VII

Mineral Waters and Arkansas River Water.

Record of
Analyses of Mineral Waters
of the state of
Arkansas -

made by the Ark. Geolog. Survey

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J.C. Branner, Ph.D., Director.

A B C D E F G H I K L M N O P Q R S T U V W Y Z.

Some Atomic and Molecular weights

K	39.03	KCl	74.40
Na	22.995	NaCl	58.365
Ca	39.91	K_2O	94.02
Mg	23.94	Na_2O	61.95
Fe	55.88	CaO	55.67
Al	27.04	MgO	39.96
C	11.97	$CaSO_4$	135.73
O	15.96	$MgSO_4$	119.76
S	31.98	K_2SO_4	173.88
Cl	35.37	Na_2SO_4	141.81
Si	28.06	CO_2	43.89
		SiO_2	59.92
		SiO_3	75.88
		CO_3	59.85
		SO_4	95.62
		$FeSO_4$	151.70
		$Al_2(SO_4)_3$	341.37

Imp gall x .833 = US gallon

US gallon x 1.2 = Imp gallon.

Pounds per 100,000 x .7 = grains per Imp gal

" 100,000 x .5837 = grains per US gallon.

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Lab No 46

Mammoth Spring Fulton County.
Collected by Mr. F. W. Gibb July 23/87.

Quantitative analysis: Sept. 16/87 begun. -

Total solids: Took 700 cc. of the water.

Wt platinum dish + residue = 14.24443 grains
" of platinum dish alone = 14.22256 grains
" Residue = 0.0187 grains.

Total solids = 18.7 grains per Imperial Gallon.

Silica, SiO_2: 700 cc. of water used.

Wt crucible + silica + ff. = 15.5381 grams.
" Crucible alone = 15.52282 "
" Silica + ff = 0.0099 "
" ff = 0.00011 "
" Silica = 0.00979 "

Silica = 0.979 grains per imp. Gallon.

Alumina, Al_2O_3: in 700 cc of water.

Wt. crucible + ff + Al_2O_3 = 15.5290 "
" Crucible alone = 15.5283 "
" Al_2O_3 + ff = 0.00070 "
" ff = 0.00004 "
" Al_2O_3 = 0.00066

Al_2O_3 = 0.066 grains per imp. gallon.

$Al = 0.0352$ grains per imp. Gallon.

Lime, CaO: in 700 cc. of water.

Wt. Crucible + CaO + ff = 15.5783 "
" Crucible alone = 15.52290 "
" CaO + ff = 0.0493 "
" ff = 0.00007 "
" CaO = 0.04923 "

CaO = 4.923 grains per imp. Gallon.

$Ca = 3.5764$ grains per imp. gallon.

Sulphuric acid, SO_3: in 1400 cc. of water.

Wt Cruc. + $BaSO_4$ + ff = 15.53980 "
" Crucible alone = 15.52875 "
" $BaSO_4$ + ff = 0.01105 "
" ff = 0.00007 "
" $BaSO_4$ = 0.01098 "

$\frac{.01098 \times 80}{233}$ = wt SO_3
= .003769 grams.
$\therefore SO_3$ = 0.18845 grains per imp. gallon.

Magnesia, MgO.: in 700 cc. of water.

wt. cruc + (pp = $Mg_2P_2O_7$ = 15.6157 grams.
" Crucible alone = 15.5286 "
" $Mg_2P_2O_7$ + pp = 0.0865 "
" pp = 0.00007 "
" $Mg_2P_2O_7$ = 0.086443 "

$\frac{.086443 \times 80}{222}$ = at. MgO = .031145 grams.

MgO = 3.1145 grains per imp. Gallon
Mg = 1.8687 " " " "

Alkalies. KCl and NaCl.: in 2 litres of water.

wt. pt dish + Alk. chlorids = 14.2505 grams.
" Dish alone = 14.2260 "
" Alkali chlorids = 0.0245 "

K = 0.1141 Grains per imp. Gallon.

wt. cruc + K_2PtCl_6 = 21.5450 "
" Crucible alone = 21.5246 "
" K_2PtCl_6 = 0.0204 "

Na = 0.2514 Grains per Gallon.

wt. NaCl + KCl = 0.0245 "
wt KCl = 0.00622263 "
wt NaCl = 0.0182737 "

Constituents found.	Grains per Gallon. (Of 70000 grains)	(Parts per 100,000.)
SiO_2	0.9790	
Al	0.0352	
Fe	trace	
Ca	3.5164	
Mg	1.8687	
K	0.1141	
Na	0.2514	
SO_4	0.2262	
Cl	trace	
	6.9910	
CO_3 calculated	10.4234	
	17.4144	

Mammoth Spring (Concluded). Lab N° 46

Probable combination of residue dried on the water bath: I

Constituents	Grains per gallon.	(Parts per 100,000)
Silica, SiO_2	0.9790	
Aluminium sulphate $Al_2(SO_4)_3+18aq$	0.4263	
Iron	trace	
Potassium sulphate, K_2SO_4	0.0759	
" Carbonate, K_2CO_3	0.1417	
Sodium " Na_2CO_3	0.5793	
Calcium " , $CaCO_3$	8.7920	
Magnesium " , $MgCO_3$	6.5321	
	17.5263	
Total solids	18.7000	
	93.72% accounted for.	

II

SiO_2	0.9790
$Al_2(SO_4)_3+18aq$	0.4263
Iron	trace
$MgSO_4+7aq$	0.1086
$MgCO_3$	6.5037
Na_2CO_3	0.5793
K_2CO_3	0.4037
$CaCO_3$	8.7920
	17.7926
Total solids	18.7000
	95.14% accounted for.

18aq = 0.2068 grs. per gallon
7aq = 0.0556 " " "
Total 0.2624 " " "

$\frac{0.2624 \times 100}{17.7926} = 1.4747\%$

$18.7 \times 1.4747 = .2757$ grains

$\therefore 18.7 - 0.2757 =$ anhydrous residue $= 18.4243$.

III Anhydrous.

SiO_2	0.9790
$Al_2(SO_4)_3$	0.2195
$MgSO_4$	0.0530
$MgCO_3$	6.5037
Na_2CO_3	0.5793
K_2CO_3	0.4037
$CaCO_3$	8.7920
	17.5302
Total solids	18.4243
	95.14% accounted for.

Remarks:
Temperature of water = 58.5° (Cylinder H.W. Gift)
July 23/87.

E. T. Allen
Ref. Brewers

O.K.

4 See page 14, for completion.

Lab. No. 247

Griffin Spring, White County, 4 mi. N. of Searcy. — Collected March 23rd/88 by Mr. J. Perrin Smith. Temp. water 58°F., air 50°F.

Quantitative analysis:

"Total solids": 70 cc of water.

wt. Dish + residue	=	14.22315	grams
" Dish	=	14.21170	"
" Residue	=	0.01145	"

11.45 grains per gallon (70,106 grains).

For silica, iron, aluminium, calcium and magnesium evaporate to dryness 4 Litres of water with hydrochloric acid acidified. And 2 Litres of water for sulphuric acid and the alkalies.

Silica SiO_2: 4 Litres of water. [ff ash = 0.000085]

wt. cruc. + ff. + SiO_2	=	6.36940	grams
" Crucible + ff.	=	6.26388	"
wt. SiO_2	=	0.10581	"

1.8515 grains per gallon.

Ferric oxide, Fe_2O_3: 4 Litres of water

wt. cruc. + Fe_2O_3 + ff	=	15.45895	grams.
" Crucible + ff	=	15.45498	"
wt. Fe_2O_3	=	0.00396	"

All a trace (!)

0.0694 grains per gallon.
∴ Fe = 0.0486 " " "

CaO. Lime: 4 Litres of water

wt. cruc. + CaO	=	22.45540	grams
" Cruc.	=	22.32231	"
wt. CaO	=	0.1309	"

2.2907 grains per gallon.
∴ Ca = 1.6363 " " "

Magnesia, MgO: 4 Litres of water

wt. cruc. + $Mg_2P_2O_7$	=	22.37013	grams
" Crucible	=	22.15745	"
wt. $Mg_2P_2O_7$	=	0.21270	"

0.6706 grains per gallon.
Mg = 0.8046 " "

Sulphuric acid, SO_4: 2 Litres of water.

wt. cruc. + ff + $BaSO_4$	=	21.90630	grams
" Crucible + ff	=	21.73835	"
wt. $BaSO_4$	=	0.16795	

2.4216 grains per gallon.
(2.4216)

Alkalies: 2 Litres of water.

wt. KCl + NaCl + Dish	=	14.32950	grams.
" Dish	=	14.20885	"
wt. KCl + NaCl	=	1.12065	"

K = 0.3292 grains per gallon.
Na = 1.4157 grains per gallon.

wt. K_2PtCl_6 + cruc.	=	22.44670	grams.
" crucible	=	22.38870	"
wt. K_2PtCl_6	=	0.0587	"

wt. KCl + NaCl	=	0.12065	grams.
wt. KCl	=	0.01793	"
wt. NaCl	=	0.10272	

Nitric acid small quantity; undetermined.

Total Carbonic acid CO_3, determined = 22.9806 grains per gallon. Small quantity organic matter. (undetermined)

Griffin Spring (Ca. Co.), Lab. No. 0247 5

Chlorine, Cl. Determined — 1.0853 grains p. Gallon

Hence have:

Constituents found	grains p. Gallon
Silica, SiO_2	1.8515 ✓
Iron, Fe	0.0486 ✓
Aluminium, Al	trace ✓
Calcium, Ca	1.6363 ✓
Magnesium, Mg	0.8046 ✓
Potassium, K	0.3292 ✓
Sodium, Na	1.4157 ✓
Sulphuric acid, SO_4	2.4216 ✓
Nitric acid, NO_3	trace ✓
Chlorine, Cl	1.0853 ✓
Carbonic acid, CO_3	22.9806 ✓
Organic matter	Small quantity ✓

Probable Combination:	Grains p. Gallon
Silica SiO_2	1.8515
Sodium Chloride, NaCl	0.0719
Potassium ", KCl	0.0130
Ferrous sulphate + 7 aq	0.2414
Magnesium " "	0.5367
Calcium " + 2 aq	3.2724
" Carbonate $CaCO_3$	2.1858
Magnesium Chloride $MgCl_2$ + 6 aq	2.9607
	11.1374
Total solids	11.4500

Anhydrous — have:

Silica SiO_2	1.8515	
NaCl	0.0719	1.2988
KCl	0.0130	.6275
$FeSO_4$	0.1329	(.1319
$MgSO_4$	0.2619	(.5677
~~Na_2SO_4~~ $CaSO_4$	2.5988	(2.7888
Mg ~~Cl_2~~ CO_3	1.3836	(2.4188
$CaCO_3$	2.1858	4.0907
	8.4924	
Total solids	8.73 ~~64~~ 18	

Free carbonic acid (determined) 21.6691 ! —

97.25% accounted for.

(Analyzed by Brackett and Smith)

Lab. No 248.

Searcy Sulphur Spring, White County.

Collected by Mr. J. Perin Smith, March 23/84.

Noted by Mr. Smith: Considerable bubbling of gas in the spring. A strong smell of sulphuretted hydrogen (H_2S).

Temp. 430 Bm. air 58°F.; water 59°F.

Quantitative analysis:

Total Solids: in 200 cc of water.

21.5250 grains per Gallon. dried at 110°–115° C.

wt. Dish & residue	=	14.26985 grams
" Dish	=	14.20835 "
wt residue	=	0.06150 "

Sulphuric acid SO_4: 2 Litres of water.

2.5956 grains per gallon.

wt $BaSO_4$ + Cruc	=	22.2768 grams.
" Crucible	=	22.0968 "
wt $BaSO_4$	=	0.1800 "

Silica SiO_2: 2 Litres of water

1.6299 grains per Gallon

wt cruc + ff + SiO_2	=	15.50000 grams
" cruc + ff	=	15.45343 "
wt SiO_2	=	0.04657 "

Magnesium Mg: 2 Litres:

Mg: 0.4096 grains per Gallon.

wt. cruc. + $Mg_2P_2O_7$ + ff	=	15.00046 grams.
" crucible + ff	=	15.45046
wt $Mg_2P_2O_7$	=	0.05014

Alkalies,: 1 Litre of water.

K = 0.2935 grains per Gallon.

Na = 5.4905 grains per Gallon.

wt. Dish + NaCl + KCl	=	14.40850 "
" Dish	=	14.20135 "
wt KCl + NaCl	=	0.20715 "
wt K_2PtCl_6 + Cruc.	=	21.7865 "
wt cruc	=	21.7598 "
wt K_2PtCl_6	=	0.0267 "
∴ wt KCl	=	0.007996 grams.
wt KCl + NaCl	=	0.20715 0 "
wt NaCl	=	0.199154 "

Aluminium and Iron in 4 Litres quantity.

Al = 0.02 54

Fe = 0.0186

wt cruc. + Fe_2O_3 + ff	=	15.43385 0 "
" cruc + ff	=	15.42958 "
wt Al_2O_3 + Fe_2O_3	=	0.00427
wt cruc + Fe_2O_3 + ff	=	15.43000 "
" cruc + ff	=	15.42848 "
wt Fe_2O_3	=	0.00152 "
wt Fe_2O_3 + Al_2O_3	=	0.00427 "
wt Fe_2O_3	=	0.00152 "
wt Al_2O_3	=	0.00275

Seaney S. Spring, Seaney, White county.
in 2½ litres of water.

Lime CaO: in 2 litres of water.
wt crucible + CaO = 21.9064 grains
" crucible = 21.8440 "
wt CaO = 0.0624 "

Ca = 1.5599 grains per gallon

Chlorine Cl = 2.3698 grains per Gallon.
Carbonic acid, CO_3 = 26.5602 grains per Gallon.

Have then:

Constituents found	Grains per Gallon (70,000)
Silica, SiO_2	1.6299 ✓
Sulphuric acid, SO_4	2.5956 ✓
Iron, Fe	0.0186 ✓
Aluminum, Al	0.0254 ✓
Calcium, Ca	1.5599 ✓
Magnesium, Mg	0.4096 ✓
Potassium, K	0.2935 ✓
Sodium, Na	5.4807 ✓
Chlorine, Cl	2.3698 ✓
Carbonic acid Total	26.5602 ✓

Probable combination anhydrous.

Constituents.	Grains per Gallon.
Silica, SiO_2	1.6299
Ferrous sulphate, $FeSO_4$	0.0504
Aluminum Sulphate, $Al_2(SO_4)_3$	0.1608
Sodium sulphate, Na_2SO_4	3.5940
" Chloride, NaCl	3.4707
Potassium " , KCl	0.5595
Sodium carbonate, Na_2CO_3	6.5919
Magnesium " , $MgCO_3$	1.4337
Calcium " , $CaCO_3$	3.8997
	21.3906

Total solids (anhydrous) 21.4465
99.73% accounted for.
Free carbonic acid = 19.5528

O.K.

Analysis by
Bracket and Smith.

8 Lab No 749 Darling Spring. Mt Nebo.

Collected by Dr J. C. Branner Oct. 26/88.

Note by Dr Branner: The new and Cook also water clear save very slight precipitate of iron hydroxide.

Note by G. D. Harris: Temp. of water, Nov. 13/88, 59.1° F.
" " air " " 42° F.

The spring first appears about 175 ft below the bottom of the cap-rock of Mt Nebo (S.W. 1/4 of S.W. 1/4 of section 29, 21W., 7N.) and seems to come from the black shales. It is situated with the so-called "bench" on the west side of Mt Nebo. —

Quantitative analysis:

Laboratory note: Oct. 27, when opened, there was a heavy black or very dark colored precipitate consisting chiefly of iron hydroxide, and from which the water was filtered for analysis. The cork was found very dark and attacked. Taste pleasant & not unacceptable.

Silica, SiO_2: 1.2469 grains per gallon.

1500 cc of water
wt crucible + ppt + SiO_2 = 15.11920 grams
wt crucible + ppt = 15.09248 "
wt SiO_2 = 0.02672 "

Sulphuric acid, SO_4: 1.0593 grains per gallon

1500 cc of water.
wt. crucible + ppt + $BaSO_4$ = 22.70495 grams
" crucible + ppt = 22.64944 "
wt $BaSO_4$ = 0.05551 "

Calcium, Ca: 0.5152 grains per gallon

3 Litres of water
wt. crucible + ppt + CaO = 15.52480 grams
" crucible + ppt = 15.49388 "
wt CaO = 0.03092 "

Magnesium, Mg: 0.1358 grains per gallon

1500 cc of water.
wt. crucible + ppt + $Mg_2P_2O_7$ = 15.15795 "
" crucible + ppt = 15.14448 "
wt $Mg_2P_2O_7$ = 0.01347 "

Iron Fe and Aluminium Al: Fe = 0.0738 grains per gallon. Al = 0.0600 grains per gallon.

1500 cc of water
wt crucible + ppt + Al_2O_3 and Fe_2O_3 = 15.09605 "
" crucible + ppt = 15.09138 "
wt Al_2O_3 and Fe_2O_3 = 0.00467 "

wt $Al_2O_3 + Fe_2O_3$ = 0.00467 grams
" Fe_2O_3 = 0.00226 "
wt AlO_2O_3 = 0.00241 "

Alkalies: K = 0.1269 grains per gallon. Na = 0.5917 grains per gallon.

1500 cc of water
wt Dish & alk chlorides = 15.83139 grams
wt Dish = 15.79939 "
wt NaCl + KCl = 0.03374 "

wt KCl + NaCl = 0.03740 grams
wt KCl = 0.00518 "
wt NaCl = 0.03222

wt K_2PtCl_6 + cruc. = 22.14699 grams
wt crucible = 22.12799 "
wt K_2PtCl_6 = 0.0190

Darling Spring. — Lab. No 249.

Near Alice

Constituents found	Grains per Gallon.	
Silica, SiO_2	1.2469	
Sulphuric acid, SO_4	1.0593	1.0593
Chlorine, Cl	0.3550	
Iron, Fe	0.0738	
Aluminium, Al	0.0595	
Calcium, Ca	0.5152	
Magnesium, Mg	0.1358	0.1358
Sodium, Na	0.5917	0.5915
Potassium K	0.1269	0.1269
Total solids =	5.9000	(in water of cryst.)
=	5.3909	anhydrous*

Probable Combination.

Constituents.	Grains per Gallon.
Silica, SiO_2	1.2469
Ferrous sulphate, $FeSO_4$	0.2003
Aluminium sulphate, $Al_2(SO_4)_3$	0.3712
Potassium sulphate, K_2SO_4	0.2825
Sodium sulphate, Na_2SO_4	0.6889
Sodium chloride, NaCl	0.3856
Sodium carbonate, Na_2CO_3	0.3167
Magnesium carbonate, $MgCO_3$	0.4757
Calcium carbonate, $CaCO_3$	1.2880
	5.4558

101.02 % accounted for.

Analysis by Smith, (P.)
Ref Brackets

Jan 1.89

* water of crystallization = 8.63% of 5.9714 = 0.5156

5.4558
.5156
5.9714

Total solids or water bath = 5.9000
" " anhydrous = 5.3909

O.K.

10 August 22, 1888. — Collected

Lab. No. 50

— Arkansas River Water —

Quantitative Analysis of water collected by R. E. Brackett from hydrant in Survey Laboratory August 22, 1888. Stage of river (per U.S. Signal Office) 2.4. Water slightly cloudy but easily filtered clear through plaited double thickness of German filter paper (No. 597).

Details of analysis were lost, but results are as follows:

[Total solid: 54.6892 grains per Gallon (70,000 grains)].

Found.		Probable Combination.	
Silica, SiO_2	1.0185	Silica SiO_2	1.0185
Sulphuric acid, SO_4	7.0890	Ferrous sulphate, $FeSO_4$	0.0577
Chlorine, Cl	21.1600	Aluminium sulphate, $Al_2(SO_4)_3$	0.0306
Iron, Fe	0.0213	Magnesium sulphate, $MgSO_4$	4.7104
Aluminium, Al	0.0732	Calcium sulphate, $CaSO_4$	0.9050
Calcium, Ca	4.2774	Sodium sulphate, Na_2SO_4	3.2734
Magnesium, Mg	0.9421	Sodium Chloride, NaCl	34.3023
Potassium, K	0.4228	Potassium Chloride, KCl	0.8152
Sodium, Na	14.5744	Calcium carbonate $CaCO_3$	10.1697
	49.5787		55.2828
Carbonic acid Calculated	6.1018		
	55.6805		

101.08% accounted for.

Analysis by J. Perin Smith

CA

Dec. 20th/88 Collected.

Lab. No. 111

Arkansas River Water

Quantitative analysis of the water collected by Ret Bradlett, Jr. Survey Laboratory. Dec. 20th/88. water muddy. Hydrant

Total solids: 7.5000 grains per gallon a crater bath

wt Dish + "TS"	=	15.80105
wt Dish	=	15.79355
wt "TS"	=	0.00750

"B water slightly opalescent.

Four 4 Litres of the slightly opalescent water used for determination of all save alkalies and sulphuric acid:

Silica, SiO_2: 0.9014 grains per gallon.

wt Cruc + SiO_2 + ff	=	15.12755
" Crucible	=	15.07639
" SiO_2 + ff	=	0.051600
" ff. SiO_2	=	0.000085
" SiO_2	=	0.051515

Calcium; Ca: Ca = 0.5435 grains per gallon.

wt. cruc + CaO + ff	=	15.52450
" Crucible	=	15.44675
" CaO + ff	=	0.07775
" ff CaO	=	0.00141
" CaO	=	0.07634

Magnesium, Mg: Mg = 0.1299 grains per gallon.

wt $Mg_2P_2O_7$ + ff + Cruc	=	15.48127
" Crucible	=	15.44680
" $Mg_2P_2O_7$ + ff	=	0.03447
" ff $Mg_2P_2O_7$	=	0.00011
" $Mg_2P_2O_7$	=	0.03435

Iron (Fe) and Aluminum (Al): Al = 0.0293; Fe = 0.1925 grains per gallon.

wt Al_2O_3 + ff + Cruc	15.07660	wt Cruc + ff + Al_2O_3 + Fe_2O_3	= 15.09382
wt Cruc	15.07335	" Crucible	= 15.07142
wt Al_2O_3 + ff	0.003250	" $(Al_2Fe_2)O_3$ + ff	= 0.01900
wt ff	0.000085	" Al_2O_3 + Fe_2O_3	= 0.00611
" Al_2O_3	0.003165		= 0.01884
		wt Al_2O_3	= 0.003165
		" Fe_2O_3	= 0.015719

½ Litre for Sulphuric acid and the Alkalies:

Sulphuric acid, SO_4: = 0.6195 grains per gallon.

wt Cruc + $BaSO_4$	=	21.74844
" Crucible	=	21.73770
" $BaSO_4$	=	0.01074

Alkalies:

wt K = 0.001984 grams. = 0.29 grains per gallon

wt Na = 0.010619 grams. = 1.4866 grains per gallon.

wt Chlorides + Dish	=	15.82435
wt Dish	=	15.79355
wt. KCl + NaCl	=	0.03080
wt KCl	=	0.00379
wt NaCl	=	0.02701

Griffin Spring (continued.)

Hypothetical combination: grains per gallon

Silica (SiO_2)	1.8515	Water of crystallization of $CaSO_4 + 2Aq$ = 0.2002 g. per gallon, = 1.67% of 11.9430.
(Fe_2O_3) Ferric Oxide	0.0694	
(Al_2O_3) Alumina	trace	
Sodium Chloride ($NaCl$)	1.7908	
Sodium Sulphate (Na_2SO_4)	2.1896	1.67% of 11.45 = 0.1912 grains
Potassium Sulphate (K_2SO_4)	0.7332	
Calcium Sulphate ($CaSO_4$)	0.7623	11.45 − 0.1912 = 11.2588 grains per gallon, determined on water bath, anhydrous.
Calcium Carbonate ($CaCO_3$)	3.5299	
Magnesium Carbonate ($MgCO_3$)	2.8161	
Anhydrous "T.S." =	11.7428	
water of cryst. of $CaSO_4$ =	0.2002	
Hydrous T.S. ------- =	11.9430	

Total solids on water bath = 11.45 g. per gal.
" " anhydrous = 11.259.
11.7428 ÷ 11.259 = 104.30% accounted for
Small quantity of Nitric acid, and organic matter also present.

Lot No 273. Dickens Spring.

Qualitative analysis of water sent in by Mr. G. D. Harris.

Labelled: See Darling Spring p. 8. on "bench on east side Mt. Nebo. Temp. water Nov. 15/88 60° F; air 53.3
Location NW quarter of SW quarter of section 32, 7N, 2 W. —
Evaporated 200 cc in flat dish for Total Solids.
On boiling a precipitate of $CaCO_3$ appeared.

Dissolved Matter	wt D + D.m	= 14.21200
grains per gallon	wt dish	= 14.18535
9.3275	wt D.m	= 0.02665

Evaporated 5 litres for analysis.
Divided residue into 3 portions. A. B. C.
In portion A found Silica, & Phosphoric acid.

In B. No Fluorine.

In C. B. found Nitric acid. No Li. Iodine, or Bromine
No manganese, no Barium, no Strontium.
Iron considerable, Aluminium large quantity;
large quantity Calcium & Magnesium.
Found Sodium & Potassium.

Temperature,

Trial No. 118

Water from Watalula Springs. Marked:
"Watalula Springs, 11 N., 27 W., north of Ozark, Franklin Co., Ark. A. Winslow Collector"
Only @ 500 cc brought. - Yellow sediment in bottle.
For dissolved matter took 70 cc. filtered water.

5.6 grains per gallon

wt Dish + T.S.	= 14.1855	grams
" Dish	= 14.1799	"
" Total Solids	= .0056	"

Took 500 cc for other analyses:

SiO_2 grains per gallon (70.000 grs) 1.5568 grains.

wt C. ash + SiO_2	= 6.75030
wt C + ash .00085	= 6.739185
wt SiO_2 (500 c.c.)	= 0.01112

Fe_2O_3 and Al_2O_3 . 0.0798 grs per gallon

wt C. ash + Fe_2O_3 + Al_2O_3	= 8.07620
wt C + ash	= 8.075635
wt Fe_2O_3 + Al_2O_3 (500. c.c.)	= 0.00057

Ca = 0.6916 grs. per gallon.

wt cruc. ash + CaO	= 6.75730
wt cruc + ash	= 6.750385
wt CaO	= 0.00692
wt Ca	= 0.00494

MgO wt flask .00007

Mg = 0.3374 grains per gallon.

wt cruc. ash + $Mg_2P_2O_7$	= 6.75680
" cruc + ash (.00007)	= 6.64477
" $Mg_2P_2O_7$	= .11173
wt Mg	= 0.00241

Sulphuric acid not to be used in flask in case not enough water for detection of Chlorine or Sulphuric acid.

Darling Spring, Mt Nebo, April 30. 1889. 9 A.M.
collected by Jos. Head.

Received at A. G. S. L. May 1st 1889.
Water was clear when collected; was filled with precipitated iron when received. Bottle contained 980 cc water. All was used for analysis.

SiO_2 grains per gallon (70000 cc) 1.4442 grains

SiO_2 parts per 100000 2.0632 parts.

wt c. ash + SiO_2	=	15.41970
wt c + ash .000085	=	15.399485
wt SiO_2	=	0.020225

Made filtrate from SiO_2 up to 200 c.c. - divided into two equal portions for parallel determinations of iron, Calcium and magnesium. (& perhaps alkalies).

I 100 cc.

wt c. ash + Fe_2O_3 + Al_2O_3	=	19.39010
wt c + ash .000085	=	19.383485
wt Fe_2O_3 + Al_2O_3	=	0.00662 grams
wt c + ash + Fe_2O_3	=	
wt c + ash	=	7.778485
wt Fe_2O_3		

II. 100 cc.

wt crue. ash + Fe_2O_3 + Al_2O_3	=	18.68755
wt c + ash .000085	=	18.680885
wt Fe_2O_3 + Al_2O_3	=	0.00667 grams
wt crue. ash + Fe_2O_3	=	18.686500
wt c + ash	=	18.680885
wt Fe_2O_3	=	.005615

$Fe_2O_3 + Al_2O_3 = .00667$
$Fe_2O_3 = .00562$
$Al_2O_3 = .00105$

Fe = 0.56203 grs. per Gallon
Al = 0.07938 " " "

Ca. grains per gallon (70000 cc) 0.6657
parts per 100000 0.9510 parts

I wt c. ash + CaO	=	15.40600
wt c + ash .000085	=	15.399485
wt CaO (I)	=	0.00652 grams.

Ca. grains per gallon. 0.6864
parts per 100000 0.9805 parts

II. wt c. ash + CaO	=	6.75240
wt c. + ash .000085	=	6.745685
wt CaO (II)	=	0.00672 grams.

Average grains per gallon 0.6760 grains.

Darling Spring (continued). wt of Alk Cl I = 15.8086
wt of Alk = 15.7914

wt K_2O =
wt Na_2O =
Percent K_2O =
" " Na_2O =

I wt KCl + NaCl = 0.0172
wt KCl =
wt NaCl =

wt C + K_2PtCl_6 = 22.1485
wt crue = 22.1349
wt K_2PtCl_6 = 0.0136
wt KCl =

Taking all determinations in Anal. I of Darling Spring Jr. & except Iron and assuming iron as in II have for probable Combination:

✓ Silica	1.2469		
✓ Ferrous sulphate	1.1935	✓ Bicarb. Magnesia	0.8261
✓ Aluminum sulphate	0.3712	" Lime	2.0862
✓ Bicarbonate of Iron	0.3689		
✓ Sodium Chloride	0.5856		
✓ " Carbonate	0.8304		
✓ Potassium Carbonate	0.2241		

I

wt C. ash + $Mg_2P_2O_7$ =
wt crush. .000085 = 7.626085
$Mg_2P_2O_7$ =
I Mg =

II

Mg = 0.17479 grains per gallon

wt C. ash + $Mg_2P_2O_7$ = 6.75150
crush. .000085 = 6.740185
$Mg_2P_2O_7$ = 0.08132
Mg = 0.00244

Fe 0.56203 Calculated as
$FeSO_4$ = 1.5257.

May 7/89 — Lab. No 119 — "Tribia Spring ½ miles south of Hope, Ark. May 6th 89 — Collector J. C. Brauner"

Water brownish yellow, clear; a little sediment in each bottle. Collected in ½-lite glass stoppered bottles — 8 of them full for analysis. Reaction neutral.

TOTAL SOLIDS.

Decanted 70 cc. — for determ. as a guide, in analysis.

crucible + D.S.	= 14.2834
crucible	= 14.1774
" total solids	= .1060 grams
wt on W. bath	= 14.2834
" after ignition	= 14.2388
loss on ignition	= 0.0446

On water bath 106.0 grains per gallon

Notes: Residue, after evap.^{te} on water bath, brown.
" during ignition blackened and gave off fumes, and gave off odor of burning organic matter. Nearly whole of residue charred and on further ignition

14.2388
14.1774
.0614

Ignited — 61.4 grains per gallon

No. 10

For alkalies took 4 bottles. Containing = 1904 cc
marked (1)

953	cc.
949	cc.
939	cc.
959	cc.
3802	

(1)

For Fe, Ca & Mg took 2 bottles marked (2)

Residue did not effervesce with HCl!

Sulphuric acid:

I 100 c.c.

SO_4 = 10.1661 grs. per gallon (7000 gr.)

wt crucible + $BaSO_4$	= 21.7710
" crucible	= 21.7287
" $BaSO_4$	= 0.0423
" wt SO_4	= 0.01455

II 100 cc. water

SO_4 = grs per gallon.

1st wt $BaSO_4$ + crucible	= 21.8103
2d " after washing again	= 21.8338
3 " "	= 21.8310

wt crucible + $BaSO_4$	= 21.8310
" crucible	= 21.7710
" $BaSO_4$	= .0600
" SO_4	=

Mean $BaSO_4$ = .05115 grams
" SO_4 = .017562

SO_4 = 12.2934 grains per gallon

20
Lab. No. 719

Lithia Spring (continued).
Slope, acid.

Chlorine.

I. 250 cc.

(1st) Igniting. After treatment with HNO_3 + HCl

=

wt enc. ash + AgCl = 7.920000
" enc. .000085 = 7.626435
" AgCl = .293565

II Cl 250 cc Water

wt enc. ash + AgCl = 8.20857
" " .000085 = 7.920000
.28857

mean = .28948 grains AgCl
20.0457 grains per Gallon. (20.0719 grains)

Silica from Alkalies (3 litres, + 80 c.c.)

(enc = 15.3911)

Organic matter, grains per gallon
2.2390 grains

enc. SiO_2 + ft p + organic matter = 16.4009
wt ft paper = 0.3231
enc. SiO_2 + Org. matter of ht = 16.07780
after = 15.97538
Organic matter = 0.10242

SiO_2 grains per gallon
12.7696 grains.

C. ash + SiO_2 = 15.97530
C + ash .000085 = 15.391185
SiO_2 = 0.58412

Silica from 2 bottles, (2) 1904 cc

SiO_2 ft p. + organic matter = 19.17100

(enc = 18.6707)

wt ft. paper = 0.3231
Enc. SiO_2 + Org. matter of ft. = 18.8479
after burning = 18.8325
wt Organic matter = 0.0154

enc. ash + SiO_2 = 18.83250
C + ash .000085 = 18.670785
SiO_2 = 0.16172
+ residue 0.01100
0.17272

SiO_2 after fusion = 0.16002

SiO_2
5.8830 g per gallon

from (4 bottles) 3802

Silica
Grains per gallon
5.4924 grains.

C + ash + SiO_2 = 8.07790
C + ash .000085 = 7.779585
SiO_2 0.29832

Fe + Al. I. 100 c.c. from 250 cc C. ash + Fe Al = 15.401050
C + 2 ash = 15.372485
$Fe_2O_3 + Al_2O_3$ = 0.02857

Lost June 1/89

Fe + Al II 100 cc
2 bottles 1904 cc

C. ash + Fe Al = 18.68970
C + ash .00014 = 18.66204
$Fe_2O_3 + Al_2O_3$ = 0.02766

Fe. (100 cc from 250 cc 2 bottles)
Al. grains per gallon = 0.4065 grains per gal
Fe = 1.2430 grains per gallon

C. ash + Fe_2O_3 = 8.63410
C + ash .000085 = 8.614785
Fe_2O_3 = 0.01932
Fe = .013

Ca I grains per gal
5.2727 grains per gal

C. ash + CaO = 19.44220
C + ash .000085 = 19.361885
CaO = 0.08032

Ca II (100 cc from 250 cc)
5.2922 grains per gal

C + ash + CaO = 18.74100
C + ash = 18.660385
CaO = 0.08062

Ca = ~~0.4030 in 1904 cc.~~

Mg I. 100 cc from 250 cc 2 bottles

C. ash + $Mg_2P_2O_7$ = 18.88660
C + ash .000146 = 18.661916
$Mg_2P_2O_7$ = 0.22469
Mg =

Mg II 100 cc from 250 cc 2 bottles

Mean $Mg_2P_2O_7$ = $\frac{2}{2}$ 7574
(Mg)₂ = .04918
Mg = 4.5192 grains to Gallon

C + ash + $Mg_2P_2O_7$ = 15.60300
C + ash .000146 = 15.372616
$Mg_2P_2O_7$ = 0.23039
Mg =

Lithia Spring (Lab. No. 119)

Alkalies from 4 bottles.

wt D + Alk Cl = 17.2939
D ish = 15.7901
Alk Cl = 1.5038 gm

Used Gooch's method for separating Lithium for K + Na.

The 1.5038 gm of Alk. Chlorides were dissolved in 100 cc water; in each c.c. of the water there are 0.015038 gm Alkali Chlorides.

From this solution took 25 cc; concentrated & treated according to Gooch's process. Wt KCl + NaCl + (LiCl) in 25 cc = 0.37595 gm

Note. this seemed to be too large a quantity of Alkalies to decompose readily with H_2PtCl_6.

wt crue + K_2PtCl_6 = 22.4328
crue = 22.2906
K_2PtCl_6 = 0.1422
KCl =

(Not decomposed with H_2PtCl_6 Contained NaCl in quantity

(Filtrate = 15 c c Amyl Alcohol

D + Li_2SO_4 = 14.1761
Dish = 14.1732
Li_2SO_4 = 0.00290
Error to be subtracted 0.001635
Li_2SO_4 (?) 0.00127

II Took 15 cc sol, containing 0.22557 gm KCl, NaCl + (LiCl) treated according to Gooch's process.

filtrate 11.7 cc Amyl Alcohol.
The KCl + NaCl did not decompose thoroughly with H_2PtCl_6.

D + KCl + NaCl = 16.0144
D = 15.7905
KCl + NaCl = 0.2239

Chlorides not decomposed by H_2PtCl_6

crue + K_2PtCl_6 = ———
crue = ———
K_2PtCl_6 = ———

D + Li_2SO_4 = 14.1742
Dish = 14.1728
0.00140
Li_2SO_4 (to be subtracted) 0.00128
0.00012
Li_2SO_4 =

B.D

Take 10 cc solution, containing 0.15038 gm KCl + NaCl.

Cme + K_2PtCl_6 = 22.3565

Cme = 22.3561

K_2PtCl_6 0.0004

In no case was there any perceptible precipitate of K_2PtCl_6
Seems to be no appreciable quantity of Potash in the water

Na = 10.8972 grains per gallon

Na = 10.9056 grains per Gallon. ~

Within Spring.

	Assume	Found.	
SO_4	12.2918	12.2934	Grains per Gallon
Cl	20.0419	20.0457	" " "
SiO_2	5.6877	5.6877	" " "
Fe	1.2430	1.2430	" " "
H	0.4065	0.4065	" " "
Ca	5.2812	5.2812	" (5.2824 gms)
Mg	4.5192	4.5192	"
Na	10.8972	10.8972	"
K	0.0117	0.0117	"
Li		None.	

~ Agree Results ~

SO_4	12.2934
Cl	20.0447
SiO_2	5.6877
Fe	1.2430
Ca	5.2824
Mg	4.5202
Na	10.8970
K	0.0117
Li	None
H	0.4065

Agree

Lab. No. 269. Ellington's Gas Well,
~~Section~~ North East 1/4 Section 19; 6 N.; 26 W.

About 400 yards N.E of Capt. W. J. Ellington's house.
One mile from Magazine P.O, Logan County Ark.
Time of collection 7 A.M. June 3. 1889.
Temperature of air 18.5° C. of water 17.7° C.
reaction neutral. no reaction for H_2S with Lead paper.
Water very clear. rate of flow 1 gallon in 2 minutes.
Slight smell of H_2S (? ?).
As bubbles of ~~gas~~ rise in the pipe, they ignite on touching with a match. The ~~&~~ water comes from a black pyritiferous shale.

Grains per gallon of 70000 gm
36.89 grains.

Dish + Total solids	=	15.8436
dish	=	15.7909
100 c.c. T. S	=	0.0527

Not hygroscopic.

residue blackens on heating, but the blackened mass burns off immediately.

wt T.S. after ignition = 0.0443 gm.
Effervesces with HCl like — !

Reacts ~~&~~ weakly for H_2SO_4

Heavy rains did not alter the rate of flow, or clearness of the water, according to my own observations.
The water comes from a depth of 12 ft, in a hole drilled ~~&~~ 50 ft in black pyritiferous shale.
On stopping the flow. like & blowing in the top, the water sinks down 4 or five feet, & comes up with a rush of water & gas. On letting the small iron bucket down the pipe, the water sinks with it, & rises with a fuller flow. Mr. Ellington immersed his leg for several minutes in a tub filled with the water, & it became red as though acted on by hot water.
The water was allowed to run over my arm for several minutes & it also became red. (A stream from the A. G. S. L hydrant produced the same effect.

200 c c water, with $CaCl_2$ + CaO, for CO_2

I wt CO_2 = 0.0487 gm. = 17.045 g per gal. (lost a little)
II wt CO_2 = 0.0613 " = 21.455 g per gallon (OK.

Evaporated to dryness with HCl 2 litres.

Silica

2.5907 grains per gallon.

c. ash + SiO_2 = 15.44180

c + ash .000085 = 15.367785

SiO_2 = 0.07402

Made standard solution of KCl.

Took 1.2184 gm KCl dried at 120° C., dissolved in 200 cc water.

This gives 0.006092 gm KCl in 1 c.c.

" " 0.002897 " Cl in 1 c.c.

I 5 cc KCl sol = 4.5 cc $AgNO_3$ sol.

II " " " " = 4.5 " " "

4.5 cc $AgNO_3$ sol = 0.014485 gm Cl

1 cc " " = 0.003218 " Cl.

Chlorine in Ellington Gas Well.

I 100 cc water = 1.1 cc $AgNO_3$ sol.

II 100 " " = 1.1 " " "

1.1 × 0.003218 = 0.003539 gm Cl.

100 : 70000 :: 0.003539 : X = 2.47786 grains Cl per gallon.

Chlorine = 2.47786 g per gal.

Sulphuric acid H_2SO_4. 750 cc water

SO4 grains per gallon

0.31404 grains

c + $BaSO_4$ = 22.9430

c rue = 22.9332

$BaSO_4$ = 0.0098

SO_4 in 750 c c = 0.0033648 gm

Silica 1500 cc

grains per gallon

2.1289 grains

c. ash + SiO_2 = 18.70060

c + ash .000085 = 18.6549985

SiO_2 = 0.04562

$Fe_2O_3 + Al_2O_3$ 1500 c c

c. ash + Fe + Al = 19.34810

c + ash = 19.346485

$Fe_2O_3 + Al_2O_3$ = 0.00162

Al = 0.0099 grains per gallon

c. ash + Fe_2O_3 = 8.42340

c + ash = 8.422185

Fe_2O_3 = 0.00122

Fe = 0.0398 grains per gallon

28 No 269. Ellington Gas Well.

Ca 1500 cc

Ca = 0.3373 grains per gal. 70000 grains

c. ash + CaO = 18.66350
c + ash .00085 = 18.66335
CaO = 0.01012
Ca = 0.007228

Mg of 1500 c/c was lost

D + AlkCl 1500 cc = 14.8620
Dish = 14.1726
AlkCl = 0.6894

Dissolved 0.6894 gm AlkCl in 100 cc water. 1 cc = 0.006894 gm.
For Potassium + Sodium took 25 cc. 25 cc = 0.17235 gm KCl + NaCl

25 cc

crue + K_2PtCl_6 = 22.3963
crue = 22.3870
K_2PtCl_6 = 0.0093
KCl = 0.00284
NaCl = 0.16951
Na in 25 cc = 0.06676 gm
K in " " = 0.00148 gm

wt Na in 1500 cc water = 0.26708 gm.
" K " " " " " = 0.00595 gm
Na = 12.4637 grains per gallon 70000 grains
K = 0.2776 " " " " "

Mg = 0.05007 grains per gallon

2 Litres

crue. ash + $Mg_2P_2O_7$ = 15.37270
" + ash .00085 = 15.36085
$Mg_2P_2O_7$ = 0.00662
Mg = 0.00143

Resumé of Ellington Rge. well

Found.

Chlorine	Cl	2.47 73	grains per Gallon
Sulphuric acid	SO_4	0.31 40	" " "
Silica	SiO_2	2.35 98	" " "
Iron	Fe	0.03 98	" " "
Aluminium	Al	0.00 99	" " "
Calcium	Ca	0.33 73	" " "
Magnesium	Mg	0.00 50	" " "
Sodium	Na	12.46 37	" " "
Potassium	K	0.27 76	" " "

CO_2	19.2500
CO_3	26.2500

Grs per Gallon

Total Solids on Water bath = 36.89

Hypothetical Combination anhydrous salts in the natural water

Constit.

			Grs per Gallon
Aluminium sulphate	$Al_2(SO_4)_3$		00625
Ferrous sulphate	$FeSO_4$		01080
Potassium sulphate	K_2SO_4		03505
Potassium Chloride	KCl		02293
Sodium Chloride	NaCl		39079
Sodium Carbonate	Na_2CO_3	Calculate as Bicarbonate for Report	25 14 93
Calcium Carbonate	$CaCO_3$		08431
Magnesium Carbonate	$MgCO_3$		00175
Silica	SiO_2		2 35 98

See next page for Resumé final.

R. B. Magazine Spring Ellington Tenn.

Analysis. J.P.S

	Grs. per Gallon Dry.
Aluminium sulphate	0.0625
Ferrous sulphate	0.1080
Potassium sulphate	0.3505
Potassium Chloride	0.2293
Sodium Chloride	3.9079
Sodium Bicarbonate	25.1403
Calcium bicarbonate	1.3648
Magnesium bicarbonate	0.0304

31.1937

Free Carbonic acid 10.9980 grs per Gallon (7000 grs).

Note! Hypothetical Combination above represents anhydrous salts supposed to exist in the water. Calculated in grains per Gallon of 7000 grains to the Gallon.

Lab: No. 272. Qualitative analysis of salts from well.
Label: "June 29. 1889. Evaporate of water of well at Sharp's Cross Roads, Independence county. Sent by Mr. H. Joblin, Batesville, Ark. See letter of June 27. 1889. JCB

Tested according to Fresenius.

Found:

Sulphates,	large	quantity.
Chlorides,	"	"
Carbonates,	small	"
Nitrates	very small	"
Silica		

Calcium,	large	quantity
Magnesium,	"	"
Sodium,	"	"
Potassium		

Iron & Aluminium very small quantity.

Probably contains considerable quantity of Epsom salt, and of Glauber's salt, besides Sodium Chloride, & Calcium Chloride & Sulphate, with, small quantity of Sulphate, Chloride & Nitrate of Potassium.

Lt. No 275. National Springs Ark.

S.W 1/4 of N.W. 1/4 of Section 8; 7N; 27W.
About 25 ft east of Spring St, & about 100 yards south of the iron Spring.
Notes. Flow slow. No smell of H_2S, or reaction for it. Reaction neutral with litmus paper.
Spring 7 feet deep. Water clear, No sediment of iron in or around the spring. No escape of gas apparent. Temperature of air at time of collection 2:45 o'clock P.M. June 3. 1889,

Temp of air = 27.25° C
" of water = 17.75° C
Carbonic acid (CO_2) = 42.2639 grains per gallon.

Chlorine (Cl) I. 100 cc water = 3.95 cc $AgNO_3$ sol (Smith)
II " " = 3.95 " " " (")

3.95 × 0.008218 gm Cl = 0.012711 gm Cl in 100 c.c.
100 : 70000 :: 0.012711 : X = 8.8977 grains Cl per gallon.
Chlorine = 8.8977 g. per gal.

---

70 c.c of water for Total Solids.
Total Solids = 205.00 grains per gallon

D + TS = 15.9936
D = 15.7886
T.S = 0.2050

T.S after ignition = 0.1577

On ignition fused readily. Before ignition the residue was very deliquescent. After ignition the residue does not effervesce with HCl.

Evaporated 500 c.c for H_2SO_4.
SO_4 grains per gallon
71.8382 grains . . .

Wt crue + $BaSO_4$ = 23.7232
crue = 22.2287
$BaSO_4$ = 1.4945
SO_4 (500 cc) = 0.51313

Evaporated 1500 cc for analysis.

SiO_2 grains per gallon
1.6809 grains.

c. ash + SiO_2 = 19.38110
c + ash = 19.345085
SiO_2 (1500 cc) = 0.03602

Fe grains per gallon
0.06925 grains

c. ash + Fe + Al = 18.65240
c + ash = 18.648585
$Fe_2O_3 + Al_2O_3$ = 0.00382

c. ash + Fe_2O_3 = 18.65120
c + ash = 18.649085
Fe_2O_3 = 0.00212 gm
Al_2O_3 = 0.00170 gm
wt Fe (1500 cc) = 0.001484 gm

0.4420 grains per gallon

The solution of Fe, Al, Mg + Alk. was concentrated to 250 cc, of which 2 portions of 50 cc each were used for Alkalies and 2 of 50 cc each for Mg. + Ca.

D + alk Cl = 14.3780
D = 14.1717
I KCl + NaCl 50 cc = 0.2063

D + alk Cl = 14.3877
D = 14.1726
II 50 cc KCl + NaCl = 0.2151

I + II were dissolved in 100 cc water, ~~0.4214 gm KCl + NaCl to 100 cc. 1 cc = 0.004214 gm KCl, NaCl (+c).~~

Evaporated to dryness again and weighed together.

from 100 cc of 250,
(from 1500 cc natural water)

D + Alk Cl = 14.5798
D = 14.1725
From 600 cc natural water ---- KCl + NaCl = 0.4073.

100 cc = 0.4073. 1 cc = 0.004073 cc Alkali Chlorides.

Took 2 portions 10 cc each for NaCl & KCl

(1) 10 c.c. at D + alk. Chl. = 14.21375
" D alk = 14.17280
" KCl + NaCl = 0.04095
K = wt KCl = 0.00047
Na = " NaCl = 0.04022

see p. 34

No 275. National Spring.

Ca I grains per gallon
(1 = 18.7387, 2 = 18.7386)
15.2548 g per gal.
15.2551

c. ash + CaO I	=	18.73860
c + ash, .0001.7	=	18.647070
CaO I	=	0.09153

Ca II grains per gallon
(1 = 19.4375, 2 = 19.4361, 3 = 19.4856)
15.3799 g per gal
15.4036

c. ash + CaO II	=	19.43560
c + ash	=	19.343185
CaO II	=	0.09242

(Mg I was lost.)

c. ash + $Mg_2P_2O_7$	=	15.70870
c + ash	=	15.359316
$Mg_2P_2O_7$	=	0.34939

Mg II 500 cc (of 250)
grains per gallon
17.6500

$Mg_2P_2O_7$ in 1500 cc	=	1.74695 gm.
wt Mg in 1500 cc	=	0.3782146 gm

Nat Spr. 10 cc. from 100 cc. (1) Sep. 33.

K = 0.0003 (in 10 cc.) = 0.3500 grs. per gallon
Na = 0.0158 " = 17.9680 " "
18.4310

wt c. + K_2PtCl_6	=	22.4133
" c	=	22.4109
" K_2PtCl_6	=	0.0024
" KCl	=	0.0007

Nat Spr. 10 cc. from 100 cc. (2) See page 33.

wt R + alk chl.	=	14.2129
" R	=	14.1727
" KCl + NaCl	=	0.0402
" KCl	=	02
wt c + K_2PtCl_6	=	22.4238
" c	=	22.4195
" K_2PtCl_6	=	0.0043
" KCl	=	

Lab No 275. National Spring water.

Constituents determined:

		Gm per gallon	Gr per gallon
Chlorine	Cl	8.8977	✓
Carbonic acid	CO_2	42.2639	✓
Potassium	K^2	0 3550	✓
Sodium	Na	18 4310	✓
Calcium	Ca	15 3293	✓
Magnesium	Mg	1761 00	✓
Silica	SiO_2	1 6809	✓
Iron	Fe	0 0692	✓
Aluminium	Al	0 0420	✓
Sulphuric acid	SO_4	71.8382	✓

Hypothetical Combination:

Potassium Chloride, KCl		0 6697	✓ gr per gallon
Sodium Chloride	NaCl	14 1547	✓ " " " "
Sodium Sulphate	Na_2SO_4	39 6364	✓ " " " "
Magnesium Sulphate	$MgSO_4$	55 8862	✓ " " " "
Silica	SiO_2	1 6809	✓
Aluminium Sulphate	$Al_2(SO_4)_3$	0 2652	✓
Ferrous Sulphate	$FeSO_4$	0 1878	✓
Magnesium Carbonate	$Mg(CO_3H)_2$	39 4119	3.5475
Calcium Carbonate	$Ca(CO_3H)_2$	62 0617	
		273 9548	— CO_2 to decompose Ca and Mg
		28 7306	
		185 2234	total solids

$Al_2(SO_4)_3$	0 2652	
$FeSO_4$	0 1878	
$Ca(HCO_3)_2$	62 0617	
$Mg(HCO_3)_2$	39 4116	

CO_2 in combination with Ca in natural 33.7072

" " " " " Mg " " = 23.7540

Lab. No. 298. Water from open well

"not fitten for a dog to drink".

L. D. Stephens Cabot, Yonoke Co, Ark.

Water milky, but settled at clear point brought. Sediment voluminous dark colored - clay.

Qualitative tests showed large quantities of chlorides & sulphates & little or no carbonates. No reaction for iron, copper - $(NH_4)_2S$.

Rather salty taste.

Dissolved matter — wt D + Dm. = 14.9850

wt D = 14.1725

Dm. — wt Dm. = 0.8125

812.5 grains per Gallon (of 70,000 grains) or 676.81 U.S. Gallon-grains

Unfiltered water

Chlorine. 5 cc. hat water req^d 2.72 cc. $AgNO_3$

1 cc. $AgNO_3$ = .003218 grms Cl

5 cc. hat water = 2.72 cc $AgNO_3$

= 2.72 x .003218 Cl

= .008752 Cl

1 cc. W = .0017504 Cl

70,000

70 cc. W = .1225280 Cl

= 122.52 grains per Gallon 70,000 grains

= 102.05 " " U.S. Gallon

Residue - small portion did not blacken perceptibly on ignition. No appreciable amt of Organic matter

Test. No. 298.

Residue remainder Examined with the following results:

Nitrates – no reaction for

Iodine – } not examined for.
Bromine – }

Aq. of residue has alkaline reaction.

A qualitative analysis gave:

Iron none; Aluminium – very little; Calcium Barium, Strontium; – only Calcium found & quantity small

Sulphuric acid:

SO_4

10 cc. Nat. water.

wt Eff + $BaSO_4$ = 18.7509
wt C. 000085 = 18.643685
wt $BaSO_4$ = 0.10722

250.6 grains per gallon (Imp. 70000)
208.74 " per U.S. gallon

wt SO_4 = 0.0368

A.R.B. This water contains in Solution:

Sulphate of Magnesia – $MgSO_4$ – } Chiefly
Chloride of Sodium – NaCl – } "
Sulphate of lime Small proportion
Silica " "

Qua reaction for potassium.
Not examined for lithium.

R.A.B.

Aug 19 1889

Lab. No. 304 Hot Springs R.

5 Gallons — and a deposit - a Carbonate.

Water clear with very slight white sediment — water salty odor, tasteless. Reaction - neutral.

Took 7 oz for total solids. wt D + Pt. = 14.1920
wt D = 14.1723
wt T. S. = 0.0197

19.7 grains Imp. Gallon = 16.4 grs U.S. Gallon

For water + loss B.B. wt = 1.0077 gm Deposit

1 = 20.2713
2 = 20.2715
3 = 20.2713

C + D & pt = 20.2792
after = 20.2713
water at 110°C = 0.0079

Percent water 0.78%

Percent loss B.B. C + D of ignit = 20.2713
after = 19.8507
loss B.B. = 0.4206

42.06%

For P_2O_5 wt air dry = 5.0002 gm
I deposit dried at 110°C = 4.9612 >

~~II For analysis wt air dry = 20.0034 gm~~ Lost.
~~deposit dried at 110°C =~~ >

Residue from HNO_3 I wt residue = 0.26349 gm

P_2O_5

Carb + $Mg_2P_2O_7$ = 7.45920
Carb = 7.452785
$Mg_2P_2O_7$ = 0.00642
P_2O_5 = 0.00391 gm

Residue ~~II~~ from 20.0034 gm. wt = 1.16779 gm
~~Refused with HK Carb.~~ LOST

SiO_2. Residue I

4.52% SiO_2

C. ash + SiO_2 = 18.84920
Carb = 18.623785
SiO_2 = 0.72542

Weighed into a beaker for analysis air dry = 20.0257 gm.
II wt dried at 110°C = 19.8695 >>

Deposit Residue I Fe + Al. $Fe_2O_3 + Al_2O_3$ = 0.02832
Fe_2O_3 = 0.00472
Al_2O_3 = 0.02360

Deposit Residue I Ca wt CaO = 0.00252 gm.
D I Residue $Mg_2P_2O_7$ = 0.00762 gm. >

Ferro 304

II 304 D. residue from 20.0257 gm = 1.09139 gm
Percent Residue = 5.49%

fused residue II. c. ash + SiO_2 =
Percent SiO_2 c + ash =
4.78 SiO_2 = 0.95123 gm

II 304 D. Residue ~~a trace of lime.~~
304 D Residue II wt $Mg_2P_2O_7$ = 0.03359
0.06% MgO wt MgO = 0.01211

II 304 D. Residue wt CaO = 0.00822 gm.
0.01% CaO

Note 304 D II 20.0257 - after dep. from P_2O_5 made up to 250 cc took 2 portions 10 cc for Ca (+Mg); 2 portions 10 cc for Fe Al &c. 19.8695

304 D residue II $Fe_2O_3 + Al_2O_3$ = 0.09912 gm
Al_2O_3 = .43% Fe_2O_3 = 0.01312
Fe_2O_3 = .06 Al_2O_3 = 0.08600 gm.

304 D II P_2O_5 wt $Mg_2P_2O_7$ = 0.00829 gm
0.026% wt P_2O_5 = 0.00530

304 D II 200 cc. .03% SiO_2 = 0.00502 gm

304 D II (1) 10 cc wt CaO = 0.40248 gm
304 D II (2) 10 cc wt CaO = 0.40199
50.60% CaO Mean wt CaO = 0.40219 gm.
wt CaO in 19.8695 gm = 10.15475 gm

304 II D. 100 cc (1) wt $Fe_2O_3 + Al_2O_3$ = 0.09092 gm.
Fe_2O_3 = 0.36% wt Fe_2O_3 = 0.02862
Al_2O_3 = 0.78% wt Al_2O_3 = 0.06230 "

304 II D 100 cc (2) wt $Fe_2O_3 + Al_2O_3$ = 0.09602 gm

304 D II 10 cc (2) wt $Mg_2P_2O_7$ = 0.01129 gm
.05% MgO MgO = 0.00406

Teabro 304 — 304 Water — 304 — 304 41

Water. 19.7 grains per Imp Gallon
16.4 " " U.S. Gallon
of matter in solution

Note Residue (304): Treated with dil. HCl effervesced briskly; heated — ignited Bunsen burner — perceptible darkening — burned white. After ignition: No effervescence — hence nearly all the carbonate is in the form of alkaline earth (and Iron) carbonates — little or no alkaline carbonate. — HCl sol. gave reactions for: good sulphuric acid; Iron very faint.

Analysis took of water (containing @ 0.2811 grams per litre) for Qualitative

Took 500 cc water for H_2SO_4.

wt $BaSO_4$ (50° Pf = 0.01202 gm

wt SO_4 = 0.00412 gm

Evap^e 6 Litres of Water without acidifying; boiled residue with distilled water have {1. aq. sol. made up to 250 cc. 2. Residue insol. in water, dissolved in HCl & made up to 200 cc.

2. Evap^d to dryness with HCl

SiO_2 wt ignited pp + SiO_2 = 18.75770

Insol in water SiO_2 parts in 100000 — wt ignited pp (0.00108) = 18.63388

2.0636 parts — wt SiO_2 = 0.12382

Made hydrochloric acid solution of 2. up to 200 cc.

Made aqueous solution 1. up to 250 cc.

Took two portions of 100 cc from 1. 250 cc for Fe, Al, Ca, Mg, & Alkalies

304 aq. sol. (1) 100 cc. wt SiO_2 = 0.00372 gm

304 aq. sol. (1) 100 cc. no Fe or Al

304 aq. sol. (1) 100 cc. wt CaO = 0.00912 gm

304 aq. sol. (1) 100 cc. wt $Mg_2P_2O_7$ = 0.03029

wt MgO =

304 Aq Sol (2) 100 cc wt $Mg_2P_2O_7$ = 0.02999 gm

wt MgO =

42 304 Hot Spring

304 (2) 100 cc Aq Sol. wt SiO_2 = 0.00352 gm

304 (2) 100 cc Aq Sol. wt CaO = 0.00842 gm

Chlorine. 100 cc = 1.1 cc aq NO_3 (1 cc = .000645 Cl
10 cc = .11 cc aq NO_3
70 cc = .77 cc aq NO_3
= 0.04965 Cl

304 Hcl. Sol. 10 cc. (1) CaO = 0.03482 gm
0.03492
2 | 0.06974
0.03487 = mean CaO

304 Hcl Sol. 10 cc. (2) CaO = 0.03492 gm (redissolved)

Mean = 0.03487
(Fe_2O_3) --- = 0.00112
CaO --- = 0.03375 = 304 Hcl Sol. CaO, mean of (1) + (2)

304 Hcl. Sol. (1) 10 cc wt $Mg_2P_2O_7$ = 0.01152 gm
wt MgO =

304 Hcl Sol (2) 10 cc wt $Mg_2P_2O_7$ = 0.01352
wt MgO =

(Alkcl (1) 100 cc was Lost)

304 Aq. sol 100 cc (2) d + alkcl = 14.1934
d = 14.1705
KCl + NaCl = 0.0229

NaCl - KCl = 0.0229
KCl = 0.0075 OK
NaCl 0.0154

cmc + K_2PtCl_6 = 22.7394
cmc = 22.7148
K_2PtCl_6 = 0.0246

304 Hcl Sol 100 cc $Fe_2O_3 + Al_2O_3$ = 0.00372 gm
Fe_2O_3 = 0.00152
Al_2O_3 = 0.00220 gm.

304 Hcl sol 150 cc. wt $Mg_2P_2O_7$ = 0.07879 gm

304. HCl. Sol. 100 c.c. wt KCl + NaCl = 0.0206
K = 0.00508 gm wt KCl = 0.0097
Na = wt NaCl = 0.0109
wt K_2PtCl_6 = 0.0319 gm.

Ag sol.

SiO_2	0.1055	grs pr	Imp Gallon	OK ✓
	0.0878	" "	U.S. Gallon	
Ca	0.1827	" "	Imp Gallon	OK ✓
	0.1521	" "	U.S. Gallon	
Mg	0.1903	" "	Imp Gallon	OK ✓
	0.1585	" "	US Gallon	
Na	0.1769	" "	Imp Gallon	OK ✓
	0.1473	" "	U.S. Gallon	
K	0.1147	" "	Imp Gallon	OK ✓
	0.0955	" "	US Gallon	

HCl sol.

SiO_2	None 5.2496			
Ca	5.6257	grs pr	Imp Gallon	✓
	4.6857	" "	US Gallon	
Mg	0.3980	" "	Imp Gallon	OK
	0.3315	" "	US Gallon	
Na	0.1001	" "	Imp Gallon	OK ✓
	0.0833	" "	US Gallon	
K	0.1187	" "	Imp Gallon	OK ✓
	0.0988	" "	US Gallon	
Fe	0.0247	" "	Imp Gallon	OK ✓
	0.0205	" "	US Gallon	
Insol in HCl	SiO_2 = 1.2382 grams			Obs.
	or 1.1445	grs pr	Imp Gallon	OK
Al	0.0271	grs pr	Imp Gallon	OK ✓
	0.0225	" "	US Gallon	

Resumé For Water
Aq. Sol + H Cl. Sol.

	Imp. galls	US galls
SiO_2	1.5500	1.2911(5)
Ca	5.8078	4.8378
Mg	0.5883	0.4900
Na	0.2770	0.2306
K	0.2334	0.1943
SO_4	0.5777	0.4812
Total	9.0392	7.5250
Cl	0.4966	0.4136
	9.5358	7.9386
Fe	0.0247	0.0205
Al	0.0271	0.0225
Total	9.5876	7.9816

19.7
.833
.591
5.96
15.7
16.288

19.7
.833
.591
5.96
15.7
16.410

note

Al_2O_3 .0511 grs. per Imp Gallon
.0425 " " U.S. Gallon

Fe_2O_3 .0354 " " Imp Gallon
.0294 " " U.S. Gallon

Dry with Combustion

SiO_2	1.5500 grs. per Imp Gallon.	
$CaSO_4$	0.6196 " " "	0.6213
$MgSO_4$	0.1759 " " "	0.1738
$MgCl_2$	0.6138 " " "	0.6153 OK
KCl	0.0799 " " "	0.0776 OK
K_2CO_3	0.3583 " " "	0.3404 OK
Na_2CO_3	0.6374 " " "	OK
$CaCO_3$	1.4066 " " "	OK
$MgCO_3$	1.3930 " " "	OK
Al_2O_3	0.0510 " " "	
Fe_2O_3	0.0352 " " "	
Total	19.5559 " " "	5.5-3

99.26% accounts for
19.7 mg total solids

Lab. No. 360.

Spring water from Long Spring
Section 19, N.S. 2 E.
Colly J.D. Conway, Washington Ariz.
August 1889.

Temperature 58° F.
" air 85° F. "

Qualitative analysis

Total solids: wt dish + T.S. = 14.1739
wt dish = 14.1687
wt Total Solids = 0.0052
(dried on water bath)

5.2 grs per gallon (Imp) wb.

after ignition wt dish + T.S. = 14.1730
wt dish = 14.1687
wt T. Solids = 0.0043

4.3 grs per gallon (Imp) ig.

Phaenomena on ignition: Scorched brown gave off white fumes, burned white.

Character of water: Clear; slight brownish yellow sediment - (iron hydroxide); odor none; taste none; reaction neutral.

Rec'd in a flat green quart whisky bottle - old cork, sealed with green wax. -

Sulphuric - faint, but decided reaction in test tube

Barium - none.

Iron & aluminium - not very strong but decided reaction in test tube for iron, with Ferrocy. - scarcely trace with NH_4Cl.

Calcium -

Magnesium -

alkalies -

Carbonic acid: - no reaction in test tube.

Hydrochloric acid: - decided reaction in test tube.

H_2S group - (100cc.) in acid sol. (HCl) no reaction

$(NH_4)_2S$ group: (100cc.) with NH_4Cl, NH_4OH
Very small precipitate - black iron.

$(NH_4)_2CO_3$, NH_4Cl, NH_4OH - no reaction for calcium
Took out portion & treated with $(NH_4)_2C_2O_4$
very small precipitate.
Filtered & reacted for Mg. Considerable Mg.

360 Continued

From 70cc F.S. – on ignition burns brown & gives off white fumes – no decided odor.

Bottle opened & analysis made Jan 9/1890

Lab No 413 — Water, marked "J.W. McConnells spring N end of E½ of S.W. ¼ of N.W. ¼ of N.E. ¼ of Sec. 7, 1N., 12W. Collected May 29th 1896 by McConnell"

— Qual test. —

water cloudy yellowish, & yellowish brown sediment in bottle. Odor none.
taste slightly flat, none decided.
70 cc. Distilled water gave

wt D + S = 15.7982
wt D = 15.7851
wt Total solids = 0.0131

Grains per gallon Imp.) 13.1 grains
" " U.S. Gallon. 10.9123"

Qual. tests on small quantities of the water decanted & allowed to stand over night showed

Chlorine — slight reaction
Sulphuric acid — none
Barium — none
Iron — slight reaction
Calcium — slight reaction
Magnesium —

None at once with H_2S — very slight with $(NH_4)_2S$.

The residue showed:
Brown color due to iron in part & partly to organic matter for
On ignition turned black gave off slight fumes with faint odor of burning organic matter — afterward all black burned off left some brownish yellow due to iron. —

wt D + S before ig = 15.7982
" " after ig = 15.7884
wt lost on ignition = 0.0098