TABLE II.—*Dry periods in 33 years by months for 12 stations*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
15 to 19 days	0	0	0	5	51	45	29	41	33	0	0	0	204
20 to 29 days	25	12	14	8	20	34	36	60	55	59	16	26	365
30 to 39 days	4	2	7	1	6	10	13	27	13	18	4	16	121
40 to 49 days	3	0	0	2	5	4	7	8	13	5	3	2	52
50 to 59 days	0	1	1	1	5	3	6	6	8	7	1	0	39
60 to 69 days	0	0	0	0	3	3	2	3	1	1	3	0	16
70 to 79 days	0	0	0	0	1	4	7	5	1	2	0	0	20
80 to 89 days	0	0	0	0	1	2	3	5	1	0	0	0	12
90 to 99 days	0	0	0	0	1	0	0	2	0	2	0	0	5
100 or more days	0	0	0	2	3	1	0	2	0	2	0	0	10
Total 12 stations, 33 years	32	15	22	19	96	106	103	159	125	96	27	44	844
Average number of periods per station per month and per year	0.08	0.04	0.06	0.05	0.24	0.27	0.26	0.40	0.32	0.24	0.07	0.11	2.13

TABLE III.—*Dry periods at stations in 33 years*

	15 to 19 days	20 to 29 days	30 to 39 days	40 to 49 days	50 to 59 days	60 to 69 days	70 to 79 days	80 to 89 days	90 to 99 days	100 or more days	Greatest number of days	Date began	Amount of precipitation
Arkansas City	28	33	12	7	4	1	4	2	1	1	105	Aug. 12, 1903	2.22
Camden	22	29	10	3	3	0	2	1	0	0	87	Aug. 2, 1929	2.21
Calico Rock	21	25	11	5	3	5	2	2	1	0	91	May 13, 1914	2.00
Dardanelle	22	35	17	9	3	1	2	0	0	2	125 103	Aug. 16, 1897 Apr. 19, 1901	2.35 3.38
Fort Smith	8	25	16	3	5	4	1	2	1	1	112	Oct. 12, 1910	1.52
Fulton	23	33	9	8	3	2	1	1	1	2	126 109	June 8, 1897 May 24, 1930	3.11 1.69
Helena	10	29	10	5	1	2	1	3	0	1	103	May 20, 1930	2.03
Little Rock	11	33	7	3	1	0	1	1	0	1	107	May 24, 1930	0.80
Mena	17	36	7	1	3	0	1	0	0	0	75	June 26, 1930	0.43
Newport	20	29	8	3	4	1	3	0	0	0	79	June 18, 1909	1.25
Pocahontas	10	28	6	1	3	0	1	0	0	1	115	Apr. 18, 1901	2.13
Rogers	12	30	8	4	6	0	1	0	1	1	106	Oct. 28, 1910	1.70
Total, 33 years	204	365	121	52	39	16	20	12	5	10			
Average number of periods per staion per year	0.52	0.92	0.32	0.13	0.10	0.04	0.05	0.03	0.01	0.03			
Little Rock	----	----	----	----	----	----	----	----	----	----	138	July 8, 1887	3.34

TABLE IV.—*Number of dry periods in 33 years with 15 days or more, 20 days or more, etc.*

	15 days or more	20 days or more	30 days or more	40 days or more	50 days or more	60 days or more	70 days or more	80 days or more	90 days or more	100 days or more
Arkansas City	93	65	32	20	13	9	8	4	2	1
Camden	70	48	19	9	6	3	3	1	0	0
Calico Rock	75	54	29	18	13	10	5	3	1	0
Dardanelle	91	69	34	17	8	5	4	2	2	2
Fort Smith	66	58	33	17	14	9	5	4	2	1
Fulton	83	60	27	18	10	7	5	4	3	2
Helena	62	52	23	13	8	7	5	4	1	1
Little Rock	58	47	14	7	4	3	3	2	1	1
Mena	65	48	12	5	4	1	1	0	0	0
Newport	68	48	19	11	8	4	3	0	0	0
Pocahontas	50	40	12	6	5	2	2	1	1	1
Rogers	63	51	21	13	9	3	3	2	2	1
Total, 33 years	844	640	275	154	102	63	47	27	15	10
Average per station per year	2.13	1.62	0.69	0.39	0.26	0.16	0.12	0.07	0.04	0.025
Number of years per one occurrence	0.47	0.62	1.40	2.56	3.85	6.25	8.33	14.29	25.00	40.00

DYNAMICAL PRESSURE EFFECT ON THE FRIEZ-TYPE AEROMETEOROGRAPH

By LOUIS P. HARRISON

[Weather Bureau, Washington, D.C., June 1933]

As is well known, the motion of air relative to an exposed object in general produces an excess of pressure over the static (or barometric) pressure on its windward side and a deficiency of pressure on its leeward side. The pressure which is recorded by an aerometeorograph mounted on a moving airplane is, therefore, subject to at least two influences which cause it to differ from the static pressure of the air at the same level. First, the motion of the airplane relative to the air produces a considerable deficiency of pressure for some distance above the wings and an excess of pressure for some distance below the wings. Second, the stream of air blowing past the aerometeorograph produces dynamical pressure effects such as are described in the first sentence, the reference pressure being what the pressure would be at the location of the aerometeorograph if the latter were absent.

The first source of error may be partially overcome by mounting the instrument on a biplane at some location between the wings where the effects of the upper and lower wings neutralize each other. In general, this position has been estimated to be somewhat nearer to the upper wing than to the lower, perhaps about two thirds of the way up, and perhaps two thirds of a chord length back of the leading edge of the upper wing. A difficulty is that the best location changes with change in angle of attack, etc. In the case of monoplanes, the instrument should be mounted as far below the wing as practicable and perhaps one half to two thirds of a chord length back from the leading edge. In any case, other disturbing elements, such as struts, etc., should be avoided as far as possible.

If the instrument is mounted in a place where the effect of the wings, struts, etc., can be considered negligible, the second source of error can be corrected for by the use of data obtained from wind-tunnel measurements and readings of the indicated air speed of the airplane. Such data for a Friez-type aerometeorograph (see figs. 1 and 2) have been obtained at the Aerodynamic Laboratory of the United States Bureau of Standards.

In the observations to this end, the instrument was mounted at the center of a wind tunnel. To determine the dynamic effect, two small copper tubes were introduced into the instrument with the open ends near the sylphon pressure element, one at the side of the element pointing vertically upward, the other at the top of the element pointing horizontally. These tubes were connected through valves to one side of an inclined manometer of approximately 5 to 1 slope containing benzol. The other side of the manometer was connected to a small hole in the wall of the wind tunnel within which the air was at the static pressure of the tunnel. By this arrangement, small pressure differences could be accurately measured. Each tube could be connected in turn to the manometer. No significant difference was observed between the readings of the two tubes, and the average values were used.

The observations showed that the dynamic pressure effect caused the instrument to read too low, and that this deficiency of pressure, Δp, was proportional to the velocity pressure $\frac{1}{2}\rho v^2$, where ρ = density of the air, and v = velocity of the air. Thus, with the instrument in the normal flying position (0° yaw) and over a range of speeds from 30 to 95 miles per hour in the tunnel the

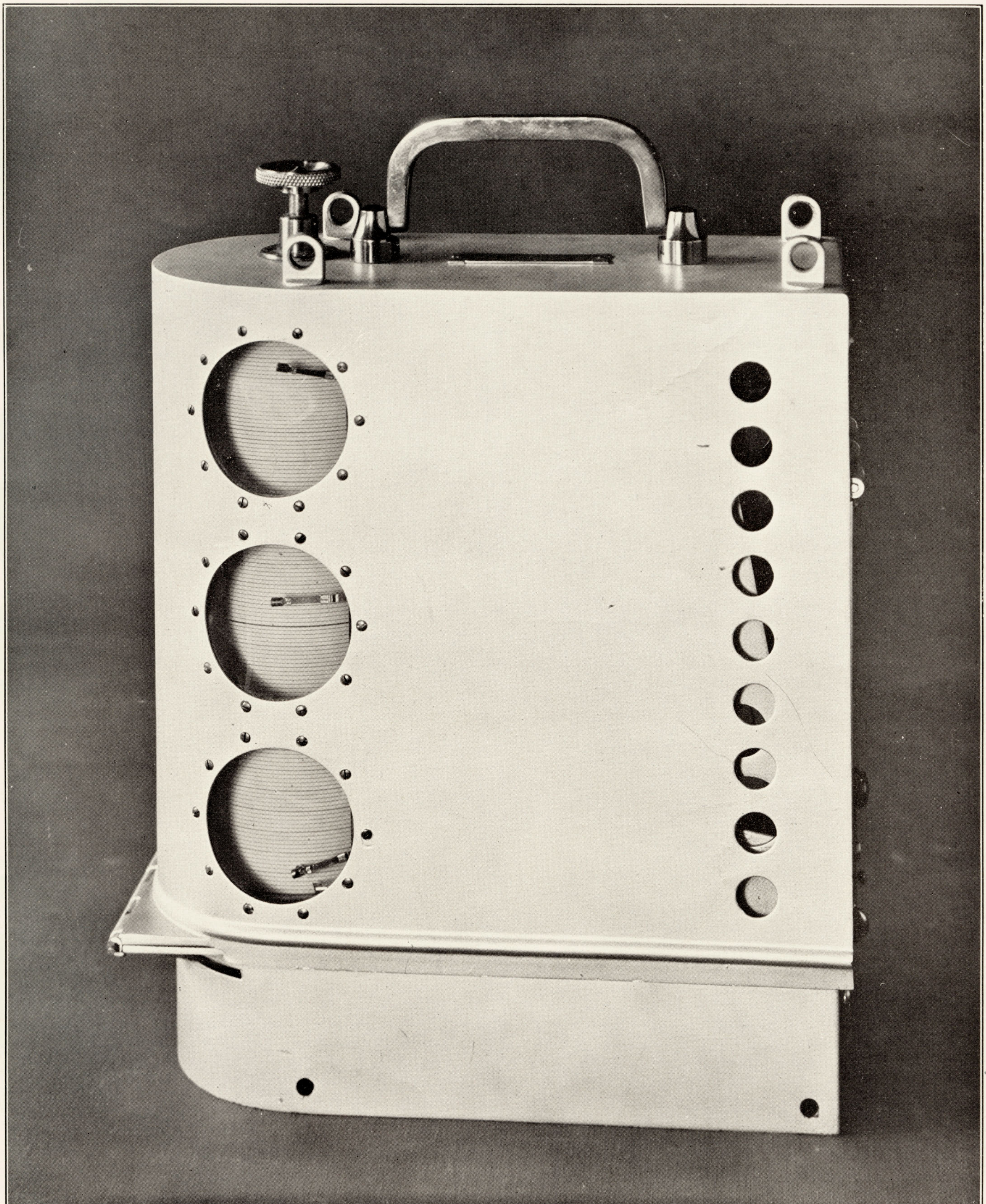

FIGURE 1.—Side view of the Friez type Aerometeorograph with cover closed. The leading edge is on the left; the ventilation holes are on the right. Length from leading edge to rear=8¾ inches, width=4 inches, height=10 inches, approximately.

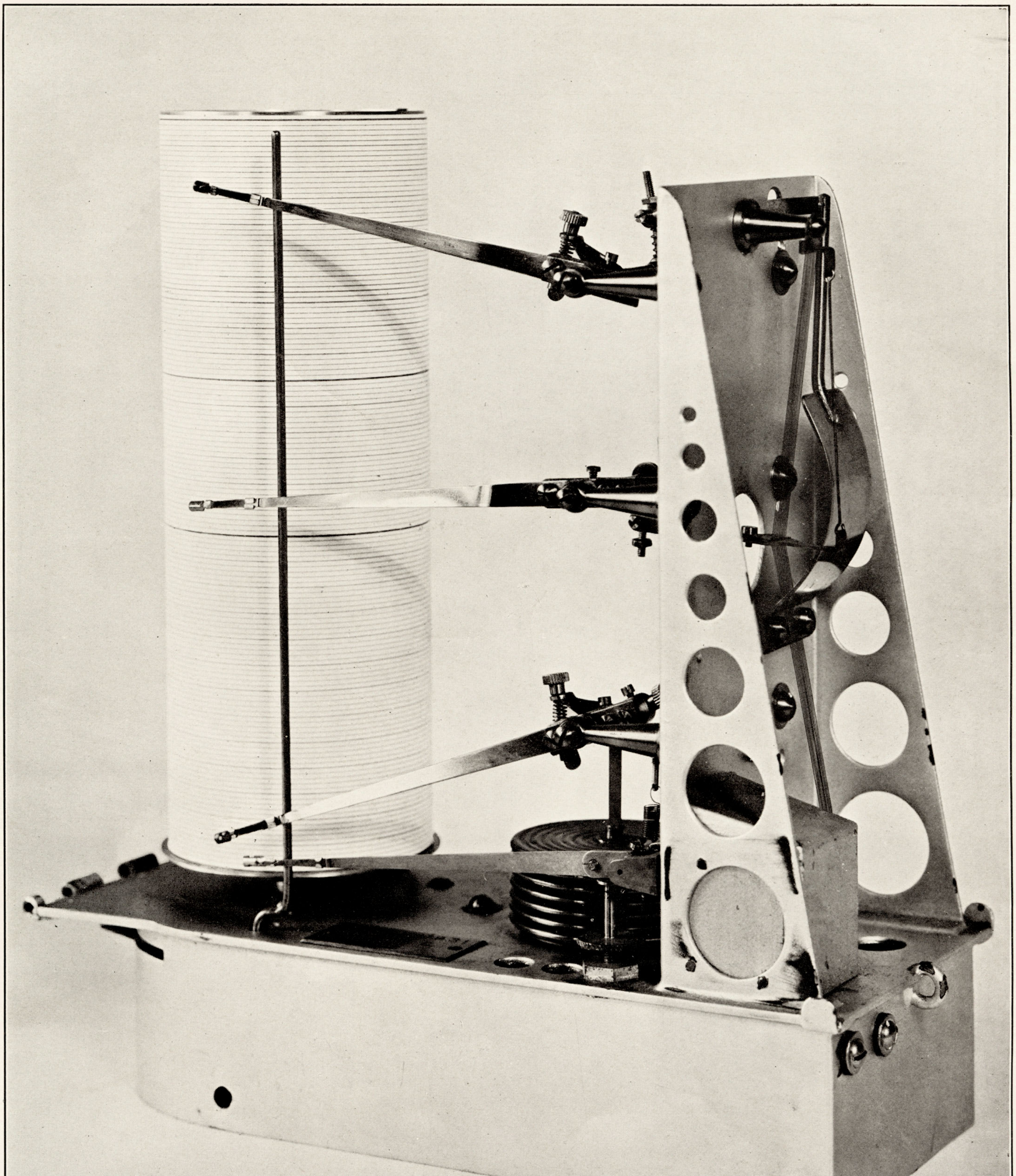

FIGURE 2.—View of Aerometeorograph with cover removed.

ratio $\Delta p/\frac{1}{2}\rho v^2$ was found to average 0.207, with individual values showing a maximum variation of 7 percent and a mean variation of 3 percent from the average.

Measurements were made at angles of yaw up to 60° with the results given in the table below, the application of which is obvious from the basic relation:

$\Delta p = kv_s^2$, where

Δp = dynamic pressure deficiency in *mm of mercury*.

v_s = "standard" (or indicated) airspeed, in *miles per hour* (referred to standard density of 0.07651 lbs./ft.^{3}).

k = constant for a given angle of yaw.

TABLE 1

Angle of yaw	k
0°	0.000190
5°	.000204
10°	.000242
15°	.000267
20°	.000353
25°	.000386
30°	.000399
45°	.000435
60°	.000407

From this it is easy to compute, for example, that at 5° yaw the absolute pressure given by the instrument at an indicated air speed of 100 miles per hour is 2 mm lower than the true static pressure.

Several attempts were made to reduce the error in question. The most promising result was secured by the use of flaps or scoops over the side holes to increase the pressure in the space at the rear of the instrument. The flaps were made by cementing flat strips of metal about ¾ inch wide and about 7¾ inches long, bent at an angle of approximately 45°, behind the side ventilation holes. At 0° angle of yaw, with the flaps, k was found to be 0.000017, and at 15°, k was 0.000094. With this arrangement, the effect is less than 0.3 mm at 100 miles per hour for small angles of yaw.

The use of flaps greatly increases the ventilation of the temperature and humidity elements, whence the question arises as to the possible effect of the strong air currents on the indications of these elements. Tests made to determine this effect were inconclusive because of the vibration of the tunnel and the slow speed of the drum. However, the effect was not very large and possibly may be avoided by the use of baffle plates to direct the air currents within the instrument.

Acknowledgement is made to Dr. H. L. Dryden and his associates of the Bureau of Standards for their kind cooperation and for making the wind tunnel measurements and experiments as well as the necessary calculations.

LITERATURE

(1) P. Raethjen und Ed. Huss.
"Über Vergleichbarkeit aerologischer Druck- und Temperaturmessungen beim augenblicklichen Entwicklungsstand des Instrumentariums und der Aufstiegsmethoden"
Beiträge zur Physik der freien Atmosphäre, Band XVIII, Heft 3, pp. 171–179, 1932.

(2) P. Duckert und W. Kopp.
"Lässt der heutige Stand der Instrumententechnik aerologisch einwandfreie Flugzeugmessungen zu oder nicht?"
Ibid, Band XVIII, Heft 4, pp. 253–262, 1932.

(3) P. Raethjen und Ed. Huss.
"Nachtrag zu der Arbeit: 'Über Vergleichbarkeit Aerologischer Druck- und Temperaturmessungen beim augenblicklichen Entwicklungsstand des Instrumentariums und der Aufstiegmethoden'"
Ibid, Band XX, Heft 1, pp. 47–50, 1932.

ANALYSIS OF THE PRECIPITATION OF RAINS AND SNOWS AT MOUNT VERNON, IOWA

By S. Francis Williams and O. Kenneth Beddow

[Cornell College, Mount Vernon, Iowa, June 1932]

Under the direction of Dr. Nicholas Knight, Cornell College, Mount Vernon, Iowa, has for the last 24 years carried on an analysis of the rain and snow precipitated here. The results of much of this work have been published in periodicals of a scientific nature.

The precipitations are collected in clean granite pans, away from trees and buildings, and stored in glass stoppered bottles. The town has no factories and, exclusive of the college, has a population of about 1,700. The sulphuric acid found, therefore, comes mainly from the coal used in private heating plants. It is worthy of note this year there has been a lack of sulphuric acid. We have never found so little sulphuric acid in the rains as we found the past winter. This may be due to the depression. The coal burned in heating plants contains sulphur which in burning becomes sulphuric acid in the atmosphere. The poor people burned wood which was furnished them, or by cutting it, they could obtain their fuel very cheaply. One of the local coal dealers claims he has sold no coal to the people living in the country. Hence the depression affected the atmosphere and consequently the precipitations.

It has been found necessary to deduct 3.55 parts per million from the reading to allow for the formation of the color in the test for the chlorides. Six drops of the potassium dichromate indicator were used. Due to some criticism special care has been taken in the analysis of the chlorides, which, after considerable work, we have reason to believe correct. The phenoldisulphonic acid method was used with the nitrates. All of the samples were colorless.

The method used in the analysis are taken from the Standard Methods of Water Analysis, sixth edition, published by the American Health Association.

The results of the school year 1931–32 are expressed in tables 1 and 2. The numbers indicate the parts of the various substances in a million parts of water. We examined 48 samples of rains and snows.