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complete it had a specific gravity of .8131. The specific gravity of the anhydrous alcohol* is given as .8148.

From the results given above it will readily be seen that calcium carbide affords a good test for water in alcohols, since it acts upon aqueous alcohol as long as any water remains in it with the evolution of acetylene, especially when slightly warmed. One would also be warranted in concluding that calcium carbide deserves to be ranked with calcium oxide as a dehydrating agent for alcohols.

THE SIOUX CITY WATER SUPPLY.

BY ALFRED N. COOK AND C. F. EBERLY.

A good water supply is one of the greatest boons man can possess. Notwithstanding this fact, it is the one thing above all others, almost, which is likely to receive the least attention. It is well known to those who have given the subject some study that the taste is no criterion by which to judge a water. So often have we known men to declare that a certain water was good because of its excellent taste, often due to chlorides, nitrates, etc., derived from sewage, or outhouses not far distant. So often men will provide their families with every comfort that modern applied science has made possible and yet unknowingly be using a contaminated water supply. This was recently well illustrated by a prosperous professional man of Sioux City who not long since built a new home in Morningside and furnished it with every modern convenience at a cost of several thousands of dollars. Instead of tapping the city water supply which was not far distant, he dug a well and within two or three rods of the well sank a large cess-pool which receives the drain from the kitchen and water closet.

*Allen's Com. Org. Anal., Vol. I, page 165.

The experimental work described in the following pages was done by Mr. C. F. Eberly, except where otherwise stated. Leffman's Manual of Water Analysis was used as a guide in the work, with frequent references to the original literature, or abstracts of the same. The results are given in milligrams per liter, except in the analysis reported by Professor Pope. The analyses made by Prof. Floyd Davis were reported in grams per U. S. gallon, but have been converted into the milligram system. Duplicate analyses were made in every case and the average of these reported.

The Big Sioux river flows along the western boundary of Sioux City about four miles west of the most thickly populated part of the city. Along its eastern bank are located a few manufacturing plants and Riverside park. It receives practically no sewage from the city. It receives the back water from the Missouri during the months of May, June and July. This back water extends a number of miles up the river and at the park rises to the height of about eight feet above the ordinary level. At other times it has a good current.

The greater portion of the ice consumed in Sioux City is obtained from this river. The specimen for analysis was taken at Riverside park, November 28, 1901, when the river was at its normal height. The water was slightly turbid but it was not filtered before making the analysis.

Total solids	340.
Loss on ignition	79.
Nitrogen as free ammonia	0.126
Nitrogen as albuminoid ammonia	0.280
Nitrogen as nitrates	Trace
Nitrogen as nitrites	None
Chlorine	9.936
Oxygen consuming power	2.011

The Missouri river forms the southern boundary of the greater part of Sioux City. It has a very swift current which carries with it a large quantity of sediment, especially when the river is high during the summer months, which is said to be due to the melting of the snow in the upper portion of its basin. The Missouri is a source

of a considerable quantity of ice used in Sioux City. The specimen for analysis was taken at the combination bridge on the Iowa side, May 27, 1901. The specimen for the determination of the suspended matter was taken December 14, 1901. If it had been taken on the first date the suspended matter would, undoubtedly, have been considerably greater.

Suspended matter	136.
Total solids	326.
Loss on ignition	73.
Nitrogen as free ammonia	.020
Nitrogen as albuminoid ammonia	.074
Nitrogen as nitrates	4.000
Nitrogen as nitrites	Trace
Chlorine	15.5
Oxygen consuming power	4.15

The Floyd river flows south through the eastern portion of the most populated portion of Sioux City, by the packing houses, and empties into the Missouri river where it turns to the south. It receives a great deal of contamination from the starch plant above the city and several small manufacturing plants upon its banks, the sewage from a large part of the business district, and the filth from the Armour and the Cudahay packing houses and the Sioux City stock yards. The water during the summer becomes very foul, so much so, that it is a nuisance to that part of the city through which it flows.

From the Seventh Street bridge to its mouth, a distance of about one mile, it has a fall of about one inch. It empties at right angles into the Missouri, from which during several months of the year it receives the back water, which extends up the river to the distance of one and one-fourth miles to the Floyd Flour mill dam. At other times when the wind is in the south the surface filth is kept from flowing out. Under any conditions the current is not sufficient to carry out the filth. When the back water from the Missouri flows out, which occurs once a year, a partial cleansing takes place.

The city is preparing to straighten the channel of the Floyd so that it will empty into the Missouri toward down

stream instead of at right angles. On account of emptying farther down stream, the river will then have a fall of seven inches, instead of one, for the last mile. This, together with the friction of the waters of the Missouri, it is believed, will give considerable increase to the velocity of the current. It is planned also to put flood gates in the Floyd, by means of which the waters will be caused to rise to the height of five feet and then be released automatically. This will, no doubt, thoroughly wash out the Floyd and put it in good sanitary condition.

The Sterling Packing Company took two crops of ice from the Floyd during the winter of 1900-1901. The specimen for analysis was obtained at the Chambers street bridge, November 13, 1901.

Total solids	402.
Loss on ignition	90.
Nitrogen as free ammonia	1.816
Nitrogen as albuminoid ammonia	3.783
Nitrogen as nitrates	Trace
Nitrogen as nitrites	.125
Chlorine	67.845
Oxygen consuming power	5.782

The water was turbid, had a very strong odor, and its stench increased when kept in a closed flask a short time. When distilled it gave off the odor which accompanies the scalding of hogs. It had a greasy appearance and even felt greasy. The large amount of chlorine is probably due to brine. Albuminoid ammonia continued to come off as long as any water remained in the distilling flask.

The Half Moon Lake, so called because of its shape, is a detached portion of the Floyd river. It is located just east of the packing house district. It is fed by springs, surface water, and by the melting of the snow. It has no outlet, except when high, when the excess of water flows off through a culvert under the railway grade. The water is always turbid, about fifteen feet deep in the center, and there are two or three feet of fine mud in the bottom of the lake. Organic decomposition is taking place as is evidenced by the bubbles continually rising to the surface. The

specimen for the technical analysis was obtained February 15, 1901, and the specimen for the sanitary analysis was obtained October 2, 1901.

TECHNICAL ANALYSIS.

Calcium oxide (CaO)	83.9
Magnesium oxide (MgO)	27.2
Silica (SiO_3)	27.
Carbon Dioxide (CO_2)	98.7
Sulphur trioxide (SO_3)	14.7
Alumnia (Al_2O_3)	7.2
Ferric Oxide (Fe_2O3)	.8

SANITARY ANALYSIS.

Total solids	226.
Loss on ignition	70.
Nitrogen as free ammonia	.101
Nitrogen as albuminoid ammonia	.320
Nitrogen as nitrates	1.000
Nitrogen as nitrites	None
Chlorine	13.775
Oxygen consuming power	10.192

Albuminoid ammonia continued to come off until the containing vessel broke.

From the above analysis we would not consider the water of the Half Moon a good potable water, yet a considerable portion of the ice used in Sioux City is taken from this lake. It is not probable that any of the filth from the Armour packing house seeps into the lake, as has popularly been suspected, since the surface of the lake is higher than the surface af the Floyd which is less than one-fourth mile away and the high railway grade between the packing house and the lake would prevent any surface water from flowing in.

The Well Water at 1609 Orleans Avenue, Morningside, is located on the low ground east of Longfellow schoolhouse. It is a dug well eighty-five feet deep. There are several water closets within a few rods, and several others have been located in the immediate locality during the past twelve years. The technical analysis was made in the month of March, and the sanitary analysis in May, 1901.

TECHNICAL ANALYSIS.

Calcium oxide (CaO)	103.1
Magnesium oxide (MgO)	32.3
Sodium oxide (Na_2O)	4.8
Carbon dioxide (CO_2)	212.2
Silica (SiO_2)	12.2
Sulphur trioxide (SO_3)	19.4
Alumina (Al_2O_3)	7.75
Ferric oxide (Fe_2O_3)	.45
Manganous oxide (MnO)	Trace

SANITARY ANALYSIS.

Total solids	388.
Loss on ignition	131.
Nitrogen as free ammonia	.034
Nitrogen as albuminoid ammonia	.030
Nitrogen as nitrates	8.100
Nitrogen as nitrites	None
Chlorine	4.000
Oxygen consuming power	.625

Considering the conditions which surround this well, the water is very much better than one would expect. The analysis shows that it comes within the prescribed limits of a safe potable water, indeed quite as good as the city water.

Mr. Culbertson's Well is located a few rods north of the preceding well and is surrounded with practically the same conditions. The results of the analysis are not quite so favorable, however. The analysis was made in the latter part of April, 1901.

Total solids	569.
Loss on ignition	203.
Nitrogen as free ammonia	.016
Nitrogen as albuminoid ammonia	.046
Nitrogen as nitrates	39.4
Nitrogen as nitrites	Trace
Chlorine	5.5
Oxygen consuming power	1.12

I. N. Stone's Well, Morningside, is situated on high ground and surrounded by a lawn. It is eighty feet deep and contains about two feet of water. When this analysis was made there was a water closet within thirty-five feet and a barn about one hundred feet distant. They have since

been removed. The water had a sparkling appearance and a slight odor. When allowed to stand in a closed vessel for some time it possessed a slight odor of urea. The analysis was made in September, 1901.

Total solids	461.
Loss on ignition	124.
Nitrogen as free ammonia	.066
Nitrogen as albuminoid ammonia	.027
Nitrogen as nitrates	6.666
Nitrogen as nitrites	.22
Chlorine	2.7
Oxygen consuming power	6.09

The amount of nitrites found would, alone, condemn its use as a potable water.

Armour & Company obtain the water for their large packing plant from two wells, 347 and 400 feet deep respectively. The analysis was made in the latter part of November, 1901.

Total solids	556.
Loss on ignition	148.
Nitrogen as free ammonia	.262
Nitrogen as albuminoid ammonia	.025
Nitrogen as nitrates	Trace
Nitrogen as nitrites	None
Chlorine	8.3
Oxygen consuming power	1.568

The Consumer's Ice Company obtain their water for manufacturing ice from a well 122 feet deep and which is said to pass through a stratum of rock into a gravel bed. It is first distilled and then frozen in cans by means of salt brine. The specimen was taken from a clear block of ice weighing 300 pounds. The analyses were made in the latter part of November, 1901. If the ice is manufactured entirely from the distilled water, we have no theory to account for the fact that both the free and albuminoid ammonia are higher in case of the ice water than from the well water from which the ice was manufactured. The presence of the chlorine may be explained by the carelessness of the operator in allowing brine to get into the water before being frozen.

ANALYSIS OF THE WATER.

Total solids	278.
Loss on ignition	48.
Nitrogen as free ammonia	.092
Nitrogen as albuminoid ammonia	.047
Nitrogen as nitrates	None
Nitrogen as nitrites	None
Chlorine	37.85
Oxygen consuming power	1.47

ANALYSIS OF THE ICE WATER.

Total solids	34.
Loss on ignition	19.
Nitrogen as free ammonia	.194
Nitrogen as albuminoid ammonia	.170
Nitrogen as nitrates	Trace
Nitrogen as nitrites	None
Chlorine	3.86
Oxygen consuming power	1.32

The Artesian Well is located at 311 Bluff street, and is 2,011 feet deep. It was originally drilled by D. A. Magee & Company. It is now owned by Christerman & Company, who use the water in their mineral water plant. Two analyses are given below. The one by Juan H. Wright, M. D., an analytical chemist of St. Louis, Missouri, was made in May, 1883. The one by Prof. Thomas E. Pope of the Iowa Agricultural College was made in 1884. The reports of these two analyses have kindly been furnished by Mr. D. A. Magee. It will be observed that there is a marked difference between the two analyses. It may be said, however, that Mr. Pope's analysis is in fair accord with that made by J. B. Weems and reported as the "official analysis" in Vol. VI, page 225, of the Report of the Iowa Geological Survey. The results are given in U. S. grams per gallon.

ANALYSIS BY POPE.

Sodium chloride ($NaCl$)	4.328
Sodium sulphate (Na_2SO_4)	14.763
Potassium sulphate (K_2SO_4)	5.045
Calcium sulphate ($CaSo_4$)	44.248
Calcium bicarbonate ($CaCO_3, H_2CO_3$)	4.305
Magnesium bicarbonate ($MgCO_3, H_2CO_3$)	15.265
Iron bicarbonate ($FeCO_3, H_2CO_3$)	.484
Silica (SiO^2)	.175
Alumina (Al_2O_3)	Trace

ANALYSIS BY WRIGHT.

Carbonate of lime ($CaCO_3$)	6.654
Magnesium carbonate ($MgCO_3$)	5.527
Iron carbonate ($FeCo_3$)	3.797
Aluminum sulphate ($Al_2(SO_3)$	22.073
Magnesium sulphate ($MgSO_4$)	10.037
Nickel sulphate ($NiSO_4$)	1.141
Calcium sulphate ($CaSO_4$)	6.839
Sodium sulphate (Na_2SO_4)	3.751
Potassium sulphate (K_2SO_4)	2.115
Iron sulphate ($FeSO_4$)	13.402
Sodium Phosphate (Na_2HPO_4)	1.667
Silica (SiO_2)	1.882
Organic matter	.864

The City Water Supply comes from 104 driven wells ninety feet deep. The source is beneath an impervious stratum of clay. The water is stored in a reservoir 150 feet in diameter, located on an eminence north of the city, from whence it is distributed to consumers. The reservoir is surrounded by an iron fence and carefully guarded. In the summer there is to be seen occasionally a green growth on the water which is so common to bodies of standing water in the summer months, but the tank is emptied and cleaned every three weeks. The specimen for Analysis I was taken from the hydrant at Morningside college, which is located six miles from the reservoir, in May, 1901. The specimen for Analysis II was taken at pumping station No. 1, in May. It will be observed that the results of the two analyses are practically the same. The specimen for the technical analysis was taken at Morningside college in February, 1901.

ANALYSIS I.

Total solids	415.
Loss on ignition	167.
Nitrogen as free ammonia	.022
Nitrogen as albuminoid ammonia	.0232
Nitrogen as nitrates	12.4
Nitrogen as nitrites	Trace
Chlorine	8.9
Oxygen consuming power	.6

ANALYSIS II.

Total solids	406.
Loss on ignition	159.
Nitrogen as free ammonia	.024
Nitrogen as albuminoid ammonia	.061
Nitrogen as nitrates	9.1
Nitrogen as nitrites	Trace
Chlorine	8.2
Oxygen consuming power	.685

The following analysis was made by Prof. Floyd Davis, chemist of the Iowa State Board of Health in April, 1891. The specimen was obtained from pumping station No. 1.

Total solids	393.
Loss on ignition	61.2
Chlorine	4.634
Free ammonia	.021
Albuminoid ammonia	.024
Nitrogen as nitrates	.735
Nitrogen as nitrites	None

The following analysis of a specimen from pumping station No. 2 was also made by Dr. Floyd Davis at the same time as the specimen mentioned above. He states that "This sample of water contained a large amount of suspended matter in it and the analysis was made of the filtered water." The water from the station is now only occasionally used for the city supply. It will be observed that the results of the two analyses are practically the same.

Total solids	415.2
Loss on ignition	69.6
Chlorine	3.6
Free ammonia	.021
Albuminoid ammonia	.045
Nitrogen as nitrates	Trace
Nitrogen as nitrites	None

The two following technical analyses were made by Mr. Davis at the same time as the sanitary analyses:

PUMPING STATION No. 1.

Silica (SiO_2)	32.43
Sodium oxide (Na_2O)	14.53
Potasssium oxide (K_2O)	5.91
Sulphur trioxide (SO_3)	9.55

Phosphoric anhydride (P_2O_5)	Trace
Aluminia (Al_2O_3)	3.97
Ferric oxide (Fe_2O_3)	Trace
Calcium oxide (CaO)	120.05
Magnesium oxide (MgO)	47.96
Carbon dioxide (CO_2)	153.96

PUMPING STATION No. 2.

Sodium oxide (Na_2O)	15.94
Silica (SiO_2)	32.19
Potassium oxide (K_2O)	4.37
Sulphur trioxide (SO_3)	7.25
Phosphoric anhydride (P_2O_5	Trace
Alumina (At_2O_3	3.805
Ferric oxide (Fe O_3)	Trace
Calcium oxide (CaO)	130.42
Magnesium oxide (MgO)	48.96
Carbon dioxide (CO_2)	170.55

The following technical analysis of the water, taken from the hydrant at Morningside college, was made in January 1901.

Silica (SiO_2)	14.4
Sodium oxide (Na_2O	27.5
Sulphur trioxide (SO^3)	12.5
Alumina (Al^2O_3)	1.00
Ferrric oxide (Fe_2O_3)	.30
Manganous oxide (MnO)	Trace
Calcium oxide (CaO)	120.6
Magnesium oxide (MgO)	53.9
Carbon dioxide (CO_2)	236.2

A comparison of the results of the technical analyses given above will reveal the fact that the mineral character of the water has not greatly changed in ten years. Ferric oxide was found in the last analysis, but this may have come from the iron pipes, through which the water flows for several miles. There is an increase in the amount of sodium, silica, alumina, and magnesium but the general character of the water remains practically the same.

A comparison of the sanitary analyses shows that there has been some change in ten years. The free and albuminoid ammonia remain about the same, but the chlorides have increased over two and one-half fold, the nitrates fifteen

fold, and the loss on ignition is very much greater. A comparison of the water supplies of several cities shows that the Sioux City supply is better than those of Brooklyn, Boston, and Cincinnati and quite as good as those of several other cities.

IGNEOUS ROCKS OF THE CENTRAL CAUCASUS, AND THE WORK OF LOEWINSON-LESSING.

BY CHARLES R. KEYES.

(Abstract.)

In view of the widespread interest that the subject of the differentiation of rock-magmas is exciting among geologists generally I am led at this time to call your attention to one of the most recent, and at the same time one of the most important contributions which has yet been made. My notice will be brief, and will consist chiefly of an exhibition of specimens of many of the most notable rock-types. An explanation of some of the most significant features will be given. Photographs of some of the most characteristic rock-masses as they appear in the field will be shown. These were obtained during a recent trip through the Caucasus region in company with the Russian investigator himself, guiding one of the excursions of the Seventh International Geological Congress.

Although the great work of the Russian petrographer, F. Loewinson-Lessing, on the Eruptive Rocks of the Central Caucasus, was issued more than two years ago, the views advanced are only beginning to get into form accessible to the majority of English students. The general interest lies in the discussions of the subjects of rock-classification and the differentiation of rock magmas.

The classification proposed for the igneous rocks is chemical. It is based primarily upon the degree of acidity of the silicate minerals. Four great groups are thus