INFLUENCES CAUSING VARIATIONS IN BUTTER FAT PRODUCTION.

BY

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Influences Causing Variations in Butter Fat Production.

It can be easily seen that where a record of the amount of milk produced by a dairy herd is kept, that there are variations in the quantity more or less marked due to changes in the weather. During very cold weather the quantity is less than in weather with moderate temperature, while a decrease may be noted after storms or other infavorable conditions. The majority of dairymen, however, are not concerned directly with the quantity of milk, but with the quantity of butter fat produced. The question then arises: in what manner is the test, percent of butter fat in the milk, affected by changes in the weather and other external conditions.

In order to determine the exact extent of the action of various influences causing variations in the amount of butter fat produced, an extensive experiment was carried on by the writer for several months. For this experiment twelve cows were chosen from the College herd. Six of these were full bloods, the others grades and scrubs. The milk of these cows was weighed to one tenth of a pound and the weight recorded morning and evening. Samples of each one were taken at the same time and were tested later by the Babcock test. Thus the record of the exact amount of butter fat produced by each cow morning and evening was obtained. These cows were well fed and cared for, being given shelter in bad weather.

Along with the butter fat record, the record of changes in weather were kept. These consisted of the temperature inside and outside the barn, direction of wind, barometric pressure, and cloudiness for the morning and evening. Also the maximum and minimum

temperature, precipitation, and any unusual atmospheric disturbance were recorded. A record was also kept of the amount of feed and changes of feed with these cows.

The problem of determining the effect of different influences upon butter fat production is indeed a complex one. Not only because several influences are brought into play at once but because many of them tend to work in the opposite direction. Among some of the chief influences may be named: changes in temperature, changes in barometric pressure, cloudiness, direction and velocity of the wind, storms, shelter, change of milkers, change of feed, and excitement.

There are a few general rules regarding the percent of butter fat in milk that should be borne in mind in considering this experiment.

The amount of butter fat secreted under normal conditions tends to remain constant. That is, when a large quantity of milk is produced the test will probably be lower than when the same cow produces a small quantity. This is not only true of daily variations but can be shown by the fact that fresh cows producing heavily will not test as high as when farther advanced in the lactation period. This rule may also be applied to different cows, e.g., a cow producing a large quantity usually tests lower than one producing a small quantity. A Holstein produces a greater quantity of milk than a Jersey but with a lower test.

Another general rule is that if for any reason obvious or otherwise, the cow does not secrete the customary amount of butter fat, an excess equal to the deficiency will be secreted at the next milk-

ing. That is an unusually low test is followed by an unusually high one. And more than that, if the test be suddenly thrown far from the normal by any unusual circumstance it will tend to oscillate, as it were, up and down for several milkings till it again returns to the average. This fact may be substantiated by the following illustration.

Morning and evening tests for five consecutive days of Cow No.1.

	Apr.19	Apr.20	Apr.21	Apr.22	Apr.23
A.M.	5.0	3.0	2.5	4.2	4.5
P.M.	5.3	9.0	6.7	5.4	5.4

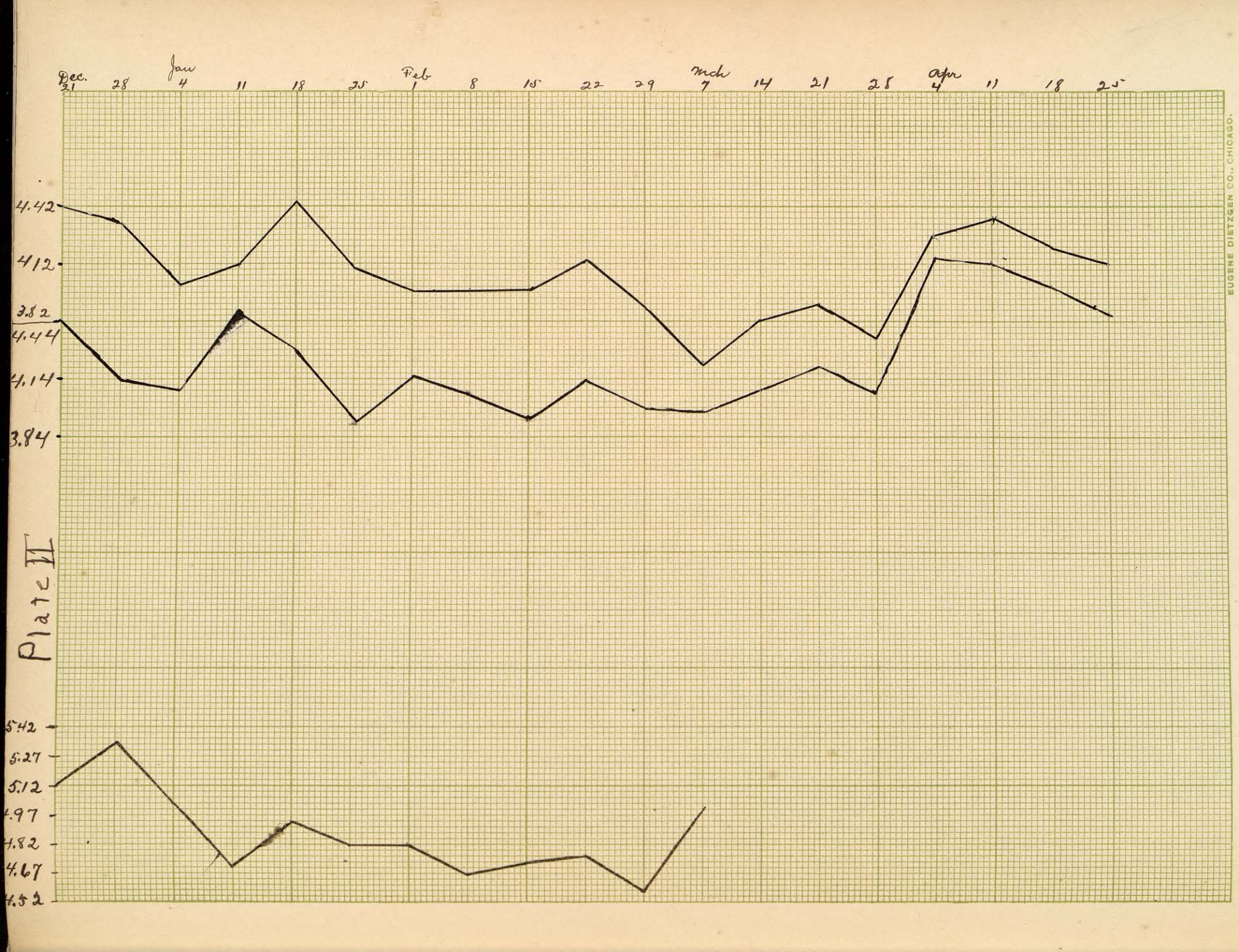
One of the most baffling circumstances in an experiment of this kind is the natural variation from day to day. It was reported that at the Indiana Experiment Station where the record of one cow was watched carefully for a year with respect to both quantity and quality, that the greatest variations were in the most favorable weather and that weather seemed to have little influence. In our experiment some of the widest variations were without obvious cause. Such natural variations tend to offset the effect of other influences to a great extent.

The experiment began December 11 and ended April 25, during which time several cows were removed and others added. The six full bloods and one grade however remained in the experiment throughout.

Before giving the data in detail it may be interesting to note the records of some of these individual cows. The following is the record of Star of Hillview, an Ayrshire, computed by finding the total amount of milk and average test for each week. Also the average weekly tests throughout for cows No. 201, 1, and 86.

	Star # milk	avg. test	201 avg. test	1 avg. test	86 avg. test
Week ending Dec. 21	215.8	4.42	4.44	5.57	5.12
" " " 28	192.0	4.33	4.14	5.23	5.34
" " Jan. 4	198.0	3.99	4.08	5.08	5.02
" " " 11	210.6	4.10	4.49	5.27	4.71
" " " 18	210.2	4.44	4.32	5.26	4.94
" " " 25	181.3	4.08	3.93	5.11	4.83
" " Feb. 1	181.5	3.98	4.14	4.81	4.84
" " " 8	175.3	3.99	4.06	4.87	4.675
" " " 15	156.1	3.97	3.93	4.77	4.71
" " " 22	137.7	4.13	4.13	4.61	4.77
" " " 29	136.9	3.89	3.98	4.64	4.56
" " Mar. 7	142.3	3.60	3.97	4.46	4.99
" " " 14	159.2	3.81	4.08	4.76	
" " " 21	141.6	3.91	4.21	4.92	
" " " 28	144.1	3.73	4.06	5.09	
" " Apr. 4	128.6	4.27	4.79	5.44	
" " " 11	112.7	4.36	4.76	5.11	
" " " 18	120.7	4.00	4.84	5.12	
" " " 23	121.3	4.12	4.47	5.36	

The relation between the amount of milk and the test as given in the record is graphically shown by curves plotted from the above figures on Plate I. The first line represents the deviation of the test, while the second shows the variations in the amount of milk produced from week to week. As would be expected, these variations are in the majority of cases in a direction opposite to those of the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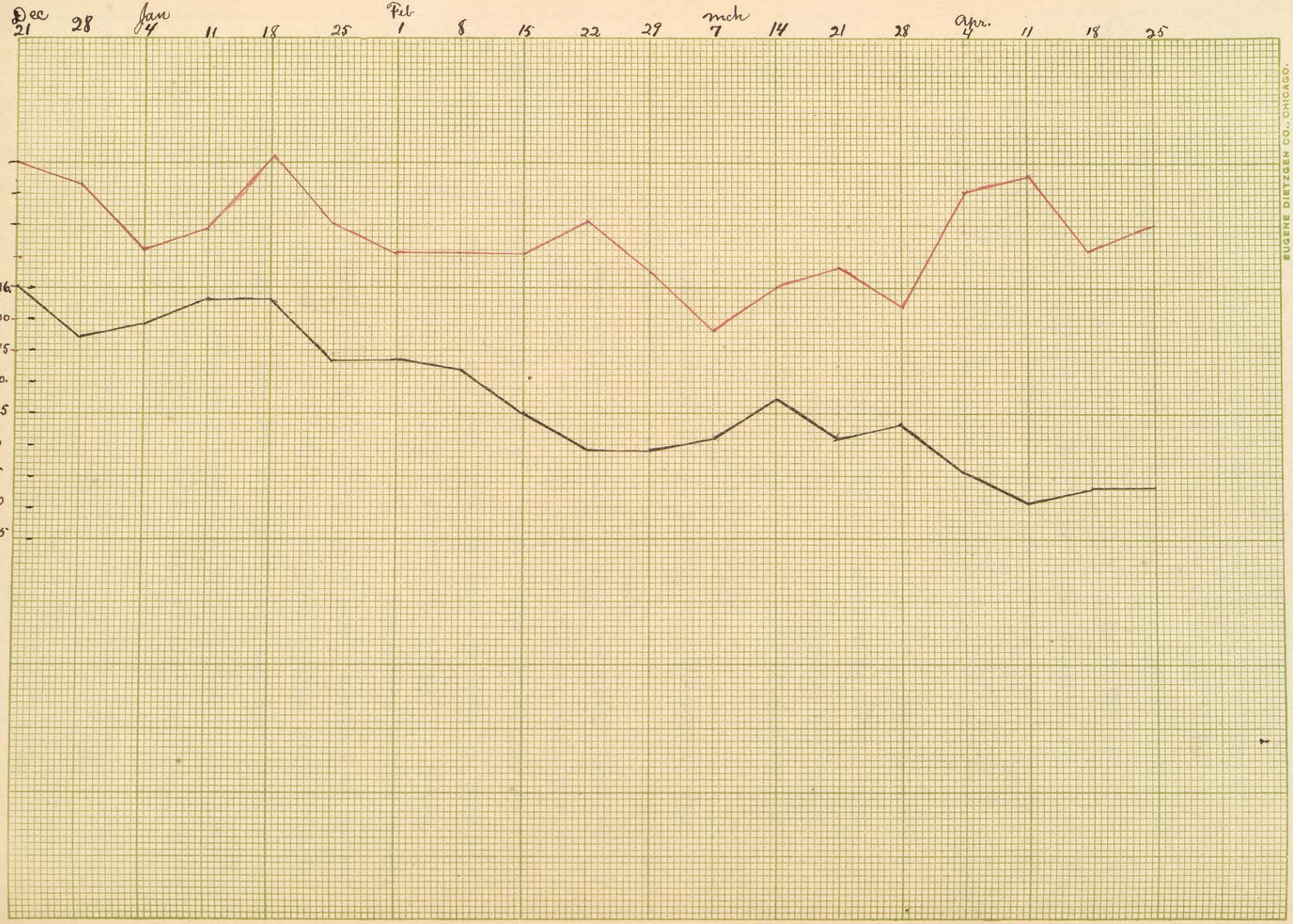
EUGENE DIETZGEN CO., CHICAGO.

Plate II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EUGENE DIETZGEN CO., CHICAGO.

Plate I

test. The coincident action of both for the week ending January 25 might be explained by the cold wave that took place at that time. It is seen that the test tends to decrease in the cold weather, raises in the warmer weather and then falls off when the cow is turned on pasture. The milk yield tends to decrease as the lactation period advances.

Plate II. shows the curves indicating variations in the test from week to week of cows No. 202, and 201. Also No.86 which dried up during the experiment. It is seen that the variations are remarkably similar for each of the three. No. 86 however falls off in the test until the last week she is milked when it suddenly increases.

The following is a record of our experiment.

Abbreviations.

B.- barometer
L.B.- low barometer
H.B.- high barometer
C.- cloudy
Cl.- clear
W.- warm
V.- very

Table I.

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Dec.11	11.99	10.69	22.78	4.25	4.883	4.566	.5157	.5300	1.0453	W.P.M.
" 12	13.04	10.63	23.67	4.44	4.82	4.63	.5737	.5116	1.0437B	.raised cooler
" 13	12.88	10.14	23.02	4.34	4.4	4.39	.5644	.4844	1.0488	H.B.
" 14	11.95	10.36	22.31	4.09	4.03	4.06	.4781	.4516	.9298	H.B.
" 15	11.75	10.43	22.18	4.11	4.96	4.53	.4829	.5269	1.0098	"W.P.M
" 16	11.61	9.65	20.26	4.54	3.97	4.25	.5274	.3797	.9071	H.B.

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Dec. 17	11.93	9.98	21.91	4.47	4.57	4.52	.5485	.4615	1.0100	B. falling
" 18	11.56	10.05	2i.61	4.21	4.05	4.13	.4884	.4099	.8983	L.B. Cl.
" 19	11.57	10.18	21.75	4.0	4.98	4.49	.4608	.5141	.9749	B. rising in P.M.
" 20	11.55	9.65	21.20	4.42	4.6	4.51	.5089	.4439	.9528	B. falling in P.M.
" 21	11.82	10.29	22.11	4.11	4.37	4.24	.4843	.445	.9293	Cl.
" 22	11.71	9.90	21.61	4.16	4.36	4.26	.4715	.4283	.8998	Cl. H.B.
" 23	11.77	9.58	21.35	4.49	4.92	4.705	.5412	.4764	1.0176	C. A.M.
" 24	11.23	9.25	20.48	4.40	4.61	4.505	.4886	.4240	.9326	Cl.
" 25	10.93	9.1	20.03	3.98	4.20	4.04	.4308	.3809	.8117	H.B. cold
" 26	10.89	8.58	19.47	4.16	4.39	4.275	.4633	.3800	.8433	Cl.
" 27	10.62	8.9	19.52	3.93	4.38	4.155	.4060	.3884	.7944	Cl.
" 30	11.11	9.12	20.23	4.3	4.23	4.265	.4374	.3873	.3220	H.B. Cl.
" 31	11.39	9.18	20.57	4.11	4.39	4.25	.4681	.4028	.8709	W. Cl.
Jan. 1	11.15	9.21	20.36	4.21	4.34	4.275	.4701	.3987	.8689	C. 1 in. snow
" 2	11.27	9.07	20.34	4.15	4.39	4.27	.4657	.3941	.8598	ColdH.B. Cl.
" 3	11.28	8.77	20.05	3.94	4.44	4.19	.4248	.3916	.8164	Cold H.B.
" 4	10.56	9.95	20.62	4.27	4.19	4.23	.4516	.4144	.8660	T rising H.B. Cl
" 5	11.1	9.42	20.52	4.27	4.43	4.35	.4692	.4155	.8847	warmer Cl.
" 6	10.44	9.3	19.74	4.27	4.46	4.365	.4481	.4181	.8668	Cl.
" 7	11.01	9.09	20.10	4.25	4.24	4.245	.4659	.3898	.8557	Cl.
" 8	11.14	9.31	20.45	4.35	4.23	4.39	.4873	.3940	.8813	B. falling W.
" 9	11.31	9.57	20.88	4.34	4.25	4.295	.4897	.4115	.9012	Warmer L.B.
" 10	11.12	9.31	20.43	4.29	4.48	4.385	.4795	.4217	.9012	W. L.B. C.
" 11	11.28	9.05	20.23	4.03	3.84	3.935	.4523	.3499	.8022	C.

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Jan. 12	11.11	9.56	20.67	4.24	4.63	4.435	.4682	.4488	.9170	Cl.
" 13	11.18	9.54	20.72	4.15	4.47	4.31	.4617	.4328	.8945	W., Cl.
" 14	10.27	9.93	20.20	4.18	4.12	4.15	.4650	.4138	.8788	H.B.
" 15	11.15	7.91	20.86	4.11	4.23	4.17	.4567	.4139	.8706	Cl.
" 16	11.55	9.6	21.15	4.12	4.29	4.405	.4743	.4177	.8920	L.B. Cl.
" 17	11.63	9.35	20.98	3.95	4.37	4.16	.4560	.4158	.8718	Cl.
" 18	11.02	9.45	20.47	3.91	4.41	4.18	.4299	.4241	.8540	Cl.
" 19	11.18	9.26	20.44	4.04	4.18	4.11	.4514	.3930	.8444	C., B. falling
" 20	10.83	9.03	19.86	4.06	4.15	4.105	.4309	.3752	.8061	C. Colder
" 21	10.71	9.09	19.80	4.46	4.3	4.38	.4756	.3898	.8654	Cold C.
" 22	10.97	8.95	19.92	4.24	4.19	4.215	.4624	.3758	.8382	Cold C.
" 23	11.27	9.18	20.45	3.70	4.03	3.865	.4099	.3682	.7899	C. Cold
" 24	11.14	9.26	20.40	4.52	4.14	4.33	.4933	.3887	.8820	Cold C.
" 25	11.04	8.91	19.95	4.175	4.42	4.3	.4663	.3932	.8595	V.Cold C.
" 26	11.29	8.92	20.21	4.09	4.38	4.235	.4423	.3830	.8253	V.Cold A M., P.M. W
" 27	10.41	10.07	20.48	3.65	4.26	3.955	.3825	.4335	.8160	W. H.B.
" 28	10.87	9.31	20.18	4.0	4.33	4.165	.4708	.4022	.8730	Big drop in B. P.M
" 29	10.74	9.3	20.04	4.14	4.69	4.415	.4351	.4382	.8733	Cl.
" 30	11.19	9.76	20.95	4.16	3.8	3.98	.4654	.3636	.8290	L.B.
" 31	11.94	9.81	21.75	3.71	4.16	3.935	.4193	.4017	.8210	Cl. B.
Feb. 1	11.46	10.34	21.80	3.9	3.92	3.91	.4491	.4031	.8522	B. V. low P.M. W
" 2	10.61	9.71	20.32	3.91	4.21	4.06	.4123	.4066	.8189	Cold H.B.
" 3	10.56	9.64	20.20	4.08	4.14	4.11	.4263	.3997	.8239	V. H.B. colder
" 4	11.33	9.81	21.14	3.9	4.39	4.14	.4332	.4339	.8671	P.M. W,

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Feb. 5	11.1	10.19	21.29	3.97	4.06	4.015	.4378	.4112	.8490	W. B. falling
" 6	11.12	9.67	20.79	4.0	3.64	3.82	.4446	.3502	.7948	V. L.B.
" 7	11.65	9.01	20.66	3.68	4.38	4.03	.4216	.3911	.8127	Cold A.M. B. Rising
" 8	11.21	8.97	20.18	4.0	4.17	4.085	.4439	.3789	.8288	Cold H.B C.
" 9	10.83	8.74	19.57	4.14	3.97	4.07	.4441	.3479	.7920	Cold H.B. C.
" 10	11.05	8.65	19.70	3.9	4.12	4.01	.4119	.3566	.7685	Cold V. H.B. C.
" 11	10.86	8.71	19.57	3.48	3.85	3.665	.3843	.3337	.7180	Cold V. H.B.
" 12	10.61	8.80	19.41	3.80	3.91	3.855	.4043	.3397	.7440	P.M. W. falling B.
" 13	10.91	8.71	19.62	3.72	4.18	3.95	.3979	.3682	.7661	W. L.B.
" 14	10.36	8.43	18.97	3.73	4.28	4.005	.3813	.3604	.7417	Cooler H.B.
" 15	10.53	8.01	18.54	4.01	4.24	4.135	.4216	.3424	.7640	Cold H.B.
" 16	10.51	8.23	18.74	3.84	4.04	3.94	.4007	.3347	.7354	Cold
" 17	10.47	8.04	18.51	3.90	4.23	4.065	.4018	.3413	.7431	Cold C.
" 18	9.83	7.62	17.45	4.11	4.51	4.31	.3997	.3303	.7300	V. HB P. M.
" 19	9.73	8.00	17.73	4.28	4.01	4.14	.4147	.3115	.7262	Cold H.B.
" 20	9.72	7.87	17.59	3.79	4.13	3.96	.3912	.3250	.7162	Cold C. H.B.
" 21	9.58	8.03	17.61	4.34	4.34	4.34	.4081	.3476	.7557	Moderate
" 22	9.68	8.63	18.31	3.78	4.34	4.06	.3612	.3743	.7355	V. W., P.M.LB.
" 23	10.05	8.22	18.27	4.15	4.21	4.18	.4069	.3460	.7529	W. L.B.
" 24	10.44	8.50	18.94	3.75	4.07	3.91	.4117	.3465	.7582	W.
" 25	10.37	8.29	18.66	3.41	4.25	3.83	.3426	.3553	.6979	V. W.
" 26	10.40	7.90	18.30	4.13	3.89	4.01	.4278	.3104	.7382	Fair
" 27	10.19	8.44	18.63	3.87	4.03	3.95	.4005	.3388	.7393	W. P.M.
" 28	10.85	8.55	19.40	3.95	4.58	4.26	.3811	.3575	.7386	W. Cl.

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A. M. Amt. butter fat	P. M. Amt. butter fat	Total	
Feb.29	9.57	7.69	17.26	4.17	4.28	4.27	.3930	.3348	.7278	W.
	Two cows dropped									
Mar. 1	10.20	8.16	18.36	3.13	4.25	3.69	.3049	.3394	.6443	W. Cl.
	One cow dropped									
" 2	10.72	8.80	19.52	3.78	4.08	3.93	.4001	.3487	.7488	V. W.
" 3	10.34	8.64	18.98	3.70	4.30	4.00	.3873	.3617	.7490	Cold AM.
" 4	10.36	8.62	18.98	3.99	4.41	4.20	.3999	.3728	.7727	V. H.B.
" 5	10.51	8.68	19.19	4.00	3.72	3.86	.4099	.3107	.7206	Rapid drop B.
" 6	10.80	9.14	19.94	3.73	4.23	3.98	.3988	.3791	.7785	Moderate
" 7	11.00	8.73	19.73	3.93	4.03	3.98	.4236	.3533	.7769	"
" 8	11.21	9.20	20.41	3.81	3.75	3.78	.4263	.3462	.7725	"
	One cow dropped									
" 9	10.52	9.67	20.19	4.37	4.03	4.20	.4405	.3874	.8279	W.
" 10	11.29	8.81	20.10	3.79	4.55	4.17	.4221	.3988	.8209	V.H.B.W.
" 11	11.21	10.03	21.24	4.32	4.04	4.19	.4868	.4034	.8892	W. L.B.
" 12	11.41	9.71	21.12	3.80	4.16	3.98	.4303	.4018	.8321	C.
" 13	12.00	9.53	21.53	3.87	3.96	3.91	.4581	.3759	.8340	2 in. snow A.M.
" 14	12.03	9.52	21.55	3.42	4.23	3.823	.4094	.4027	.8121	Cl.
" 15	11.93	9.88	21.81	3.55	3.80	3.675	.4196	.3725	.7821	Moderate
" 16	12.25	9.82	22.07	3.93	4.60	4.25	.4809	.4489	.9298	W. "
" 17	12.02	9.10	21.12	4.07	4.32	4.295	.4751	.3975	.8726	" "
" 18	11.55	9.29	21.84	4.16	4.49	4.325	.4853	.4171	.9024	" "
" 19	10.75	8.82	19.57	4.15	4.01	4.08	.4473	.3543	.8016	" L.B. P.M.
" 20	11.95	9.83	21.78	3.85	4.41	4.13	.4701	.4303	.9004	W.C.
" 21	11.44	9.47	20.91	4.20	4.28	4.24	.4634	.4005	.8639	V.W. LB. P.M.
	One cow dropped									
" 22	12.01	10.11	22.12	3.91	4.34	4.125	.4769	.4412	.9181	W. L.B.
" 23	11.88	9.67	21.55	3.68	4.17	3.925	.4357	.4054	.8411	rising B
	Four cows added									

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Mar. 24	11.11	9.76	20.87	3.99	4.35	4.17	.4368	.4267	.8635	W. C.
" 25	10.86	9.39	20.25	4.04	4.39	4.215	.4284	.4018	.8302	Cl.L.B.
" 26	9.83	9.23	19.06	4.08	5.03	4.555	.3870	.4514	.8384	H.B. P.M.
" 27	9.54	8.47	18.01	4.53	4.88	4.755	.4201	.4012	.8213	W. H.B.
" 28	10.79	8.84	19.63	4.38	4.49	4.435	.4628	.3882	.8510	W. H.B.
" 29	10.12	8.23	18.35	4.44	4.52	4.48	.4427	.3609	.8036	W. L.B.
" 30	10.13	8.53	18.66	4.62	4.72	4.67	.4589	.3934	.8523	" "
" 31	9.80	8.23	18.03	4.33	5.02	4.675	.4142	.4057	.8199	L.B. W.C.
Apr. 1	9.60	8.20	17.80	5.06	4.83	4.945	.4777	.3883	.8660	Rising B.
" 2	9.47	8.13	17.60	4.50	4.50	4.50	.4478	.3541	.8019	H.B. Cl.
" 3	9.25	7.53	16.78	4.94	5.39	5.165	.4485	.3935	.8420	H.B. W.
" 4	9.20	7.31	16.60	5.11	5.06	5.085	.4649	.3609	.8258	H.B. W.
" 5	9.48	8.53	18.01	4.88	4.73	4.805	.4498	.3643	.8141	" "
" 6	9.35	7.33	16.68	4.75	4.76	4.755	.4365	.4311	.7776	W. C.
" 7	9.39	7.27	16.66	4.92	5.34	5.13	.4508	.3755	.8263	" "
" 8	9.09	6.50	15.59	5.20	5.48	5.34	.4601	.3489	.8090	Cold C.
" 9	88.97	6.65	15.62	4.91	4.69	4.80	.4283	.3048	.7331	L.B. C.
" 10	8.86	8.22	17008	4.22	4.91	4.565	.3702	.3899	.7601	W. P.M.
" 11	9.70	7.59	17.23	4.80	4.51	4.655	.4539	.3438	.7977	W. Cl.
" 12	9.23	7.14	16.37	4.65	4.99	4.82	.4201	.3481	.7682	Moderate
" 13	10.20	8.13	18.33	4.58	4.51	4.545	.4558	.3395	.7953	W. H.B.
" 14	9.95	8.33	18.28	4.55	4.68	4.615	.4514	.3807	.8321	W. P.M.

Table I. (continued)

Date	A.M. Amt. milk	P.M. Amt. milk	Total	A.M. Test	P.M. Test	Avg.	A.M. Amt. butter fat	P.M. Amt. butter fat	Total	
Apr. 15	10.32	8.52	18.48	4.49	4.73	4.61	.4501	.3962	.8469	W.
" 16	10.70	9.10	19.80	4.26	4.71	4.555	.4428	.4192	.8620	rising B.P.M.
" 17	11.42	8.69	20.11	4.62	4.91	4.765	.4412	.4053	.4865	H.B. W. P.M.
" 18	12.07	9.72	21.79	4.61	4.63	4.62	.5472	.4439	.9811	V.W. Cl
" 19	11.48	9.51	20.99	4.94	4.63	4.785	.5502	.4262	.9764	C.
" 20	10.88	9.38	20.26	4.84	5.34	5.09	.5242	.4642	.9884	"
" 21	10.26	7.78	18.13	4.84	4.70	4.59	.4339	.3565	.7904	"
" 22	10.11	8.49	18.60	4.52	4.64	4.375	.4293	.3844	.8137	W. P.M. L.B.
" 23	10.40	8.72	19.12	4.69	4.84	4.765	.4763	.4121	.8884	C.
" 24	9.47	8.47	17.94	5.13	4.57	4.85	.4758	.3782	.8540	"
" 25	9.91	7.58	17.49	4.19	5.28	4.735	.4073	.3911	.7984	"

In order to compare the effect of certain specific influences, several tables have been constructed in which opposite conditions of weather have been brought into comparison, care being taken to select periods in which the other conditions were nearly the same in each period.

The following table shows a comparison between a period of three consecutive days of clear weather and three consecutive days of cloudy weather immediately following.

Table II.

	Avg. test per day %	Avg. lbs. butter fat per day for 12 cows.
Jan. 5--8 Clear	4.315	10.4666
" 8--11Cloudy	4.190	10.3329
Difference	.125	.1337

This table shows a marked decrease in the test due to cloudy weather, with a corresponding decrease in the amount of butter fat produced. The milk yield was not affected. There was no storm, and only a trace of precipitation during the cloudy period. The average temperature in each period was almost the same, though the range was much greater in the clear weather.

The following table shows the effect of a cold wave. The week preceeding the cold wave was clear with a very regular temperature, ranging from about 25° to 65° every day. The next eight days formed the coldest period of the winter the temperature being below 32° all the time, the lowest being 13° below 0. The cows were kept in the barn all the time being turned out to drink during the day. The temperature in the barn had a very limited range and though it went below freezing every night the lowest temperature at any milking time was 26° above 0.

Table III.

	Avg. lbs. milk per cow, per day.	Avg. test per day.	Avg. lbs. butter fat per cow, per day.
Jan. 13--19 inclusive	20.69	4.183	.8723
" 20--27 inclusive	20.13	4.173	.8353
Difference	.56	.01	.0370

This table shows a decrease in the milk flow but very little change in the test.

The next is a comparison between high and low barometer periods. The first table is a comparison between the period of lowest barometric pressure during the winter, the reading ranging from 28.18 to 28.60 inches, with the highest, the high readings ranging from 29.20 to 29.85 inches.

Table IV.

	Avg. #milk per head.	Avg. test.	Avg. #butter fat perhead.
Feb. 5--6--13 L.B.	21.18	3.93	.8034
" 8--9--10 H.B.	19.52	4.051	.7915
Difference	1.66	— .121	.0119

This table shows a marked increase in test in favor of the high barometer but with a decrease in the amount of butter fat produced.

The following table compares the same conditions.

Table V.

	Avg. #milk per head.	Avg. test.	Avg. #butter fat per head.
Mar. 29,30,31. Apr.1. Low	18.17	4.710	.8363
Apr. 2,3,4. High	17.00	4.918	.8233
Difference	1.17	— .208	.0130

This shows precisely the same resulte as the table preceeding.

The following is a comparison between a period of low with one of medium barometric pressure.

Table VI.

	Avg. test	Avg. #butter fat per head.
Mar.15--18 inclusive Medium	4.271	.9086
Mar.19--22 inclusive Low	4.232	.8810
Difference	.039	.0276

This table shows a slight increase in the test with a corresponding increase in the amount of butter fat in favor of medium barometric pressure.

The following is a table showing the effect of a characteristic cold wave. The barometer had been sinking steadily for three days until Feb.6, four o'clock P.M. when it reached 28.18 inches, with a

temperature of 73°. A sudden change began at this point, the temperature falling 43° in two hours. The change of temperature came too late to affect the cows on the afternoon milking of Feb.26, so the marked decrease in the test must have been due to the very low barometric pressure only. However the effect of the cold wave demonstrated itself on the morning of Feb.7.

Table VII.

	Avg. for 3 da. preceeding		Feb.5		Feb.6		Feb.7	
	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Test	3.96	4.25	3.97	4.06	4.00	3.64	3.68	4.38
#butter fat	.4236	.4127	.4378	.4112	.4446	.3502	.4216	.3911
Barometer reading	rather high		28.60	28.40	28.32	28.40	28.95	29.14

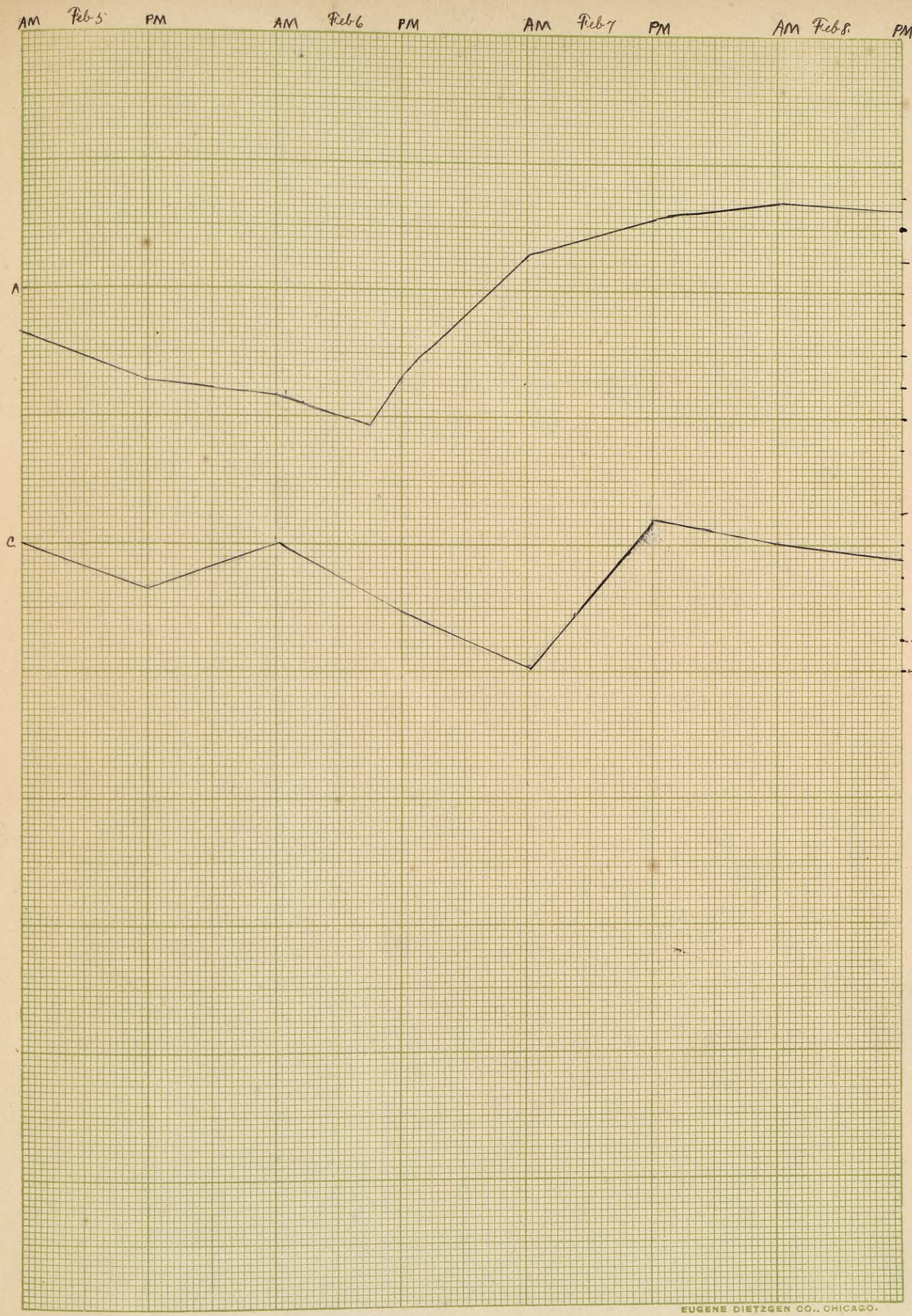
This change of test is graphically represented by plate III. of the coordinate paper. The line AB represents the average barometric pressure and the line CD, the average test of the days preceeding. The curves in each case representing the amount of deviation from the normal shown in the table.

The next table shows the results of excitement. In this part of the experiment four of the scrub cows were selected and just before milking time, which was about four o'clock P.M., they were severely chased. They were chased back and forth across the pasture, then cornered and whipped violently for some time.

Table VIII.

	Avg. test for four cows. A.M.	P.M.
Apr.6.	5.33	5.48
" 7	5.35	6.35
" 8	5.95	6.00
" 9	5.28	5.05

Plate III



The excitement was given on the afternoon of April 7th causing, as can be seen an exceedingly high test which continued for three milkings when it dropped lower than before. There was no noticeable change in the milk yield. Similar results were obtained by subsequent chasings though not so marked. This table is graphically represented in plate IV.

The herd was turned on rye pasture April 13th. A comparison between the seven days before turning on the pasture with the seven days following is shown as follows.

Table IX.

	Avg. #milk per cow, per day.	Avg. test per day	Avg. #butter fat per cow, per day.
Apr. 6--12 inclusive	16.47	4.866	.7960
" 13--19 inclusive	19.73	4.642	.8772
Difference	3.26	— .224	.0812

This shows a distinct decrease in the test upon turning upon pasture but the increase in milk yield was so great as to also increase the amount of butter fat produced.

According to the latest theories and experiments the secretion of butter fat in the mammary glands is not due to a degeneration of fatty tissue but is a result of metabolic activity brought about by a strong nervous stimuli. An essential of good dairy cows is that they have great nerve power. Any derangement of the nervous system quickly manifests itself in the test. When the nervous system is greatly excited, stimulated to abnormal activity, of course the secretion of butter fat will be abnormally increased. This was shown by the experiment of chasing the cows. It is often noticed that when cows have been shipped some distance, that upon their

arrival the test may run exceedingly high and then be very low. This is caused by the abnormal stimulus of excitement followed by a nervous collapse which means inactivity of the butter fat producing cells. Every case of abnormal increase due to excitement is followed such a reaction. This was also shown in Table VIII.

Cloudy weather has a very depressing effect on the nervous system. Sunlight is as essential to cows and other animals as to the human being. Everyone has experienced the gloomy depressed feeling caused by continuous cloudy weather as compared with effect of clear warm weather with plenty of sunshine, especially in the winter. The fact that cows are very susceptible to this influence was substanciated by the experiment as shown in Table II. in which the test was so noticably decreased.

Another depressing condition is a period of low barometric pressure. A low barometer usually preceeds a rain or some other change of weather. It is usually associated with a warm or sultry, cloudy, muggy, humid atmosphere. Such a depressing condition on the nervous system of course decreases the test in dairy cows, as was shown in every table constructed to find its effect. However the warm weather in such periods seemed to favor the milk production.

A high barometric pressure usually gives clear weather with a vigorous, bracing, wind from the Northwest or North. It may be very cold. Such a period is conducive to a high test but the cold weather generally restricts the milk flow. The decrease in amount of milk may account for the higher test. However, a study of the tables seems to show that the test and milk yield are not necessarily affected by the same influences in the same manner. The test seems to be affected much more easily and is often radically changed while there is no noticeable change in the amount of milk. The

experiment seems to show that the most favorable conditions are not found in periods of either high or low barometric pressure, but in clear warm weather with the barometer reading a little above the average.

In the case of a cold wave the total amount of butter fat produced is invariably decreased as is the amount of milk. The test in some cases is higher in cold weather but only because the milk yield has been cut down in a greater porportion than the secretion of butter fat. The records of Star of Hillview and others show that the test decreases during cold weather, increasing in the warmer periods.

While not bearing directly on the subject it may be of interest to give the data and conclusions of an experiment carried on in the Department of Physics under the direction of Professor Hamilton, with respect to the change of density and volume of butter fat with the temperature. The butter fat used in this experiment was obtained from melted butter by allowin it to settle, then drawing off the melted butter fat which was filtered. A specific gravity bottle holding about one hundred cubic centimeters was weighed empty, and then full of disilled water, to determine the tare and the volume. The bottle was filled with melted fat and heated up to exactly 70°, the temperature being taken by a standard thermometer reading to a tenth of a degree Centigrade. Care was taken to see that the bottle and stopper were full at this temperature. It was then weighed on an anylitical balance weighing to .00005 grams. The weight was taken when it was full of fat at 60°, 40° and 31.5° which was the lowest temperature at which the fat remained a clear

liquid. This seemed to be the melting point of butter fat. The bottle was then weighed when full of fat at 24°, the highest possible temperature at which the fat would remain perfectly solid.

The density and volume of butter fat at different temperature could then be computed and then the coefficient of expansion.

Data of experiment:

	Wt. of fat	Density
24°	92.4481	92.58
31.5°	91.0432	91.17
40°	90.4703	90.60
60°	89.1110	89.23
70°	88.4398	88.56

Decrease in density per ° C. of temperature .0675

Coefficient of expansion per ° C. .000765