Bulletin No. 19. 1899.

University of Idaho Agricultural Experiment Station.

MOSCOW, IDAHO.

DEPARTMENT OF CHEMISTRY.

MISCELLANEOUS ANALYSES:

a. Strawberries.

b. Peas.

c. Wines.

d. Foods, Poisons, Fertilizers.

e. Potable Water.

CHAS. W. McCURDY. THORN SMITH.

DEMOCRATIC-TIMES' JOB ROOM,
Moscow, Idaho.
1899.

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BULLETINS.

The regular bulletins of the Station are sent free to all who request them. Bulletins issued since the close of the fiscal year, June 30th, 1898,:

16. The San Jose Scale in Idaho.
17. Construction and Management of Hotbeds.
18. Sugar Beet Investigations In 1898.
19. Miscellaneous Analyses.

MISCELLANEOUS ANALYSES.

CHAS. W. McCURDY, Ph. D., Chemist.

THORN SMITH, B. Sc., Assistant.

In the following pages are presented the results of some original investigations, also some miscellaneous data collected by the Chemical Department, extending over the past three years. The analytical data, in many cases, have been reported promptly to the persons most interested, while much is of a general character, worked out by advanced students interested in agricultural and domestic chemistry under the careful supervision of the authors, and has not yet been reported upon. Regarding the information and results obtained to be of real interest and value to the general public the same is herewith presented in bulletin form for distribution and preservation.

STRAWBERRIES.

This fruit was grown by the Station during the season of 1896, without irrigation and from plants one year old. The analyses were made when the plants were in full fruit, July 8–10, for sugar content only. The juice was obtained by pressure, and the sugar determined by Fehling's solution:

VARIETY.	PER CENT. SUGAR.
Eureka	3.62
Heaverland	4.25
Shuster's Gem	2.89
Berder Wood	3.73
Van Deman	2.90
Marshall	3.04
Princeton Chief	3.62
Greenville	3.88
Woolverton	3.65
Pearl	3.69
Dayton	3.55
Risel	4.08
Meek's Early	3.65
Timbrell	3.84
Michell's Early	3.36
Stayman No. 1	3.43
Gandys	4.17
Crescent	5.49
Mrs. Cleveland	3.83
Lovetts	5.50
Burt's Seedling	4.27
Jessie	5.74
Cumberland	4.47
Princess	5.21
Shuckless	5.48
Enhanse	3.72
Chas. Downing	4.47
Buback	5.53
Wilson	4.69
Warfield No. 2	5.66
Parker's Early	5.42
Swindle	3.69
Saunders	4.46
Splendid	4.52
Sharpless	4.63
Beverly	3.76

Samples Nos. 11, 12, 14, 16, 17, 18 were analyzed 24 hours after picking; the other samples were examined the same day they were gathered.

The above report is but the preliminary of an exhaustive

study of the large and small fruits grown in the state, at different altitudes, with and without irrigation.

PEAS.

The following varieties of peas, grown by the Station, were examined for sugar content. They were grown under normal conditions, without irrigation; were picked as they matured fit for consumption upon the table. The earliest varieties came into use June 25; the analyses were completed July 10, 1897. The sample was handled as directed by the "Official Method," J. L. Gilbreth, M. Sc., a graduate student in chemistry, making the determinations:

VARIETY	TOTAL SUGAR PER CENT
Alaska (a)	1.05
Alaska (b)	0.71
American Wonder	0.70
American Champion	0.85
Abundance	1.09
Admiral	0.69
Best Extra Early	1.00
Blue Sterling	1.34
Blue Beauty	0.96
Bower's Extra Early	0.83
Burpee's Quality	0.75
Burpee's Quantity	1.02
Burpee's Profusion	1.24
Blue Peter	1.24
Bishop's Long Pod	1.15
Bliss Everbear	0.92
Bliss Abundance	1.14
Blue Imperial	1.27
Champion of England	1.42
Canfield	1.32
Carter's Daisy	1.06
Champion English	1.32
Duke of Albany	0.55
Dwarf Sugar (a)	1.12
Dwarf Sugar (b)	1.03
Dwarf Blue Imperial	1.24

VARIETY	TOTAL SUGAR PER CENT
Dwarf Champion	0.92
Extra Early Pre. Gem	0.42
Early Green	1.21
Everbearing	1.12
Early Marrowfat	1.28
Echo	1.04
First and Best	1.19
Faragon	1.13
Full Basket	1.25
Green Field	1.27
Green	1.03
Heroine	0.93
Improved Dan O'Roque	1.29
Improved Stratagem	0.87
Krombek	1.00
Krombek Shell	1.01
Lawton's Earliest Fall	0.64
Little Gem	0.40
Lawton's Alpha	1.18
Loving Field	1.26
Maud S.	0.97
McLean's Advance	1.17
Melting Sugar	1.44
Market Garden	1.03
Nott's Excelsior	0.85
Nott's No. 96	1.09
Pride of the Market	1.15
Premium Gem	1.19
Renown	0.98
Sterling	1.02
Stratagem	0.87
Shropshill Hero	1.18
Saunder's Marrow	1.32
Tom Thumb	1.16
Telephone (a)	0.75
Telephone (b)	0.63
Telegraph	1.25
Fall Sugar	1.15
Victoria	1.17
William Hurst	0.96
White Field	1.14
Yorkshire Hero	1.03

WINES.

The following samples were sent in for examination by the Payette Nursery Co., Payette, Idaho, and Robert Schleisher, Lewiston, Idaho. Returns were made May 21, 1895. No data accompanied the samples other than the request for analysis:

WINE ANALYSES.

Manufacturer.	Number.	Per cent. of alcohol by weight.	Per cent. of alcohol by volume.	Tannin.	Total acid as tartaric.	Total volatile acid as acetic.	Extract.	Ash.	Specific gravity.
Robt. Schleisher, Lewiston, Idaho	1	9.35	9.15	0.176	0.0712	0.0344	1.767	0.120	0.9875
" " " "	2	8.98	11.15	0.012	0.1041	0.0296	2.211	0.170	0.9853
Payette Nursery, Payette, Idaho	3	6.95	8.65	0.245	0.0472	0.0216	1.047	0.196	0.9882
" " " "	4	8.16	10.15	0.104	0.0520	0.0484	1.126	0.286	0.9864
" " " "	5	8.90	11.05	0.154	0.0584	0.0444	1.162	0.320	0.9854
" " " "	6	7.39	9.20	0.138	0.0544	0.0372	1.278	0.400	0.9875

PEPPER, GROUND BLACK.

Sample sent in from Moscow. A pure Sumatra sample is appended by way of comparison.

Composition.	Moscow.	Sumatra.
Moisture	8.104	10.100
Piperin	4.420	4.700
Gum	7.311	1.140
Aqueous extract	16.220	17.590
Ash	3.844	4.310

ENGLISH BREAKFAST TEA.

Bought on the market.

	Per cent
Ash	6.120
Ash soluble in water	3.300
Ash insoluble in water	2.820
Ash soluble in acid	2.188
Extract by alcohol	46.150
Total extract in leaf	54.458
Theine	2.251
Tannin	15.482

The sample of tea is of good quality and carries no adulteration.

VINEGAR.

Two samples are presented. No. 1 was sent in by local citizens; No. 2 was purchased on the market. No. 2 was manufactured by The Alden Vinegar Co., St. Louis, Mo., and diluted according to formula furnished:

Composition.	No. 1.	No. 2.
Specific gravity	1.010	1.004
Acetic acid	4.350	2.000
Total solids	0.620	0.660
Volatile matter	0.435	0 503
Ash	0.180	0.157
Water	94 410	97 283

No. 2 is a spirit vinegar of about half strength, artificially colored with caramel. The standard by law in New York is 4.5 per cent. of acetic acid, and at least 2 per cent. of vinegar solids; Massachusetts requires 5 per cent. and 1.5 per cent. respectively.

CREAM OF TARTAR.

Samples were purchased from local grocers:

No. 1. "Shilling's Best."

The sample dissolved very readily in water. The analysis returned 99 per cent. of cream of tartar—potassium acid tartrate.

No. 2. This brand was dirty, put up in 5 pound cans and manufactured by Benham & Griffiths, Spokane, Wash.

The sample carbonized scarcely at all, would not dissolve, showing it to be badly adulterated. The analyst returned:

Calcium acid phosphate	53.09	per cent.
Calcium sulfate	17.63	" "
Undetermined	29.28	" "
Total	100.00	" "

No. 1586. BREAKFAST FOOD—PALOUSE MEAL.

Obtained on the market at Moscow:

Constituents.	No. 2 Fine	
Moisture at 100 degrees C	13.69	per cent.
Ash	0.90	"
Ether extract (fat)	3.34	"
Fiber	0.91	"
Nitrogen	2.48	"
Protein	15.50	"
Nitrogen, free extract	65.66	"

A practical test was made of a portion of the sample and it was found to possess good flavor, and cooking qualities. It is evidently manufactured from wheat.

No. 1587. K. C. BAKING POWDER.

An original package of this powder, put up by Jaques M'f'g Co., of Chicago, and intended for free distribution, gave results as follows:

Available carbonic acid gas, 8.73 per cent.

ANALYSIS OF RESIDUE.

Soda	22.05 per cent.
Potash	1.50 "
Alumina	1.63 "
Iron oxid	trace
Phosphoric acid	2.92 "
Sulfuric acid	12.89 "
Carbonic acid	9.42 "
Starch and water of crystalization	49.59 "
Total	100.00 "

It is difficult to classify this combination of "25 ounces for 25 cents." It would make an excellent fertilizer, but as a baking powder we cannot recommend it.

GERMAN WASHING FLUID.

The sample was purchased on the market in Moscow in the original package. The analysis showed it to contain:

Free sodic hydrate	4.74 per cent.
Soap (by difference)	1.67 "
Total solids	6.41 "
Water	93.59 "

The sample was manufactured by the German Washing Fluid Co., of San Francisco, was put up in a whiskey bottle, capacity one quart, and retailed at 25 cts. The bottle and con-

tents were not worth to exceed 5 cts.—400 per cent. profit. The label stated: "Beware of Imitations." It would be difficult to perpetrate a greater fraud.

LYE

An original package of "B. T. Babbitt's Pure Concentrated Lye, Double Strength of Common Potash" showed up as follows under the cold-blooded analysis of the chemist:

Sodium hydrate	86.90 per cent.
Sodium chlorid	7.56 "
Sodium sulfate	4.85 "
Water	.58 "
Insoluble	.01 "
Total	99.90 "

Instead of being true to the label the sample contained absolutely no potash, but was a sodic lye, a much cheaper article.

Another brand marked "American Concentrated Lye, *Warranted Pure*," manufactured by the American Lye Company, Philadelphia, came out of the crucible of the chemist as follows:

Sodium hydrate (lye)	72.01 per cent.
Sodium chlorid	16.70 "
Sodium sulfate	4.94 "
Sodium carbonate	0.33 "
Alumnia	0.06 "
Iron oxid	trace
Magnesia	trace
Insoluble	trace
Water as undertermined	1.87 "
Total	100.00 "

"SOLID SILVER WARE"

As an illustration of the extent to which the public permits itself to be duped and taken in by the street fakir a "Solid Silver Spoon," samples of which, by the half-dozen, were eagerly sought by the crowd, was purchased upon the streets of Moscow. The analyst's returns were:

Iron	97.56 per cent.
Tin	2.18 "
Total	99.74 "

PARIS GREEN.

This chemical known as Schweinfort Green, or Aceto-arsenite of copper, $Cu(C_2H_3O_2)_2$, $3(Cu\ O\ As_2O_3)$, as usually made, varies much in composition. Originally manufactured as a pigment, it has come to be used in enormous quantity as an insecticide. It is rarely found pure in commerce, that is, corresponding to the formula above; on the other hand, it is very generally adulterated in states having no pure food and drug laws, and when the percentage of arsenic falls below 50 it should be so regarded. The following may be accepted as the average composition of pure Paris Green:

Moisture at 100 degrees C	1.29 per cent.
Arsenious oxid	59.28 "
Copper oxid	32.51 "
Acetic acid	4.74 "
Insoluble matter	0.17 "

Samples sent in for examination:

No.	Place.	Date.	Arsenic.	Copper Oxid.
1	Lewiston	May, 1898	59.96 per cent.	
2	"	"	51.20 "	
3	"	"	39.61 "	
4	"	March, 1899	56.03 "	29.98 per cent.
5	"	"	56.08 "	29.91 per cent.
6	Moscow	April, 1899	54.95 "	
7	Kendrick	"	57.41 "	

SULFUR

Two samples of sulfur were sent on by the Idaho Wool Growers' Association for analysis. Combined with lime it is used as a dip for "scab." March, 1899:

Constituents.	Domestic.	Oregon.
Soluble sulfur	99.960 percent	98.660 percent
Insoluble	0.144 "	0.576 "
Lime	none	trace
Foreign matter	0.196 "	0.764 "
Total	100.000 "	100.000 "

HOPS.

Samples of hops submitted by the Director and grown on the Station grounds in 1896. In portions of the state this crop is receiving considerable attention.

No. 1, Pole System; No. 2, Flat on Ground.

	No. 1	No. 2
Water	2.490 percent	1.400 percent
Ash	8.700 "	9.310 "
Lupulen	0.161 "	0.139 "
Crude Fiber	16.432 "	17.001 "
Other residues undetermined	72.219 "	72.150 "
Total	100.000 "	100.00 "

SUNFLOWER SEED.

Submitted by the Director. As a food for fowls it is a most excellent ration. Dr. W. W. Watkins, one of our most enthusiastic poultry men, reports having fed the large Russian variety all through the winter with splendid results, both as to egg producing and health giving qualities:

Per cent. of kernel to whole seed	42.825 per cent.
Per cent. of hull	57.175 "
Total	100.000 "
Per cent. of oil in kernel, ether extract	36.739 per cent.
Per cent. of marc	62.261 "
Total	100.000 "

ASH.

The following analyses were made for the purpose of learning the composition of the ash as a fertilizer for growing crops, also for the production of lye for soap making. The yellow and white pine, red and white fir, and tamarack are the woods used for heating purposes in the homes of northern Idaho and eastern Washington. The sage brush is largely made use of in a similar way in South Idaho:

Constituents.	Yellow Pine.	White Pine.	Red Fir.	Tamarack.	Box Elder.	Sage Brush, Xampa, entire plant.	Rock Spring Coal, Wyoming.
Moisture	0.7300	0.4900	0.4450	0.4150	....	0.5600	0.7000
Potash and soda	10.7391	6.4107	7.1595	5.2120	6.5320	3.7970	0 7672
Lime	24.9479	29.5475	31.0322	22.8762	12.7000	8.5290	3.9225
Phosphoric acid	0.6190	1.2821	1.6465	2.1982	4.2530	1.0170	1.0401
Silica	11.0575	9.1075	8.7565	5.4414	7.4850	70.6400	4.9724
Insoluble matter	16.3895	15,6465	15.8665	17.6554	34.4486		52 9234

SAMPLES OF COAL FOUND IN THE STATE.

No. 1 from H. H. Hoff, obtained in Bear Lake county; No. 2 from T. F. Hutchinson, Rockland, Oneida county; No. 3 is a sample of Brier Hill coal, Wyoming:

Constituents.	No. 1	No. 2	No. 3
Moisture at 100 degrees C.	0.65 per cent.	1.39 per cent.	2.21 per cent.
Volatile carbon	32.45 "	6.53 "	44.65 "
Fixed carbon	43.10 "	69.80 "	51.54 "
Sulfur	7.41 "	not det.	not det.
Ash	16.40 "	17.74 "	1.60 "
Total	100.01 "	95.46 "	100.00 "

POTABLE WATER.

As stated in a former publication of this Station, Bulletin No. 8, water is one of the most abundant and at the same time most universally consumed of any thing known to man. No other one substance contributes so much to his health and happiness and his existance, air alone excepted, as water. Good health is one of the greatest blessings we can enjoy, and pure water is a prime factor in its promotion.

"To those who value their health and that of their family, to those who would have strong and thrifty animals, to those who desire pure milk and first-class butter, we would say that it is of primary importance that the water supply should be from a source beyond suspicion, and that this source should be carefully guarded against pollution."—Sanitary Home.

Being almost a universal solvent, water is never found pure in nature, but is charged with gaseous and solid material as it falls through the air and percolates through the soil in its unremitting round to meet the law of supply and demand. Under normal conditions, the soil water, as it enters the well by a vein or issues from the ground as a spring, is pure; and its pollution, in a majority of instances, as shown by chemical data, is derived from the drainage of farm buildings and barnyards, privy vaults, house and street sewerage. If a well or spring be polluted the cause may be traced almost invariably to its location and dirty surroundings; if the water be taken from a river direct or from an irrigating ditch, the city sewerage, decaying vegetable matter growing along its banks, fresh water *algae*, hair, excreta, water fleas, spongilla, and parasites of various sorts will likely be the contaminating agencies.

From a careful study of the data accompanying the samples of potable water analyzed by this Station, and from personal inspection of several of the sources of supply, we are convinced that a close relation exists between the depth of water in wells, cisterns and the flow from springs, and sickness from typhoid fever, dysentary, cholera, etc. The statistics of Boards of Health demonstrate that the maximum of sickness and the minimum of water are coincident in September or October. Usually a low stage of water represents a concentrated state of contamination, hence typhoid fever outbreaks that are traceable almost directly

to the drinking water and its source of supply during those months.

The Michigan State Board of Health may be quoted with force on this point:

"The most scrupulous care should be taken to keep the present sources of drinking water pure, and to procure future supplies only from clean sources. The general water supply of cities and villages is a matter of greatest concern; it should be procured from places where there can be no probability of immediate or remote contamination. The well known outbreak of typhoid fever at Plymouth, Pa., where over a thousand cases and one hundred and fourteen (114) deaths occurred, is apparently an illustration of how great a calamity may follow the fouling of a general water supply by the discharges of a person sick with typhoid fever. When there is no general water supply, nor good sewers, much may be done to protect wells by the abolition of cess-pits and privy vaults, by the use of dry earth in privies, and by the frequent removal therefrom of all their contents. * * * Privies often drain into wells, unsuspected by those who use the water. Should typhoid fever discharges pass into such a privy, an outbreak of typhoid fever among those using the water from a neighboring well would be likely to occur. If such a well were the source of the general water supply of a city, typhoid fever might soon be epidemic there. * * * There is good reason to suspect the water of a well whenever a vault is situated within a hundred feet of it, particularly if the soil be porous. In numerous instances fluids from excreta have leached into wells from much greater distances; and it has been proved that a well thirty rods from a cemetery received water which had filtered through the soil of the cemetery. Dangerously contaminated water may be, and often is found to be, clear and colorless, and to have no bad taste."

A case in point is the "Big Spring" at Kendrick, Idaho, used by the residents "on the hill," the water of which is "clear and sparkling." "This so-called spring," writes Dr. A. F. Wohlenberg, Aug. 26, 1896, "is at the base of a bluff, below the bed of the stream and of a slough, some distance away containing stagnant water in August, but separated from the spring by a gravel bank. Sixty feet from the spring is a house occupied by eight people; forty feet distant is a stable occupied by horses and cows; a privy vault is near the slough; ducks and chickens in flocks, and all this filth filtering into the slough which apparently feeds the spring." Need one seek farther as to the cause of some twenty cases of typhoid fever in a half dozen families, in 1895-96, using this water exclusively? More dirty surroundings of a spring or well could hardly be conceived.

"About fifty thousand persons die annually in the United States from typhoid fever, and more than ten times this number are sick with this disease," writes Dr. V. C. Vaughn, of Michigan. It behoves the farmer, the community, the city to guard well its public water supply and reservoirs, and during warm weather to have the same frequently inspected.

ARTESIAN WATER OF MOSCOW.

Fortunately the city of Moscow and the University buildings and campus are provided with water of exceptional purity. The water is artesian and the wells are five in number, varying in depth from 94 to 105 feet; supply is 12,000 gallons per hour; the temperature of the water is 53 degrees F. No outbreak of typhoid fever or any other contagious disease, traceable to the water supply, has occurred in our midst wherever the shallow wells throughout the city have been discarded for the artesian supply. The standpipe system is in use here.

Following is a complete chemical analysis of the city water, sampled at the pumping station, near the north end of the city, March 23, 1899, and analyzed by Mr. Thorn Smith, the assistant chemist:

COMPOSITION OF THE CITY WATER, MOSCOW, IDAHO.

Constituents	Parts per million
Appearance	slightly turbid
Total solids	190.00
Loss on ignition	42.80
Mineral matter	147.20
Chlorin	3.29
Nitrogen as free ammonia	0.09
Nitrogen as albuminoid ammonia	0.08
Nitrates	Trace.
Nitrites	None.
Oxygen consuming power	Slight.
Hardness, total	190.00
" temporary	145.00
" permanent	45.00
Temperature at the wells	53° F
MINERAL MATTER.	
Silica, $Si O_2$	61.40
Alumina, $Al_2 O_3$	2.30
Iron oxid, $Fe_2 O_3$	Trace.
Calcium carbonate, $Ca CO_3$	55.85
Magnesium carbonate, $Mg CO_3$	15.23
Sodium chlorid, $Na Cl$	5.43
Sodium sulfate, $Na_2 SO_4$	5.32
Potassium sulfate, $K_2 SO_4$	1.60
Undetermined	.07
Total	147.20

NOTE.—To reduce parts per million to grains per U. S. gallon, multiply by 0.058.

WATER ANALYSES.

The following table presents a comparative view of potable waters sent in for analysis. The analysis of well water at this Station has thus far been confined to chemical tests looking to an excess of foreign matter from barns, closets and service pipes.

Laboratory No.	Sample submitted by	Post office	Date collected	Parts Per One Hundred Thousand: Total solids at 105° C	Loss on ignition	Chlorin	Free ammonia	Albuminoid ammonia	Nitrogen as nitrates	Nitrogen as nitrites	Oxygen consumed	Permanent hardness, Clark's Scale	Source of water	Quality of water
28	Soldiers' Home.	Boise	9-'94	33.56	10 64	1.237	0.003	0.004	.....	.....	.....	7.43	spring	Excellent
29	M M Snow	Moscow	10-'94	31 36	9 80	1.415	0.020	0.060	.....	.....	.....	11 32	23 ft well	Good
31	D H V Clymer..	Huntington, Or.	2-'95	215.28	97.24	1.033	trace	0.010	.....	.....	.....	3.00	well	A carbonate water
32	W A Zumhof...	Moscow	2-'95	21.20	9.12	0.688	trace	0.028	.....	.....	.....	7.70	56 ft well	Wholesome
33	J W Diamond...	Juliaetta	2 '95	82.72	4.62	1.032	0.006	0.011	.....	.....	.....	3.72	w in town	Good
34	O F Bacon	Bruneau Valley.	2-'95	38.96	7.20	0.206	0.002	0.007	.....	.....	.....	0.50	3.0 ft well	Artesian, good
35	O F Bacon	Bruneau Valley.	2 '95	36 0	4.80	0.231	trace	0.041	.....	.....	.....	0.53	3.5 ft well	Artesian, excellent
37	Jno Moore	Moscow	7 '95	20.40	7.12	0.688	0 010	0.018	.....	.....	.....	5 00	.....	Odor & taste of rotten wood
38	J N Wiggles	Santa	7 '95	16.00	4 00	1.376	0.001	0.008	.....	.....	.....	7.80	spring	Good quality
39	Exp Station	Grangeville	10-'94	29.24	12.32	1.057	0.015	0 087	0.003	TRACE	0.004	12.50	75 ft well	H_2S & ir'n, fin'ly divided clay
40	R H Campbell..	Moscow	11-'95	12.40	2 06	3.600	trace	trace	TRACE	TRACE	.....	22.40	24 ft well	Good
42	Dr Wohlenberg.	Kendrick	8-'96	12.00	4.00	0.010	trace	0.001	none	TRACE	0.075	1.08	spring	Sur's bad, no bact ex'm made
43	John Thompson.	South Moscow	12-'96	73.68	28.00	8.000	0.000	41.000	1.66	0.250	1.760	26.61	well	Filthy—mineral
44	Mark Patrie	Market Lake	2-'97	37.44	18 40	1 759	trace	0 040	none	none	.....	25.92	well	Good
45	S Coffin	Caldwell	2-'97	30.00	6 40	3.80	0 396	0.030	none	TRACE	....	14.90	well	Good
46	J S Cobbs	Weiser	5-'97	91.40	13.00	9.000	1 040	0.1 0	.....	.....	.....	9 40	well	Alk. pitch odor. m'ch sus mat
47	J N Cobbs	Weiser	5-'97	189.50	24.60	9.000	0.436	0.080	none	none	.....	2.16	well	Settles clear after two hours
48	A F Parker	Grangeville	6-'97	41.00	14 66	1.120	0.080	0.018	0.125	none	0.009	15 55	school w	Quality—Good
49	R Woodworth	East Moscow	11-'98	17.92	.....	1.42	0.046	0 038	0.180	0.011	0 112	2 18	dug well	Bad
50	S J Pefley	Moscow	2 '99	30.45	5.00	trace	0.004	0 002	none	none	.....	.....	well	Wholesome

SOLID AND GASEOUS MATTER IN WATER.

Color, odor, taste. Water of the highest purity should be clear, colorless, odorless and nearly tasteless. If recently distilled it will have an insipid or flat taste.

Total solids. This is the residue remaining after water has been evaporated to dryness over the water bath and exposed to a temperature of 105 degrees C. for several hours. Sanitary authorities have fixed the limit at 60 parts per 100,000. Many good artesian waters exceed this limit.

Volatile matter. This represents the loss by ignition at red heat; the percentage should be small, the lower the better.

Chlorin. If the water be of deep origin the quantity of chlorin present, principally as common salt, may be high, since its origin is mineral or vegetable; but if it is of animal origin any excess of the limit should be regarded with suspicion.

Free ammonia. This gas is the result of absorption, and of the putrefactive fermentation of nitrogenous organic matter.

Albuminoid ammonia. This is obtained by treating the water remaining in the retort, after the free ammonia has been expelled, with alkaline potassium permanganate. It indicates an excess of nitrogenous matter; if of animal origin the analyst condemns the water as unsafe for potable use, if high.

Nitrates. This represents organic matter in a state of oxidation not disclosed by the free and albuminoid ammonia tests, and is thought to indicate putrefaction of animal rather than vegetable tissue.

Nitrites. This is a stage of decomposition due either to reduction of pre-existing nitrates in the presence of organic matter, or caused by direct oxidation of organic nitrogen.

Oxygen consumed. This is a third step for estimating the

organic matter, and deals principally with the organic carbon present. In brown, peaty and surface waters the readings are naturally high, due to organic matter in suspension.

Hardness. This is a condition of water due to the presence of bicarbonates and sulfates of calcium, magnesium, etc. The bicarbonates are precipitated by boiling, leaving a "fur" upon the kettle. The earthy sulfates remaining represent the "permanent hardness." Hardness may be measured in degrees, Clark's scale, equal to one grain of calcium carbonate, or its equivalent, in one gallon of water; or, by the French scale, one part of calcium carbonate in 100,000 parts of water. Above 8 degrees, water is regarded as hard. "Each grain of lime carbonate per gallon of water causes an increased expenditure of 2 ounces of soap per 100 gallons of water."

Poisonous metals. The most common looked for are lead and copper, while arsenic, frequently found in running streams, containing iron oxid, and in wells and springs in mountainous regions, near mines and manufactures, should not be overlooked. Iron is objectionable if in considerable quantity. Zinc, while not a cumulative poison, is, nevertheless, undesirable. Service pipes, as a rule, are the principal source of these poisons.

INTERPRETATION OF RESULTS.

Leffman and Beam give the following table as a guide:

	PARTS PER ONE HUNDRED THOUSAND			
	Rain water	Surface	Subsoil	Artesian
Total solids	5 to 20	15 upward	30 upward	45 upward
Nitrogen as free ammonia	.2 to .5	.00 to .03	.00 to .03	gener'ly high
Nitrogen as alb. ammonia	.8 to .20	.05 to .15	.05 to .10	.03 to .10
Chlorin	traces to 1	1 to 10	2 to 12	trc. to excess

Some of the limiting amounts which have been suggested by other chemists are:

STANDARDS OF PURITY.

PARTS IN ONE HUNDRED THOUSAND

	Total Solids.	Organic Matter.	Nitric Acid.	Chlorin.	Total Hardness
Richordt	50	2	0.4	0.2-0.8	18
Kubel	50	5	0.5-1.5	2-3	18-20
Wibel	50	5	0.1-1	3.5	18-20
Fischer	50	4	2.7	3.5	17

—From Neichols.

According to Wanklyn, the total solids should not exceed 57.14 parts per 100,000, (40 grains per gallon).

The presence of chlorin alone does not necessarily indicate organic contamination.

If chlorin is absent, but free and albuminoid ammonia present, the source of contamination is vegetable.

Chlorin in excess of 7.14 per 100,000 (5 grains per gallon), providing more than .80 parts of free ammonia and 1.00 part of albuminoid ammonia accompany it, the contamination is clearly animal,—sewage, decaying animal matter or urine. Such water should be condemned.

If the free and albuminoid ammonia exceed the parts above named, even without chlorin, the water should be regarded with suspicion.

When the albuminoid ammonia exceeds 1.5 parts per 100,000 in potable water, such water is certainly unsafe.

In cases where the water is suspected as having been the cause of typhoid fever, tests should be made for nitrates and nitrites, and the chemical results confirmed by a bacteriological analysis and the sanitary survey.

DIRECTIONS FOR SAMPLING WATER.

1. For sanitary analysis not less than two quarts should be sent; one gallon is preferred.

2. Large glass stoppered bottles are best for sampling, but if not at hand, a demijohn or glass fruit can, fitted with new stoppers, should be employed; metallic vessels, stone ware jugs or wooden casks must not be employed.

3. Cleanse the vessel thoroughly with warm water, then rinse several times with sample water. Use new, soft corks; secure in place with string or wire; do not seal with wax.

4. Obtain an average sample and fill the container nearly full, allowing space for possible expansion. Take the water direct from spring, well, cistern, and if from a stream or pond, select the middle of stream or pond if only one sample is taken.

5. The sample should be plainly and accurately addressed, and should be accompanied by a statement giving information on the immediate surroundings of the well or spring; depth of same; source of supply and whether abundant or meager; effect of rainfall or drouth on the volume; temperature of the water; some account of the soil through which the well or flow has passed; and whether used for domestic purposes only.

6. Bear in mind, throughout, that water analysis deals with material present in very minute quantity, therefore, the least carelessness in collecting the samples must vitiate the results; and any neglect in reporting information regarding the source of the water, the general geological formation of the district, and the likelihood of contamination, puts the analyst at a disadvantage in interpreting and reporting his results.

7. Water sampled according to these directions—for potable, boiler or irrigation use—will be analyzed free of charge. For the examination of mineral water, a small fee is charged.

8. Forward all samples by express, *charges prepaid*, to

Agricultural Experiment Station,

For the Chemist. Moscow, Idaho.