TABLE 4.—*Distribution of local rains at New Orleans, La., 1919, and departure from the group mean in each case*—Continued.

	May.			June.			July.		
Dates	12	26	29	2	13	24	12	20	25
Group mean	1.60	1.62	0.66	0.53	1.72	0.98	1.61	0.62	1.93
Dublin	+ .63	− .51	+ .27	+1.22	− .51	− .11	+ .17	+ .34	− .13
Park	+ .10	+ .20	+ .44	− .46	− .01	− .14	+ .79	+ .39	+ .62
Jefferson	− .46	− .02	+ .52	− .45	+ .16	− .31	+ .46	+ .09	− .55
Hall	− .33	+ .01	− .36	− .36	− .11	+ .21	+ .08	+ .06	− .08
Algiers	+ .19	+ .16	− .29	− .53	− .15	+ .01	− .34	− .33	+ .82
London	− .13	+ .18	− .55	+ .55	− .35	− .16	−1.05	− .54	− .67
Weather Bureau	+ .26	− .23	− .32	− .34	− .39	− .23	− .06	+ .02	− .20

TABLE 4.—*Distribution of local rains at New Orleans, La., 1919, and departure from the group mean in each case*—Continued.

	August.			September.		October.			November.	
Dates	5	13	24	7	13	4	5	16	9	10
Group mean	0.34	0.74	0.99	0.93	1.47	1.10	1.00	0.65	0.94	3.51
Dublin	− .34	− .74	.00	+ .24	− .37	− .03	− .24	+ .44	+ .52	+ .69
Park	+1.22	− .74	− .46	− .24	+ .44	.00	− .66	+ .40	− .40	− .07
Jefferson	+ .13	− .74	− .09	+ .38	+ .36	− .31	+1.32	− .16	+ .01	− .38
Hall	− .34	− .20	+ .66	+ .02	− .19	+ .02	− .19	− .65	− .52	+ .80
Algiers	− .34	+ .78	+ .36	− .12	− .05	+ .29	− .13	− .65	+ .41	− .47
London	− .34	+1.64	− .47	− .29	− .17	+ .01	+ .30	+ .60	− .03	− .57
Weather Bureau	− .34	− .13	+ .66	− .11	− .29	− .10	− .36	− .65	+ .38	− .63

SUBSTANCES DISSOLVED IN RAIN AND SNOW.

551.577: 551.510.4

By SHERMAN SHAFFER.

[Mount Vernon, Iowa, June 10, 1921.]

The determination of the character and quantities of the substances dissolved in rain and snow is of considerable interest and importance. My work is a continuation of the rain and snow analyses which have been made at Cornell College for a number of years.

The samples for analysis were collected in enameledware pans, at an open spot near the center of the village of Mount Vernon, Iowa. Mount Vernon is a town of about 2,100 population, situated 17 miles from a manufacturing center, and with no industries of its own. The samples were analyzed as soon as possible after they were collected. They were analyzed under ordinary laboratory conditions, but every precaution was taken to avoid contamination.

Forty-five samples of rain and snow were analyzed, during the period from August 18, 1920, to June 1, 1921. The precipitation during this period was 20.97 inches, 18.14 inches of rain and 34 inches of snow. Twelve inches of snow are taken as equal to one inch of rain.

The nitrates which fell during this period amounted to 0.60126 pounds per acre, assuming that 1 inch of water on 1 acre weighs 226,875 [1] pounds. The average [2] content was 0.3 part per million. The highest nitrogen content was 1 part per million on January 4, 1921. The amount of nitrates is influenced by the length of the interval between rains. A curve drawn for intervals between rains as abscissæ and nitrates per inch of rain as ordinates tends to rise as the interval is increased. There is no noticeable variation of the amount of nitrates with the seasons. On the contrary, the average through the year is quite constant. When the amount of nitrate per inch of rain for each month is compared with the rainfall in inches for each month, it is found that the nitrates are greater when the rainfall is less—that is, the solution is more concentrated, as might be expected. When the nitrates are determined by the phenolsulphonic method and no sodium carbonate is added before evaporating the water, no nitrates are found. This would seem to indicate that all the nitrate is in the form of free nitric acid. If this is true, the ammonia present must be united with some other acid radicle, or it would combine with the nitric acid.

The nitrites totaled 0.03985 pound per acre. The highest figure was 0.03 part per million on May 17, 1921. The average was 0.0033 part per million. A curve drawn for intervals between rains as abscissæ and nitrites per inch of rain as ordinates showed an increase with an increasing interval, but the curve was very irregular. The nitrites, like the nitrates, tended to greater concentration when there was less rain, but this tendency was not so marked as in the case of the nitrates.

The total amount of free ammonia was 1.48045 pounds. The highest ammonia was in the snow of November 27, 1920, which tested 2.1 parts per million. The average was 0.47 part per million. On the whole, no difference was found in the amounts of substances dissolved by snow and by rain under the same circumstances. This differs from the results of former investigators, who found that snow did not dissolve as much of the substances as did rain.

The albuminoid ammonia amounted, during the period, to 1.16022 pounds per acre. The highest being 2 parts per million, on December 13, 1920, and the lowest 0 on April 1, 1921. The average was 0.38 part per million, considerably less than the free ammonia. A curve drawn between albuminoid ammonia per inch of rain and number of days between rains showed a very striking increase of ammonia with increase of interval. The albuminoid ammonia remained on the average fairly constant throughout the year, as did the free ammonia. Both were lower in the spring than during the fall and winter.

A total of 34.43179 pounds of chlorides per acre was found. The average chlorine content was 10.1 parts per million. The highest was 49.7 parts per million. The chlorides were higher during the winter and spring than during the fall. They were not found to be present in constant proportion as was reported by former investigators, but varied from 3.5 parts per million to 49.7. The chlorides show the same tendency as the other substances to be more concentrated when the rainfall is less. A curve between chlorides and intervals of time shows a tendency toward increase in chlorides with increase in time interval.

The total sulphates amounted to 327.0619 pounds per acre, figured as SO_3. The average was 29.9 parts per million, and the highest 101.2, on May 17, 1921. The sulphates undoubtedly come from the combustion of the sulphur in coal used for heating. The amounts found rise from none in August, to 4.8 pounds per acre in September, and to 66.2 pounds per acre in February, after which they again decline.

Thirteen determinations of sulphurous acid were made, using N/10 iodine-potassium iodide solution against N/10 sodium thiosulphate solution. Seven of the tests

[1] The latest edition of *Smithsonian Meteorological Tables* gives the weight of an inch of rainfall per acre at a temperature of 62° as 113 short tons or 226,000 pounds.—Ed.

[2] The arithmetical mean of all of the analyses.

showed none present. The average of the other tests was 1.43 parts per million. The highest was 1.8 parts per million on May 17, 1921.

The total nitrogen which fell, in all forms, was 3.28178 pounds per acre. This was divided as follows: As nitric acid, 5.74 per cent; as nitrous acid, 0.511 per cent; as ammonia, 93.73 per cent.

Grateful acknowledgment is made of the kind assistance and suggestions of Dr. N. Knight in carrying out this work.[3]

TABLE 1.—*Chemical contents of rain and snow at Mount Vernon, Iowa (pounds per acre).*

[× means "not tested."]

Date.	Precipitation.	Nitrates.	Nitrites.	Free ammonia.	Albuminoid ammonia.	SO_3	SO_2	Cl
1920.	*Inches.*							
Aug. 13	0.35	×	×	0.00357	0.02857	None.	×	×
Aug. 20	.32	0.02177	0.00021	.11975	.00726	None.	×	0.51529
Sept. 23	.20	.01724	.00018	.02540	.01829	None.	×	.16103
Sept. 26	.12	.02177	.00060	.01851	.01306	1.7962	×	.19321
Oct. 15	.06	.00544	.00007	×	×	1.0478	×	.07239
Oct. 15	.30	.03742	.00020	.05443	.04218	3.6742	×	.23814
Oct. 19	.05	.00454	×	×	×	×	×	×
Oct. 20	.30	.00513	.00007	.04627	.01905	×	×	.23814
Nov. 1	.65	.02211	.00044	.17690	.01622	×	×	×
Nov. 1	.05	.00170	.00003	×	×	×	×	×
Nov. 8	.95	.06464	.00150	.06033	.04309	17.4520	×	1.52980
Nov. 14	.16	.01451	×	×	×	2.6490	×	×
Nov. 22	.06	.00136	None.	×	×	.93895	×	.11975
Nov. 27	.32	.00726	.00015	.15241	.05806	3.9917	×	.63867
Nov. 30	.05	.00227	.00005	×	×	2.0979	×	.14062
Dec. 3	.60	.01361	.00007	.05931	.05443	6.5318	×	×
Dec. 13	.55	.04990	.01247	.00499	.24948	13.0977	×	1.32220
Dec. 22	.32	.02903	.00004	.01452	.05225	10.8864	×	.51503
Dec. 25	.50	.03402	.01134	.02717	.04082	10.4328	×	1.20200
1921.								
Jan. 4	.05	.01134	.00001	×	×	1.5309	×	.56360
Jan. 13	.32	.00726	.00004	.00290	.1814	×	×	.63867
Jan. 25	.16	.01996	×	.0508	.01452	×	0.2141	.57698
Feb. 8	.10	.01588	.00014	.01814	.01593	×	.0079	.36061
Feb. 22	.20	.01814	None.	.07258	.02177	6.62256	×	.72122
Mar. 5	.10	×	×	.03175	×	3.2886	×	.32206
Mar. 7	.12	.01225	.00019	.02286	.00435	2.2045	×	.19323
Mar. 14	3.00	Trace.	.00068	Trace.	.13608	61.2360	.0340	7.21224
Mar. 24	.06	.00476	.00014	×	×	1.1975	×	.14424
Mar. 29	.05	.00397	.00010	×	×	.0907	×	.08051
Apr. 6	.20	Trace.	.00014	.01814	.00717	2.4494	×	.64411
Apr. 6	.50	None.	.00034	.00907	None.	11.2266	×	.39690
Apr. 8	.65	Trace.	.00007	.00295	.04128	×	.0590	.51597
Apr. 14	.25	.01985	.00028	.03175	.02268	4.9494	None.	.40257
Apr. 15	1.75	.00992	.00119	.02381	.01588	37.7055	×	2.10357
Apr. 17	1.00	None.	.00227	.00227	Trace.	13.6080	×	1.61028
Apr. 21	.25	.01134	.00011	.02381	.00340	×	×	1.20771
Apr. 23	.05	.00284	×	×	×	×	×	×
Apr. 26	.60	.00680	.00027	.03810	.04899	.2722	None.	.72122
Apr. 27	.75	.01701	Trace.	.01021	.00577	23.1336	None.	1.60306
May 1	.45	.00510	.00020	.03614	None.	8.7322	None.	.72463
May 10	1.10	×	None.	.02994	.00998	10.2287	None.	1.77131
May 7	.05	.00397	.00125	×	×	.39690	×	.12020
May 11	.55	.00624	.00062	.04491	.00499	10.1040	None.	×
May 17	.40	.03629	.00272	×	×	26.7624	.1633	2.34057
May 27	.45	.03572	.00122	.12247	.11022	9.6957	.0123	1.08184
May 31	.40	Trace.	.00045	.02903	.02177	6.8040	None.	.31752
June 1	1.50	×	×	.09526	.01361	10.2250	×	1.19070
Total	20.97	.60126	.03985	1.48045	1.16022	327.0619	.4006	34.43179

Twelve inches of snow have been taken to equal 1 inch of rain.

NITROGEN IN THE RAINWATER AT ITHACA, N. Y.[1]

By B. D. WILSON.

[Abstract reprinted from *Exp. Station Record*, U. S. Department of Agriculture, vol. 44, No. 9.]

Studies conducted at Cornell University on the amounts of ammoniacal and nitrate nitrogen added to the soil by rain showed that with an average annual rainfall of 29.31 inches, between May 1, 1915, and May 1, 1920, the soil received annually 12.51 pounds of nitrogen to the acre. Of this amount 11.5 pounds was in the form of ammoniacal nitrogen and 1.01 pounds in the form of nitrate nitrogen. The ammoniacal nitrogen fluctuated from month to month and from year to year, while the nitrate nitrogen remained more constant. The amount of total nitrogen in the rainwater was to a large extent dependent upon the amount of rainfall, a high nitrogen content accompanying a correspondingly high precipitation.

The rainfall during the spring and summer months contained more nitrogen than that falling during the other two seasons. The ammoniacal nitrogen decreased rather suddenly during August and continued low during September and October in spite of heavy rainfalls. This decrease is considered to be probably due to the atmosphere being washed comparatively free of ammonia by previous rains. Electrical discharges did not increase the nitrate nitrogen content of the rainwater to any considerable extent.

The amount of ammoniacal nitrogen brought down in the rain falling at Ithaca, N. Y., is said to be somewhat larger than that reported from many parts of the world, while the nitrate nitrogen content is about the same.

A bibliography of 12 references to the literature of the subject is given.

LONDON SMOKE FOGS.

By J. S. OWENS.

[Abstracted from *The Meteorological Magazine*, London, Mar., 1921, pp. 29-33.]

The Advisory Committee on Atmospheric Pollution has always recognized the fact that the measurement of atmospheric pollution by means of open-topped gages[1]—similar to rain gages—gives an incomplete statement of the case because only those particles of dust heavy enough to be precipitated find their way into the gage. Recently, however, a method of measuring the *suspended impurities* over cities has been established. Instruments were installed at the Meteorological Office, South Kensington, at Kew Observatory, and at 47 Victoria Street, Westminster. Continuous records are now available since October, 1920. From these records curves have been drawn showing the amount of suspended matter for each hour over a number of days. This has been done for ordinary week-days (exclusive of Saturdays and Sundays), and for Saturdays and Sundays separately. In drawing the curves the author splits up each group into foggy and non-foggy days.

When more data are available it is hoped a study of the graphs will make it possible to state definitely what proportion of the suspended impurity is due to domestic fires for heating and cooking and what to factory furnaces.

A survey of the curves already drawn shows the atmosphere least polluted between midnight and early morning when all classes of fires are practically dormant. On week days and Saturdays at about 6 a. m., (Sundays at 7 a. m.), a rapid increase in the amount and impurity starts, reaching a maximum about five hours later. About 10 p. m. a rapid fall starts, continuing until midnight when the minimum period sets in.

Referring to the curve for nonfoggy Saturdays, there is no sudden falling off in the amount of smoke after 1 o'clock when most factories close; on the contrary, there is a distinct rise and a very marked peak at 5 o'clock. The inference is clear that since the shutting down of factories does not bring about a marked reduction in the amount of impurity recorded, factory fires are not mainly responsible for the pollution. Thus both the quantity of suspended matter and its distribution point toward the domestic heating and cooking fires as being chiefly responsible.

From the somewhat brief data so far available, the writer ventures the opinion that the values plotted would indicate that domestic fires appear to be responsible for two-thirds of the total smoke in Westminster.—*H. L.*

[3] Cf. Trieschmann, J. E.: Nitrogen and other compounds in rain and snow. Abstract reprinted in Mo. WEATHER REV., Nov., 1919, 47: 807.

[1] *Soil Science*, 11 (1921), No. 2, pp. 101-110.

[1] For an account of the amount of solid matter collected in gages, see the Mo. WEATHER REV., March, 1921, 49; 159-160, "Atmospheric pollution."