Sulphate	27.9	1.62			26.5	1.55	61.6	3.59
Magnesium Carbonate	71.3	4.16	154.6	8.96	76.4	4.45	57.2	3.33
Calcium Sulphate								
Calcium Carbonate	143.8	8.40	183.0	10.61	157.5	9.19	185.7	10.83
Ferrous Carbonate	12.1	.71	7.2	.42	6.1	.35	3.5	.20
Alumina	6.	.35	16.	.93	2.4	.14	2.1	.12
Silica	55.9	3.26	15.6	.90	10.4	.60	16.5	.96
Suspended matter								
Total	1198.2	69.83	458.7	26.58	1152.9	67.23	365.3	21.43
Analyst			A. R. J.		P. B.		R. W. S.	

Waters—Continued.

Lake Bluff...	Lake Bluff...	LakeFore't	Lake Forest.	LakeFore't	LakeFore't
Lake.........	Lake.........	Lake.......	Lake.........	Lake	Lake ......
10548..........	12166..........	4282.........	9928...........	10545........	10551........
Aug. 12, 1902.	June 18, 1904.	Oct. 28, 1898	Dec. 17, 1901..	Aug.12, 1902	Aug.14, 1902
A. K. Stern..	W.F.Wein'rs	Dr. Haven.	S. Largent...	B. L. Smith	E. B. W'y'n
183 feet.......	1600 feet......	Artesian ..	1500 feet......	350 feet.....	1100 feet....
Rock.........	Rock.........	Rock	Rock.........	Rock	Rock ......
....	City supply..	Flowing...	....	....	....
Clear.........	Slight........	Slight	V. slight.....	....	Distinct....
.000	.000	.04	.01	....	Yellowish..
.000	.000	.000	.000	....	Aromatic...

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
352.4	580.8	648.	636.	256.	614.
6.8	....	30.	28.4	12.	25.2
10.3	14.5	26.	27.	32.4	24.
2.6	1.2	.7	1.9	3.3	2.2
.112	.096	.44	.28	.12	.216
.086	.018	.038	.028	.056	.016
.008	.000	.000	.000	.000	.000
.272	.24	.2	.16	.04	.16
1.5	14.6	15.0	17.1	9.0	12.9
67.4	51.8	51.6	53.1	74.8	34.3
.1	....	.6	.4	....	.3
12.8	18.9	25.5	27.5	5.4	26.9
23.0	126.9	120.2	124.8	8.4	112.7
.3	.4	.6	.8	.3	.3
.2	6.6	.3	1.4	.5	1.6
5.0	4.5	7.2	3.4	3.6	4.6
1.3	1.0	.9	.7	.2	.7
10.3	14.5	26.0	27.0	32.4	24.
150.2	187.8	224.5	198.7	2.3	209.5

Combinations.

Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per million ..	
2.1	.12	1.7	.10	1.4	.82	1.1	.06	.4	.02	1.1	.06	KNO_3..........
1.3	.08	26.6	1.55	27.7	1.61	31.9	1.86	6.7	.39	23.9	1.39	KCl..............
....	......	....	......	......	......	....	......	4.1	.24	......	......	K_2SO_4..........
....	......	....	......	......	......	....	......	6.2	.36	......	......	K_2CO_3 ....
7.6	.44	3.0	.18	21.1	1.22	19.6	1.15	......	......	20.8	1.22	Na Cl...........
198.6	11.58	156.2	9.11	133.6	7.79	140.1	8.18	......	......	80.6	4.71	Na_2SO_4 ....
....	......	....	......	......	......	....	......	171.9	10.03	......	......	Na_2CO_3 ....
.4	.02	....	......	1.6	.09	1.5	.09	......	......	1.1	.06	$(NH_4)_2SO_4$.....
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$ ....
19.7	1.15	94.2	5.49	126.6	7.38	128.9	7.52	......	......	133.5	7.78	Mg SO_4.........
30.9	1.80	....	......	......	......	5.5	.32	18.9	1.10	......	......	Mg CO_3.........
....	......	13.1	.76	45.0	2.62	....	......	......	......	67.2	3.92	$CaSO_4$...........
57.5	3.36	307.4	17.93	267.3	15.59	311.8	18.19	20.9	1.22	232.2	13.55	$CaCO_3$..........
.6	.04	.8	.05	1.3	.07	1.6	.09	.6	.03	.6	.04	$FeCO_3$.........
.4	.02	12.5	.73	.6	.03	2.6	.15	.9	.05	3.1	.18	Al_2O_3 ....
10.7	.62	9.5	.55	15.2	.88	7.2	.42	7.6	.44	9.8	.58	SiO_2............
....	......	....	......	......	......	....	......	......	......	30.8	1.79	....
329.8	19.23	625.0	36.45	641.4	38.10	651.8	38.03	238.2	13.88	604.7	35.28	

P. B.	J. M. L.	R. W. S.	A. D. E.	P. B.	P. B.

Analyses of Illinois

Town	Lake Forest	LaMoille	LaMoille	LaSalle
County	Lake	Bureau	Bureau	LaSalle
Laboratory number	12705	9140	12616	10662
Date	Nov. 29, 1904	July 10, 1901	Oct. 3, 1904	Oct. 1, 1902
Owner	A. L. Baker	O. Risdon	A. Kendall	C. A. Farnum
Depth	2237 feet	40 feet	255 feet	Spring
Strata	Rock	Drift	Rock	
Remarks				
Turbidity		Very slight	Decided	Slight
Color		.01	Red	.000
Odor		Decayed wood	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	586.0	545.6	611.2	562.
Loss on ignition	....	76.8	....	59.2
Chlorine	20.	15.	2.4	20.
Oxygen consumed	1.4	2.2	17.7	2.8
Nitrogen as. Free ammonia	.276	.05	16.00	.006
Nitrogen as. Alb. ammonia	.058	.064	.312	.034
Nitrogen as. Nitrites	.000	.012	.000	.002
Nitrogen as. Nitrates	.20	5.188	.08	8.4
Potassium K	15.6	....	....	....
Sodium Na	42.7	13.4	49.8	14.9
Ammonium (NH_4)	....	....	20.6	....
Magnesium Mg	21.7	54.6	39.5	32.7
Calcium Ca	119.4	116.9	115.7	108.3
Ferrous Fe	.8	....	19.1	....
Aluminium Al	.6	....	5.1	....
Silica Si	3.2	11.4	10.4	6.3
Nitrate NO_3	.9	23.0	....	37.2
Chloride Cl	20.0	15.0	2.4	20.0
Sulphate SO_4	187.0	39.0	.2	128.5

Hypothetical

	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.
Potassium Nitrate	1.5	.09	....	....	....	....	....	....
Potassium Chloride	28.4	1.66	....	....	....	....	....	....
Sodium Nitrate	....	....	31.5	1.83	....	....	51.	2.97
Sodium Chloride	10.7	.62	21.7	1.26	4.0	.23	2.8	.16
Sodium Sulphate	119.1	6.95	....	....	.4	.02	....	....
Sodium Carbonate	....	....	....	....	110.8	6.46	....	....
Ammonium Chloride	....	....	....	....	....	....	....	....
Ammonium Carbonate	....	....	....	....	54.8	3.20	....	....
Magnesium Chloride	....	....	2.4	.14	....	....	24.6	1.44
Magnesium Sulphate	108.0	6.30	48.8	2.83	....	....	131.1	7.64
Magnesium Carbonate	....	....	153.7	8.91	138.3	8.01	....	....
Calcium Sulphate	28.6	1.67	....	....	....	....	50.5	2.95
Calcium Carbonate	277.1	16.16	292.1	16.94	289.1	16.86	233.4	13.62
Oxide of Iron and Aluminium	....	....	2.8	.16	....	....	49.5	2.89
Ferrous Carbonate	1.6	.09	....	....	39.4	2.30	....	....
Alumina	1.2	.07	....	....	9.6	.56	....	....
Silica	6.7	.39	24.2	1.40	22.2	1.29	13.3	.78
Total	582.9	34.00	577.2	33.47	668.6	38.93	556.2	32.45
Analyst	J. M. L.		A. L. W.		J. M. L.		P. B.	

Waters—Continued.

LaSalle	LaSalle	LaSalle	Lena	Lena	Lewistown
LaSalle	LaSalle	LaSalle	Stephenson .	Stephens'n	Fulton.....
9058	10279	10663	8972	9830	8970 ....
Mar. 22, 1901.	Feb. 18, 1902.	Oct. 1, 1902.	Jan. 22, 1901..	Nov. 20, 1901	Jan. 22, 1901
I. C. R. R ...	C. A. Farnum	C. A. Far'm	W. Renshaw.	W. R'nsh'w	P. J. Stand'd
450 feet	Springs	River	595 feet	595 feet	Spring .....
....	....	....	Rock	Rock	Gravel .....
Flowing	City supply .	City sup'ly	....	....	....
....	Slight........	Decided	Very slight..	....	Very slight
....	.01	Muddy	.01	....	.01
....	Musty	.000	.000	....	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
....	430.4	378.8	447.2	....	614.8
....	42.8	37.6	43.2	....	25.2
....	45.	21.5	11.	12.	2.6
....	3.8	9.4	2.5	....	1.7
....	.042	.012	.128	....	.082
....	.076	.152	.084	....	.078
....	.016	.02	.002	....	.000
2.4	.784	1.26	.718	....	.08
....	5.4	....	....	....	1.8
46.1	28.9	12.2	7.8	11.9	13.4
....	....	....	.2	....	.1
30.4	41.1	14.1	51.1	53.1	63.3
68.9	75.3	71.1	97.5	115.0	120.1
....	.9	....	....	....	....
....	.4	....	....	....	....
14.6	2.8	3.4	6.3	5.9	9.1
10.1	3.6	5.6	3.2	3.6	.6
63.0	45.0	22.0	11.0	12.0	2.6
57.8	49.9	39.0	33.2	84.2	176.8

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
....	......	5.8	.34	......	......	....	......	......	......	.6	.03	KNO_3 ....
....	......	5.8	.34	......	......	....	......	......	......	3.2	.18	K Cl ....
14.6	.85	....	......	7.7	.45	4.4	.26	1.3	.08	......	......	Na NO_3 ....
103.8	6.02	69.8	4.07	25.9	1.51	16.8	.97	19.8	1.16	1.6	.09	Na Cl ....
4.4	.26	4.8	.28	......	......	....	......	11.5	.67	38.9	2.27	Na_2 SO_4 ....
....	......	....	......	......	......	....	......	......	......	......	......	Na_2 CO_3 ....
....	......	....	......	......	......	.6	.03	......	......	......	......	NH_4 Cl ....
....	......	....	......	......	......	....	......	......	......	.3	.01	$(NH_4)_2$ CO_3 ....
....	......	....	......	8.5	.50	.4	.02	......	......	......	......	Mg Cl_2 ....
68.6	3.98	58.4	3.40	48.8	2.85	41.6	2.41	95.9	5.59	......	......	Mg SO_4 ....
57.8	3.35	102.1	5.95	7.4	.43	148.3	8.60	117.6	6.85	220.0	12.76	Mg CO_3 ....
....	......	....	......	......	......	....	......	......	......	213.3	12.37	Ca SO_4 ....
172.1	9.98	188.2	10.98	177.7	10.37	243.6	14.13	286.2	16.69	143.2	8.29	Ca CO_3 ....
9.0	.52	....	......	38.4	2.24	1.1	.06	1.6	.09	......	......	Fe_2 O_3+Al_2 O_3.
....	......	1.9	.11	......	......	....	......	......	......	......	......	Fe CO_3.........
....	......	.8	.05	......	......	....	......	......	......	......	......	Al_2 O_3 ....
31.0	1.80	5.9	.34	7.2	.42	13.5	.78	12.6	.74	20.2	1.17	Si O_2............
461.3	26.76	443.5	25.86	321.6	18.77	470.3	27.26	546.5	31.87	641.3	37.15	
A. L. M.		A. D. E.		P. B.		A. L. M.		A. D. E.		A. R. J.		

Analyses of Illinois

Town	Lewistown	Lewistown	Lexington	Lexington
County	Fulton	Fulton	McLean	McLean
Laboratory No	2127	12808	3815	3814
Date	Apr. 17, 1897	Dec. 31, 1904	July 10, 1898	July 11, 1898
Owner	W. S. Edwards	J. Depler	W. M. Davis	W. M. Davis
Depth	20 feet	2,000 feet	Spring	40 feet
Strata	Sand	Rock	...	Sand
Capacity	...	...	...	...
Remarks	From tap	Flowing	...	Flowing
Turbidity	Slight	.000	Distinct	Slight
Color	.01	.000	.05	.04
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	268.	2266.0	506.	462.4
Loss on ignition	25.2	...	18.	16.
Chlorine	7.	466.0	12.	22.
Oxygen consumed	1.3	3.8	23.5	6.
Nitrogen as Free ammonia	.001	1.360	4.644	2.712
Nitrogen as Alb. ammonia	.022	.060	.374	.102
Nitrogen as Nitrites	.000	.000	.000	.000
Nitrogen as Nitrates	1.28	.12	.2	.2
Potassium K	1.5	21.1	3.9	3.9
Sodium Na	9.5	520.3	70.4	120.2
Ammonium (NH_4)	...	1.7	5.9	3.5
Magnesium Mg	23.7	53.5	32.8	18.1
Calcium Ca	61.4	118.4	69.4	31.6
Ferrious Fe	...	...	3.1	.7
Aluminium Al	...	...	3.1	.6
Silica Si	4.0	7.	20.	8.2
Nitrate NO_3	5.4	.6	.9	.9
Chloride Cl	7.0	466.0	12.0	22.0
Sulphate SO_4	46.6	837.0	2.5	13.5

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	3.8	.22	.9	.05	.5	.09	1.5	.09
Potassium Chloride	...	...	39.1	2.28	6.3	.37	6.3	.37
Sodium Nitrate	4.6	.26	...	...	...	...	...	...
Sodium Chloride	11.6	.67	740.5	43.20	14.8	.88	31.3	1.81
Sodium Sulphate	11.5	.67	716.1	41.77	3.7	.21	20.0	1.16
Sodium Carbonate	...	...	...	...	146.2	8.52	231.9	13.53
Ammonium Sulphate	...	...	6.2	.36	...	...	...	...
Ammonium Carbonate	...	...	...	...	15.7	.91	9.3	.54
Magnesium Sulphate	48.8	2.84	265.8	15.50	...	...	...	...
Magnesium Carbonate	50.1	2.91	...	...	103.4	6.02	62.8	3.66
Calcium Sulphate	...	...	186.7	10.89	...	...	...	...
Calcium Carbonate	153.3	8.94	158.4	9.24	173.4	10.10	78.9	4.60
Oxide of Iron and Aluminium	1.1	.06	9.6	.56	...	...	...	...
Ferrous Carbonate	...	...	...	...	6.4	.37	1.4	.08
Alumina	...	...	...	...	5.9	.34	1.2	.07
Silica	8.5	.49	14.8	.86	42.5	2.48	17.5	1.01
Total	293.1	17.06	2138.1	124.71	519,8	30.29	462.1	26.92
Analyst	C. R. R.		J. M. L.		R. W. S.		R. W. S.	

Waters—Continued.

Libertyville..	Libertyville..	Lib'rtyville	Lockhaven..	Loda......	L'd'n Mills
Lake.........	Lake.........	Lake.......	Jersey.......	Iroquois...	Fulton.....
2384..........	6646..........	10896.......	11853.........	10524.......	5569........
July 15,1897..	Jan. 8,1900...	Feb. 13,1903	Mar. 4,1904 ..	July 29,1902	Apr. 4,1899.
F. Grabbe...	C. Fellows...	J.L.Taylor	M.R.Thayer	Abe R'ndle	C.A. Matier
Spring.......	50 feet........	171 feet.....	84 feet........	70 feet......	Spring.....
....	Blue clay....	Gravel.....	Gravel.......	Sand.......	Clay.......
....	5 gal. per min	....	....	....	....
....	Flowing.....	Flowing..	....	....	....
V. Slight....	Slight........	Clear......	Distinct.....	Clear......	Distinct...
....	.02	.000	Yellow......	.000	.02
.000	.000	.000	Petroleum ..	Musty.....	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.

554.8	709.2	720.8	320.	841.6	384.8
28.	39.2	47.2	....	65.2	60.8
5.	4.5	4.2	3.3	1.8	2.2
....	1.6	2.3	6.4	2.4	.9
....	.52	.392	.96	.672	.024
....	.06	.034	.144	.098	.02
....	.000	.000	.000	.000	.000
.4	.08	.12	.16	.2	.09
1.2	2.7	5.0	....	2.7	.8
66.6	84.8	80.8	22.8	41.9	9.5
....	.7	.5	1.2	.9	....
30.5	39.7	32.9	33.6	78.8	37.4
60.2	66.6	72.7	48.3	134.5	87.1
1.2	.5	1.5	....	.8	1.3
6.9	.3	.16	....	1.3	.6
6 8	7.9	7.5	2.8	7.2	10.6
1.7	.3	.6	.7	.9	.3
5.0	4.5	4.2	3.3	1.8	2.2
276.2	400.8	404.2	12.9	278.8	12.3

Combinations.

Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal.	
2.9	.16	.6	.03	.9	.05	....	......	1.5	.09	.6	.03	KNO_3..........
....	......	4.7	.27	8.9	.52	....	......	3.8	.22	.9	.05	K Cl............
....	......	....	......	......	......	9	.05	......	......	......	......	$Na NO_3$.........
8 2	.48	3.8	.22	......	......	5.5	.32	......	......	2.9	.17	Na Cl..........
152.7	9.24	257.2	15.00	249.4	14.55	19.2	1.12	129.2	7.54	18.3	1.07	$Na_2 SO_4$........
....	......	....	......	......	......	32.3	1.88	......	......	5.6	.33	$Na_2 CO_3$........
....	......	2.5	.14	1.8	.11	....	......	3.3	.19	......	......	$(NH_4)_2 SO_4$....
....	......	....	......	......	......	3,2	.19	......	......	......	......	$(NH_4)_2 CO_3$....
152.8	9.34	197.4	11.51	163.5	9.53	....	......	236.5	13.80	......	......	$Mg SO_4$.........
....	......	....	......	......	......	117.0	6.82	108.8	6.34	130.0	7,58	$Mg CO_3$.........
104.7	6.09	78.2	4.56	146.7	8.56	....	......	......	......	......	......	$Ca SO_4$..........
71.4	4.16	108.9	6.35	73.8	4.31	120.6	7.03	336.1	19.61	217.7	12.70	$Ca CO_3$.........
....	......	....	......	......	......	16.7	.97	......	......	......	......	$Fe_2 O_3 + Al_2 O_3$
2.4	.14	1.1	.06	3.1	.18	....	......	1.6	.09	2.7	.16	$Fe CO_3$.........
1.3	.07	.6	.03	.3	.02	....	......	2.4	.14	1.2	.07	$Al_2 O_3$..........
14.4	.83	16.8	.98	15.9	.93	5.9	.34	15.4	.90	22.5	1.31	$Si O_2$............
510.8	30.51	671.8	39.15	664.3	38.76	321.3	18.72	838.6	48.92	402.4	23.47	
R. W. S.		R. W. S.		P. B.		D. K.		P. B.		R. W. S		

Analyses of Illinois

Town	Macomb	Macomb	Macomb	Macomb
County	McDonough	McDonough	McDonough	McDonough
Laboratory number	8094	9331	10185	10216
Date	Aug. 4, 1900	Aug. 27, 1901	Jan. 14, 1902	Jan. 25, 1902
Owner	A. McLean	W. Thompson	A. Fisher	E. Pollock
Depth	1,325 feet	1,360 feet	225 feet	78 feet
Strata	St. Peter	St. Peter	Rock	Grav. and sand
Turbidity	Distinct	Slight	Decided	Decided
Color	.01	.04	Yellow	Yellow
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	3222.4	3567.2	530.4	418.4
Loss on ignition	86.4	130.8	15.6	30.
Chlorine	935.	1148.0	4.4	1.
Oxygen consumed	6.	9.4	13.9	3.6
Nitrogen as. Free ammonia	.96	1.64	8.8	3.2
Nitrogen as. Alb. ammonia	.030	.082	.304	.064
Nitrogen as. Nitrites	.070	.015	.004	.000
Nitrogen as. Nitrates	.36	1.185	.236	.08
Potassium K	94.3	8.7	7.5	....
Sodium Na	668.8	948.1	79.7	29.2
Ammonium (NH_4)	1.2	2.1	....	....
Magnesium Mg	71.5	73.8	36.0	30.1
Calcicum Ca	183.6	175.8	81.2	86.8
Ferrous Fe	5.6	.9	2.8	....
Aluminium Al	2.3	.6	1.8	....
Silica Si	6.6	6.2	7.1	10.9
Nitrate NO_3	1.6	5.3	1.0	.3
Chloride Cl	935.0	1148.0	4.4	1.0
Sulphate SO_4	996.4	937.3	.9	.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	2.6	.15	8.6	.50	1.7	.10	....	....
Potassium Chloride	178.0	10.41	10.3	.60	9.3	.54	....	....
Potassium Sulphate	....	....	....	....	1.7	.10	....	....
Potassium Carbonate	....	....	....	....	2.2	.13	....	....
Sodium Nitrate	....	....	....	....	....	....	.5	.03
Sodium Chloride	1400.8	81.94	1883.0	109.21	....	....	1.7	.10
Sodium Sulphate	369.6	21.62	639.4	37.08	....	....	1.1	.06
Sodium Carbonate	....	....	....	....	183.7	10.72	65.0	3.79
Ammonium Sulphate	4.5	.26	7.7	.45	....	....	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Sulphate	355.2	20.78	366.6	21.26	....	....	....	....
Magnesium Carbonate	....	....	....	....	125.2	7.30	107.1	6.24
Calcium Sulphate	623.9	36.50	292.2	16.95	....	....	....	....
Calcium Carbonate	....	....	224.5	13.02	202.9	11.84	216.8	12.65
Oxide of Iron and Aluminium	....	....	....	....	....	....	14.6	.86
Ferrous Sulphate	15.2	.89	....	....	....	....	....	....
Ferrous Carbonate	....	....	1.9	.11	5.8	.34	....	....
Alumina	4.4	.25	1.2	.07	3.4	.20	....	....
Aluminium Sulphate	....	....	....	....	....	....	....	....
Silica	14.0	.82	13.2	.77	15.2	.88	23.2	1.35
Suspended Matter	....	....	....	....	....	....	....	....
Total	2968.2	173.62	3448.6	200.02	551.1	32.15	430.0	25.08
Analyst	A. R. J.		A. L. M.		A. D. E.		A. D. E.	

Waters—Continued.

Macomb.....	Makanda	Makanda ..	Makanda	Makanda ..	Malden....
McDonough	Jackson	Jackson ...	Jackson	Jackson....	Bureau ....
10519	6719–20	6727	6937	11404	10397 ....
July 28, 1902..	Jan. 18, 1900..	Jan. 21, 1900	Feb. 19, 1900.	Sept. 21, 1903	May 14, 1902
A. Krauser ..	T. L. Bailey.	Lee Agnew	B. Wiley	E. Roberts.	D.K. M'rris
60 feet........	Spring, 5 feet	Spring 14 ft.	Spring.......	Spring....	151 feet ....
Sand	Slate & rock..	Soap stone	Sandstone...	....	Rock ......
Distinct	Distinct	Slight......	Distinct	Distinct ...	Distinct....
....	Yellow	.01	Yellow	Yellow	Yellowish .
Musty	.000	.000	.000	Peculiar ...	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
1255.6	432.	1286.8	160.	1044.8	437.6
41.2	32.8	109.6	14.4	161.6	54.
3.4	10.	55.4	4.3	62.5	1.6
4.8	1.7	.9	1.4	4.9	8.5
.56	.056	.216	.016	.144	1.2
.074	.074	.074	.024	.38	.136
.001	.000	.013	.000	.040	.000
.079	.44	1.04	.12	1.560	.11
3.8	5.9	2.0	1.4	1.4	2.4
18.7	10.9	69.3	9.7	47.4	33.2
.7	....	.3	....	.2	1.5
70.6	36.9	71.5	10.8	58.5	35.4
243.6	56.5	140.2	21.7	124.4	71.7
.6	13.7	46.8	9.3	13.7	.2
.2	2.1	9.3	.8	5.7	.3
6.1	6.7	15.5	8.	13.8	8.9
.3	1.1	4.6	.6	6.9	.5
3.4	10.0	55.4	4.3	62.5	1.6
600.0	215.7	797.7	60.7	37.4	.2

Combinations.

Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	
.6	.03	1.9	.11	5.1	.30	.9	.05	3.7	.22	.7	.04	KNO_3 ....
6.8	.40	9.8	.57	......	......	2.0	.12	......	......	3.4	.20	KCl............
....	......	....	......	......	......	....	.....	......	......	.4	.02	K_2SO_4..........
....	......	....	......	......	......	....	......	......	......	.3	.02	K_2CO_3..........
....	......	....	......	2.0	.12	....	......	6.3	.37	......	......	$NaNO_3$ ....
.3	.02	7.1	.41	91.2	5.31	5.6	.33	103.1	6.01	......	......	NaCl...........
57.3	3·34	25.2	1.47	101.7	5.93	23.1	1.34	15.6	.92	......	......	Na_2SO_4.........
....	......	....	......	......	......	....	......	......	......	76.6	4.46	Na_2CO_3 ....
2.6	.15	....	......	1.1	.06	....	......	.7	.04	......	......	$(NH_4)_2SO_4$.....
....	......	....	......	......	......	....	......	......	......	4.0	.23	$(NH_4)_2CO_3$ ....
351.0	20.48	183.3	10.69	355.5	20.74	53.7	3.13	33.	1.93	......	......	$MgSO_4$ ....
....	......	....	......	......	......	....	......	180.4	10.52	123.3	7.19	$MgCO_3$.........
394.9	23.3	73.8	4.31	476.5	27.79	3.1	.18	......	......	......	......	$CaSO_4$ ....
318.2	18.56	88.7	5.17	......	......	52.0	3.03	310.8	18 13	179.1	10.44	$CaCO_3$..........
....	......	....	......	......	......	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$..
....	......	....	......	127.0	7.41	....	......	......	......	......	......	$FeSO_4$ ....
1.3	.07	28.3	1.65	......	......	19.3	1.12	28.3	1.65	.5	.03	$FeCO_3$.........
.4	.02	4.0	.23	12.3	.72	1.7	.10	10.7	.62	.6	.03	Al_2O_3..........
....	......	....	......	28.0	1.63	....	......	......	......	......	......	$Al_2(SO_4)_3$......
13.0	.75	15.2	.88	33.0	1.92	17.0	.99	29.4	1.71	19.0	1.11	SiO_2 ....
43.8	2.60	....	......	......	......	....	......	......	......	17.0	.99	
1190.2	69.45	437.3	25.49	1233.4	71.93	178.4	10.39	722.0	42.12	424.9	24.76	
P. B.		R. W. S.		R. W. S.		R. W. S.		P. B		A. D. E.		

Analyses of Illinois

Town	Manville	Mapleton	Maquon	Marion
County	Livingston	Peoria	Knox	Williamson,
Laboratory number	10766	2534	4269	11365
Date	Nov. 24, 1902	Aug. 6, 1897	Oct. 26, 1898	Sept. 24, 1903
Owner	J. Giolina	E.N. Armstro'g	E. E. Truitt	W. O. Potter
Depth	Spring	16 feet	Spring	Mine shaft
Strata		Gravel	Coal	
Remarks				
Turbidity	Clear	Very slight	Slight	Distinct
Color	.000	.02	.1	1.
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	457.2	315.2	5174.	1426.0
Loss on ignition	65.2	40.8	913.2	247.2
Chlorine	4.	4.	5.5	16.
Oxygen consumed	2.7	2.7	1.2	1.8
Nitrogen as. Free ammonia	.576	.000	.972	.000
Nitrogen as. Alb. ammonia	.036	.039	.072	.068
Nitrogen as. Nitrites	.000	.002	.000	.000
Nitrogen as. Nitrates	.08	5.6	.2	.72
Potassium K	3.3		5.9	
Sodium Na	34 1	10.0	24.2	76.9
Ammonium (NH_4)	.7		1.2	
Magnesium Mg	40.6	26.0	270.7	64.3
Calcium Ca	76.7	71.3	462.7	235.7
Ferrous Fe	.4		349.8	
Aluminium Al	.5		67.1	
Silica Si	8.5	8.3	7.3	14.6
Nitrate NO_3	.3	24.8	.9	3.2
Chloride Cl	4.0	4.	5.5	16.0
Sulphate SO_4	7.3	17.6	3235.3	721.9

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.6	.04			1.5	.09		
Potassium Chloride	5.9	.34			10.1	.58		
Sodium Nitrate			34.0	1.98			4.4	.26
Sodium Chloride	2.	.11	2.0	.11	1.1	.06	26.4	1.54
Sodium Sulphate	10.8	.63			73.3	4.27	201.8	11.78
Sodium Carbonate	80.2	4.68						
Ammonium Chloride								
Ammonium Sulphate					4.4	.25		
Ammonium Carbonate	1.9	.11						
Magnesium Chloride			7.3	.42				
Magnesium Sulphate			22.0	1.28	1345.8	78.49	319.8	18.65
Magnesium Carbonate	141.3	8.25	68.7	4.00				
Calcium Chloride								
Calcium Sulphate					1572.3	91.72	467.	27.24
Calcium Carbonate	191.6	11.17	178.2	10.39			245.6	14.33
Oxide of Iron and Aluminium			3.1	.18			14.0	.82
Ferrous Sulphate					949.5	55.38		
Ferrous Carbonate	.8	.05						
Alumina	.9	.05						
Aluminium Sulphate					421.6	24.59		
Silica	18.1	1.06	17.6	1.02	15.5	.90	30.1	1.76
Total	454.1	26.49	332.9	19.38	4431.0	258.42	1309.1	78.38
Sulphuric acid					35.9	2.09		

Analyst	P. B.	R. W. S.	R. W. S.	P. B.

Waters—Continued.

Marion	Markham	Marquette	Marseilles	Marshall	Marshall
Williamson	Morgan	Bureau	La Salle	Clark	Clark
13155	9287	4915	8578	9956	7278
May 15, 1905	Aug. 8, 1901	Apr. 8, 1899	Sept. 29, 1900	Dec. 3, 1901	Apr. 10, 1900
H. Zim'erm'n	J. Cleary	M. Covery	C. Peddicord	C. Purdium	O. Mitchell
250 feet	Spring	Spring, 4 ft.	2180 feet	21 feet	75 feet
Sandstone		Gravel	Sandstone	Gravel	Drift
			Flowing	City sup'ly	
Decided	Distinct	Slight	Distinct	Very slight	Distinct
Muddy	.04	.01	Muddy	.01	Yellow
Peculiar	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
1433.6	400.	498.	2806.	227.2	698.4
	53.6	58.8	82.4	29.6	18.8
185.0	6.4	3.4	1450.0	5.	118.5
6.65	2.4	1.3	7.8	1.6	8.7
1.440	.144	.01	1.32	.018	22.
.280	092	.018	.032	.022	.18
Trace	.003	.000	.000	.000	.000
.200	1.237	.2	.2	.56	.16
	2.1	3.6	51.8		5.5
404.6	8.9	10.2	801.7	9.4	139.9
	.14		1.7		28.3
36.9	32.6	68.9	27.5	14.3	34.5
45.7	87.7	60.8	135.5	52.6	82.9
	1.7	.6	2.8		4.8
	11.8	1.3	4.7		2.3
15.2	21.	14.7	3.2	5.1	8.7
.9	5.5	.9	.8	2.5	.7
185.0	6.4	3.4	1450.0	5.0	118.5
627.4	4.9	41.4	74.4	27.3	.2

Combinations.

Parts per million	Grains per U.S. gal.	Parts per U.S. gal.	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per U.S. gal.	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	
		5.4	.31	1.5	.09	1.3	.07			1.1	.06	KNO_3
				5.9	.34	97.8	5.67			9.7	.56	KCl
1.3	.08	3.0	.17					3.5	.20			$NaNO_3$
305.2	17.80	10.6	.61	1.0	.05	2038.	118.20	8.3	.48	187.7	10.95	$NaCl$
876.4	51.12	7.3	.43	30.4	1.77			16.0	.93	trace.	trace.	Na_2SO_4
		3.8	.22							152.2	8.88	Na_2CO_3
						5.	.29					NH_4Cl
												$(NH_4)_2SO_4$
		.4	.02							75.3	4.39	$(NH_4)_2CO_3$
												$MgCl_2$
43.8	2.55			26.1	1.51	42.7	2.48	20.0	1.17			$MgSO_4$
97.9	5.71	113.4	6.62	221.3	12.90	65.9	3.82	35.5	2.07	120.1	7.00	$MgCO_3$
						329.3	19.10					$CaCl_2$
						57.	3.31					$CaSO_4$
114.3	6.67	219.0	12.77	152.0	8.85			131.5	7.67	207.1	12.08	$CaCO_3$
8.4	.49							2.4	.14			$Fe_2O_3 + Al_2O_3$
												$FeSO_4$
		3.7	.22	1.3	.07	5.8	.34			10.0	.58	$FeCO_3$
		22.2	1.29	2.5	.14	8.8	.51			4.4	.26	Al_2O_3
												$Al_2(SO_4)_3$
32.4	1.89	43.9	2.56	31.2	1.81	6.8	.39	10.8	.63	18.6	1.08	SiO_2
1479.7	86.31	432.7	25.22	473.2	27.53	2658.4	154.18	228.0	13.29	786.2	45.84	
J. M. L.		A. D. E.		R. W. S.		A. R. J.		A. D. E.		R. W. S.		

Analyses of Illinois

Town	Marshall	Mattoon	Mattoon	Mattoon
County	Clark	Coles	Coles	Coles
Laboratory number	6230	11244	1372	1373
Date	Nov. 6, 1899	Aug. 1, 1903	Sept. 14, 1905	Sept. 14, 1896
Owner	W. Dittman	S. D. Enochs	A. Millar	A. Millar
Depth	Spring 3 feet	Spring	72 feet	60 feet
Strata	Hardpan		Gravel	Sand & gravel.
Remarks				City supply
Turbidity	Distinct	Decided		
Color	.20	.2		
Odor	.000	.000		

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	596.4	690.8		
Loss on ignition	19.2	98.		
Chlorine	7.2	12.		
Oxygen consumed	1.2	3.2		
Nitrogen as Free ammonia	.176	.384		
Nitrogen as Alb. ammonia	.028	.048		
Nitrogen as Nitrites	.000	Lost		
Nitrogen as Nitrates	.20	.12		
Potassium K	1.6	1.5	3.6	2.7
Sodium Na	26.6	14.5	42.8	25.6
Ammonium (NH_4)	.2	.5	19.6	13.
Magnesium Mg	49.4	59.6	31.6	52.9
Calcium Ca	126.4	135.5	89.8	103.3
Ferrous	.9	2.5	3.7	3.8
Aluminium Al	.8	1.8	3.8	10.2
Silica Si	13.	8.5	12.0	12.7
Nitrate NO_3	.9	.3	.3	.2
Chloride Cl	7.2	12.0	5.5	15.0
Sulphate SO_4	98.1	161.6	24.1	26.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.5	.09	.6	.04	.5	.03	.4	.02
Potassium Chloride	1.9	.11	2.4	.14	6.4	.37	4.7	.27
Sodium Nitrate								
Sodium Chloride	10.2	.59	17.8	1.04	3.6	.21	20.9	1.22
Sodium Sulphate	69.6	4.05	23.4	1.36	35.7	2.08	39.6	2.30
Sodium Carbonate					66.3	3.87	15.6	.90
Ammonium Sulphate	.7	.04	1.8	.11				
Ammonium Carbonate					42.5	2.48	34.3	2.00
Magnesium Sulphate	63.3	3.69	180.6	10.54				
Magnesium Carbonate	127.5	7.43	81.1	4.74	110.2	6.41	185.1	10.79
Calcium Sulphate								
Calcium Carbonate	315.7	18.41	338.5	19.75	224.1	13.07	257.9	15.04
Ferrous Carbonate	6.1	.35	5.2	.30	7.6	.44	8.0	.47
Alumina	1.5	.09	3.4	.20	7.2	.42	19.2	1.11
Silica	27.5	1.60	18.1	1.06	25.6	1.48	25.2	1.46
Suspended matter								
Total	625.5	36.45	672.9	39.28	529.7	30.86	610.9	35.58
Analyst	R. W. S.		P. B.		A W P & C R R		A W P & C R R	

Waters—Continued.

Maywood....	McHenry....	Menard....	Mendon.....	Middle'w'h	Middle'w'h
Cook.........	McHenry....	Randolph..	Adams......	Shelby	Shelby ....
5633...........	4842...........	10570.........	2582...........	3644-5.......	3646-7.......
Aug. 14, 1899.	Mar. 17, 1899..	Aug. 22, 1902	Aug. 21, 1897..	June 2, 1898.	June 2 1908.
W. S. Pickard	F. K. Granger	A. M. Lee.	E. W. Battle.	G. Douthit.	G. L. Do'h't
1590 feet......	58 feet........	Spring 6 ft.	1010 feet......	Spring 6 ft.	Spring 6 ft.
Sandstone....	Gravel.......	Rock......	Sandstone...	....	....
City supply..	Flowing.....	....	City supply..	....	....
Slight........	Distinct......	Distinct....	Distinct......	Distinct...	Distinct....
.05	.15	Muddy....	.06	Yellow.....	Yellow.....
.000	.000	.000	.000	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
597.2	332.	475.2	6,920.	612.	610.
66.	44.	38.4	180.0	44.	49.2
4.2	1.5	17.	3,100.0	15.	15.
1.1	2.3	2.2	14.8	13.7	15.1
.4	.8	.004	2.32	10.2	10.2
.026	.042	.026	.062	.358	.43
.000	.000	.000	.000	.000	.000
.16	.15	3.2	.10	.3	.45
4.6	1.9	1.8	4.7	5.5	6.7
42.2	14.3	25.6	2,076.4	99.3	95.2
.5	1.0	....	2.97	13.1	13.1
49.5	37.5	29.3	122.9	37.8	37.9
93.6	63.2	68.3	276.3	80.2	80.0
.4	2.0	.7	2.3	4.4	4.6
.4	.8	10.6	2.3	1.5	1.7
6.5	9.	11.1	14.8	10.1	11.7
.7	.7	14.1	.4	1.4	1.8
4.2	1.5	17.0	3,100.0	15.0	15.0
240.3	11.0	43.4	986.2	2.7	2.5

Combinations.

Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	
1.1	.06	1.1	.06	4.7	.27	.7	.04	2.3	.13	2.9	.17	KNO_3..........
7.9	.46	2.8	.16	......	......	89.9	5.24	8.9	.51	10.6	.61	KCl............
....	......	....	......	15.4	.89	....	......	......	......	......	......	$NaNO_3$.........
.8	.05	....	......	28.1	1.63	5.038.2	293.89	17.8	1.03	16.4	.95	$NaCl$...........
129.4	7.55	1.6	.09	32.1	1.87	291.0	16.97	4.1	.23	3.7	.21	Na_2SO_4........
....	......	31.8	1.85	......	......	....	......	212.6	12.39	201.2	11.73	Na_2CO_3........
1.8	.10	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2SO_4$....
....	......	2.7	.16	......	......	15.9	.92	34.9	2.03	34.9	2.03	$(NH_4)_2CO_3$....
190.2	11.09	....	......	27.3	1.59	610.9	35.63	......	......	......	......	$MgSO_4$..........
39.1	2.27	130.6	7.61	82.7	4.82	....	......	131.5	7.66	132.0	7.74	$MgCO_3$........
....	......	....	......	......	......	426.2	24.86	......	......	......	......	$CaSO_4$..........
233.9	13.64	157.8	9.21	170.6	9.95	377.0	19.72	200.4	11.68	199.8	11.65	$CaCO_3$..........
.8	.05	4.2	.24	1.5	.09	4.7	.27	9.1	.53	9.6	.55	$FeCO_3$..........
.8	.05	1.5	.09	19.9	1.16	4.3	.25	2.8	.16	3.2	.18	Al_2O_3..........
13.9	.81	19.1	1.11	23.6	1.37	31.3	1.82	22.6	1.31	23.2	1.34	SiO_2............
....	......	....	......	37.3	2.18	....	......	......	......	......	......	
619.7	36.13	353.2	20.58	443.2	25.82	6,890.1	399.61	647.0	37.66	638.3	37.16	
R. W. S.		R. W. S.		P. B.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Middlesworth.	Milan	Mill Shoals	Milo
County	Shelby	Rock Island	White	Bureau
Laboratory number	3648	7536	11186	4444
Date	June 2, 1908	May 14, 1900	July 8, 1903	Dec. 2, 1898
Owner	G. L. Douthit	G. G. Craig	C. E. Webber	Thos. Brown
Depth	Spring, 9 feet	1157 feet	Spring	142 feet
Strata	....	St. Peter	Rock	Gravel & sand.
Remarks	....	Flowing	....	....
Turbidity	Distinct	Very slight	Distinct	Distinct
Color	Yellow	.01	.1	.6
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	634.	1148.	942.8	382.
Loss on ignition	64.4	18.	75.2	58.
Chlorine	7.	183.	11.	1.
Oxygen consumed	14.	3.8	3.4	6.5
Nitrogen as: Free ammonia	9.6	1.32	1.32	4.
Nitrogen as: Alb. ammonia	.4	.012	.094	.108
Nitrogen as: Nitrites	.000	.002	.000	.000
Nitrogen as: Nitrates	.45	.16	.08	.25
Lithium Li	....	....	....	....
Potassium K	7.8	11.9	2.5	4.5
Sodium Na	55.1	343.4	30.4	26.4
Ammonium (NH_4)	12.34	1.7	1.7	5.1
Magnesium Mg	44.8	18.1	42.3	41.8
Calcium Ca	114.2	40.7	187.5	69.0
Ferrous Fe	3.1	.4	2.8	1.5
Aluminium Al	1.5	.5	4.1	2.2
Silica Si	11.4	6.0	9.9	4.6
Nitrate NO_3	2.0	.7	.3	1.1
Chloride Cl	7.0	183.0	11.0	1.0
Sulphate SO_4	106.8	389.5	657.6	.7
Phosporic PO_4	....	....	....	....

Hypothetical

	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.
Potassium Nitrate	3.2	.19	1.1	.06	.6	.04	1.9	.11
Potassium Chloride	12.4	.72	21.9	1.27	4.3	.25	2.1	.12
Potassium Sulphate	....	....	....	....	....	....	1.3	.07
Potassium Carbonate	....	....	....	....	....	....	3.8	.22
Sodium Nitrate	....	....	....	....	....	....	....	....
Sodium Chloride	1.8	.10	284.4	16.59	14.9	.87	....	....
Sodium Sulphate	15.8	.83	576.2	33.61	73.5	4.29	....	....
Sodium Carbonate	113.3	6.61	103.1	6.01	....	....	60.9	3.55
Ammonium Sulphate	....	....	....	....	6.2	.36	....	....
Ammonium Carbonate	32.8	1.91	4.5	.26	....	....	13.6	.79
Magnesium Sulphate	....	....	....	....	210.	12.25	....	....
Magnesium Carbonate	156.0	9.09	63.0	3.67	....	....	145.3	8.46
Calcium Sulphate	....	....	....	....	616.8	35.98	....	....
Calcium Carbonate	285.4	16.64	101.8	5.93	15.0	.88	172.3	10.00
Ferrous Carbonate	6.4	.37	.8	.05	5.8	.34	3.0	.20
Alumina	2.8	.16	1.0	.06	7.8	.46	4.2	.24
Silica	24.3	1.42	12.8	.75	20.2	1.18	9.7	.56
Lithia	....	....	....	....	....	....	Trace.	Trace.
Total	654.2	38.04	1170.6	68.26	975.1	56.90	481.1	24.32
Analyst	R. W. S.		R. W. S.		P. B.		R. W. S.	

Waters—Continued.

Milton.......	Minonk	Momence .	Montgom'ry	M'tgomery	M'tgomery
Pike	Woodford ...	Kankakee .	Kane	Kane	Kane ......
4142	3539	4428	6877	77	11674 ....
Sept. 28, 1898.	May 3, 1898 ..	Nov. 29, 1898	Feb. 8. 1900 ..	Oct. 14, 1895	Dec. 11, 1903
Wm. Perry..	W. Minshall.	A. S. Burt .	E. E. Caldw'l	J. Templ'n	J. Wells...
44 feet	1780 feet	22 feet	80 feet	Artesian ...	132 feet ....
Drift..........	Rock	Limestone.	Rock	....	Rock .....
....	City supply.	....	Flowing.....	Flowing...	Flowing...
Slight.........	Slight.........	Slight.......	Slight........	....	Very slight
.03	.02	.02	.01	....	.000
.000	.000	.000	.000	....	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
312.	2226.	584.	476.8	....	520.8
18.	8.	102.	8.4	....	....
8.	980.	40.	5.	....	3.2
1.2	5.2	1.8	1.5	....	1.6
.000	.8	.532	.376	....	.718
.026	.036	.07	.032	....	.026
.000	.000	.003	.000	....	.001
1.10	.4	2.	.08	....	.04
....	....	....	....	.12	....
1.7	27.4	20.1	5.0	10.4	8.9
6.8	845.7	21.4	187.8	117.4	89.8
....	1.0	.7	.5	....	.9
26.1	4.2	47.2	2.2	3.4	27.1
62.5	8.2	93.9	4.6	14.0	45.1
1.0	.7	.1	Trace .	.6	.2
1.1	.5	.5	.4	....	1.1
11.4	4.4	2.4	4.7	2.6	4.1
4.8	1.8	.9	.3	....	.2
8.0	980.0	40.0	5.0	3.3	3.2
2.6	118.6	96.6	18.2	17.6	139.4
....	....	....	....	....	....

Combinations.

Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	
4.5	.26	2.9	.17	1.5	.09	.6	.03	......	......	.4	.02	KNO_3 ....
....	......	51.1	2.98	37.2	2.16	9.0	.52	....	......	6.8	.40	KCl ....
....	......	....	......	......	......	....	......	23.3	1.36	11.5	.67	K_2SO_4 ....
....	......	....	......	......	......	....	......	......	......	......	......	K_2CO_3 ....
2.8	.16	....	......	......	......	....	......	......	......	......	......	$NaNO_3$ ....
13.2	.76	1575.4	91.90	36.7	2.14	1.1	.06	6.5	.38	......	......	$NaCl$ ....
2.7	.16	175.4	10.23	21.3	1.25	27.0	1.57	26.0	1.52	196.9	11.48	Na_2SO_4 ....
....	......	372.8	21.75	......	......	411.4	24.00	245.2	14.31	59.8	3.49	Na_2CO_3 ....
....	......	....	......	2.6	.15	....	......	......	......	......	......	$(NH_4)_2SO_4$ ....
....	......	2.7	.12	......	......	1.3	.08	......	......	2.4	.14	$(NH_4)_2CO_3$ ....
1.0	.06	....	......	101.5	5.92	....	......	......	......	......	......	$MgSO_4$ ....
90.1	5.25	14.6	.80	91.7	5.34	7.6	.44	12.	.7	94.3	5.50	$MgCO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$CaSO_4$ ....
156.2	9.11	20.4	1.19	234.5	13.67	11.4	.66	35.	2.04	112.9	6.59	$CaCO_3$ ....
2.1	.12	1.5	.08	.3	.02	Trace .	......	1.3	.08	.5	.03	$FeCO_3$ ....
2.0	.11	1.0	.06	.9	.05	.6	.02	Tr'ce	Tr'ce	.2	.01	Al_2O_3 ....
24.3	1.41	9.4	.55	5.0	.29	9.9	.58	5.5	.32	8.8	.51	SiO_2 ....
....	......	....	......	......	......	....	......	......	......	......	......	Li_2O ....
298.9	17.40	2226.8	129.83	533.2	31.08	479.9	27.97	354.8	20.71	494.5	28.84	

R. W. S.	R. W. S.	R. W. S.	R. W. S.	A. W. P.	P. B.

Analyses of Illinois

Town	Morgan Park	Morrison	Mossville	Mound City
County	Cook	Whiteside	Peoria	Pulaski
Laboratory number	9212	3093	13385	3561
Date	July 24, 1901	Dec. 25, 1897	July 28, 1905	May 11, 1898
Owner	W. H. Knox	J. Grierson	D. H. Maury	A. Dougherty.
Depth	50 feet	1640 feet	Spring	800 feet
Strata	Clay	Potsdam		Flint rock
Remarks				Flowing
Turbidity	Clear	Slight	Clear	Distinct
Color	.000	.01	.000	.03
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	2907.2	824.	382.	417.2
Loss on ignition	94.2	64.		40.
Chlorine	71.	1.	1.9	160.
Oxygen consumed	3.2	1.4	1 25	1.9
Nitrogen as. Free ammonia	.05	.18	.038	.36
Nitrogen as. Alb. ammonia	.076	.03	.050	.012
Nitrogen as. Nitrites	.000	.000	.000	.000
Nitrogen as. Nitrates	21.	.12	.020	.5
Potassium K	6.5	7.8	3.4	8.5
Sodium Na	56.8	10.2	4.7	82.0
Ammonium (NH_4)		.24		.5
Magnesium Mg	79.1	31.8	35.7	14.4
Calcium Ca	604.0	61.6	84.5	53.8
Ferrous Fe	.7		.3	.6
Aluminium Al	1.5		4.2	
Silica Si	7.1	3.2	5.9	4.9
Nitrate NO_3	93.0	5.0	4.0	2.2
Chloride Cl	71.0	1.0	1.9	160.0
Sulphate SO_4	1644.7	20.8	23.2	15.2

Hypothetical

	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.
Potassium Nitrate	16.8	.97	.9	.05	6.6	.39	3.6	.21
Potassium Chloride			2.1	.11	1.6	.09	13.7	.79
Potassium Sulphate			13.4	.81				
Sodium Nitrate	113.3	6.57						
Sodium Chloride	64.3	3.73			1.8	.11	208.5	12.15
Sodium Sulphate			19.0	1.15	12.1	.71		
Sodium Carbonate			6.6	.38				
Ammonium Chloride							1.4	.07
Ammonium Sulphate								
Ammonium Carbonate			.6	.03				
Magnesium Nitrate								
Magnesium Chloride	42.8	2.48					56.8	3.30
Magnesium Sulphate	360.9	20.93			18.9	1.1		
Magnesium Carbonate			110.8	6.45	111.1	6.48		
Calcium Chloride							15.2	.96
Calcium Sulphate	1921.0	111.42					21.6	1.25
Calcium Carbonate	96.4	5.59	153.9	8.97	211.1	12.31	104.9	6.11
Oxide of Iron and Aluminium			.1	.01				
Ferrous Carbonate	1.4	.08			.6	.04	1.3	.07
Alumina	2.8	.16			7.9	.46		
Silica	15.2	.88	6.6	.38	12.6	.74	10.5	.61
Total	2634.9	152.81	314.0	18.34	384.3	22.43	437.4	25.52
Analyst	A. L. M.		R. W. S.		J. M. L.		R. W. S.	

Waters—Continued.

Mound City.	Mound City.	Mo'nd City	Mt. Morris ..	Mt. Pulaski	Mt.Sterling
Pulaski	Pulaski	Pulaski	Ogle....	Logan	Brown .....
8927	8991	9833	2598	13558-9-60 ..	3373 ....
Dec. 29, 1900.	Mar. 13, 1901.	Nov.22,1901	Aug. 25, 1897.	Sept.18,1905	Feb. 22, 1898
Citv W. W..	M. Miller....	W.R'nsh'w	R.McCreedy	W.H.Staf'd	E. Gesch'er
634 feet.......	800 feet	800 feet	500 feet.......	33 feet......	2433 feet....
Rock	Rock	Rock	Sandstone...	Drift.......	St. Peter...
City supply .	Flowing.....	Flowing...	City supply .	City sup'ly	City well ..
Slight........	Very slight..	....	Very slight..	Clear	Distinct....
.01	.1	....	.02	.000	Muddy ....
.000	Stale	....	.000	.000	Sour ....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
258.4	263.6	....	400.4	694	4076.4
10.	7.2	....	46.8	....	390.
66.	67.	67.	28.0	57.8	1310.
2.6	2.8	....	1.5	2.8	466.8
.264	.264	....	.000	.022	.48
.034	.038	....	.022	.050	2.24
.000	.000	....	.000	.000	.002
.04	.08	....	10.76	18.0	.16
22.8	....	....	2.0	....	58.6
33.6	47.1	57.9	15.5	17.2	1064.6
.3	.3	....	....	....	.6
9.7	9.4	10.7	41.1	59.1	72.4
37.3	42.2	36.5	78.6	182.9	170.8
.6	....	....	.6	....	4.0
.2	....	....	.5	....	1.5
4.1	2.7	3.	6.2	3.6	5.6
.2	.4	....	47.5	88.5	.7
66.0	2.8	67.0	28.0	57.8	1310.0
12.2	14.6	17.5	24.1	112.8	855.1

Combinations.

Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. hal.	Parts per million ..	Grains per U. S. gal.	
.3	.02	......	......	......	......	5.2	.30	......	......	1.2	.06	KNO_3 ....
43.3	2.51	......	......	......	......	......	......	......	......	111.0	6.47	KCl ....
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4 ....
......	......	.5	.03	......	......	57.3	3.34	63.3	3.70	......	......	$NaNO_3$ ....
74.8	4.34	4.6	.26	110.6	6.45	......	......	......	......	2071.7	120.85	$NaCl$ ....
13.	.75	21.6	1.25	25.9	1.51	......	......	......	......	770.0	44.93	Na_2SO_4 ....
......	......	87.9	5.09	14.4	.84	......	......	......	......	......	......	Na_2CO_3 ....
......	......	......	......	......	......	......	......	......	......	......	......	NH_4Cl ....
......	......	......	......	......	......	......	......	......	......	2.3	.13	$(NH_4)_2SO_4$ ....
.9	.05	.9	.05	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$ ....
......	......	......	......	......	......	3.2	.20	50.6	2.96	......	......	$Mg(NO_3)_2$ .....
......	......	......	......	......	......	74.9	4.37	77.9	4.55	......	......	$MgCl_2$ ....
......	......	......	......	......	......	30.2	1.76	141.6	8.26	359.9	20.99	$MgSO_4$ ....
33.6	1.95	32.7	1.89	37.4	2.18	53.6	3.12	8.8	.51	......	......	$MgCO_3$ ....
......	......	......	......	......	......	......	......	......	......	......	......	$CaCl_2$ ....
12.4	.72	......	......	......	......	......	......	......	......	63.8	3.75	$CaSO_4$ ....
81.3	4.89	105.3	6.11	91.1	5.31	196.2	11.50	457.0	26.66	379.8	12.15	$CaCO_3$ ....
......	......	1.2	.07	2.4	.14	......	......	7.2	.42	......	......	$Fe_2O_3+Al_2O_3$.
1.3	.07	......	......	......	......	1.3	.07	......	......	8.2	.48	$FeCO_3$ ....
.3	.02	......	......	......	......	1.0	.06	......	......	2.9	.16	Al_2O_3 ....
8.8	.51	5.8	.33	6.4	.37	13.1	.75	7.7	.45	12.0	.70	SiO_2 ....
273.0	15.83	260.5	15.08	288.2	16.80	436.0	25.47	814.1	47.51	3782.8	210.66	
A. R. J.		A. R. J.		A. D. E.		R. W. S.		J. M. L.		R. W. S.		

Analyses of Illinois

Town	Mt. Sterling...	Mt. Sterling...	Mt. Vernon ...	Mt. Vernon ...
County	Brown	Brown	Jefferson	Jefferson
Laboratory number	3374	9648	4388	8106
Date	Feb. 22, 1898	Nov. 2, 1901	Nov. 17, 1898	Aug. 6, 1900
Owner	E. Geschwind'r	C. Brockman	A. C. Johnson	H. Plummer
Depth	2433 feet	2433 feet	Spring	Spring
Strata	St. Peter	St. Peter	....	....
Remarks	City well	City well	....	....
Turbidity	Slight	Decided	Distinct	V. Slight
Color	.02	Yellow	Yellow	Yellow
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	714.	1782.8	1348.8	2654.8
Loss or Ignition	36.4	228.	72.	238.8
Chlorine	73.	445.	23.	28.
Oxygen consumed	2.5	7.3	2.3	3.1
Nitrogen as — Free ammonia	.008	.512	1.52	.128
Nitrogen as — Alb. ammonia	.084	.128	.044	.068
Nitrogen as — Nitrites	.002	.012	.000	.065
Nitrogen as — Nitrates	.21	.148	.75	1.76
Potassium K	9.9	18.6	5.6	6.3
Sodium Na	206.7	445.2	101.6	111.1
Ammonia (NH_4)	....	.7	1.9	.2
Magnesium Mg	23.6	20.1	68.5	203.0
Calcium Ca	39.6	56.6	125.6	319.1
Ferrous Fe	1.4	21.0	22.8	7.8
Aluminium Al	.8	15.	12.2	36.1
Silica Si	5.1	13.6	20.2	30.1
Nitrite NO_2	....	....	....	....
Nitrate NO_3	.9	.9	3.3	7.8
Chloride Cl	73.0	445.0	23.0	28.0
Sulphate SO_4	61.6	268.5	940.8	1590.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrite	......	......	......	......	......	......	......	......
Potassium Nitrate	1.5	.09	1.5	.09	5.4	.31	12.7	.74
Potassium Chloride	17.8	1.03	34.3	2.00	6.8	.39	2.7	.16
Potassium Sulphate	......	......	......	......	......	......	......	......
Potassium Carbonate	......	......	......	......	......	......	......	......
Sodium Nitrate	......	......	......	......	......	......	......	......
Sodium Chloride	106.4	6.20	707.4	41.26	32.6	1.89	44.5	2.60
Sodium Sulphate	90.5	5.28	397.2	23.17	273.6	15.96	283.9	16.60
Sodium Carbonate	312.5	17.46	87.9	5.12	......	......	......	......
Ammonium Sulphate	......	......	......	......	6.9	.40	......	......
Ammonium Carbonate	......	......	1.9	.11	......	......	.4	.02
Magnesium Chloride	......	......	......	......	......	......	......	......
Magnesium Sulphate	......	......	......	......	340.5	19.83	552.4	32.04
Magnesium Carbonate	82.4	4.80	70.1	4.08	......	......	319.2	18.51
Calcium Sulphate	......	......	......	......	426.9	24.90	1085.6	63.50
Calcium Carbonate	97.8	5.70	141.5	8.26	......	......	......	......
Oxide of Iron and Aluminium	......	......	......	......	......	......	......	......
Ferrous Sulphate	......	......	......	......	61.8	3.61	......	......
Ferrous Carbonate	2.9	.16	43.5	2.51	......	......	16.1	.94
Alumina	1.6	.09	28.2	1.64	......	......	......	......
Aluminium Sulphate	......	......	......	......	76.6	4.46	227.	13.17
Silica	10.8	.63	28.8	1.68	43.0	2.51	65.6	3.84
Free Sulphur Acid	......	......	......	......	36.5	2.12	......	......
Suspended matter	......	......	......	......	......	......	......	......
Total	724.2	41.44	1542.3	89.92	1310.6	76.38	2610.1	152.12
Analyst	R. W. S.		A. D. E.		R. W. S.		A. R. J.	

Waters—Continued.

Mt. Vernon .	Mt. Vernon .	Moweaqua	Murphysb'ro	Neponset..	Neunert....
Jefferson....	Jefferson	Shelby	Jackson......	Bureau.....	Jackson....
9146...........	10957..........	9064.........	2607...........	9264.........	4307.........
June 25, 1901.	Mar. 26, 1903.	Mar. 22, 1901	Aug. 27, 1897.	Aug. 3, 1901	Nov. 1, 1898
F. J. Butler..	M D. Greene	I. C. R. R.	J. D. Peters.	A. E. Stets'n	J. Schlimp't
13 feet........	102 feet.......	650 ft. shaft.	Spring	167 feet.....	51 feet.....
Drift	....	....	....	Rock	Sand ....
....	....	....	....	....	....
Distinct......	Decided......	....	Slight.........	Decided....	Decided....
Cloudy	Yellow.......	....	.02	Muddy	Yellow.....
Whisky	.000	....	.000	.000	.000

Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
....	1092.80	....	2317.2	504.8	314.
....	93.2	....	180.	21.6	22.
....	18.4	....	24.	....	2.0
....	5.1	....	2.7	5.6	3.
....	1.04	....	.11	2.	.16
....	.096	....	.102	.128	.052
.04	1.05	....	.016	.007	.000
5.96	6.19	4.8	6.	.233	.2
4.5	12.6	....	6.6	4.6	2.2
36.3	107.5	383.2	152.9	17.2	68.3
....	1.3	....	....	2.8	....
4.3	33.6	108.3	54.1	39.6	14.8
305.1	121.1	205.0	416.7	88.1	71.8
.8	3.3	....	.14	4.2	9.9
1.3	1.7	....	.84	17.0	8.0
7.	21.	12.7	17.2	21.8	17.7
....	3.4	....	....	....	....
26.4	27.5	21.2	27.5	1.0	.9
20.0	18.4	820.0	24.0	.6	2.0
80.4	628.5	432.9	1420.5	2.4	3.4

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
....	......	5.3	.31	......	......	....	......	....	......	......	......	KNO_2 ....
11.6	.67	27.5	1.61	......	......	17.	.99	1.7	.10	1.5	.09	KNO_3 ....
....	......	....	......	......	......	....	......	1.3	.08	3.0	.17	$K Cl$ ....
....	......	....	......	......	......	....	......	4.4	.26	......	......	K_2SO_4 ....
....	......	....	......	......	......	....	......	2.3	.13	......	......	K_2CO_3 ....
26.4	1.53	14.5	.85	29.1	1.69	22.	1.28	......	......	......	......	$Na NO_3$ ....
33.0	1.91	30.2	1.76	954.1	55.34	39.5	2.3	......	......	1.0	.05	$Na Cl$ ....
49.9	2.89	282.8	16.49	......	......	405.4	23.64	......	......	5.0	.29	Na_2SO_4 ....
....	......	....	......	......	......	....	......	39.7	2.31	12.8	.74	Na_2CO_3 ....
....	......	4.8	.28	......	......	....	......	......	......	......	......	$(NH_4)_2SO_4$ .....
....	......	....	......	......	......	....	......	7.4	.43	......	......	$(NH_4)_2CO_3$ .....
....	......	....	......	323.0	18.73	....	......	......	......	......	......	$Mg Cl_2$ ....
21.6	1.25	266.4	15.54	129.9	7.53	269.	15.67	......	......	......	......	$Mg SO_4$ ....
....	......	....	......	......	......	....	......	137.8	8.03	51.6	3.00	$Mg CO_3$ ....
41.6	2.41	312.6	18.23	466.1	27.03	1319.4	76.95	......	......	......	......	$Ca SO_4$ ....
731.6	42.43	72.7	4.24	169.5	9.83	70.9	4.13	221.3	12.91	178.2	10.39	$Ca CO_3$ ....
....	......	....	......	6.2	.36	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$ ..
....	......	....	......	......	......	....	......	......	......	......	......	$Fe SO_4$ ....
1.8	.10	6.8	.40	......	......	.3	.02	8.7	.51	20.4	1.18	$Fe CO_3$ ....
2.4	.14	5.3	.31	......	......	1.6	.09	32.9	1.92	15.1	.87	$Al_2 O_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Al_2(SO_4)_3$ ......
14.8	.86	44.8	2.62	27.0	1.57	36.6	2.13	46.5	2.71	37.6	2.18	$Si O_2$ ....
....	......	....	......	......	......	....	......	......	......	......	......	....
....	......	47.0	3.32	......	......	....	......	......	......	......	......	....
934.7	54.19	1130.7	65.96	2104.9	122.08	2181.7	127.2	504.0	29.39	326.2	18.96	

A. L. M.	P. B.	A. L. M.	R. W. S.	A. D. E.	R. W. S.

Analyses of Illinois

Town	New Burnside.	Newman	Newman	Niota
County	Johnson	Douglas	Douglas	Hancock
Laboratory No	7934	1693	4750	13567
Date	July 16, 1900	Dec 4, 1896	Feb. 28, 1899	Sept. 18, 1905
Owner	G. W. Smoot	J. H. Williams	C. S. Burgett	J. C. Berg
Depth	62 feet	72 feet	155 feet	Spring
Strata	Sand stone		Sand	
Remarks		Flowing	Flowing	
Turbidity	Distinct		Decided	Decided
Color	.04		Yellow	Muddy
Odor	.000		.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	5872.8		1224.	449.
Loss on ignition	596.		8.2	
Chlorine	60.4		450.	2 4
Oxygen consumed	1.5		28.5	3.35
Nitrogen as. Free ammonia	.12		12.	.056
Nitrogen as. Alb. ammonia	.056		.72	.1
Nitrogen as. Nitrites	.004		.000	.000
Nitrogen as. Nitrates	.16		.3	.08
Potassium K	18.6	6.7	8.3	4.0
Sodium Na	288.9	108.9	371.5	15.8
Ammonium (NH_4)		1.5	15.4	
Magnesium Mg	597.5	20.7	23.2	32.0
Calcium Ca	402.5	32.3	50.8	113.8
Ferrous Fe	28.6	.6	8.1	1.1
Aluminium Al	7.4	2.2	1.7	1.0
Silica Si	13.1	1.2	6.	12.5
Nitrate NO_3	.7	.4	1.3	.3
Chloride Cl	60.4	12.0	450.0	2.4
Sulphate SO_4	2118.7		.7	9.5

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.1	.06	.7	.04	2.0	.11	.6	.04
Potassium Chloride	34.7	2.02	12.3	.72	14.4	.84	5.0	.29
Potassium Sulphate							2.4	.14
Sodium Chloride	72.3	4.22	10.1	.58	730.4	42.60		
Sodium Sulphate	803.5	46.87			1.0	.06	12.1	.71
Sodium Carbonate			241.8	14.10	193.0	11.25	27.5	1.61
Ammonium Sulphate								
Ammonium Carbonate			3.9	.23	40.9	2.38		
Magnesium Sulphate	1969.8	114.90						
Magnesium Carbonate	700.1	40.83	72.4	4.22	78.9	4.60	111.3	6.50
Calcium Carbonate	1005.7	58.66	80.5	4.69	126.9	7.40	284.3	16.55
Oxide of Iron and Aluminium								
Ferrous Carbonate	59.2	3.45	1.3	.07	16.7	.97	2.3	.13
Alumina	14.0	.82	4.2	.24	3.2	.18	2.0	.12
Silica	24.4	1.42	2.6	.15	12.7	.74	26.6	1.56
Total	4684.8	273.25	429.8	25.04	1220.1	71.13	474.1	27,65
Analyst	R. W. S.		C. R. R.		R. W. S.		J. M. L.	

Waters—Continued.

Normal......	Normal......	N. Chicago	Oak Park....	Oakwood..	Oconee....
McLean	McLean	Lake.......	Cook	Vermilion.	Shelby.....
10359	4273	6922	6118	12818	6437 ....
Apr. 22, 1902..	Oct. 27, 1898..	Feb. 15, 1900	Oct. 19, 1899..	Jan. 8, 1905.	Dec. 1, 1899.
R. McCauley	O. Seibert...	M'rro' Bros	W. P. Utley.	J.E. Dysert	C. Moref'ld
106 feet.......	179 feet.......	174 feet.....	Artesian	40 feet......	Spring .....
....	Gravel sand..	Rock	....	....	....
....	City supply .	....	Flowing.....	Flowing...	....
Slight.........	Distinct......	Slight......	Slight........	Decided ...	Distinct....
.2	.2	.01	.01	Muddy	Yellow ....
Musty	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
370.	410.8	424.4	779.2	1251.2	772.
23.6	30.	11.2	17.6	....	94.
1.4	10.	18.2	164.	79.5	10.2
3.3	7.1	1.8	1.4	19.05	4.4
1.4	1.12	.22	.376	14.40	.52
.06	.176	.074	.022	.460	.128
.006	.000	.000	.002	.000	.000
.634	.4	.12	.16	.20	.28
4.6	2.8	.7	13.5	6.5	2.7
37.3	71.8	103.3	135.4	157.6	88.8
1.8	1.4	.3	.5	17.5	.7
32.7	23.8	10.6	32.5	21.4	55.8
60.3	52.3	21.8	92.7	38.9	79.6
1.2	1.4	.2	.3	....	11.9
.8	.7	.4	.9	....	4.7
6.3	7.6	4.6	3.5	5.	16.4
2.7	1.7	.6	.7	.9	1.3
1.4	10.0	18.2	164.0	79.5	10.2
13.2	....	201.6	189.6	1.3	230.6

Combinations.

Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	
4.5	.26	2 8	.16	.9	.05	1.1	.06	1.5	.09	2.0	.11	KNO_3 ....
2.9	.17	3.3	.19	.8	.05	24.9	1.45	11.3	.66	3.8	.22	$K\,Cl$ ....
3.1	.18	......	......	......	......	......	......	......	......	......	......	$K_2\,SO_4$ ....
......	......	13.8	.80	29.3	1.71	250.7	14.62	122.3	7.13	13.8	.80	$Na\,Cl$ ....
17.0	.99	......	......	283.0	16.50	113.6	6.62	2.0	.12	257.2	15.00	$Na_2\,SO_4$ ....
73.3	4.28	152.9	8.92	......	......	......	......	250.7	14.62	......	......	$Na_2\,CO_3$ ....
......	......	......	......	1.1	.06	1.8	.10	......	......	2.5	.14	$(NH_4)_2\,SO_4$ ....
4.7	.27	3.7	.21	......	......	......	......	46.6	2.72	......	......	$(NH_4)_2\,CO_3$....
......	......	......	......	12.0	.70	140.7	8.20	......	......	68.7	4 00	$Mg\,SO_4$..........
113.8	6.63	82.9	4.83	28.6	1.66	14.7	.86	74.6	4.35	146.2	8.52	$Mg\,CO_3$ ....
150.7	8.78	130.7	7.62	54.6	3.19	231.6	13.51	97.3	5.68	198.9	11.60	$Ca\,CO_3$ ....
......	......	......	......	......	......	......	......	1.9	.11	......	......	$Fe_2\,O_3 + Al_2\,O_3$
2.4	.14	2.8	.16	.3	.02	.6	.03	......	......	24.6	1.43	$Fe\,CO_3$ ....
1.5	.09	1.3	.08	.7	.04	1.1	.06	......	......	8.8	.51	$Al_2\,O_3$ ....
13.3	.77	16.2	.91	9.7	.56	7.5	.44	10.7	.52	34.1	1.98	$Si\,O_2$..........
387.2	22.56	410.4	23.88	421 0	24.54	783.3	45.95	618.9	36.0	760 6	44.31	
A. D. E.		R. W. S.		R. W. S.		R. W. S.		J. M. L.		R. W. S.		

Analyses of Illinois

Town	Oconee	Oconee	Odell	Odell
County	Shelby	Shelby	Livingston	Livingston
Laboratory number	6439	6440	4815	5051
Date	Dec. 1, 1899	Dec. 1, 1899	March 15, 1899	Mar. 16, 1899
Owner	C. Morefield	C. Morefield	H. McCleary	W. P. Cleary
Depth	Spring	Spring	292 feet	6 feet
Strata	.....	.....	Rock	Sand and grav.
Capacity	.....	.....	.....	8x12x6
Remarks	.....	.....	.....	.....
Turbidity	Slight	Slight	Distinct	Distinct
Color	.02	.03	.04	.07
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	1269.2	825.2	1148.	762.4
Loss on ignition	124.8	96.4	32.	35.2
Chlorine	20.	14.7	485.	7.
Oxygen consumed	.4	1.1	4.	1.3
Nitrogen as. Free ammonia	.004	.024	.44	.09
Nitrogen as. Alb. ammonia	.062	.11	.082	.082
Nitrogen as. Nitrites	.006	.06	.000	.000
Nitrogen as. Nitrates	1.4	2.8	.15	.12
Potassium K	3.0	2.7	17.6	3.0
Sodium Na	132.9	97.5	411.2	27.0
Ammonium (NH_4)	.....	.....	.6	.....
Magnesium Mg	105.6	65.8	6.7	69.8
Calcium Ca	126.1	93.1	19.9	128.4
Ferrous Fe	Trace	1.1	.9	2.9
Aluminium Al	.8	2.8	1.7	.9
Silica Si	9.2	13.6	4.4	8.4
Nitrate NO_3	6.2	12.4	.7	.6
Chloride Cl	20.0	14.7	485.0	7.0
Sulphate SO_4	538.5	229.2	2.5	254.4

Hypothetical

	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.
Potassium Nitrate	7.7	.45	7.1	.41	1.1	.06	.9	.05
Potassium Chloride	.....	.....	.....	.....	32.8	1.91	5.1	.30
Sodium Nitrate	2.0	.11	11.0	.64	.....	.....	.....	.....
Sodium Chloride	32.9	1.92	24.2	1.41	773.6	45.13	7.6	.44
Sodium Sulphate	368.7	21.50	262.4	15.31	3.7	.21	74.2	4.32
Sodium Carbonate	.....	.....	.....	.....	243.7	14.21	.....	.....
Ammonium Sulphate	.....	.....	.....	.....	.....	.....	.....	.....
Ammonium Carbonate	.....	.....	.....	.....	1.6	.09	.....	.....
Magnesium Sulphate	361.6	21.09	64.8	3.77	.....	.....	255.3	14.88
Magnesium Carbonate	114.4	6.68	183.5	10.70	23.5	1.37	64.0	3.73
Calcium Sulphate	.....	.....	.....	.....	.....	.....	.....	.....
Calcium Carbonate	315.0	18.37	232.5	13.56	49.6	2.88	370.7	18.70
Ferrous Carbonate	Trace	Trace	2.2	.13	1.9	.11	6.1	.35
Alumina	1.5	.09	5.4	.31	2.2	.13	1.8	.10
Silica	19.6	1.14	29.0	1.69	9.4	.55	17.8	1.03
Suspended	.....	.....	.....	.....	.....	.....	.....	.....
Total	1223.4	71.35	822.1	47.93	1143.1	66.65	803.5	43.90
Analyst	R. W. S.		R. W. S.		R. W. S.		R. W. S.	

Waters—Continued.

Olney	Omaha	Omega	Onarga	Onarga	Onarga ....
Richland	Gallatin	Marion	Iroquois	Iroquois ...	Iroquois ...
4371	7645	13004	10334	10368	10374 ......
May 15, 1898..	June 1, 1900..	Mar. 14, 1905	Mar. 26, 19:2..	Mar. 29, 1902	Mar. 28, 1902
C. Edmiston.	S. C. Hall....	J. L. Reat.	W. Mathews.	Mathews ..	W. M'thw's
22 feet	190 feet	D. well 100ft	113 feet	113 feet	114 feet ....
....	....	....	Sand.........	Sand.......	Sand ....
....	Flowing.....	....	....	....	....
Slight........	Distinct......	Decided ...	Slight........	Very slight	Decided ...
.01	.50	Yellow	Very little...	.01	Red mud ..
.000	.000	.000	.05	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
462.8	2358.4	4864.4	1090.8	1070.8	1022.8
30.	35.2	....	113.2	131.2	112.
48.	1015.0	120.	65.0	71.5	8.7
.8	5.7	3.15	3.9	3.3	3.4
.001	2.16	.040	.156	.128	1.12
.01	.028	.098	.042	.05	.084
.000	.000	.000	.032	.028	.018
2.8	.16	.16	8.968	8.572	.182
3.0	7.4	17.4	6.1	7.3	6.0
49.0	876.7	206.3	69.1	69.9	130.2
....	2.8	....	.2	.2	1.4
17.5	11.3	422.7	56.8	61.2	61.7
72.9	34.0	546.1	163.8	165.5	143.7
.4	3.2	2.9	.7	.7	.9
1.6	.7	2.8	....	.5	1.3
11.3	4.2	2.1	3.5	9.7	8.9
12.4	.7	.7	39.7	38.1	.8
48.0	1015.0	120.	65.0	71.5	8.7
54.1	47.1	2625.2	388.3	403.2	422.8

Combinations.

Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	
7.7	.45	1.1	.06	1.1	.06	15.7	.91	18.9	1.10	1.3	.08	KNO_3 ....
....	......	13.3	.77	32.5	1.90	....	......	......	......	10.5	.61	KCl............
10.5	.61	....	......	......	......	41.4	2.41	36.3	2.12	......	......	$NaNO_3$ ....
79.1	4.60	1662.2	96.96	172.6	10.07	107.3	6.26	117.1	6.82	6.4	.37	NaCl............
49.2	2.86	69.7	4.06	427.1	24.91	48.8	2.85	43.1	2.51	394.1	22.98	Na_2SO_4.........
....	......	461.2	26.90	......	......	....	......	......	......	......	......	Na_2CO_3 ....
....	......	....	......	......	......	....	......	......	......	5.1	.30	$(NH_4)_2SO_4$.....
....	......	7.4	.43	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$ ....
26.1	1 52	....	......	2119.2	123.62	282.3	16.46	334.2	19.48	190.9	11.13	$MgSO_4$ ....
42.6	2 48	39.3	2.29	......	......	....	......	......	......	81.1	4.73	$MgCO_3$.........
....	......	....	......	908.7	53.01	183.6	10.70	151.7	8.85	......	......	$CaSO_4$ ....
182.1	10.62	85.0	4.96	696.2	40.61	274.5	16.01	301.8	17.60	359.0	20.93	$CaCO_3$..........
.8	.04	6.6	.38	6.0	.35	1.4	.08	1.4	.08	1.9	.11	$FeCO_3$..........
.3	.02	1.4	.08	5.2	.30	....	......	.1	.01	2.4	.14	Al_2O_3..........
24.1	1.40	9.	.52	4.4	.26	7.5	.44	20.7	1.21	19.0	1.11	SiO_2... ....
....	......	....	......	......	......	....	......	......	......	35.7	2.07	
422.5	24.60	2356.2	137.41	4373.0	255.09	962.5	56.12	1025.3	59.78	1107.3	64.56	
R. W. S.		R. W. S.		J. M. L.		A. D. E.		A. D. E.		A. D. E.		

Analyses of Illinois

Town	Onarga	Oquawka	Oregon	Ottawa
County	Iroquois	Henderson	Ogle	LaSalle
Laboratory number	10375	5588	4957	4909
Date	Mar. 28, 1902	Aug. 7, 1899	Apr. 23, 1899	Apr. 7, 1899
Owner	W.D.A.M'th'w	H. Patterson	C. Schneider	R. M. Bruner
Depth	105 feet	50 feet	1604 feet	Spring
Strata	Sand	Sand	St.P.& Potsd'm	St. Peter
Remarks			Flowing	
Turbidity	Distinct	Slight	Distinct	Slight
Color	Yellow	.01	.04	Clear
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	995.6	168.4	300.4	360.8
Loss on ignition	102.	24.4	43.2	44.
Chlorine	7.9	6.	4.6	14.
Oxygen consumed	3.	.7	.8	1.5
Nitrogen as Free ammonia	1.68	.001	.08	.54
Nitrogen as Alb. ammonia	.05	.024	.01	.012
Nitrogen as Nitrites	.000	.000	.000	.000
Nitrogen as Nitrates	.04	5.44	.1	.04
Potassium K	6.6	.8	6.8	5.8
Sodium Na	71.0	8.4	8.2	24.1
Ammonium (NH_4)	2.2			.7
Magnesium Mg	58.6	9.3	33.4	32.6
Calcium Ca	149.8	32.9	63.5	71.0
Ferrous Fe	2.8	.15	.3	
Aluminium Al	1.2	.6	.4	
Silica Si	9.4	11.6	3.7	3.7
Nitrate NO_3		24.1	.5	.2
Chloride Cl	7.9	6.	4.6	14.
Sulphate SO_4	398.4	9.1	16.3	23.0

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate			2.1	.12	.7	.04	.3	.02
Potassium Chloride	12.7	.74			9.6	.56	10.8	.63
Potassium Sulphate					3.3	.19		
Sodium Nitrate			31.0	1.80				
Sodium Chloride	3.1	.18					14.5	.84
Sodium Sulphate	215.3	12.55			21.5	1.25	34.1	1.98
Sodium Carbonate					2.7	.16	16.7	.97
Ammonium Chloride								
Ammonium Sulphate	8.1	.47						
Ammonium Carbonate							1.8	.10
Magnesium Chloride			8.0	.46				
Magnesium Sulphate	291.6	17.00	11.4	.66				
Magnesium Carbonate			17.2	1.00	116.1	6.77	113.6	6.62
Calcium Chloride								
Calcium Sulphate	19.6	1.14						
Calcium Carbonate	360.1	21.00	82.1	4.78	158.7	9.25	177.3	10.33
Oxide of Iron and Aluminium							.6	.04
Ferrous Sulphate								
Ferrous Carbonate	5.8	.34	.3	.02	.6	.03		
Alumina	2.2	.13	1.2	.07	.8	.05		
Aluminium Sulphate								
Silica	20.0	1.17	24.7	1.44	7.8	.45	7.9	.46
Total	938.5	54.72	178.0	10.35	321.8	18.75	377.6	21.99
Analyst	A. D. E.		R. W. S.		R. W. S.		R. W. S.	

Waters—Continued.

Ottawa.......	Ottawa	Ottawa	Ottawa......	Palatine....	Palestine ..
LaSalle......	LaSalle......	LaSalle	LaSalle	Cook	Crawford...
9277...........	9259............	12816........	022..	12427........	13504........
Aug. 5, 1901..	Aug. 8, 1901..	Jan. 16, 1905	Mar. 16, 1897..	Sept. 9, 1904	Sept. 1, 1905
Thos. Large.	Thos. Large.	R.C. Jord'n	C. Halm.....	H.J. Theiss	David Fife.
Spring.......	Artesian	400 feet.....	1120 feet......	130 feet.....	1255..........
Gravel	....	....	....	Gravel	Rock ......
....	Flowing.....	Flowing...	Flowing.....	Flowing...	Flowing ...
Distinct.	Slight........	None	Slight........	V. slight...	Decided....
.03	.01	.000	.04	.000	Muddy ....
.000	.000	.000	.000	Peculiar ...	.000
Milligrams per 1,000 c. c	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
378.4	3175.2	2179.2	372.8	785.2	13189.2
18.4	34.	....	45.6	....	....
9.	1530.	950.	25.	3.1	5880.0
1.6	9.4	5.9	1.	2.3	19.9
.03	1.4	1.120	.512	.476	3.800
.036	.07	.038	.016	.030	.052
.001	.000	.000	.002	.000	.004
3.52	.2	.12	.05	.160	.076
4.2	37.5	21.9	9.7	2.3	69.4
7.2	764.2	429.2	46.1	28.6	4316.3
....	1.8	1.4	....	.6	4.9
40.4	185.2	65.8	26.1	55.5	197.
63.5	124.2	171.5	64.0	82.1	267.3
1.0	.8	....	.4	.5	15.9
2.3	.2	....	.3	2.4	16.0
7.	5 4	5.8	11.1	10.1	55.
15.6	.9	.12	.2	.7	3.3
9.0	1530.	950.0	25.0	3.1	5880.0
68.2	181.4	130.8	4.1	403.2	2380.5

Combinations.

Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	
10.7	.62	1.1	.06	.9	.05	.4	.02	1.1	.06	5.4	.32	KNO_3 ....
....	......	70.8	4.13	41.2	2.40	18.3	1.07	3.6	.21	128.5	7.50	K Cl.............
....	......	....	......	......	......	......	......	......	......	....	......	K_2SO_4 ....
12.4	.72	....	......	......	......	......	......	......	......	....	......	Na NO_3..........
9.8	.57	1942.5	113.32	1091.6	63.68	26.8	1.56	2.5	.15	9614.4	560.85	Na Cl............
....	......	....	......	......	......	16.5	.96	85.4	4.98	1647.2	96.08	Na_2 SO_4 ....
....	......	....	......	......	......	69.7	4.06	......	......	....	......	Na_2 CO_3.........
14.8	.87	11.4	.66	12.4	.72	10.2	.59	21.6	1.26	117.0	6.82	NH_4 Cl..........
....	......	5.4	.31	4.2	.25	......	......	......	......	....	......	$(NH_4)_2$ SO_4 ....
....	......	....	......	......	......	......	......	2.2	.13	17.9	1.04	$(NH_4)_2$ CO_3....
....	......	....	......	......	......	......	......	......	......	....	......	Mg Cl_2..........
4.2	.25	423.1	24.68	257.5	15.02	......	......	......	......	....	......	Mg SO_4..........
....	......	....	......	......	......	......	......	275.7	16.08	658.5	38.42	Mg CO_3 ....
135.0	7.87	269.2	15.71	......	......	95.2	5.55	......	......	....	......	Ca Cl_2...........
....	......	....	......	116.3	6.78	......	......	......	......	....	......	Ca SO_4 ....
....	......	....	......	185.5	10.81	......	......	174.8	10.20	908.4	5.74	Ca CO_3 . ...
215.6	12.58	310.4	18.10	187.3	10.93	159.9	9.33	76.4	4.46	....	......	$Fe_2O_3 + Al_2O_3$.
....	......	....	......	5.6	.33	......	......	......	......	....	......	Fe SO_4 ....
....	......	....	......	......	......	......	......	......	......	43.1	2.52	Fe CO_3..........
2.1	.12	1.6	.09	......	......	1.7	.10	1.1	.06	....	......	Al_2 O_3 ....
4.3	.25	.4	.02	......	......	......	......	4.6	.26	8 6	.50	Al_2 $(SO_4)_3$......
....	......	....	......	......	......	......	......	......	.....	72.5	4.23	Si O_2............
408.9	23.85	3035.8	177.08	1902.5	110.97	398.7	23.24	649.0	37.85	13221.5	724.02	
A. D. E.		A. D. E.		J. M. L.		J. M. L.		J. M. L.		C. R. R.		

Analyses of Illinois

Town	Pana	Paris	Paris	Paris
County	Christian	Edgar	Edgar	Edgar
Laboratory number	9237	10179	994	10346
Date	Aug. 1, 1901	Jan. 17, 1902	June 17, 1896	Apr. 5, 1902
Owner	S. Simpson	Harry Wood	J. Hines	J. Hines
Depth	16 feet	Reservoir	30 feet	35 feet
Strata	Drift			Sand
Remarks		Water works	Flowing	Flowing
Turbidity	Very slight	Very slight		Decided
Color	.000	.000		Muddy
Odor	.000	.000		Disagreeable
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	2961.6	536.		1844.
Loss on ignition	216.	21.6		43.6
Chlorine	19.	62.		3.4
Oxygen consumed	2.5	2.7		31.4
Nitrogen as. Free ammonia	.018	.008		18.4
Nitrogen as. Alb. ammonia	.064	.03		4.64
Nitrogen as. Nitrites	.001	.000		.000
Nitrogen as. Nitrates	.16	5.2		.12
Potassium K	5.3	5.4	5.4	6.0
Sodium Na	197.5	28.9	34.9	35.3
Ammonium (NH_4)			24.4	23.6
Magnesium Mg	227.9	41.6	57.2	23.9
Calcium Ca	422.9	74.5	117.2	159.1
Ferrous Fe	1.2	.9	10.9	.2
Aluminium Al	.8	.4	11.7	1.2
Silica Si	13.1	2.8	16.3	11.1
Nitrate NO_3	.7	3.6		.6
Chloride Cl	19.0	62.0	5.2	3.4
Sulphate SO_4	1532.0	49.9	2.7	4.8

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.1	.06	5.8	.34			.9	.05
Potassium Chloride	9.4	.55	5.8	.34	10.3	.60	7.2	.42
Potassium Sulphate							4.3	.25
Potassium Carbonate								
Sodium Nitrate								
Sodium Chloride	24.1	1.46	69.8	4.07	.5	.03		
Sodium Sulphate	579.8	33.81	4.8	.28	4.1	.24	3.7	.22
Sodium Carbonate					80.0	4.67	78.0	4.55
Ammonium Carbonate					65.1	3.80	62.8	3.67
Magnesium Sulphate	1132.8	66.07	58.4	3.40				
Magnesium Carbonate			102.1	5.95	119.2	6.95	83.2	4.85
Calcium Sulphate	330.0	19.24						
Calcium Carbonate	814.1	47.48	188.2	10.98	293.0	17.14	404.7	23.60
Oxide of Iron and Aluminium								
Ferrous Carbonate	2.6	.15	1.9	.11	22.6	1.32	.6	.03
Alumina	1.6	.09	.8	.05	22.0	1.29	2.2	.13
Silica	28.0	1.63	5.9	.34	34.7	2.02	23.2	1.35
Suspended matter							1273.3	73.75
Total	2923.5	170.54	443.5	25.86	651.3	38.06	1944.1	112.87
Analyst	A. D. E.		A. D. E.		A. W. P.		A. D. E.	

Waters—Continued.

Paris	Paris	Paris	Parkersburg .	Paw Paw...	Paxton ....
Edgar	Edgar	Edgar	Richland	Lee	Ford ....
10286	12342	12817	4501	4687	5374 ....
Feb. 26, 1902 .	Aug. 1, 1904..	Jan. 5, 1905.	Dec. 20, 1898..	Feb. 9, 1899	Aug. 14, 1899
J. Hines	J. Hines	O.T. Merkl	S M. Thpsn.	C. F. Prstn.	I. C. R. R.
253 feet	121 feet	121 feet	40 feet	1018 feet ...	120 feet.....
Rock	Rock	Rock	....	Limestone	....
Flowing.....	....	....	....	....	....
Clear	Decided	Decided ...	Slight........	Slight......	....
.05	Yellow	Yellow	.02	.03	....
.000	.000	.000	.000	.000	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per1,000c.c.	Milligrams per 1,000 c. c	Milligrams per1,000c.c.	Milligrams per1,000c.c.
588.	332.0	438.8	979.6	240.	....
22.	....	....	98.8	20.	....
33.0	1.1	9.8	40.	1.	....
6.6	4.5	3.65	1.6	2.	....
1.44	7.800	4.80	.01	.52	....
.138	.214	.176	.072	.03	....
.000	.001	.000	.000	.000	....
.12	.080	.12	1.	.15	.2
5.7	1.9	1.7	6.6	2.7	....
142.4	25.5	38.7	139.6	29.5	52.9
1.9	....	6.2	....	.7	....
27.9	14.3	49.8	33.2	21.5	34.4
51.2	54.2	43.7	89.9	39.4	73.5
....	3.1	3.4	3.0	1.5	....
....	2.1	2.2	.8	.5	....
6.9	3.1	7.8	24.3	5.7	10.4
.6	.3	.6	4.4	.7	.9
33.0	1.1	9.8	40.0	1.0	2.7
.1	12.6	7.3	494.0	.8	4.6

Combinations.

Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	Parts per million .	Grains per U. S. gal.	
.9	.05	.6	.04	.9	.05	7.1	.41	1.1	.06	......	......	KNO_3 ....
10.3	.60	2.3	.13	2.7	.16	7.4	.43	2.1	.12	......	......	K Cl ....
....	......	.9	.05	......	......	....	......	1.5	.09	......	......	$K_2 SO_4$ ....
....	......	....	......	......	......	....	......	1.0	.06	......	......	$K_2 CO_3$ ....
....	......	....	......	......	......	....	......	......	......	1.2	.07	$Na NO_3$ ....
46.4	2.70	....	......	14.4	.84	60.1	3.50	......	......	4.4	.26	Na Cl ....
.2	.01	22.8	1.33	10.8	.63	357.7	20.86	......	......	6.7	.39	$Na_2 SO_4$ ....
284.2	16.57	37.6	2.19	68.2	3.98	....	......	67.0	3.91	112.5	6.56	$Na_2 CO_3$........
5.1	.30	....	......	16.5	.96	....	......	1.8	.10	......	......	$(NH_4)_2 CO_3$....
....	......	....	......	......	......	164.7	9.60	......	......	......	......	$Mg SO_4$........
97.0	5.65	49.6	2.89	173.5	10.12	....	......	74.8	4.36	119.7	6.98	$Mg CO_3$ ....
....	......	....	......	......	......	170.7	9.95	......	......	......	......	$Ca SO_4$ ....
127.9	7.46	135.4	7.9	109.1	6.36	99.1	5.77	98.4	5.73	183.6	10.71	$Ca CO_3$ ....
.8	.05	....	......	......	......	....	......	......	......	4.4	.26	$Fe_2O_3 + Al_2O_3$.
....	......	6.4	.37	8.2	.48	6.4	.37	.5	.03	......	......	$Fe CO_3$ ....
....	......	3.9	.23	4.1	.24	1.6	.09	.9	.05	......	......	$Al_2 O_3$ ....
14.6	.85	6.5	.38	16.5	.96	51.8	3.02	12.2	.71	22.4	1.30	$Si O_2$............
....	......	....	......	......	......	....	......	......	......	......	.....	....
587.4	34.24	266.0	15.51	424.9	24.78	926.6	54.00	261.3	15.22	454.9	26.53	
A. D. E.		J. M. L.		J. M. L.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Paxton	Paxton	Pekin	Peoria
County	Ford	Ford	Tazewell	Peoria
Laboratory number	6728	12128	5376	3072
Date	Jan. 22, 1900	Jan. 8, 1905	Aug. 14, 1899	Dec. 15, 1897
Owner	J. Swanson	R. McCracken	Big Four	E.N.Armstro'g
Depth	166 feet	90 feet	River	
Strata	Sand	Sand		
Remarks				Blow off from locomotive
Turbidity	Distinct	Slight		
Color	.30	.2		
Odor	.000	H_2S		
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	738.4	545.2		
Loss on ignition	30.			
Chlorine	1.8	1.		270.
Oxygen consumed	1.9	9.4		
Nitrogen as Free ammonia	1.2	6.00		.73
Nitrogen as Alb. ammonia	.03	.052		
Nitrogen as Nitrites	.017	.010		17.5
Nitrogen as Nitrates	.4	.160	3.8	4.8
Potassium K	3.7	3.0		31.4
Sodium Na	51.2	39.5	21.5	612.2
Ammonium (NH_4)	1.5	7.7		.9
Magnesium Mg	57.7	58.2	33.4	16.4
Calcium Ca	123.8	94.8	81.1	54.3
Ferrous Fe	3.3	.8		
Aluminium Al	.7	2.1		
Silica Si	8.7	7.5	50.8	3.5
Nitrite NO_2				57.5
Nitrate NO_3	1.7	.7	16.8	21.3
Chloride Cl	1.8	1.0	20.1	270.0
Sulphate SO_4	257.4	82.3	76.5	997.0
Carbonate CO_3				
Hydrogen Sulphide		Much		

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrite							106.2	6.19
Potassium Nitrate	2.8	.16	1.1	.06			34.6	2.02
Potassium Chloride	3.8	.22	2.1	.12			1.4	.06
Potassium Sulphate	1.5	.09	3.3	.19				
Sodium Nitrate					23.0	1.34		
Sodium Chloride					17.5	1.02	443.9	25.89
Sodium Sulphate	158.0	9.22	119.1	6.95	7.1	.41	1349.6	78.73
Sodium Carbonate			2.0	.11				
Ammonium Sulphate	5.5	.32					3.4	.20
Ammonium Carbonate			1.6	.08				
Magnesium Sulphate	182.2	10.63			89.7	5.23	82.1	4.78
Magnesium Carbonate	73.3	4.28	202.6	11.82	53.5	3.12		
Calcium Sulphate							28.9	1.68
Calcium Carbonate	309.3	18.04	237.0	13.83	202.5	11.80	114.5	6.66
Oxide of Iron and Aluminium					18.4	1.07	3.0	.02
Ferrous Carbonate	6.9	.40	1.6	.09				
Alumina	1.4	.08	4.1	.24				
Silica	18.6	1.08	15.9	.92	108.0	5.88	7.5	.74
Suspended Matter								
Total	763.3	44.52	590.4	34.41	519.7	29.87	2175.1	126.97
Analyst	R. W. S.		J. M. L.		R. W. S.		R. W. S.	

Waters—Continued.

Peoria	Peoria	Peoria	Peoria	Peoria	Peoria .....
Peoria	Peoria	Peoria	Peoria	Peoria	Peoria .....
10636	3623	3650	7557	7558	2499 ....
Sept. 22, 1902.	May 26, 1898. .	Jan. 3, 1898.	June 6, 1900. .	June 6, 1900	Jan. 28, 1897
Herschel Co.	J. A. Harman	J. Harman.	H. Williams.	H. Willi'ms	J Harman.
Creek	Spring	Spring	Spring No. 2.	Spring	95 feet ......
....	....	....	....	....	Gravel .....
....	....	....	....	....	....
Very slight..	Slight........	Slight......	Slight........	Distinct	.000
.000	.04	.03	.06	Muddy	.01
.000	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
868.	494.4	428.4	380.8	443.2	1306.
69 6	56.	46.	28.8	56.4	80.
4.8	5.	2.2	7.	7.	18.
14.8	1.4	1.6	1.	3.4	2.
.056	.004	.002	.008	.02	.001
.416	.016	.018	.04	.176	.05
.01	.000	.000	.002	.025	.002
.63	.25	.12	1.6	.24	.9
....	1.8	1.1	2.2	4.3	....
14.5	8.8	8.7	9.0	33.0	76.1
.1	....	....	....	....	....
25.6	53.0	32.2	34.5	38.3	73.9
90.0	107.9	109.1	84.8	84.6	163.5
....	.4	....	.3	2.3	....
....	.26	....	.7	.6	....
1.9	10.1	11.9	10.1	11.1	5.6
....	....	....	....	....	....
2.7	1.1	.5	7.1	1.0	3.9
4.8	5.0	2.2	7.0	7.0	18.0
39.9	31.9	19.3	24.9	7.5	583.1
....	....	....	....	....	....
....	....	....	....	....	....

Combinations.

Parts per million..	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	Parts per million...	Grains per U. S. gal.	
......	......	......	......	......	......	......	......	......	......	......	......	KNO_2 ....
......	......	1.8	.10	.9	.05	5.6	.33	1.7	.10	......	......	KNO_3 ....
......	......	2.1	.12	1.6	.09	......	......	7.0	.41	......	......	KCl ....
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4.........
3.8	.22	......	......	......	......	5.0	.29	......	......	5.3	.31	$NaNO_3$ ....
7.9	.46	6.6	.38	2.4	.14	11.5	.67	6.1	.35	29.7	1.73	$NaCl$ ....
31.8	1.86	19.0	1.10	24.1	1.40	9.6	.56	11.2	.65	194.4	11.34	Na_2SO_4 ....
......	......	......	......	......	......	......	......	62.2	3.63	......	......	Na_2CO_3........
.4	.02	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2SO_4$ ....
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$....
23.1	1.35	23.9	1.39	3.7	.22	23.1	1.34	......	......	367.2	21.42	$MgSO_4$.........
72.9	4.25	167.7	9.77	109.4	6.38	103.7	6.04	133.1	7.76	......	......	$MgCO_3$ ....
......	......	......	......	......	......	......	......	......	......	223.9	13.06	$CaSO_4$..........
224.9	13.12	269.5	15.70	272.7	15.90	211.9	12.36	211.4	12.33	243.9	14.23	a CO_3 ....
4.0	.23	......	......	2.8	.16	......	......	......	......	1.8	.10	$Fe_2O_3+Al_2O_3$
......	......	.7	.04	......	......	.6	.03	4.8	.28	......	......	$FeCO_3$..........
......	......	.5	.03	......	......	1.3	.07	1.1	.06	......	......	Al_2O_3 ....
4.0	.23	21.6	1.25	25.3	1.46	21.6	1.25	23.5	1.37	11.9	.69	SiO_2............
447.2	26.09	......	......	......	......	......	......	......	......	......	......	....
820.0	47.83	513.4	29.88	442.9	25.80	393.9	22.94	462.1	26.94	1078.1	62.88	
P. B.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Peoria	Peoria	Peoria	Peoria
County	Peoria	Peoria	Peoria	Peoria
Laboratory number	10509	10634	10635	11855
Date	July 17, 1902	Sept. 22, 1902	Sept. 22, 1902	March 8, 1904
Owner	D. Maury	Herschel Co	Herschel Co	J. I. Black
Depth	Tap	16 feet	60 feet	65 feet
Strata	Drift	Drift	Drift	Drift
Remarks	City supply	....	....	....
Turbidity	Clear	Decided	Clear	Clear
Color	.000	Yellow	.000	.000
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	300.8	582.	654.8	620.
Loss on ignition	42.4	76.8	81.6	....
Chlorine	8.4	6.6	9.	15.7
Oxygen consumed	3.6	2.7	2.	2.5
Nitrogen as. Free ammonia	.01	.24	.036	.006
Nitrogen as. Alb ammonia	.068	.016	.042	.036
Nitrogen as. Nitrites	.000	.001	.004	.000
Nitrogen as. Nitrates	.56	.04	.566	1.2
Potassium K	4 0	....	....	....
Sodium Na	22.9	11.3	13.0	17.7
Ammonium (NH_4)	....	.3	.1	....
Magnesium Mg	24.9	32.6	51.7	54.1
Calcium Ca	64 0	124.8	130.8	131.2
Ferrous Fe	1.5	....	....	....
Aluminium Al	.7	....	....	....
Silica Si	5.0	8.1	.8	6.2
Nitrite NO_2	....	....	....	....
Nitrate NO_3	.2	.2	2.4	5.3
Chloride Cl	8.4	6.6	9.0	15.9
Sulphate SO_4	40.7	67.9	116.0	150.9

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrite	....	....	....	....	....	....	....	....
Potassium Nitrate	4.1	.24	....	....	....	....	....	....
Potassium Chloride	4.6	.27	....	....	....	....	....	....
Sodium Nitrate	....	....	.3	.02	3.3	.19	7.2	.42
Sodium Chloride	10.2	.59	10.9	.63	14.9	.87	25.9	1.50
Sodium Sulphate	58.2	3.39	27.9	1.63	19 2	1.12	17.2	1.00
Sodium Carbonate	....	....	....	....	....	....	....	....
Ammonium Sulphate	....	....	1.1	.06	.4	.02	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Sulphate	1.8	.10	60.3	3.52	128.6	7.50	174.2	10.16
Magnesium Carbonate	85.3	4.98	71.2	4.15	89.7	5.23	66.2	3.86
Calcium Sulphate	....	....	....	....	....	....	....	....
Calcium Carbonate	160.0	9.33	311.8	18.19	326.8	19.07	327.7	19.10
Oxide of Iron and Aluminium	....	....	54.6	3.19	3.3	.19	2.6	.15
Ferrous Carbonate	3.2	.19	....	....	....	....	....	....
Alumina	1.4	.08	....	....	....	....	....	....
Silica	10.6	.61	17.2	1.00	1.8	.11	13.2	.77
Total	339.4	19.78	555.3	32.39	588.0	34.30	634.2	36.96
Analyst	P. B.		P. B.		P. B.		D. K.	

Waters—Continued.

Peoria	Peoria	Peoria	Peoria	Peoria	Peoria .....
Peoria	Tazewell	Tazewell ..	Peoria	Peoria	Peoria .....
12577	10230	10280	10464	12164	12415 ....
Oct. 22, 1904..	Feb. 20, 1902	Feb. 20, 1902	June 18, 1902.	June 17, 1904	Sept. 8, 1904
Steel & T. Co	P. Mineral Co	P. Min. Co.	A. Harv. Co	G. A. Zeller	W. A. Gray
22 feet........	500 feet.......	1000 feet....	365 feet.......	1864 feet....	980 feet.....
Drift.........	Rock	Rock	Rock	St. Peter...	Sandstone .
....	....	....	Flowing.....	....	....
....	Distinct......	Distinct....	Slight........	Slight......	....
....	Cloudy	Milky......	.4	.000	....
....	.000	.000	Musty	Peculiar ...	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
584.4	6714.4	3150.4	8183.6	1592.0	3216.8
....	61.2	16.8	24.	....	....
6.2	3637.5	1395.	4637.5	298.5	1562.5
....	17.1	9.5	16.4	3.2	8.7
....	2.	1.6	2.48	.012	1.600
....	.064	.008	.024	.024	.006
....	.000	.000	.000	.65	.000
2.160	.18	.17	.08	.19	.16
....	31.9	30.5	....	14.6	25.2
21.4	2492.1	1078.2	3022.6	440.1	1086.1
....	....	....	3.2	....	1 9
46.2	23.7	29.3	35.9	27.1	20.8
108.5	50.6	57.0	56.3	68.9	42.6
.3	2.6	.6	....	....	....
1.1	2.9	1.2	....	....	....
6.2	11.5	5.4	3.7	4 9	7.9
....	....	....	....	2.0	....
9.5	.8	.7	.3	.8	.7
6.2	3637.	1395.0	4637.5	298.5	1562.5
161.0	17.3	295.1	1.2	644.6	238.5

Combinations.

Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	
....	......	....	......	....	......	....	......	3.8	.22	....	......	KNO_2 ....
....	......	1.3	.08	1.1	.06	....	......	1.3	.07	1.1	.06	KNO_3 ....
....	......	59.9	3.49	57.5	3.33	....	......	23.6	1.37	46.9	2.73	$K Cl$ ....
13.1	.76	....	......	....	......	.5	.03	....	......	....	......	$Na NO_3$ ....
10.2	.59	5954.0	347.33	2256.7	131.61	7651.9	446.38	471.8	27.53	2541.3	148.25	$Na Cl$ ....
42.8	2.50	25.6	1.50	436.7	25.47	1.8	.11	785.0	45.79	266.5	15.55	$Na_2 SO_4$ ....
....	......	327.8	19.12	112.9	6.58	27.4	1.6	....	......	....	......	$Na_2 CO_3$........
....	......	....	......	....	......	....	......	....	......	7.3	.42	$(NH_4)_2 SO_4$ ....
....	......	....	......	....	......	8.5	.5	....	......	....	......	$(NH_4)_2 CO_3$....
165.2	9.64	....	......	....	......	....	......	134.4	7.84	66.4	3.87	$Mg SO_4$.........
44.9	2.62	82.7	4.82	102.1	5.95	124.7	7.27	....	......	25.8	1.51	$Mg CO_3$ ....
....	......	....	......	....	......	....	......	9.2	.54	....	......	$Ca SO_4$ ....
271.1	15.81	126.4	7.37	142.5	8.31	140.7	8.21	165.4	9.64	106 4	6.20	$Ca CO_3$ ....
....	......	....	......	....	......	3.0	.18	4.2	.25	3.6	.21	$Fe_2 O_3+Al_2 O_3$.
.6	.04	5.5	.32	1.3	.08	....	......	....	......	....	......	$Fe CO_3$ ....
2.0	.12	5.4	.32	2 2	.13	....	......	....	......	....	......	$Al_2 O_3$ ....
13.1	.76	24.4	1.42	11 4	.66	7.8	.46	10.4	.60	16.8	.98	$Si O_2$...........
563.0	32.84	6613.0	385.77	3124.4	182.18	7966.3	464.74	1609.1	93.85	3082.1	179.78	
J. M. L.		A. D. E.		A. D. E.		A. D. E.		J. M. L.		J. M. L.		

Analyses of Illinois

Town	Peotone	Peru	Petersburg	Piper City
County	W ll	LaSalle	Menard	Ford
Laboratory number	8871	491	9122	2451
Date	Dec. 6, 1900	Feb. 13, 1895	May 28, 1901	July 15, 1897
Owner	W. Elliott	W. Holly	L. E. Hartrick	E. N. Armst'g.
Depth	100 feet	700 feet	2011 feet	15 feet
Strata	Limestone	Rock	Rock	Sand
Remarks	City supply	Flowing	Flowing	
Turbidity	Very slight		Distinct	Distinct
Color	.01		Cloudy	.4
Odor	.000		H_2S	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	589.2		6964.8	760.4
Loss on Ignition	21 6		204.8	60 8
Chlorine	1.7		3475.	32.
Oxygen consumed	1.6		27.4	3.3
Nitrogen as — Free ammonia	.208		3.36	.88
Nitrogen as — Alb. ammonia	.036		.052	.036
Nitrogen as — Nitrites	.000		.000	.003
Nitrogen as — Nitrates	.16		.33	.2
Potassium K	8.3	27.7	23.6	
Sodium Na	30.7	1654.0	2403.8	26.8
Ammonium (NH_4)	.27		4.3	1.13
Magnesium Mg	37.4	15.8	28.5	46.1
Calcium Ca	158.2	48.2	52.6	110.8
Ferrous Fe		8.0	.15	
Aluminium Al	2.2		3.1	
Silica Si	2.0	3.6	6.2	8.
Nitrate NO_3	.7		1.5	.9
Chloride Cl	1.7	2264.1	3475.0	32.0
Sulphate SO_4	196.3	320.4	316.6	210.0

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.1	.06			2.4	.14		
Potassium Chloride	3.6	.21	52.6	3.07	43.5	2.52		
Potassium Sulphate	13.5	.78						
Sodium Nitrate							1.2	.07
Sodium Chloride			3690.	215.20	5692.7	330.18	52.7	2.95
Sodium Sulphate	94.8	5.50	474.	27.74	468.2	27.16	20.1	1.16
Sodium Carbonate			112.5	6.56	28.2	1.64		
Ammonium Sulphate	1.0	.06					4.1	.24
Ammonium Carbonate					11.4	.66		
Magnesium Chloride								
Magnesium Sulphate	141.4	9.20					167.1	9.74
Magnesium Carbonate	31.5	1.82	55.	3.19	99.1	5.75	43.8	2.55
Calcium Sulphate							30.8	1.79
Calcium Carbonate	395.3	22.93	120.4	7.02	131.4	7.62	250.0	14.57
Oxide of Iron and Aluminum							4.7	.27
Ferrous Carbonate			16.6	.98	3.2	.18		
Alumina					6.0	.35		
Aluminium Sulphate	13.9	.80						
Silica	4.2	.24	7.7	.44	13.2	.77	17.1	.99
Total	700.3	41.60	4528.8	264.20	6499.3	376.97	591.6	34.33
Analyst	A. R. J.		A. W. P.		A. L. M.		R. W. S.	

Waters—Continued.

Piper City...	Pisgah.......	Plainfield .	Plano	Poag	Polo ....
Ford	Morgan......	Will	Kendall	Madison...	Ogle.......
2637	9804	5444	9219	3280	10189 ....
Aug. 8, 1897..	Nov. 18, 1901.	July 18, 1899	July 26, 1901 .	Feb. 18, 1898	Jan. 16, 1902
E.N. Armst'g	W. Conley..	C. Fraser..	W. Griswold.	E.C. Boesh.	A. Wat'rby
15 feet	Spring	101 feet	Spring.......	55 feet	90 feet .....
Sand.	....	Rock	....	Sand.......	Limestone
....	....	....	....	....	....
Distinct	Very slight..	Distinct ...	Very slight..	Very slight	Decided ...
.15	.01	.02	.0	.02	Yellow ....
.000	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
476.0	338.4	803.6	314.8	153.2	530.4
24.0	30.4	121.2	18.4	14.	56.8
13.0	4.	114.	1.6	2.8	5.2
2.7	1.7	2.	1.5	.8	5.4
.214	.014	.008	.014	.001	1.7
.022	.024	.038	.032	.012	.16
.280	.001	.003	.002	.002	.003
.05	.24	15.2	1.4	3.6	.077
3.4	2.2	9.0	1.8	1.6	....
23.7	10.2	78.7	4.2	5.9	16.8
....	....	....	....	....	....
45.8	36.2	61.4	23.6	6.6	50.0
92.4	77.2	106.2	81.3	29.7	126.5
1.7	3.5	1.1	.3	.8	....
.4	.8	1.3	.6	.14	....
6.5	6.7	6.	8.3	14.1	10.1
.21	1.	67.3	6.2	15.9	.3
13.0	4.0	114.0	1.6	2.8	5.3
95.4	9.4	118.5	21.5	12.1	16.8

Combinations.

Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	
.4	.02	1.7	.10	23.2	1.35	4.7	.27	4.3	.25	......	......	KNO_3 ....
6.2	.36	3.0	.02	......	......	......	......	......	......	......	......	K Cl ....
......	......	......	......	......	......	......	......	......	......	......	......	K_2SO_4 ....
......	......	......	......	72.7	4.24	4.6	.26	18.3	1.06	.5	.03	$NaNO_3$..........
16.5	.96	4.3	.25	149.8	8.74	2.6	.15	2.5	.14	8.7	.51	Na Cl ....
53.2	3.10	13.8	.81	......	......	8.2	.48	......	......	24.9	1.45	Na_2SO_4 ....
......	......	9.2	.54	......	......	......	......	......	......	11.9	.69	Na_2CO_3..........
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2SO_4$ ....
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$....
......	......	......	......	30.9	1.80	......	......	3.5	.20	......	......	$MgCl_2$..........
73.3	4.28	......	......	148.2	8.65	20.0	1.16	25.7	1.50	......	......	$MgSO_4$..........
105.5	6.15	125.8	7.34	82.7	4.82	68.0	3.94	1.8	.10	173.9	10.15	$MgCO_3$..........
......	......	......	......	......	......	......	......	......	......	......	......	$CaSO_4$..........
230.7	13.46	193.4	11.28	265.2	15.47	202.7	11.76	74.3	4.33	316.1	18.44	$CaCO_3$..........
......	......	......	......	......	......	......	......	......	......	13.4	.80	$Fe_2O_3 + Al_2O_3$.
3.5	.20	7.3	.43	2.2	.13	.6	.03	.2	.01	......	......	$FeCO_3$..........
.8	.05	1.4	.08	2.4	.14	1.1	.06	.3	.02	......	......	Al_2O_3..........
......	......	......	......	......	......	......	......	......	......	......	......	$Al_2(SO_4)_3$ ....
13.9	.81	14.2	.83	12.8	.74	17.7	1.03	30.0	1.75	21.6	1.27	SiO_2..........
504.0	29.39	374.1	21.68	790.1	46.08	330.2	19.14	160.9	9.36	571.0	33.34	
R. W. S.		A. D. E.		R. W. S.		A. L. M.		R. W. S.		A. D. E.		

Analyses of Illinois

Town	Polo	Pontiac	Pontiac	Pulaski
County	Ogle	Livingston	Livingston	Pulaski
Laboratory number	10188	9365	5151	9151
Date	Jan. 17, 1902	Oct. 24, 1901	June 5, 1899	June 23, 1901
Owner	A. Waterbury	C. Acklin	J. Stiles	W. A. Lackey
Depth	2100 feet	23 feet	88 feet	Spring
Strata	Sandstone	...	Rock	...
Remarks	City supply	...	...	...
Turbidity	Slight	Distinct	Distinct	Decided
Color	...	.04	.04	Yellow
Odor	...	.000	.000	Decayed V'gt's

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	322.	968.	5855.2	388.4
Loss on Ignition	26.	22.8	38.4	20.
Chlorine	2.	49.	3140.	4.8
Oxygen consumed	1.9	3.	6.3	3.5
Nitrogen as Free ammonia	.112	.148	1.44	.596
Nitrogen as Alb. ammonia	.006	.096	.028	.056
Nitrogen as Nitrites	.001	.001	.000	.000
Nitrogen as Nitrates	.09	3.28	.1	.12
Potassium K	1.5	6.8	34.4	2.4
Sodium Na	7.1	308.1	2189.9	13.3
Ammonium (NH_4)	...	.2	1.8	.76
Magnesium Mg	40.3	10.6	12.6	26.0
Calcium Ca	69.3	22.8	19.8	90.3
Ferrous Fe	.4	.4	.15	4.2
Aluminium Al	5.8	7.0	.7	5.0
Silica Si	4.3	5.3	16.5	11.8
Nitrate NO_3	.3	14.6	.5	.5
Chloride Cl	2.0	49.0	3140.0	4.8
Sulphate SO_4	23.5	293.5	10.1	27.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.6	.04	17.6	1.03	.7	.04	.9	.05
Potassium Chloride	4.2	.25	...	...	65.3	3.81	4.0	.23
Potassium Sulphate	3.5	.20	...	...	...	...	...	...
Sodium Nitrate	...	...	5.2	.30	...	...	...	...
Sodium Chloride	...	...	80.9	4.72	5123.5	298.88	4.8	.28
Sodium Sulphate	22.0	1.28	434.2	25.33	1.6	.09	34.6	2.01
Sodium Carbonate	...	...	301.3	17.58	400.5	23.36	...	...
Ammonium Nitrate	...	...	...	...	...	...	...	...
Ammonium Chloride	...	...	...	...	...	...	...	...
Ammonium Sulphate	...	...	...	...	...	...	2.8	.16
Ammonium Carbonate	...	...	.5	.03	4.8	.28	...	...
Magnesium Nitrate	...	...	...	...	...	...	...	...
Magnesium Chloride	...	...	...	...	...	...	...	...
Magnesium Sulphate	8.6	.50	...	...	...	...	6.0	.35
Magnesium Carbonate	134.4	7.84	37.0	2.16	43.7	2.55	85.9	4.98
Calcium Sulphate	...	...	...	...	...	...	...	...
Calcium Carbonate	173.2	10.11	56.4	3.29	49.6	2.89	225.7	13.09
Oxide of Iron and Aluminium	...	...	...	...	...	...	...	...
Ferrous Sulphate	...	...	...	...	...	...	...	...
Ferrous Carbonate	.8	.05	.8	.05	Trace..	Trace..	8.7	.50
Alumina	10.9	.63	13.2	.77	1.3	.07	9.0	.52
Aluminium Sulphate	...	...	...	...	...	...	...	...
Silica	9.1	.53	11.2	.65	35.0	2.04	25.0	1.45
Suspended matter	...	...	...	...	...	...	...	...
Magnesium Nitrite	...	...	...	...	...	...	...	...
Total	367.3	21.43	958.3	55.91	5726.0	334.01	407.4	23.62
Analyst	A. D. E.		A. D. E.		R. W. S.		A. L. M.	

Waters—Continued.

Quincy	Quincy	Quincy	Quincy	Quincy	Quincy ....
Adams.......	Adams	Adams	Adams	Adams	Adams ....
7738..........	2987............	1446..........	8710.............	10337.........	5311.........
June 18, 1900.	Nov. 26, 1897.	Oct. 5, 1896.	Oct. 29, 1900..	Mar. 28, 1902	June 27, 1899
L. Irwin......	B. Homan..	J. B. Schott	J. B. Schott..	H.N.W'el'r	E. Prince..
Spring.......	Spring.......	100 feet.....	60 feet........	200 feet.....	144 feet.....
Sand.........	Limestone...	Rock	Rock	Limestone.	Rock ......
....	....	Flowing...	....	....	At Payson.
V. Slight.....	V. Decided..	....	....	Decided...	.000
.01	Yellow.......	....	....	Yellow.....	.01
.000	.000	....	....	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per1,000c.c.	Milligrams per1,000c.c.
300.	539.2	....	3318.4	322.	365.6
20.	44.4	....	30.4	20.4	44.8
5.	6.8	....	1330.	6.5	36.5
1.1	6.8	....	8.2	1.9	2.4
.013	6.4	....	.036	.032	.204
.042	.198	....	.072	.016	.034
.000	.000	....	.003	.000	1.5
.2	.07	....	33.	.12	12.
1.2	7.2	13.4	10.3	3.2	1.7
8.6	21.5	481.9	634.2	17.9	16.7
....	7.9	....	.05	....	.3
12.6	36.6	176.6	140.5	30.0	23.1
82.3	109.4	270.5	260.7	75.0	70.5
.15	41.4	....	3.3	.8	.5
.5	6.2	....	10.7	.6	1.7
9.7	15.	11.3	3.6	5.4	6.3
.9	.3	145.9	146.1	.6	53.1
5.0	6.8	1041.1	1330.0	6.5	36.5
15.1	2.6	219.6	323.9	8.0	11.2

Combinations.

Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	
1.5	.09	.5	.03	33.7	1.97	26.7	1.55	.9	.05	4.3	.25	KNO_3..........
1.2	.07	14.3	.83	......	......	....	......	5.4	.31	......	......	K Cl...........
....	......	1.6	.09	......	......	....	......	......	......	......	......	K_2SO_4 ....
....	......	....	......	171.7	10.20	177.9	10.32	......	......	61.7	3.60	Na NO_3.........
7.2	.42	....	......	1107.	64.60	1490.8	86.46	6.4	.37	......	......	Na Cl ....
17.9	1.04	3.4	.20	......	......	....	......	11.9	.69	......	......	Na_2SO_4.........
....	......	46.3	2.69	......	......	....	......	26.5	1.55	......	......	Na_2CO_3.........
....	......	....	......	......	......	....	......	......	......	1.3	.07	NH_4NO_3 ....
....	......	....	......	......	......	.2	.01	......	......	......	......	NH_4Cl..........
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2SO_4$ .....
....	......	21.9	1.28	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$.....
....	......	....	......	......	......	....	......	......	......	5.3	.31	$Mg(NO_3)_2$......
....	......	....	......	494.3	28.85	569.	33.	......	......	48.8	2.85	$MgCl_2$ ....
3.7	.21	....	......	252.3	14.72	....	......	......	......	13.9	.81	$MgSO_4$..........
41.4	2.41	127.5	7.44	......	......	....	......	98.5	5.75	19.9	1.15	$MgCO_3$ ....
....	......	....	......	25.3	1.47	365.5	21.20	......	......	......	......	$CaSO_4$ ....
205.5	11.98	273.3	15.95	657.1	38.36	268.8	15.59	187.4	10.93	176.2	10.27	$CaCO_3$..........
....	......	....	......	4.8	.28	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$..
....	......	....	......	......	......	9.	.52	......	......	......	......	$FeSO_3$ ....
.3	.02	85.8	5.00	......	......	....	......	.2	.01	1.0	.05	$FeCO_3$..........
1.	.05	11.6	.67	......	......	....	......	1.2	.07	3.2	.18	Al_2O_3..........
....	......	....	......	......	......	69.5	4.03	......	......	......	......	$Al_2(SO_4)_3$.......
20.6	1.20	32.5	1.89	23.6	1.37	7.6	.44	11.4	.66	13.5	.79	SiO_2...........
....	......	....	......	......	......	....	......	8.4	.49	......	......	....
....	......	....	......	......	......	....	......	......	......	6.3	.37	$Mg(NO_2)_2$......
300.3	17.49	618.7	36.07	2769.8	161.82	2985.0	173.12	358.2	20.88	355.4	20.70	
R. W. S.		R. W. S.		A. W. P.		A. R. J.		A. D. E.		R. W. S.		

Analyses of Illinois

Town	Quincy	Rantoul	Redbud	Richview
County	Adams	Champaign	Randolph	Washington
Laboratory No	10502	3430	10341	10582
Date	July 12, 1902	Apr. 5, 1898	Mar. 29, 1902	Sept. 9, 1902
Owner	D. N. Wisherd	E. V. Moore	C. Becker	W. Thompson
Depth	1202 feet	110 feet	280 feet	17 feet
Strata	Rock	Sand	Sand stone	
Remarks	Flowing	City supply		
Turbidity	Distinct	Distinct	Slight	Slight
Color	.2	.25	.2	.000
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	8774.4	331.8	339.2	2014.8
Loss on ignition	360.	41.2	8.8	250.4
Chlorine	4200.	.7	5.55	9.2
Oxygen consumed	18.7	2.5	1.8	2.8
Nitrogen as — Free ammonia	2.88	.52	.304	.026
Nitrogen as — Alb. ammonia	.036	.054	.01	.082
Nitrogen as — Nitrites	.000	.000	.006	.000
Nitrogen as — Nitrates	.14	.35	.234	2.8
Potassium K	73.1	3.4	4.3	5.1
Sodium Na	2582.4	16.8	28.7	131.8
Ammonium (NH_4)	3.7	.63	.4	
Magnesium Mg	145.3	32.6	22.2	111.2
Calcium Ca	518.7	67.9	71.3	280.8
Ferrous Fe	1.2	5.9	.9	.9
Aluminium Al	.8	1.2	.5	1.4
Silica Si	8.3	6.7	3.9	7.5
Nitrate NO_3	.6	1.5	1.0	12.4
Chloride Cl	4200.0	.7	5.55	9.2
Sulphate SO_4	1007.5	2.7	30.0	721.6

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per mill on	Grains per U. S. gal.
Potassium Nitrite								
Potassium Nitrate	.9	.05	2.5	.15	1.7	.10	13.3	.78
Potassium Chloride	138.9	8.10	1.5	.08	7.6	.44		
Potassium Sulphate			3.7	.21				
Sodium Nitrate							5.8	.34
Sodium Chloride	6564.5	382.84			3.2	.19	15.2	.89
Sodium Sulphate			1.0	.06	44.4	2.59	383.8	22.39
Sodium Carbonate			38.0	2.21	29.1	1.69		
Ammonium Chloride	11.0	.63						
Ammonium Sulphate								
Ammonium Carbonate			1.8	.10	1.1	.06		
Magnesium Chloride	198.9	11.59						
Magnesium Sulphate	471.3	27.50					552.6	32.23
Magnesium Carbonate			112.4	6.55	77.3	4.51		
Calcium Sulphate	930.6	54.29					28.7	1.67
Calcium Carbonate	619.2	36.12	167.9	9.78	178.1	10.38	680.5	39.70
Ferrous Carbonate	2.6	.15	12.3	.71	1.9	.11	1.9	.11
Alumina	1.6	.09	2.3	.12	.9	.05	2.6	.15
Silica	17.8	1.04	14.2	.83	8.3	.48	16.0	.90
Suspended Matter	21.	1.22						
Total	8978.3	523.62	357.6	20.80	353.6	20.60	1700.4	99.16
Analyst	P. B.		R. W. S.		A. D. E.		A. D. E.	

Waters—Continued.

Ripley	Riverside	Riverside	Roanoke	Roanoke	Robinson
Brown	Cook	Cook	Woodford	Woodford	Crawford
10226	10691	10689	4149	4148	9880
Jan. 29, 1902	Oct. 18, 1902	Oct. 18, 1902	Sept. 30, 1898	Sept. 30, 1898	Nov. 26, 1901
S. Burgesser	Dr. F. Rich	Dr F. Rich	Roan'k' M.C.	Ro'n'k M.C	R. Simily
Spring	2000 feet	2000 feet	79 feet	120 feet	150 feet
....	Limestone	Limestone	Sand	Rock	Sandstone
....	City supply	Well No. 2, city sup'y	Flowing	Flowing	....
Distinct	V. Slight	V. Slight	Decided	Decided	Decided
.04	.000	.1	Yellow	Yellow	Muddy
.000	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
625.6	817.6	647.2	507.6	513.2	315.6
14.4	33.6	77.2	46.8	48.	22.
4.	222.	29.75	4.	4.1	10.
5.2	2.5	2.6	8.7	9.5	3.1
.018	.248	.128	6.	4.8	.032
.036	.04	.66	.174	.214	.026
.001	.15	.1	.000	.000	.05
.32	.17	.06	.1	.1	3.15
3.8	20.6	4.8	4.4	4.6	2.5
14.5	200.6	28.1	45.8	46.4	43.2
....	.3	.2	7.7	6.1	....
43.8	20.2	62.1	38.7	39.4	17.3
145.4	62.7	117.9	92.6	93.1	46.2
2.	.5	1.5	3.4	3.2	1.9
2.2	2.0	3.3	1.2	1.0	7.4
8.9	3.6	6.1	12.4	11.5	15.1
1.4	.5	.3	.5	.5	13.9
4.0	222.0	29.8	4.0	4.1	10.0
115.2	88.0	206.8	.8	1.3	19.2

Combinations.

Parts per million...	Grains per million...	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	Parts per million...	Grains per U. S. gal..	
....	......	.9	.05	.7	.04	....	......	......	......	......	......	KNO_2
2.2	.13	1.3	.08	.4	.02	.7	.04	.7	.04	6.4	.37	KNO_3
5.7	.33	37.6	2.20	8.2	.48	7.9	.46	8.4	.49	......	......	KCl
....	......	....	......	......	......	....	......	......	......	......	......	K_2SO_4
....	......	....	......	......	......	....	......	......	......	13.7	.80	$NaNO_3$
2.1	.12	336.8	19.65	42.7	2.49	.3	.02	......	......	16.5	.96	$NaCl$
42.4	2.37	130.3	7.60	35.	2.04	1.2	.07	1.9	.11	28.4	1.65	Na_2SO_4
....	......	59.7	3.48	......	......	104.3	6.08	105.5	6.12	54.9	3.20	Na_2CO_3
....	......	....	......	......	......	....	......	......	......	......	......	$NH Cl$
....	......	....	......	.7	.04	....	......	......	......	......	......	$(NH_4)_2SO_4$
....	......	.8	.05	......	......	20.5	1.19	16.2	.94	......	......	$(NH_4)_2CO_3$
....	......	....	......	......	......	....	......	......	......	......	......	$MgCl_2$
108.3	6.31	....	......	228.5	13.33	....	......	......	......	......	......	$MgSO_4$
123.7	7.22	70.1	4.09	55.9	3.26	134.8	7.86	137.1	8.00	60.1	3.51	$MgCO_3$
....	......	....	......	......	......	....	......	......	......	......	......	$CaSO_4$
363.3	21.19	156.8	9.15	294.6	17.16	231.4	13.49	232.7	13.57	115.4	6.74	$CaCO_3$
4.2	.25	1.	.05	3.2	.19	7.0	.40	6.6	.38	3.9	.23	$FeCO_3$
4.2	.25	3.8	.22	6.2	.36	2.3	.13	1.9	.11	14.0	.82	Al_2O_3
19.0	1.11	7.6	.44	13.	.76	26.4	1.53	24.7	1.44	32.8	1.92	SiO_2
....	......	....	......	......	......	....	......	......	......	......	......	Susp. Mat.
675.1	39.38	806.7	47.06	689.1	40.20	536.8	31.27	535.7	31.20	346.1	20.20	
A. D. E.		P. B.		P. B.		R. W. S.		R. W. S.		A. D. E.		

Analyses of Illinois

Town	Rochelle	Rochelle	Rochelle	Rockford
County	Ogle	Ogle	Ogle	Winnebago
Laboratory number	3914	3915	11743	9142
Date	Aug. 6, 1898	Aug. 6, 1898	Jan. 12, 1904	June 21, 1901
Owner	F. G. Crowell	Dr. Crowell	W. McHenry	I. C. R. R
Depth	Spring	Spring	1896 feet	Creek
Strata			Potsdam	
Remarks		Southworth's	City supply	
Turbidity	Decided	Slight	Clear	
Color	.2	.02	.000	
Odor	.000	.000	.000	

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	338.4	291.8	325.6	334.
Loss on ignition	10.8	48.8	....	44.
Chlorine	1.2	2.	2.2	7.
Oxygen consumed	2.7	2.	1.4	....
Nitrogen as. Free ammonia	.68	.003	.096	....
Nitrogen as. Alb. ammonia	.022	.026	.018	....
Nitrogen as. Nitrites	.001	.000	.000	....
Nitrogen as. Nitrates	.2	.3	1.20	2.08
Potassium K	3.8	.7	1.7	....
Sodium Na	11.1	5.2	7.8	14.2
Ammonium (NH_4)	.8	....	.096	....
Magnesium Mg	25.2	31.0	24.7	34.0
Calcium Ca	78.5	55.7	81.1	62.1
Ferrous Fe	....	.5	3.2	....
Aluminium Al	....	.6	1.7	....
Silica Si	10.1	6.7	5.2	5.6
Nitrate NO_3	.9	1.3	1.4	9.2
Chloride Cl	1.2	2.0	2.2	7.0
Sulphate SO_4	2.8	11.4	15.2	27.3

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.5	.08	2.0	.11	2.3	.13	....	....
Potassium Chloride	2.5	.14	....	....	1.7	.10	....	....
Potassium Sulphate	4.2	.24	....	....	....	....	....	....
Potassium Carbonate	....	....	....	....	....	....	....	....
Sodium Nitrate	....	....	....	....	....	....	12.6	.73
Sodium Chloride	....	....	3.3	.19	2.3	.13	11.5	.67
Sodium Sulphate	.7	.04	12.1	.70	21.3	1.24	19.2	1.11
Sodium Carbonate	25.1	1.40	....	....	....	....	....	....
Ammonium Carbonate	2.1	.12	....	....	....	....	....	....
Magnesium Sulphate	....	....	4.0	.23	1.1	.06	18.0	1.04
Magnesium Carbonate	87.6	5.10	105.2	6.13	85.2	4.97	105.8	6.14
Calcium Carbonate	196.2	11.44	138.3	8.04	203.7	11.88	155.0	8.99
Oxide of Iron and Aluminium	2.8	.16	....	....	....	....	5.6	.32
Ferrous Carbonate	....	....	1.1	.06	4.1	.24	....	....
Alumina	....	....	1.1	.06	3.2	.19	....	....
Silica	22.1	1.28	14.3	.82	12.7	.74	12.0	.70
Total	344.8	20.00	281.4	16.34	337.6	19.69	339.7	19.70
Analyst	R. W. S.		R. W. S.		D. K.		A. L. M.	

Waters—Continued.

Rockford	Rockford	Rockford ..	Rockford	Rockford ..	Rockford ..
Winnebago .	Winnebago .	Winn'bago	Winnebago .	Winn'bago	Winn'bago
9286	13347	11146	13670	12328	8971 ....
Aug. 4, 1901..	May 26, 1905..	June 12, 1903	Oct. 18, 1905..	Aug. 17, 1904	Jan. 22, 1901
I. C. R. R ...	W. Renshaw	J. Safford..	J. C. Allen..	E. Lofgren	I. C. R R ..
River	Kent creek..	119 feet.....	200 feet	350 feet.....	400 to 2100 ft
....	....	Clay	Sandstone ...	....	....
....	....	....	....	....	City sup'ly
....	Very slight..	Slight......	Slight.........	Clear	Slight......
....	.000	.000	.000	.000	.01
....	Musty	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
....	....	356.	320.	312.0	299.2
....	....	26.8	....	....	25.2
9.	....	1.4	.75	4.0	3.
....	....	1.3	1.0	1.0	2.3
....	....	,000	.024	.008	.008
....	....	.006	.032	.022	.036
....	....	.000	.000	.000	.014
.24	....	1.6	.12	.20	.106
....	....	.08	7.1	2.9	....
16.0	9.4	5.6	1.6	8.0	7.9
....	....	....	....	....	....
32.7	36.0	42.7	32.5	35.7	36 5
46.9	65.6	83.2	87.1	61.2	63 3
....	....	.6	.5	.4	....
....	....	.6	5.2	1.8	....
14.1	....	6.1	10.1	4.7	5.3
1.0	....	7.1	.6	.9	.5
9.0	8.5	1.4	.8	4.0	3.0
13.9	28.8	6.6	6.6	13.4	10.5

Combinations.

Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	
....	......	....	......	.2	01	.9	.05	1.5	.09	......	......	KNO_3 ....
....	......	....	......	......	......	1.7	.10	4.4	.25	......	......	$K\,Cl$ ....
....	......	....	......	......	......	12.0	.70	......	......	......	......	$K_2\,SO_4$ ....
....	......	....	......	......	......	.9	.05	......	......	......	......	$K_2\,CO_3$ ....
1.4	.08	....	......	9.6	.56	....	......	......	......	.6	.03	$Na\,NO_3$ ....
14.8	.86	14.0	.82	2.3	.13	....	......	3.1	.18	4.9	.28	$Na\,Cl$ ....
20.6	1.19	11.9	.69	6.4	.37	....	......	19.9	1.16	15.6	.90	$Na_2\,SO_4$ ....
7.4	.43	....	......	......	......	3.8	.22	.9	.05	1.7	.10	$Na_2\,CO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2\,CO_3$....
....	......	26.0	1.52	2.9	.17	....	......	......	......	......	......	$Mg\,SO_4$..........
113.8	6.60	107.1	6.25	146.4	8.54	113.0	6.60	124.3	7.25	127.1	7.37	$Mg\,CO_3$ ....
117.1	6.79	164.0	9.57	207.9	12.13	217.5	12.69	152.9	8.92	158 0	9.16	$Ca\,CO_3$ ....
10.8	.63	4.4	.26	......	......	....	......	......	......	1.5	.09	$Fe_2\,O_3+Al_2\,O_3$.
....	......	....	......	.8	.05	1.1	.06	.8	.05	......	......	$Fe\,CO_3$ ....
....	......	....	......	1.1	.06	9.8	.57	3.4	.20	......	....	$Al_2\,O_3$ ....
30.8	1.79	10.4	.61	12.9	.75	22.7	1.32	10.1	.59	9.1	.53	$Si\,O_2$ ....
316.7	18.37	337.8	19.72	390.5	22.77	383.4	22.36	321.3	18.74	318.5	18.46	
A. L. M.		J. M. L.		P. B.		J. M. L.		J. M. L.		A. L. M.		

Analyses of Illinois

Town	Rock Island	Rock Island	Rock Island	Rock Island
County	Rock Island	Rock Island	Rock Island	Rock Island
Laboratory number	10325	7682	10299	10326
Date	Mar 17,1902	June 7,1900	Mar. 28,1902	Mar.17,1902
Owner	M.J. Hamers	G. G. Craig	R. Bancroft	M.J. Hammers
Depth	Mississippi	Spring	Spring	Mississippi
Strata	River			River
Remarks	Water from drum of 250 h. p. boiler	Black Hawk	Black Hawk	
Turbidity	Decided	Slight	Clear	Decided
Color	Brownish	.01	.000	Muddy
Odor	Disagreeable	.000	.000	Steam
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	1372.4	642.	524.	80.8
Loss on ignition	263.6	76.4	56.8	16.
Chlorine	55.	30.6	18.	.4
Oxygen consumed	185.4	2.2	3.2	11.5
Nitrogen as: Free ammonia	.096	.008	.02	.592
Nitrogen as: Alb. ammonia	2.88	.052	.048	.176
Nitrogen as: Nitrites	.03	.000	.000	.004
Nitrogen as: Nitrates	13.97	14.8	3.4	.236
Potassium K		9.3	5.0	
Sodium Na	361.1	35.2	15.4	4.3
Ammonium (NH_4)	.1			
Magnesium Mg	2.1	49.3	40.1	1.9
Calcium Ca	84.3	173.3	112.8	4.3
Ferrous Fe			.5	
Aluminium Al			.9	9.
Silica Si	2.6	11.8	7.0	2.1
Nitrate NO_3	61.9	65.5	15.1	1.0
Chloride Cl	55.0	30.6	18.0	0.4
Sulphate SO_4	268.3	244.3	132.7	9.1

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate			24.1	1.40	12.9	.74		
Potassium Chloride								
Sodium Nitrate	84.8	4.95	69.6	4.05	9.8	.57	1.4	.08
Sodium Chloride	90.8	5.30	41.5	2.42			.7	.04
Sodium Sulphate	396.9	23.15			39.6	2.30	11.5	.67
Sodium Carbonate	245.9	14.34						
Ammonium Sulphate							2.0	.12
Ammonium Carbonate	.3	.02					.8	.05
Madnesium Chloride			7.2	.42				
Magnesium Sulphate			225.8	13.17	132.5	7.73		
Magnesium Carbonate	7.1	.41			46.6	2.71	6.5	.38
Calcium Sulphate			95.9	5.59				
Calcium Carbonate	210.7	12.29	362.3	21.13	281.9	16.43	10.7	.62
Oxide of Iron and Aluminium	3.6	.21	0.6	.03			3.0	.17
Ferrous Carbonate					1.2	.07		
Alumina					1.8	.10		
Silica	37.2	2.17	25.0	1.46	14.8	.87	4.5	.26
Suspended Matter	92.9	5.42					41.0	2.39
Total	1170.2	68.26	852.0	49.67	541.1	31.52	82.10	4.78
Analyst	A. D. E.		R. W. S.		A. D. E.		A. D. E.	

Waters—Continued.

Rock Island.	Romeoville.	Rosemond	Roseville....	Roseville..	Rushville..
Rock Island.	Will.........	Christian..	Warren......	Warren....	Schuyler..
7535..........	9317..........	4441........	12793.........	12094.......	10421.......
May 14, 1900..	Aug. 23, 1901.	Nov. 23, 1908	Dec. 20, 1904..	May 30, 1904	May 26, 1902
G.G. Craig..	J. J. Keig..	C.S. Bailey	E. G. Willard	J.C. Lewis	H.F. Dyson
2292 feet......	167 feet......	Spring.....	1260 feet......	1260 feet....	1512 feet....
Potsdam.....	Rock........	....	Rock........	Sandstone.	Sandstone.
Flowing.....	Village well.	City sup'ly	....	City sup'ly	....
Very slight..	Slight........	Distinct...	None........	Slight......	Distinct....
.01	.2......	.05	.000	1.	Muddy....
.000	.000	.000	.000	.000	Gassy......
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
1635.6	985.6	302.8	2810.	1233.2	4284.8
14.4	44.4	38.	....	....	102.8
660.	44.	2.	245.	218.	1485.
3.7	7.4	1.3	2.0	Not det'ed	9.6
1.32	.464	.072	1.360	....	1.88
.014	.152	.044	.040	....	.04
.075	.000	.000	.130	.016	.000
.24	.08	.25	.070	.040	.08
17.6	1.3	2.8	19.1	....	....
443.5	37.3	16.0	496.6	480.3	1192.2
1.7	.6	....	1.7	....	2.4
35.9	81.5	28.1	93.	85.6	76.5
102.8	172.5	71.0	225.5	213.6	175.6
1.4	.8	1.0	2.3	....	....
.5	.6	1.6	13.8	....	....
3.6	4.	20.1	5.8	4.5	3.9
1.0	.3	1.1	....	....	....
660.0	44.0	2.0	245.0	218.5	1485.0
420.4	343.9	7.5	1486.0	1338.0	1026.3

Combinations.

Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	Parts per million...	Grains per U.S. gal..	
1.7	.10	.6	.03	1.9	.11	......	......	......	......	......	......	KNO_3........
32.3	1.87	2.1	.12	4.0	.23	35.0	2.04	......	......	......	......	KCl..........
......	......	......	......	......	......	......	......	......	......	......	......	$NaNO_3$........
1062.3	61.96	54.3	3.17	......	......	376.7	21.97	360.5	21.03	2450.2	142.89	$NaCl$..........
80.1	4.66	42.1	2.46	11.2	.63	1074.7	62.69	1043.1	60.84	704.2	41.06	Na_2SO_4........
......	......	......	......	28.5	1.66	......	......	......	......	......	......	Na_2CO_3........
6.2	.36	2.2	.13	......	......	6.2	.36	......	......	8.8	.51	$(NH_2)_2SO_4$....
......	......	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$....
......	......	......	......	......	......	......	......	......	......	......	......	$MgCl_2$..........
178.5	10.40	405.0	23.62	......	......	462.3	26.97	425.4	24.81	380.4	22.19	$MgSO_4$......
......	......	......	......	97.8	5.70	......	......	......	......	......	......	$MgCO_3$........
310.4	18.10	100.5	5.86	......	......	545.7	31.83	415.1	24.22	339.7	19.81	$CaSO_4$..........
28.6	1.66	357.2	20.83	177.3	10.33	160.8	9.38	228.4	13.32	189.	11.02	$CaCO_3$..........
......	......	......	......	......	......	......	......	6.4	.37	3.4	.2	$Fe_2O_3 + Al_2O_3$
2.9	.17	1.6	.09	2.1	.12	4.7	.27	......	......	......	......	$FeCO_3$........
1.0	.06	1.2	.07	3.0	.02	26.0	1.52	......	......	......	......	Al_2O_3..........
7.6	.44	8.6	.50	43.9	2.55	12.4	.72	9.6	.56	8.4	.49	SiO_2............
......	......	......	......	......	......	......	......	......	......	37.6	2.29	....
1711.6	99.78	975.4	56.88	369.7	21.35	2704.5	157.75	2488.5	145.15	4121.7	240.45	
R. W. S.		A. D. E.		R. W. S.		J. M. L.		J. M. L.		A. D. E.		

Analyses of Illinois

Town	Russell	Russell	Salem	Shawneetown.
County	Lake	Lake	Marion	Gallatin
Laboratory number	10217	10996	9043	3485
Date	Feb 12, 1902	Apr. 13, 1903	Mar. 19, 1901	Apr. 21, 1898
Owner	G. Holland	Murrie Bros.	E. M. Coffman	Dr. Egan
Depth	30 feet	165 feet	Spring	Spring
Strata	......	Rock	Sand	Sand
Capacity	......	60 bbls. per day	......	......
Remarks	......	......	......	......
Turbidity	Distinct	Slight	Decided	Distinct
Color	.6	2.	Yellow	.03
Odor	.000	.000	.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	816.4	312.	268.	273.6
Loss on ignition	94.8	10.	16.	26.4
Chlorine	38.	12.	1.8	1.8
Oxygen consumed	4.8	4.3	7.9	3.5
Nitrogen as. Free ammonia	.608	.288	.336	.022
Nitrogen as. Alb. ammonia	.118	.062	.56	.102
Nitrogen as. Nitrites	.005	.000	.004	.001
Nitrogen as. Nitrates	.315	.08	.116	.185
Potassium K	27.1	2.7	1.0	2.4
Sodium Na	45.0	79.9	7.3	5.6
Ammonium (NH_4)	......	.4	.43	......
Magnesium Mg	64.3	23.6	8.2	25.7
Calcium Ca	116.1	34.2	17.0	56.9
Ferrous Fe	1.9	3.0	.9	1.3
Aluminium Al	......	5.7	1.3	.5
Silica Si	9.1	5.5	6.8	18.
Nitrate NO_3	1.4	.3	.5	.8
Chloride Cl	38.0	12.0	1.8	1.8
Sulphate SO_4	247.2	64.9	15.6	6.7

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	2.2	.13	.6	.04	.8	.04	1.3	.08
Potassium Chloride	50.1	2.93	4.6	.27	1.2	.07	3.3	.19
Potassium Sulphate	......	......	......	......	......	......	......	......
Sodium Nitrate	......	......	......	......	......	......	......	......
Sodium Chloride	23.6	1.38	16.2	.94	2.3	.14	.4	.02
Sodium Sulphate	110.1	6.42	96.0	5.60	20.6	1.20	9.9	.58
Sodium Carbonate	......	......	97.6	5.70	......	......	6.8	.39
Ammonium Sulphate	......	......	......	......	......	......	......	......
Ammonium Carbonate	......	......	1.1	.06	1.1	06.	......	......
Magnesium Sulphate	215.9	12.59	......	......	......	......	......	......
Magnesium Carbonate	122.0	7.12	82.1	4.79	28.5	1.65	89.5	5.22
Calcium Sulphate	......	......	......	......	......	......	......	......
Calcium Carbonate	289.4	16.88	85.4	4.98	42.5	2.46	141.1	8.31
Oxide of Iron and Aluminium	......	......	......	......	......	......	......	......
Ferrous Sulphate	......	......	......	......	......	......	......	......
Ferrous Carbonate	3.9	.23	6.3	.37	1.9	.11	2.8	.16
Alumina	......	......	10.7	.62	1.3	.07	9.9	.58
Aluminium Sulphate	......	......	......	......	2.0	.11	......	......
Silica	19.4	1.13	11.6	.68	14.4	.82	38.4	2.24
Sulphuric Acid	......	......	......	......	......	......	......	......
Suspended matter	......	......	......	......	150.8	8.74	......	......
Total	836.6	48.81	412.2	24.05	267.4	15.47	303.4	17.77
Analyst	A. D. E.		P. B.		A. R. J.		R. W. S.	

Waters—Continued.

Shawneeto'n	Shelbyville..	Sheldon ...	Sidell........	S. Bart'nv'e	S. Elgin ...
Gallatin	Shelby	Iroquois ...	Vermilion. .	Peoria	Kane ......
12212	5144	4922	4011	8954	7525 ....
June 30, 1904	June 1, 1899..	Apr. 24. 1899	Aug. 28, 1898.	Jan. 17, 1901	June 6, 1900
A. McBane..	S. Water Co.	J.D.W'k'ns	W.B. Cra'ble	Acme Co..	F. Wills..
148 feet	25 feet	1,800 feet ..	Spring.......	Creek......	115 feet ....
Rock	Gravel	Rock	Clay	....	Rock ......
....	....	....	....	....	....
....	City supply.	City sup...	....	....	Flowing...
Decided	Decided	Distinct....	Decided	V. decided.	Slight......
Muddy	Yellow	.03	Red..........	Muddy	.01
.000	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
541.2	574.	788.	7690.8	488.8	312.
....	50.4	26.	366.	20.4	8.8
2.6	14 2	320.	47.	3.4	6.
1.45	1.5	2.3	4.2	17.3	.7
.200	.24	.4	2.32	.24	.4
.020	.034	.034	.224	.624	.036
.000	.000	.000	.000	.034	.001
.120	.04	.1	.05	1.726	.12
3.8	2.7	8.3	12.5	....	7.9
20.2	19.9	283.6	206.5	14.6	74.7
....	.3	.5	3.0	.3	.5
50.9	46.5	7.4	266.9	14.2	17.3
113.9	114.6	14.2	474.1	53.1	28.1
....	5.6	.7	996.6	....	.4
....	1.1	.5	110.3	....	.4
13.4	5.3	3.5	32.2	82.8	4.6
.6	.1	.5	.2	7.7	.6
2.6	14.2	320.0	47.0	3.4	6.0
8.6	164.4	17.5	5056.8	57.9	6.1

Combinations.

Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per. U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	Parts per million ..	Grains per U. S. gal.	
.9	.05	.2	.01	.7	.04	.4	.02	......	......	.9	.05	KNO_3 ....
5.5	.32	4.9	.28	15.4	.89	23.6	1.37	......	......	12.6	.73	KCl ....
1.5	.08	....	......	......	......	....	......	......	......	2.2	.13	K_2SO_4 ....
....	......	....	......	......	......	....	......	10.5	.61	......	......	$NaNO_3$ ....
....	......	19.6	1.13	515.3	30.05	59.0	3.44	5.6	.32	......	......	NaCl.............
11.5	.68	37.5	2.19	25.9	1.51	565.6	32.98	29.5	1.71	7.3	.42	Na_2SO_4 ....
38.0	2.20	....	......	166.9	9.73	....	......	......	......	166.5	9.71	Na_2CO_3 ....
....	......	1.1	.06	......	......	11.0	.64	1.1	.06	......	......	$(NH_4)_2SO_4$.....
....	......	....	......	1.3	.07	....	......	......	......	1.3	.07	$(NH_4)_2CO_3$ ....
....	......	172.9	10.09	......	......	1326.6	77.38	24.0	1.39	......	......	$MgSO_4$ ....
177.2	10.33	40.7	2.37	25.8	1.50	....	......	32.8	1.90	60.3	3.52	$MgCO_3$ ....
....	......	....	......	......	......	1610.6	93.94	......	......	......	......	$CaSO_4$ ....
284.5	16.59	286.4	16.70	35.5	2.07	....	......	132.7	7.70	70.2	4.09	$CaCO_3$..........
4.4	.26	....	......	......	......	....	......	64.7	3.75	......	......	$Fe_2O_3+Al_2O_3$..
....	......	....	......	......	......	2704.8	157.78	......	......	......	......	$FeSO_4$..........
....	......	11.6	.67	1.5	.08	....	......	......	......	.8	.05	$FeCO_3$..........
....	......	2.0	.11	.9	.05	....	......	......	......	.8	.05	Al_2O_3..........
....	......	....	......	......	......	694.5	40.51	......	......	......	......	$Al_2(SO_4)_3$.......
28.6	1.67	11.3	.66	7.4	.43	68.4	3.99	176.0	10.21	9.8	.57	SiO_2............
....	......	....	......	......	......	148.	8.21	......	......	......	......	SO_3 ....
....	......	....	......	......	......	....	......	......	......	......	......	
552.1	32.18	588.2	34.27	796.6	46.42	7212.5	420.26	476.9	27.65	332.7	19.39	
J. M. L.		R. W. S.		R. W. S.		R. W. S.		A. L. M.		R. W. S.		

Analyses of Illinois

Town	South Elgin	South Elgin	Sparta	Springfield
County	Kane	Kane	Randolph	Sangamon
Laboratory number	10735	12448	2737	9609
Date	Nov. 1, 1902	Sept. 14, 1904	Sept. 30, 1897	Nov. 13, 1901
Owner	T. A. Fraser	Daily Smith	H. Guthrie	A. Hay
Depth	160 feet	237 feet	500 feet	Spring
Strata	Limestone	Limestone	Rock	Clay and coal
Remarks	......	......	......	......
Turbidity	Very slight	Clear	Decided	......
Color	.000	.000	Muddy	......
Odor	.000	.000	.000	......

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	344.8	548.0	447.6	1334.8
Loss on ignition	16.4	......	32.	98.4
Chlorine	2.	8.5	4.4	11.
Oxygen consumed	1.8	1.1	9.7	2.
Nitrogen as Free ammonia	.28	.20	.004	.28
Nitrogen as Alb. ammonia	.062	.022	.4	.064
Nitrogen as Nitrites	.000	.004	.015	.001
Nitrogen as Nitrates	.16	.240	.3	.16
Potassium K	10.3	2.2	7.5	5.9
Sodium Na	137.1	231.8	829.1	30.1
Ammonium (NH_4)	.6	......	1.0	.4
Magnesium Mg	7.2	1.0	3.1	92.6
Calcium Ca	14.8	2.4	2.7	255.4
Ferrous Fe	1.3	.2	1.0	5.4
Aluminium Al	.7	.8	.8	.8
Silica Si	4.5	3.	3.9	5.5
Nitrate NO_3	.7	1.0	1.7	.5
Chloride Cl	2.0	8.5	4.4	11.0
Sulphate SO_4	5.9	15.9	......	434.6

Hypothetical

	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.	Parts per million.	Grains per U.S. gal.
Potassium Nitrate	1.1	.06	1.7	.10	2.3	.13	.7	.04
Potassium Chloride	12.6	.74	3.0	.17	13.0	.75	10.8	.63
Potassium Sulphate	8.7	.51	......	......	......	......	......	......
Sodium Nitrate	......	......	......	......	......	......	......	......
Sodium Chloride	......	......	11.7	.68	789.1	46.02	9.9	.56
Sodium Sulphate	.4	.02	23.6	1.38	......	......	79.7	4.66
Sodium Carbonate	115.9	12.59	505.6	29.49	1194.0	69.64	......	......
Ammonium Chloride	......	......	......	......	......	......	......	......
Ammonium Sulphate	......	......	......	......	......	......	1.5	.08
Ammonium Carbonate	1.6	.09	......	......	2.7	.16	......	......
Magnesium Chloride	......	......	......	......	......	......	......	......
Magnesium Sulphate	......	......	......	......	......	......	460.5	26.86
Magnesium Carbonate	25.	1.46	3.6	.21	10.7	.62	......	......
Calcium Sulphate	......	......	......	......	......	......	19.4	1.12
Calcium Carbonate	37.	2.16	5.9	.34	6.8	.40	624.0	36.40
Oxide of Iron and Aluminium	......	......	......	......	......	......	......	......
Ferrous Sulphate	......	......	......	......	......	......	......	......
Ferrous Carbonate	2.7	.16	.5	.03	2.0	.11	11.3	.66
Alumina	1.3	.08	1.6	.09	1.5	.09	1.5	.09
Aluminium Sulphate	......	......	......	......	......	......	......	......
Silica	9.5	.55	6.4	.37	8.20	.05	11.8	.69
Sulphuric Acid	......	......	......	......	......	......	......	......
Total	315.8	18.42	563.6	32.86	2030.3	117.97	1231.1	71.79
Analyst	P. B.		J. M. L.		R. W. S.		A. D. E.	

Waters—Continued.

Springfield..	Springfield..	Spring Val.	Staunton	St. Charles.	St. Charles.
Sangamon ..	Sangamon ..	Bureau	Macoupin ...	Kane	Kane ......
10638	13529	451	10835	10404	10405 ....
Sept. 28, 1902.	Sept. 11, 1905.	Jan. 31, 1896	Jan. 2, 1903 ..	May 21, 1902	May 21, 1902
G.S. Conn'ly	M. D. Schaff.	M. Cov'ny.	H. A. Fisher.	W.J. Calhn	W.J. Calhn
Spring	28 feet	Artesian ...	....	210 feet	150 feet ....
....	....	....	Rock	Rock	Rock ......
....	....	Flowing...	City supply .	....	....
Very slight..	....	....	Decided	Distinct ...	Very slight
.000	....	....	Blackish.....	.05	.000
.000	....	....	Vinegar	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
1910.4	425.	....	600.4	376.	432.
260.	....	....	65.6	62.	34.4
140.	....	....	6.1	.8	3.2
5.5	....	....	37.3	3.	1.2
1.6	....	....	.56	.48	.376
.12	....	....	.032	.056	.04
.035	....	....	.003	.02	.003
.125	....	....	.56	.38	.397
7.1	....	18.4	....	4.1	12.9
57.7	19.2	882.1	40.0	22.2	64.6
2.1	....	....	.7	.6	.48
115.2	31.7	18.2	30.8	42.4	26.7
428.9	84.3	58.0	54.7	67.2	56.6
1.4	....	7.2	5.2	1.1	.9
2.6	....	....	6.0	1.3	.9
5.6	5.2	4.7	2.7	6.7	3.1
.5	....	....	2.5	1.7	1.7
140.0	17.0	1276.9	6.1	.8	3.2
695.5	150.8	48.0	401.8	4.8	81.7

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
.9	.05	......	......	......	......	......	......	2.8	.16	2.8	.16	KNO_3 ....
13.	.76	......	......	36.2	2.11	......	......	1.5	.09	6.7	.39	$K Cl$ ....
......	......	......	......	......	......	......	......	5.4	.32	19.8	1.16	$K_2 SO_4$ ....
......	......	......	......	......	......	3.5	.20	......	......	......	......	$Na NO_3$..........
146.8	8.57	28.1	1.64	2076.	121.09	10.1	.59	......	......	......	......	$Na Cl$ ....
......	......	25.2	1 47	70.9	4.13	107.9	6.29	2.7	.16	104.7	6.10	$Na_2 SO_4$ ....
......	......	......	......	98.	5.72	......	......	49.1	2.87	70.6	4.12	$Na_2 CO_3$..........
6.2	.36	......	......	......	......	......	......	......	......	......	......	$NH_4 Cl$ ....
......	......	......	......	......	......	2.6	.15	......	......	......	......	$(NH_4)_2 SO_4$ ....
......	......	......	......	......	......	......	......	1.6	.09	1.3	.08	$(NH_4)_2 CO_3$....
54.8	3.20	......	......	......	......	......	......	......	......	......	......	$Mg Cl_2$..........
503.1	29.35	157.8	9.21	......	......	153.3	8.94	......	......	......	......	$Mg SO_4$..........
......	......	......	......	63.5	3.70	......	......	147.4	8.60	92.8	5.42	$Mg CO_3$ ....
415.1	24.23	10.7	.62	......	......	185.8	10.84	......	......	......	......	$Ca SO_4$..........
766.4	44.70	201.7	11.77	145.	8.43	......	......	167.9	9.79	141.5	8.26	$Ca CO_3$ ....
......	......	2.8	.16	......	......	......	......	......	......	......	......	$Fe_2O_3 + Al_2O_3$.
......	......	......	......	......	......	14.1	.83	......	......	......	......	$Fe SO_4$ ....
2.9	.17	......	......	15.	.87	......	......	2.3	.13	1.9	.11	$Fe CO_3$ ....
5.	.29	......	......	......	......	......	......	2.4	.14	1.8	.11	$Al_2 O_3$ ....
......	......	......	......	......	......	38.9	2.27	......	......	......	......	$Al_2(SO_4)_3$ ......
12.0	.70	11.0	.64	10.	.58	5.7	.33	14.2	.83	6.6	.39	$Si O_2$..........
......	......	......	......	......	......	32.	1.87	......	......	......	......	$H_2 SO_4$ ....
1926.2	112.38	437.3	25.51	2514.6	146.63	553.9	32.31	397.3	23.18	450.5	26.30	
A. D. E.		J. M. L.		A. W. P.		P. B.		A. D. E.		A. D. E.		

Analyses of Illinois

Town	St. Charles	Sterling	Sterling	Sterling
County	Kane	Whiteside	Whiteside	Whiteside
Laboratory number	10406	3744	3745	13251
Date	May 12, 1902	June 24, 1898	June 24, 1898	June 24, 1905
Owner	W. J. Calhoun	B. Stakemiller	B. Stakemiller	J. Harpham
Depth	230 feet	Spring	Spring	Spring
Strata	Rock			
Remarks				
Turbidity	Clear	Very slight	Very slight	Clear
Color	.000	.02	.02	.000
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	460.	350.4	643.6	402.0
Loss on ignition	52.4	52.	82.8	
Chlorine	13.	8.	23	9.
Oxygen consumed	1.4	.7	3.2	1.35
Nitrogen as Free ammonia	.384	.001	.016	.040
Nitrogen as Alb. ammonia	.022	.01	.096	.058
Nitrogen as Nitrites	.014	.001	.001	.000
Nitrogen as Nitrates	3.906	1.75	.15	5.200
Potassium K	13.4	2.1	2.5	4.0
Sodium Na	33.5	7.6	19.9	6.8
Ammonium (NH_4)	.49			
Magnesium Mg	35.4	39.3	68.9	48.1
Calcium Ca	71.9	73.3	105.4	42.3
Ferrous Fe	.2	.5	.3	.3
Aluminium Al	.2	.6	.7	2.5
Silica Si	3.4	6.6	11.5	1.3
Nitrate NO_3	17.3	7.7	.7	23.1
Chloride Cl	13.0	8.0	23.0	9.0
Sulphate SO_4	80.7	21.2	108.7	24.0

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	28.3	1.65	5.4	.31	1.1	.06	10.3	.60
Potassium Chloride	4.9	.29			3.9	.22		
Potassium Sulphate								
Sodium Nitrate			6.0	.35			23.0	1.34
Sodium Chloride	18.6	1.09	13.2	.76	34.8	2.03	1.5	.09
Sodium Sulphate	86.6	5.06	2.5	.14	19.2	1.11		
Sodium Carbonate								
Ammonium Sulphate	1.8	.11						
Ammonium Carbonate								
Magnesium Chloride							10.9	.63
Magnesium Sulphate	26.1	1.53	24.4	1.42	119.5	6.96	30.0	1.75
Magnesium Carbonate	105.	6.12	119.9	6.98	154.1	8.98	136.5	7.95
Calcium Sulphate								
Calcium Carbonate	179.7	10.49	183.2	10.68	263.2	15.34	108.0	6.30
Ferrous Carbonate	.5	.03	1.1	.06	.6	.03	.6	.03
Alumina	.4	.02	1.2	.07	1.4	.08	4.8	.28
Silica	7.3	.43	14.0	.80	24.6	1.43	2.7	.16
Total	459.2	26.82	370.9	21.57	622.4	36.24	328.3	19.13
Analyst	A. D. E.		R. W. S.		R. W. S.		J. M. L.	

Waters—Continued.

Sterling......	Sterling......	Stockton ..	Stonefort	Stonefort...	Strawn .....
Whiteside...	Whiteside....	JoDaviess..	Saline.......	Saline......	Livingston
4212..........	6300..........	4242.........	8647..........	9524 feet....	12296........
Oct. 12, 1898..	Nov. 13, 1899..	Oct 21, 1898.	Oct. 8, 1900...	Oct. 18, 1901.	July 30, 1904
J.B.Crandall.	J.B.Crandall.	J.M.Sharp.	Ira Schnee...	A. J. Kelly	Pete Kuntz
1460 feet......	1606 feet......	1500 feet....	72½ feet......	101 feet.....	120 feet.....
St. Peter.....	St. Peter.....	Sandstone..	Rock.........	Rock	Sand & gr..
Flowing.....	Flowing	....	....	....	....
City supply..	City supply..	....	....	....	....
Slight........	Slight........	Distinct....	....	Decided....	Decided....
.01	.02	.04	....	Muddy	.6
.000	.000	.000	....	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
331.2	341.2	328.8	3,449.2	2,026.8	315.2
64.	36.4	38.	364.	121.2	....
10.	9.	.6	51.	38.	.9
.9	.9	2.	17.8	1.5	1.3
.008	.152	.37	.12	.84	.256
.01	.012	.018	.064	.024	.036
.000	.000	.000	.003	.000	.000
.4	.12	.1	.117	.08	.16
5.9	6.7	1.1	13.6	23.9	1.6
5.8	6.2	14.6	169.0	202.3	11.1
....	....	.5	.2	1.1	....
36.3	35.7	32.0	134.7	89.1	31.8
66.9	61.8	105.6	189.3	248.9	65.1
.07	.3	.7	122.2	2.5	1.9
.4	.4	1.4	15.0	1.3	.7
4.1	4.2	6.8	15.8	6.3	6.6
1.7	6	.5	.6	....	.7
10.0	9.0	.6	51.0	38.0	1.0
28.4	25.1	1.1	1,126.5	933.8	1.3

Combinations.

Parts per million.	Grains per U. S. gal.	Parts per Million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	
2.8	.16	.9	.05	.7	.04	.9	.05	......	......	1.1	.06	KNO_3
9.2	.54	11.4	.66	1.2	.07	26.0	1.51	45.6	2.65	2.1	.12	$K Cl$
......	......	......	......	.4	.02	......	......	......	......	.2	.01	K_2SO_4
......	......	......	......	......	......	......	......	......	......	......	......	$Na NO_3$
9.2	.54	5.9	.34	......	......	63.8	3.70	26.9	1.56	......	......	$Na Cl$
6.9	.40	11.9	.69	1.2	.07	442.9	25.69	591.5	34.50	2.3	.13	$Na_2 SO_4$
......	......	......	......	32.6	1.89	......	......	......	......	21.9	1.28	$Na_2 CO_3$
......	......	......	......	......	......	.7	.04	......	......	......	......	$(NH_4)_2 SO_4$
......	......	......	......	1.3	.07	......	......	......	......	......	......	$(NH_4)_2 CO_3$
......	......	......	......	......	......	......	......	......	......	......	......	$Mg Cl_2$
29.7	1.73	21.3	1.23	......	......	662.0	38.62	442.8	25.82	......	......	$Mg SO_4$
105.4	6.14	109.2	6.37	111.3	6.49	......	......	......	......	110.7	6.46	$Mg CO_3$
......	......	......	......	......	......	425.0	34.78	254.5	14.82	......	......	$Ca SO_4$
167.1	9.74	154.2	8.99	191.4	11.16	160.0	9.33	434.9	25.37	162.5	9.47	$Ca CO_3$
.2	.01	.6	.03	1.4	.08	253.0	14.67	5.2	.30	4.0	.23	$Fe CO_3$
.8	.05	.7	.04	2.6	.15	28.4	1.65	2.4	.14	1.4	.08	$Al_2 O_3$
8.7	.51	8.9	.52	14.4	.83	33.6	1.95	13.4	.78	14.0	.82	$Si O_2$
340.0	19.82	325.0	18.92	358.5	20.87	2123.6	123.17	1817.2	105.96	320.2	18.66	
R. W. S.		R. W. S.		R. W. S.		A. R. J.		A. D. E.		J. M. L.		

Analyses of Illinois

Town	Streator	Streator	Streator	Streator
County	LaSalle	LaSalle	LaSalle	LaSalle
Laboratory number	6192	13603	7807	10759
Date	Oct. 30, 1899	Sept. 16, 1905	June 28, 1900	Nov. 21, 1902
Owner	D. S. Conley	D. Heenan	D. S. Conley	Glass & Bot. Co
Depth	Vermilion riv'r	70 feet	563 feet	1115 feet
Strata	....	Sandstone	Rock	Limestone
Remarks	City supply	....	....	....
Turbidity	Distinct	Decided	Decided	Distinct
Color	1.08	Muddy	Turbid	Muddy
Odor	.000	.000	.000	.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	331.6	2250.	1173.2	1949.
Loss on ignition	38.8	....	42.	106.
Chlorine	11.	260.	470.	800.
Oxygen consumed	5.4	15.	8.2	8.1
Nitrogen as Free ammonia	.008	.438	....	1.36
Nitrogen as Alb. ammonia	.304	.120	....	.028
Nitrogen as Nitrites	.000	.000	.001	.000
Nitrogen as Nitrates	.68	.12	.28	.16
Alkalinity K	....	....	....	....
Potassium	3.3	9.1	18.6	....
Sodium Na	19.5	748.0	298.1	413.3
Ammonium (NH_4)	....	....	1.4	1.8
Magnesium Mg	32.7	11.7	32.1	60.2
Calcium Ca	52.8	24.9	68.2	143.3
Ferrous Fe	.8	15.2	.9	....
Aluminium Al	.7	8.8	1.3	....
Silica Si	5.3	69.6	13.6	2.4
Nitrate NO_3	2.9	.6	1.1	.7
Chloride Cl	10.5	260.0	470.0	800.0
Sulphate SO_3	70.0	5.3	53.2	202.0
Lithium Li	....	....	....	....

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	4.7	.27	.9	.05	1.9	.11	....	....
Potassium Chloride	2.8	.16	16.6	.97	34.1	1.98	....	....
Potassium Sulphate	....	....	....	....	....	....	....	....
Sodium Nitrate	....	....	....	....	....	....	.9	.05
Sodium Chloride	15.2	.88	416.0	24.27	747.9	43.63	1095.8	63.92
Sodium Sulphate	41.7	2.43	7.8	.46	12.1	.70	....	....
Sodium Carbonate	....	....	1340.1	78.18	....	....	....	....
Ammonium Chloride	....	....	....	....	....	....	5.3	.31
Ammonium Sulphate	....	....	....	....	5.1	.30	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	177.5	10.36
Magnesium Sulphate	52.3	3.05	....	....	51.9	3.02	75.3	4.40
Magnesium Carbonate	77.2	4.50	40.7	2.37	75.6	4.40	....	....
Calcium Chloride	....	....	....	....	....	....	....	....
Calcium Sulphate	....	....	....	....	....	....	200.9	11.72
Calcium Carbonate	131.9	7.69	62.2	3.63	170.3	9.93	217.4	12.68
Oxide of Iron and Aluminium	....	....	....	....	....	....	2.8	.16
Ferrous Carbonate	1.6	.09	31.6	1.84	1.9	.11	....	....
Alumina	1.3	.07	16.6	.97	2.4	.14	....	....
Silica	11.3	.66	148.8	8.68	29.0	1.69	5.2	.30
Suspended Matter	....	....	88.6	5.17	....	....	27.4	1.60
Lithium Sulphate	....	....	....	....	....	....	....	....
Total	340.0	19.80	2169.9	126.59	1132.2	66.01	1808.5	105.5
Analyst	R. W. S.		J. M. L.		R. W. S.		P. B.	

Waters—Continued.

Streator	Streator	Streator	Stronghurst .	Sumner	Tallula ....
LaSalle	LaSalle	LaSalle	Henderson ..	Lawrence .	Menard ....
10892	10901	13753	4105	11726	12402 ....
Feb. 12, 1903..	Feb. 25, 1903 .	Nov. 18, 1905	Sept. 20, 1898.	Jan. 6, 1904..	Sept. 1, 1904
Gas & Lt. Co.	J. Dougherty	Clay Mf. Co	I. F. Harter ..	H. Fagin ..	W.S.T'ylor
598 feet	800 feet	100 feet	1600 feet	Spring	12 ft. spring
Sandstone ...	Rock	St. Peter ...	St. Peter	....	Gravel .....
....	....	....	....	....	....
Very slight..	Decided	Decided ...	Slight	Decided ...	Distinct....
.000	Muddy	Muddy	.02	Yellow	Yellow ....
.000	Mouldy	....	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
1060.8	894.	891.	1319.2	6560.	532.4
22.8	24.	....	24.	....	....
413.	260.	216.5	290.	79.	2.9
5.3	16.6	....	3 3	4.2	4.
.576	.92	....	1.08	.88	.456
.052	.024	....	.014	.126	.176
.021	.000	.000	.012	.000	.000
.099	.2	....	.25	.000	.040
....	....	828.0	....	....	....
28.2	....	20.1	27.0	6.6	2.1
269.0	189.5	241.2	302.8	354.0	22.1
.7	1.2	1.2	1.4	1.1	.6
26.7	24.1	24.6	34.1	219.0	46.9
72.2	49.9	46.6	81.1	912.1	118.8
1.2	....	1.8	.3	7.2	1.7
2.2	....	3.0	.8	3.0	1.1
3.9	2.8	18.2	1.1	3.9	8.9
.5	.9	.4	.1	....	....
413.	260.0	216.5	290.0	79.0	2.9
103.6	14.6	5.5	525.1	3820.3	4.7
....	....	....	.1	....	....

Combinations.

Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	Parts per million ...	Grains per U. S. gal.	
.7	.04	....	......	.6	.04	1.7	.10	......	......	......	......	KNO_3 ....
53.4	3.11	....	......	38.8	2.27	50.2	2.92	12.7	.74	4.8	.28	K Cl ....
....	......	....	......	......	......	....	......	......	.....	......	......	K_2SO_4 ....
....	......	1.3	.08	......	......	....	......	......	......	......	......	Na NO_3..........
639.5	37.30	429.0	25.03	326.7	19.06	438.5	25.57	120.4	7.02	......	......	Na Cl..........
53.8	3.14	21.7	1.27	8.2	.48	401.9	23.44	945.8	55.23	7.9	.46	Na_2 SO_4 ....
....	......	29.6	1.73	253.4	14.78	....	......	......	......	43.9	2.55	Na_2 CO_3..........
....	......	....	......	......	.....	....	......	......	......	......	......	NH Cl..........
2.6	.15	....	......	......	......	5.1	.30	4.0	.23	......	......	$(NH_4)_2$ SO_4 ....
....	......	3.2	.19	3.2	.19	....	......	......	......	1.8	.10	$(NH_4)_2$ CO_3....
....	......	....	......	......	......	....	......	......	......	......	......	Mg Cl_2 ....
81.8	4.78	....	......	......	......	169.2	9.87	1088.4	63.45	......	......	Mg SO_4 ....
35.5	2.07	84.0	4.90	85.7	5.00	....	......	......	......	163.2	9.52	Mg CO_3 ....
....	......	....	......	......	......	....	......	......	......	......	......	Ca Cl_2 ....
....	......	....	......	......	......	161.2	9.40	2762.5	161.05	......	......	Ca SO_4 ....
180.4	10.52	124.7	7.27	116.4	6.79	83.9	4.90	248.8	14.47	296.8	17.32	Ca CO_3..........
....	......	4.8	.28	......	......	....	......	......	......	......	......	$Fe_2O_3 + Al_2O_3$.
2.6	.15	....	......	3.7	.22	.6	.03	14.5	.86	3.5	.20	Fe_2CO_3 ....
4.2	.25	....	......	5.6	.33	1.6	.09	5.6	.33	2.1	.12	Al_2 O_3 ....
8.4	.49	6.0	.35	38.2	2.23	2.4	.14	8.4	.49	19.0	1.10	Si O_2..........
....	......	26.4	1.54	......	......	....	......	......	......	......	......	....
....	......	....	......	......	......	.7	.04	......	......	......	......	Li_2 SO_4..........
1062.9	62.00	730.7	42.64	880.5	51.39	1317.0	76.80	5211.1	303.87	543.9	31.65	
P. B.		P. B.		J. M. L.		R. W. S.		D. K.		J. M. L.		

Analyses of Illinois

Town	Tamaroa	Tennessee	Tolono	Tolono
County	Perry	McDonough	Champaign	Champaign
Laboratory number	8951	12838	8997	5835
Date	Jan. 15, 1901	Jan. 12, 1905	Feb. 15, 1901	Sept. 12, 1899
Owner	T. H. Evans	Rev. Lentz	G. Karcher	J. Edwards
Depth	24 feet	Spring	Spring	134 feet
Strata	Rock			Gravel
Remarks				
Turbidity	Decided	Decided	Distinct	Distinct
Color	Yellow	Yellow	.01	Yellow
Odor	Sulphur		.000	.000

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	5745.6	715.2	227.2	830.4
Loss on ignition	392.4		16.8	161.6
Chlorine	342.	8.8	1.5	2.9
Oxygen consumed	14.4	2.6	3.1	15.3
Nitrogen as: Free ammonia	.024	.096	.018	32.
Nitrogen as: Alb. ammonia	.2	.086	.07	.456
Nitrogen as: Nitrites	.000	Trace	.000	.000
Nitrogen as: Nitrates	.04	.12	3.28	.52
Potassium K	13.6	1.3	2.7	6.1
Sodium Na	373.8	7.2	5.5	64.6
Ammonium (NH_4)	.08		.02	41.1
Magnesium Mg	202.1	66.1	14.1	96.9
Calcium Ca	702.1	122.9	43.4	117.5
Ferrous Fe	3.1	3.8	.5	5.0
Aluminium Al	2.5	3.9	.1	.9
Silica Si	5.1	6.1	5.5	11.4
Nitrate NO_3	.2	.6	14.5	2.3
Chloride Cl	342.0	8.8	1.5	2.9
Sulphate SO_4	2796.6	197.6	21.3	.5

Hypothetical

	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.
Potassium Nitrate	.3	.02	.9	.05	6.9	.40	3.7	.21
Potassium Chloride	25.8	1.49	1.9	.11			6.1	.35
Potassium Sulphate							.9	.05
Potassium Carbonate							2.0	.11
Sodium Nitrate					16.2	.94		
Sodium Chloride	558.7	32.50	13.4	.78	.4	.02		
Sodium Sulphate	475.4	27.57	6.0	.35				
Sodium Carbonate							148.8	8.68
Ammonium Carbonate	.1	.01			.1	.01	109.3	6.37
Magnesium Nitrate								
Magnesium Chloride								
Magnesium Sulphate	972.	56.38	242.0	14.12				
Magnesium Carbonate	21.	1.22	60.5	3.53	49.1	2.85	337.3	19.67
Calcium Chloride					2.0	.11		
Calcium Sulphate	2386.8	138.43			30.2	1.75		
Calcium Carbonate			307.1	17.91	85.0	4.93	293.4	17.11
Oxide of Iron and Aluminium								
Ferrous Carbonate	6.4	.37	7.9	.46	1.0	.06	10.3	.60
Alumina			7.3	.43	.2	.01	1.8	.10
Aluminium Sulphate	16.0	.93						
Silica	10.8	.62	12.9	.75	11.6	.67	24.2	1.41
Total	4473.3	259.54	659.9	38.49	202.7	11.75	937.8	54.66
Analyst	A. R. J.		J. M. L.		A. R. J.		R. W. S.	

Waters—Continued.

Tolono	Tonica	Tuscola	Tuscola	Urbana	Urbana ....
Champaign .	LaSalle	Douglas ...	Douglas	Champa'n .	Champa'n .
1772	10935	2581	2931	1412	1413 ....
Dec. 28, 1896..	March 10, 1903	Aug. 23, 1897	Nov. 10, 1898.	Sept. 17, 1896	Sept. 28, 1896
N. H. Stubbs	J. C. Daily ..	J. L. Reat .	J. L. Reat. ..	U. of I	Dr. Burrill.
140 feet.......	300 feet	617 feet	3013 feet	22 feet	20 feet ......
Sand	Rock	Sandstone .	Gr'v.&s'dst'e	Drift	Drift ....
City supply .	....	....	....	....	....
....	Slight........	Distinct	Distinct	....	....
....	.3	.05	.6	....	....
....	Disagreeable	.000	Oily	....	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
....	472.8	515.2	954.4	....	....
....	11.2	30.0	32.	....	....
....	18.8	-34.0	76.	....	....
....	7.8	7.1	14.2	....	....
....	.34	2.08	4.2	....	....
....	.164	.142	.32	....	....
....	..000	.000	.000	....	....
....	.16	.40	.3	....	....
5.1	....	6.0	9.1	3.6	.8
125.9	132.2	120.8	337.9	20.1	8.3
9.0	.4	2.67	5.4	....	....
30.1	10.1	24.9	13.2	58.7	22.3
80.9	18.8	47.8	33.7	111.5	70.8
1.1	....	2.2	1.6	.4	.7
1.7	....	1.6	1.1	12.0	10.3
11.7	4.6	10.1	5.0	5.8	7.1
.3	.7	1.7	1.3	97.6	3.8
5.5	18.8	34.0	76.0	19.0	12.0
4.8	1.3	7.4	1.1	176.2	87.7

Combinations.

Parts per million .	Grains per U.S. gal.	Parts per million .	Grains per U.S. gal.	Parts per million .	Grains per U.S. gal.	Parts per million .	Grains per U.S. gal.	Parts per million .	Grains per U.S. gal.	Parts per million .	Grains per U.S. gal.	
.4	.02	....	......	2.9	.17	2.2	.13	9.4	.54	2.1	.12	KNO_3 ....
9.5	.55	....	......	9.3	.54	15.3	.89	......	......	......	......	$K Cl$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$K_2 SO_4$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$K_2 CO_3$ ....
....	......	.9	.05	......	......	....	......	74.7	4.36	3.5	.20	$Na NO_3$ ....
1.7	.09	31.	1.81	48.8	2.48	113.3	6.70	......	......	18.6	1.08	$Na Cl$ ....
7.1	.41	2.	.12	11.0	.64	1.3	.07	......	......	......	......	$Na_2 SO_4$ ....
277.4	16.17	274.5	16.01	225.3	13.14	670.8	39.12	......	......	......	......	$Na_2 CO_3$ ....
24.	1.40	1.1	.06	7.1	.41	14.4	.84	......	......	......	......	$(NH_4)_2 CO_3$....
....	......	....	......	......	......	....	......	44.5	2.6	......	......	$Mg (NO_3)_2$ .....
....	......	....	......	......	......	....	......	28.2	1.64	.9	.05	$Mg Cl_2$ ....
....	......	....	......	......	......	....	......	220.7	12.87	109.7	6.39	$Mg SO_4$ ....
104.9	6.11	35.3	2.06	86.7	5.05	47.8	2.79	2.8	16	......	......	$Mg CO_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Ca Cl_2$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Ca SO_4$ ....
202.0	11.77	47.1	2.75	119.5	6.96	84.0	4.90	278.5	16.24	176.6	10.30	$Ca CO_3$ ....
....	......	6.2	.36	......	......	....	......	......	......	......	......	$Fe_2 O_3+Al_2 O_3$.
2.9	.17	....	......	4.5	.25	2.9	.17	.9	.05	1.5	.09	$Fe CO_3$ ....
3.2	.18	....	......	3.0	.17	1.7	.01	22.8	1.33	19.5	1.13	$Al_2 O_3$ ....
....	......	....	......	......	......	....	......	......	......	......	......	$Al_2 (SO_4)_3$ ......
23.2	1.34	9.8	.57	21.6	1.25	10.5	.61	12.3	.72	15.2	.90	$Si O_2$............
656.3	38.21	407.9	23.79	539.6	31.06	964.2	56.23	694.8	40.51	347.6	20.26	
C. R. R.		P. B.		R. W. S.		R. W. S.		C.R.R. and A. W. P.		C.R.R. and A. W. P.		

Analyses of Illinois

Town	Urbana	Urbana	Urbana	Urbana
County	Champaign	Champaign	Champaign	Champaign
Laboratory No	4217	13735	1416½	2078
Date	Oct. 15, 1898	Nov. 13, 1905	Sept. 30, 1896	Apr. 5, 1897
Owner	Uni. Farm	W. S. Collins	City Water	Water Works
Depth	23 feet	19 feet	180 feet	180 feet
Strata			Drift	Drift
Remarks				City supply
Turbidity	Slight	Decided		Distinct
Color	.02	.3		.6
Odor	.000	Vinegar		.000
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	359.2	1255.		487.2
Loss on ignition	44.			42.4
Chlorine	1.5	54.0		2.2
Oxygen consumed	1.1	3.4		4.4
Nitrogen as — Free ammonia	.001	.110		3.00
Nitrogen as — Alb. ammonia	.012	.064		.072
Nitrogen as — Nitrites	.000	.002		.000
Nitrogen as — Nitrates	.16			.12
Alkalinity		800.		
Potassium K	1.2	11.2	4.3	2.2
Sodium Na	5.2	43.1	27.6	19.6
Ammonium (NH_4)			4.11	3.8
Magnesium Mg	34.5	89.6	35.4	10.1
Calcium Ca	74.7	204.7	76.1	99.7
Ferrious Fe	.6	3.3	2.8	.5
Aluminium Al	1.2	2.0	1.5	4.5
Silica Si	8.1	7.6	8.7	9.4
Nitrates NO_3	.7	.9	.2	.6
Chloride Cl	1.5	54.0	2.5	2.2
Sulphate SO_4	49.5	447.8	1.6	.9
Lithium Li	.008			
Phosphorus PO_4			2.09	

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	1.1	.06	1.5	.09	.3	.02	.9	.05
Potassium Chloride	1.6	.09	20.3	1.19	1.0	.05	3.5	.20
Potassium Sulphate					2.6	.15		
Sodium Nitrate								
Sodium Chloride	1.1	.06	73.3	4.28	3.4	.20	.9	.05
Sodium Sulphate	14.6	.85	44.0	2.57			1.4	.08
Sodium Carbonate					60.5	3.53	43.3	2.53
Ammonium Carbonate					19.7	1.14	10.1	.58
Magnesium Chloride								
Magnesium Sulphate	49.6	2.88	445.5	25.99				
Magnesium Carbonate	85.5	4.99	87.4	5.10	120.7	7.04	35.2	2.05
Calcium Carbonate	186.6	10.88	447.2	26.09	189.1	11.03	248.0	14.47
Oxide of Iron and Aluminium								
Ferrous Carbonate	1.3	.07	6.9	.40	5.8	.33	1.0	.06
Alumina	2.2	.13	3.8	.22	3.0	.17	8.4	.49
Silica	17.3	1.01	16.2	.94	18.5	1.08	20.0	1.17
Potassium Phosphate					4.8	.28		
Lithia	Trace..	Trace..						
Total	360.9	21.02	1146.1	66.87	429.4	25.02	372.7	21.73
Analyst	R. W. S.		J. M. L.		A. W. P.		C. R. R.	

Waters—Continued.

Urbana	Urbana	Vandalia ..	Vandalia	Vandalia ..	Vandalia ..
Champaign .	Champaign..	Fayette....	Fayette......	Fayette....	Fayette....
3304	7502	13016	13017	13018	13019 ....
Feb. 28, 1898..	May 10, 1900..	Mar. 24, 1905	Mar. 24, 1905..	Mar. 24, 1905	Mar. 24, 1905
C. V. Millar.	A. N. Talbot	C. Hi'nb'm	Same..........	Same	Same ......
160 feet.......	155 feet.......	Spring No. 1	Spring No. 2.	Spring No. 3	Spring No. 4
Drift	....	....	....	....	....
City supply .	....	....	....	....	....
Distinct	Distinct	Clear	Clear	Clear	Decided ...
.8	.50	.000	.000	.000	.8
.000	.000	.000	Musty	Musty	Earthy.....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000c.c.	Milligrams per 1,000c.c.
396.4	352.	725.2	1212.4	1061.2	154.0
33.6	26.8	....	....	....	....
2.	2.6	67.3	61.5	76.	13.0
5.5	4.7	2.45	2.05	2.2	6.75
4.	1.6	.008	.016	.008	.016
.112	.074	.040	.066	.064	.348
.000	.000	Trace	Trace	.006	.000
.048	.08	20.00	10.4	19.6	.08
....	....	....	....	....	....
3.2	....	2.7	2.6	3.2	1.3
27.6	37.0	50.4	84.0	99.5	14.3
5.1	2.0	....	....	....	....
35.6	31.1	41.1	97.9	75.4	10.1
78.2	65.3	138.0	175.8	142.5	26.4
3.4	1.7	.5	....	....	1.2
1.2	.6	2.1	....	....	1.2
8.3	8.7	9.1	12.	9.	3.7
.2	....	88.5	46.	86.8	.3
2.0	2.6	67.3	61.5	76.0	13.0
.8	.2	7.3	416.4	243.9	5.3
....	....	....	....	....	....
....	....	....	....	....	....

Combinations.

Parts per million..	Grains per U.S. gal..	Parts per million..	Grains per U.S. gal..	Parts per million..	Grains per U.S. gal..	Parts per million..	Grains per U.S. gal..	Parts per million..	Grains per U.S. gal..	Parts per million..	Grains per U.S. gal..	
.4	.02	....	......	6.9	.40	6.4	.37	8.4	.49	.6	.04	KNO_3 ....
4.2	.24	....	......	......	......	....	......	......	......	2.1	.12	K Cl ....
1.5	.09	....	......	......	......	....	......	......	......	......	......	K_2SO_4 ....
....	......	....	......	115.5	6.74	57.8	3.37	111.9	6.53	......	......	Na NO_3 ....
....	......	4.3	.25	46.0	2.68	102.2	5.96	125.4	7.32	19.8	1.15	Na Cl ....
....	......	....	......	......	......	86.8	5.06	61.4	3.58	7.7	.45	Na_2SO_4 ....
64.3	3.75	74.7	4.36	......	......	....	......	......	......	9.1	.53	Na_2CO_3 ....
13.6	.79	5.3	.31	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$ ....
....	......	....	......	52.4	3.06	....	......	......	......	......	......	Mg Cl_2 ....
....	......	....	......	91.4	5.33	447.5	26.09	253.2	14.77	......	......	Mg SO_4 ....
124.1	7.24	108.1	6.30	32.6	1.90	27.5	1.60	85.2	4.97	35.1	2.05	Mg CO_3 ....
195.0	11.38	163.2	9.52	344.7	20.11	439.4	25.63	356.5	20.80	66.1	3.86	Ca CO_3 ....
....	......	....	......	......	......	4.2	.25	5.2	.30	......	......	$Fe_2O_3 + Al_2O_3$
7.1	.41	3.5	.20	1.0	.06	....	......	......	......	2.4	.14	Fe CO_3 ....
2.1	.12	1.2	.07	3.9	.23	....	......	......	......	2.2	.13	Al_2O_3 ....
17.4	1.01	18.6	1.08	19.3	1.13	75.6	1.49	19.2	1.12	7.8	.46	Si O_2 ....
....	......	....	......	......	......	....	......	......	......	......	......	K_3PO_4 ....
....	......	....	......	......	......	....	......	......	......	......	......	Li ....
429.7	25.05	378.9	22.09	713.7	42.24	1247.4	69.82	1026.4	59.88	152.9	8.93	
R. W. S.		R. W. S.		J. M. L.		J. M. L.		J. M. L.		J. M. L.		

Analyses of Illinois

Town	Vandalia	Vandalia	Vermont	Villa Ridge
County	Fayette	Fayette	Fulton	Pulaski
Laboratory number	13020	13021	8637	9144
Date	March 24, 1905	March 24, 1905	Oct. 6, 1900	June 23, 1901
Owner	D. Higinbot'm	D. Higinbot'm	J. M. Wilkins.	L. Redden
Depth	Spring No. 5,	Spring No. 6	2300 feet	45 feet
Strata			Rock	Gravel
Remarks				
Turbidity	Clear	Clear		
Color	.000	.000		
Odor	.000	.000		

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	389.2	1101.2	3490.4	399.2
Loss on ignition			83.2	71.2
Chlorine	17.5	63.	1175.	32.
Oxygen consumed	1.55	2.00	8.	2.1
Nitrogen as Free ammonia	.016	.008	2.	.034
Nitrogen as Alb. ammonia	.044	.076	.018	.038
Nitrogen as Nitrites	Trace	.001	.000	.000
Nitrogen as Nitrates	9.2	14.4	.04	8.
Potassium K	.7	1.7	44.5	1.3
Sodium Na	12.2	75.7	896.2	35.6
Ammonium (NH_4)			2.6	
Magnesium Mg	26.5	85.3	47.7	30.8
Calcium Ca	85.2	134.0	181.5	56.8
Ferrous Fe			3.7	.3
Aluminium Al				1.1
Silica Si	6.3	10.3	6.8	10.4
Nitrate NO_3	40.7	63.7	.2	35.4
Chloride Cl	17.5	63.0	1175.0	32.0
Sulphate SO_4	17.6	303.1	964.2	1.3

Hypothetical

	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.	Parts per million.	Grains per U. S. gal.
Potassium Nitrate	1.7	.10	4.5	.26	.4	.02	3.4	.20
Potassium Chloride					84.9	4.92		
Potassium Sulphate								
Sodium Nitrate	45.0	2.63	83.6	4.88			45.6	2.64
Sodium Chloride			104.0	6.06	1869.6	109.06	52.7	3.06
Sodium Sulphate			37.3	2.18	495.6	28.74	2.0	.12
Sodium Carbonate							4.3	.25
Ammonium Carbonate					6.9	.40		
Magnesium Nitrate	8.2	.48						
Magnesium Chloride	23.5	1.37						
Magnesium Sulphate	22.1	1.29	347.4	20.26				
Magnesium Carbonate	51.5	3.00	53.6	3.13	165.5	9.60	107.1	6.21
Calcium Sulphate					476.0	27.60		
Calcium Carbonate	212.9	12.42	335.4	19.57	103.6	6.00	142.2	8.25
Oxide of Iron and Aluminium	2.3	.13	2.4	.14				
Ferrous Carbonate					7.7	.44	.6	.03
Alumina							2.0	.12
Silica	13.4	.78	22.0	1.28	14.4	.83	22.2	1.29
Total	380.6	22.20	990.2	57.76	3224.6	187.61	382.1	22.17
Analyst	J. M. L.		J. M. L.		A. R. J.		A. L. M.	

Waters—Continued.

Waltham	Warren	War'nville.	Waukegan ..	Waverly ..	Wenona ...
LaSalle	Jo Daviess ..	Dupage....	Lake	Morgan ...	Marshall...
6433	5008	2710	5193	9910	8980 ....
Nov. 30, 1899.	May 9, 1899 ..	Sept. 24, 1897	June 9, 1899..	Nov. 26, 1901	Aug. 1, 1900
J. A. Hanley	B. W. Hicks.	W. J. Man'g	E. L. Upton	H. J. Rog'rs	I. C. R. R..
65 feet	100 feet	212 feet	Spring, 4 feet	54 feet	1856 feet ...
Sand rock ...	Rock	Rock	Gravel	....	Rock ......
....	....	Flowing...	....	....	....
Distinct......	Slight........	Very slight	.000	Very slight	....
Yellow	.03	.02	.02	.01	....
.000	.000	.000	.000	.000	....
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c.c.	Milligrams per 1,000 c.c.
421.6	534.	418.8	636.	787.2	....
60.	155.6	10.8	54.	67.2	....
2.	36.	1.8	38.	54.	555.
.7	1.5	1.3	1.7	1.8	....
.32	.001	.488	.001	.48	....
.128	.046	.014	.036	.016	....
.000	.015	.000	.021	.005	....
.08	20.	.13	7.2	.155	.28
1.9	4.0	10.9	5.4	....	....
17.3	16.3	34.7	22.5	290.2	457.3
....	....	....	....	.6	....
40.1	67.7	34.9	57.6	9.8	38.5
72.7	46.2	70.8	104.6	18.1	59.5
4.4	.9	....	.3	....	....
.7	.6	....	.2	....	....
14.5	6.1	3.1	7.4	4.6	2.6
.3	88.5	.6	31.9	.7	1.3
2.0	36.0	1.8	38.0	54.0	555.0
33.6	23.5	102.8	148.5	3.6	182.8

Combinations.

Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	Parts per million	Grains per U.S. gal.	
.6	.03	10.3	.60	.9	.05	13.9	.81	......	......	......	......	KNO_3 ....
3.2	.19	......	......	3.8	.22	......	......	......	......	......	......	KCl ....
......	......	......	......	19.3	1.11	......	......	......	......	......	......	K_2SO_4 ....
......	......	60.3	2.52	......	......	32.1	1.87	1.10	.06	1.7	.10	$NaNO_3$ ....
.8	.05	......	......	......	......	35.3	2.05	89.0	5.19	914.6	53.05	$NaCl$ ....
21.7	1.26	......	......	107.0	6.23	......	......	5.3	.31	270.5	15.69	Na_2SO_4 ....
2.2	.13	......	......	......	......	......	......	583.5	34.07	21.5	1.25	Na_2CO_3 ....
1.0	.06	......	......	......	......	......	......	......	......	......	......	$(NH_4)_2CO_3$ ....
......	......	45.6	2.65	......	......	......	......	......	......	......	......	$Mg(NO_3)_2$ .....
......	......	48.2	2.81	......	......	22.2	1.29	......	......	......	......	$MgCl_2$ ....
......	......	29.4	1.71	24.9	1.45	185.7	10.83	......	......	......	......	$MgSO_4$ ....
139.4	8.13	147.6	8.60	104.2	5.86	50.8	2.96	34 0	1.98	134.0	7.77	$MgCO_3$ ....
......	......	......	......	......	......	......	......	......	......	......	......	$CaSO_4$ ....
181.6	10.59	115.3	6.72	178.2	10.42	261.4	15.25	45.9	2.68	148.7	8.62	$CaCO_3$ ....
......	......	......	......	.9	.05	......	......	15.6	.92	2.8	.16	$Fe_2O_3 + Al_2O_3$.
9.2	.53	1.9	.11	......	......	.6	.03	......	......	......	......	$FeCO_3$ ....
1.4	.08	1.1	.06	......	......	.3	.02	......	......	......	......	Al_2O_3 ....
30.8	1.80	13.0	.76	6.6	.04	15.7	.91	9.8	.57	5.6	.32	SiO_2 ....
391.9	22.85	472.7	27.54	445.8	25.43	618.0	36.02	784.1	45.78	1499.4	86.96	
R. W. S.		R. W. S.		R. W. S.		R. W. S.		A. D. E.		A. L. M.		

Analyses of Illinois

Town	W. Chicago	W. Chicago	Wilmington	Wilmington
County	DuPage	DuPage	Will	Will
Laboratory number	2474	12236	9139	1352
Date	July 21, 1897	July 14, 1904	June 19, 1901	Sept. 7, 1896
Owner	J. T. Hosford	S. H. Wolfe	C. H. Kahler	C. H. Kahler
Depth	874 feet	876 feet	Spring	43 feet
Strata	Sand rock	Sand rock	....	Sand stone
Remarks	....	City supply	....	....
Turbidity	Slight	Distinct	Very slight	....
Color	.06	.6	.01	....
Odor	.000	.000	.000	....

	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	354.	407.2	1088.4	....
Loss on ignition	20.	....	90.	....
Chlorine	10.	14.8	148.5	....
Oxygen consumed	1.8	1.3	5.3	....
Nitrogen as Free ammonia	.56	.352	.034	....
Nitrogen as Alb. ammonia	.034	.042	.064	....
Nitrogen as Nitrites	.000	.000	.019	....
Nitrogen as Nitrates	.06	.08	11.181	....
Potassium K	2.4	1.9	26.7	7.6
Sodium Na	21.6	26.3	119.9	69.1
Ammonium (NH_4)	....	....	....	.62
Magnesium Mg	30.7	40.1	49.3	34.7
Calcium Ca	56.9	65.1	144.8	57.8
Ferrous Fe	1.9	1.2	.6	....
Aluminium Al	1.1	.7	.8	....
Silica Si	11.8	6.6	6.7	6.6
Nitrate NO_3	.8	.3	49.5	.4
Chloride Cl	10.0	14.8	148.5	39.0
Sulphate SO_4	42.1	65.5	272.4	61.4

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.1	.07	.6	.04	69.2	4.01	.7	.04
Potassium Chloride	4.2	.24	3.2	.19	....	....	14.1	.82
Sodium Nitrate	....	....	....	....	9.6	.56	....	....
Sodium Chloride	13.2	.77	22.3	1.30	244.7	14.19	53.2	3.10
Sodium Sulphate	51.8	2.02	54.3	3.17	65.0	3.77	90.9	5.30
Sodium Carbonate	....	....	....	....	....	....	43.1	2.51
Ammonium Sulphate	....	....	....	....	....	....	....	....
Ammonium Carbonate	....	....	....	....	....	....	....	....
Magnesium Nitrate	....	....	....	....	....	....	....	....
Magnesium Chloride	....	....	....	....	....	....	....	....
Magnesium Sulphate	9.0	.52	36.0	2.10	250.2	14.51	....	....
Magnesium Carbonate	104.0	6.06	114.2	6.65	....	....	120.7	7.04
Calcium Sulphate	....	....	....	....	40.1	2.33	....	....
Calcium Carbonate	139.7	8.15	162.5	9.48	332.3	19.27	144.3	8.42
Oxide of Iron and Aluminium	....	....	....	....	....	....	Trace	Trace
Ferrous Carbonate	3.8	.22	2.6	.15	1.3	.08	....	....
Alumina	1.8	.10	1.4	.08	1.6	.09	....	....
Silica	24.8	1.44	14.0	.82	14.2	.82	14.0	.82
Total	352.3	20.57	411.1	23.98	1028.2	59.63	481.0	28.05
Analyst	R. W. S.		J. M. L.		A. L. M.		R. W. S.	

Waters—Continued.

Winchester .	Winchester .	Winfield ..	Winnetka ...	Woodbine	Woodbine.
Scott.........	Scott.........	DuPage ...	Cook	JoDaviess.	JoDaviess
9183	9911	7114	7113	7224	7225 ... .
July 15, 1901..	Nov. 26, 1901.	Mar. 19, 1900	Mar. 20, 1900..	April 2, 1900	April 2, 1900
A. P. Grout .	W. Hardister	R.M'C'm'k	S.W.Crand'll	E. Herm'n	E. Herm'n
Spring.......	Spring.......	400 feet	250 feet	130 feet	137 feet ....
....	....	Rock	Rock	Lime stone	Lime stone
....	....	....	....	....	....
Decided	Very slight..	Distinct....	Slight........	Distinct....	Distinct....
Yellow	.01	.02	.01	.01	.02
.000	.000	.000	.000	.000	.000
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1,000 c. c.	Milligrams per 1000 c.c.	Milligrams per 1000 c.c.
424.4	377.6	440.	729.2	496.4	429.2
36.8	50.	28.4	56.	26.4	42.8
2.2	3.	2.6	50.	8.	16.
5.9	1.5	1.3	2.3	.8	.5
4.8	.02	.448	.014	.002	.000
.144	.034	.034	.102	.018	.02
.000	.000	.000	.1	.000	.000
.16	3.68	.08	21.	.12	9.2
1.7	3.0	8.3	3.8	6.6	1.6
12.4	8.6	33.8	9.7	7.0	7.3
6.2	....	.6	....	....	....
35.2	45.5	34.8	64.6	46.8	45.2
92.1	82.2	70.1	131.9	116.1	83.8
5.9	.5	1.3	.3	1.5	1.2
4.0	1.5	.4	1.3	.4	1.0
8.4	8.8	4.6	6.	3.7	8.
.7	16.4	.3	93.0	.6	40.7
2.2	3.0	2.6	50.0	8.0	16.0
1.4	5.3	114.9	163.2	63.2	13.2

Combinations.

Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	Parts per million ..	Grains per U.S. gal.	
1.1	.06	7.7	.45	.6	.03	9.9	.58	.9	.05	4.1	.24	KNO_3 ....
2.4	.14	....	......	15.4	.89	....	......	11.9	.69	......	......	KCl...........
....	......	16.1	.94	......	......	35.9	2.09	......	......	27.1	1.57	$NaNO_3$ ....
2.0	.12	5.0	.29	30.0	1.75	....	......	3.9	.23	......	......	NaCl............
2.1	.12	7.6	.44	67.1	2.91	....	......	16.9	.98	......	......	Na_2SO_4.........
25.1	1.46	....	......	......	......	....	......	......	......	......	......	Na_2CO_3 ....
....	......	....	......	1.6	.09	....	......	......	......	......	......	$(NH_4)_2SO_4$.....
16.5	.96	....	......	......	......	....	......	......	......	......	......	$(NH_4)_2CO_3$ ....
....	......	....	......	......	......	72.5	4.23	......	......	22.0	1.28	$Mg(NO_3)_2$ .....
....	......	....	......	......	......	66.9	3.90	......	......	21.4	1.24	$MgCl_2$ ....
....	......	.3	.02	85.5	4.99	178.2	10.40	64.8	3.78	16.5	.96	$MgSO_4$..........
122.6	7.11	158.1	9.22	61.1	3.56	....	......	117.6	6.86	117.6	6.86	$MgCO_3$..........
....	......	....	......	......	......	29.2	1.70	......	......	......	......	$CaSO_4$ ....
230.0	13.34	205.4	11.99	175.2	10.22	308.0	17.97	290.2	16 93	209.5	12.21	$CaCO_3$..........
....	......	....	......	......	......	....	......	......	......	......	......	$Fe_2O_3+Al_2O_3$.
12.2	.71	1.0	.06	2.7	.16	.6	.04	3.2	.18	2.6	.15	$FeCO_3$.........
7.4	.43	2.8	.16	.7	.04	2.4	.14	.8	.05	1.9	.11	Al_2O_3...........
17.8	1.03	8.8	1.10	9.7	.56	12.7	.74	7.8	.45	17.0	.99	SiO_2 ....
439.2	25.48	412.8	24.67	449.6	26.20	716.3	41.79	518.0	30.20	439.7	25.61	
A. L. M.		A. D. E.		R. W. S.		R. W. S.		R. W. S.		R. W. S.		

Analyses of Illinois

Town	Woodhull	Woodhull	Woodstock	Wyoming
County	Henry	Henry	McHenry	Stark
Laboratory number	10445	10939	7440	10362
Date	June 12, 1902	March 4, 1903	June 1, 1900	April 22, 1902
Owner	W. P. Kirkland	E. L. Miller	F. Hutchinson	F. J. Graves
Depth	182 feet	1394 feet	900 feet	Spring
Strata	Sandrock	St. Peter	Rock	
Turbidity	Decided	Distinct	Distinct	V. Decided
Color	Yellow	.1	.04	Brownish
Odor	.000	.000	Sulphur	Peculiar
	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.
Total residue	522.	949.6	12805.2	889.2
Loss on Ignition	32.4	16.	1150.4	121.6
Chlorine	1.	154.	6510.	2.2
Oxygen consumed	3.5	4.1	12.4	39.5
Nitrogen as. Free ammonia	1.84	1.04	6.8	.656
Nitrogen as. Alb. ammonia	.048	.018	.04	2.08
Nitrogen as. Nitrites	.000	.001	.000	.001
Nitrogen as. Nitrates	.09	.08	.4	.17
Potassium K	2.8	14.1	111.7	8.1
Sodium Na	45.1	220.0	2405.4	9.8
Ammonium (NH_4)	2.4	1.3	8.2	.8
Magnesium Mg	34.9	20.4	380.0	58.2
Calcium Ca	99.9	51.8	1203.3	136.2
Ferrous Fe	....	3.4	....	45.4
Aluminium Al	....	3.0	....	23.5
Silica Si	7.8	7.3	1.4	57.2
Nitrate NO_3	.5	.3	1.7	.7
Chloride Cl	1.0	154.0	6510.0	2.2
Sulphate SO_4	2.6	265.5	1630.0	6.9

Hypothetical

	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.	Parts per million	Grains per U. S. gal.
Potassium Nitrate	.7	.04	.6	.04	2.8	.16	1.1	.06
Potassium Chloride	2.1	.12	26.5	1.55	211.1	12.31	4.6	.27
Potassium Sulphate	3.3	.19	....	....	....	....	12.8	.75
Sodium Chloride	....	....	233.3	13.61	6114.4	356.68	....	....
Sodium Sulphate	1.2	.07	392.8	22.91	....	....	....	....
Sodium Carbonate	103.1	6.06	1.9	.11	....	....	22.6	1.31
Ammonium Chloride	....	....	....	....	24.3	1.41	....	....
Ammonium Carbonate	6.4	.37	3.5	.20	....	....	2.1	.12
Magnesium Chloride	....	....	....	....	1496.2	87.28	....	....
Magnesium Carbonate	121.4	7.08	71.2	4.15	....	....	202.4	11.80
Calcium Chloride	....	....	....	....	1414.2	82.50	....	....
Calcium Sulphate	....	....	....	....	2309.3	134.71	....	....
Calcium Carbonate	249.7	14.56	129.1	7.53	34.1	1.98	340.4	19.85
Oxide of Iron and Aluminium	1.2	.07	....	....	3.5	.20	....	....
Ferrous Carbonate	....	....	7.1	.41	....	....	58.4	3.40
Alumina	....	....	5.5	.32	....	....	44.4	2.60
Silica	16.6	.97	15.6	.92	3.	.17	121.6	7.09
Suspended matter	55.4	3.22	....	....	....	....	....	....
Total	561.1	32.75	887.1	51.75	11612.9	677.4	810.4	47.25
Analyst	P. B.		P. B.		R. W. S.		A. D. E.	

Waters—Continued.

Wyoming.....	Wyoming...	Wyoming.				
Stark..........	Stark.........	Stark.......				
7285............	9084...........	10723........				
April 10, 1900 ..	April 20, 1901	Oct. 6, 1902.				
G. W. Scott...	G. W. Scott..	City offic'ls				
212 feet.........	300 feet.......	1557 feet....				
Sand and rock.	Rock	St. Peter...				
Distinct........	Decided......	Distinct....				
.30	Milky	.2				
.000	.000	.000				
Milligrams per 1,000 c. c.	Milligrams per 1,000 c. c.	Milligrams per1,000c.c.	Milligrams per1,000c.c.	Milligrams per1,000c.c.	Milligrams per1,000c.c.	
476.	379.2	815.6				
22.4	40.	27.3				
4.8	7.4	144.				
4.2	1.8	4.1				
2.56	1.04	1.44				
.078	.04	.094				
.000	.000	.000				
.08	.2	.12				
3.4	1.7	21.6				
103.6	129.6	219.5				
3.3	1.3	1.9				
24.1	38.0	24.4				
56.6	8.8	29.4				
2.3	.5	.15				
1.4	.7	.3				
5.5	3.6	6.6				
.3	.9	.6				
4.8	7.4	144.0				
.2	.7	165.1				

Combinations.

Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	Parts per million ..	Grains per U. S. gal..	
Trace..	Trace..	1.5	.08	.9	.05							KNO_3..........
6.5	.38	2.2	.13	40.6	2.37							KCl............
....	......	....	......	......	......							K_2SO_4..........
2.6	.15	10.7	.62	205.8	12.01							Na Cl...........
Trace..	Trace..	1.1	.06	244.2	14.24							Na_2SO_4.........
236.3	13.79	288.1	16.70	95.5	5.57							Na_2CO_3.........
....	......	....	.....	......	......							$(NH_4)Cl$........
8.8	.51	3.5	.18	5.1	.30							$(NH_4)_2CO_3$.....
....	....	....	......	......	......							$Mg Cl_2$..........
83.8	4.89	13.2	.76	85.3	4.98							$Mg CO_3$.........
....	....	....	......	......	......							$Ca Cl_2$..........
....	....	....	......	......	......							$Ca SO_4$.........
140.3	8.19	20.2	1.16	73.6	4.30							$Ca CO_3$.........
....	....	....	......	......	......							$Fe_2O_3+Al_2O_3$..
4.8	.28	1.1	.06	.3	.02							$Fe CO_3$.........
2.6	.15	1.4	.08	.6	.04							Al_2O_3...........
11.7	.68	7.6	.44	14.0	.82							$Si O_2$...........
....	....	....	......	15.6	.91							....
497.4	29.02	350.6	20.27	781.5	45.61							
R. W. S.		A. R. J.		P. B.								

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