PRODUCTION AND MARKETING OF MILK FOR WASHINGTON, D. C.

By

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PREFACE

This study is devoted to a description of the production and marketing of milk for the City of Washington. An attempt has been made to bring out the factors which have led to the development of the industry in its present form. The choice of materials has been dictated by their value in bringing out the most important characteristics and problems of the industry.

Thus, in the section on Climate, there is much greater emphasis on mid-summer moisture deficiency than on the other elements of climate. Regulation by the Health Department has been described in detail, because it was felt that this regulation is fundamental to the present development of the industry.

The field work for the study was done in the fall and winter of 1948-49. About 75 dairy farms, located in different parts of the Milk Shed, were visited, in the company of the inspectors of the Health Departments. County Agents and other agricultural leaders were interviewed. Information on marketing of milk was obtained by interviews with executives of six dairies, and from statistical data published by the Producers' Association.

My thanks are due to all the persons who have helped me in this work. I am especially thankful to the officers of the Health Departments and to the County Agents in the different counties. At the University, Profs. A. E. Hamilton and O. W. Beal of the Agricultural Economics Department and Dr. H. P. Thomas of the Soils Department have given valuable help on the portions which dealt with their respective fields.

In the end, I thank Dr. O. E. Baker, teacher and inspirer for his constant help and guidance. The opinions expressed here, are my own and I alone am responsible for them. The criticism is directed not against individuals but against institutions and should be taken in that light.

PART I. PRODUCTION

CHAPTER I

DEFINITION AND LOCATION OF THE MILK SHED

In this study we shall concentrate our attention on that portion of the milk supply of the Washington Metropolitan area which is produced and distributed under the regulations of the Health Department of the District of Columbia. The dairy farmers, producing this milk, represent 84 per cent of all the milk producers shipping milk to the Washington market. The remaining 16 per cent of the producers ship milk to dairies, in the Metropolitan area, which are located outside the District lines and do not sell any milk in the District. These latter producers and dairies are under the regulations of local Health Departments of the city of Alexandria, in case of the dairy in Alexandria, and of Prince Georges County and Montgomery County, in case of dairies located in the Maryland part of the Metropolitan area.

This concentration of attention on a part of the milk supply may be questioned, but appears necessary. The regulations of the D. C. Health Department impose certain conditions under which the farms and dairies must operate. These regulations have radically changed the conditions of milk production and have a profound effect on the organisation of the market. Also, the local Health Departments try to follow the pattern set by the D. C. Health Department. By devoting attention mainly to the producers and dairies operating under D. C. regulations, we shall be able to get a better appreciation of the conditions in the Milk Shed and the

market, and of the problems arising therefrom.

Location of the milk producers. "The Washington Milk Shed". 1,472 milk producers held permits (from the D. C. Health Department) to ship milk into the District of Columbia in 1948. The general pattern of location of these producers is shown in Map 1. The relationship between location of producers and physical, economic, and social factors is discussed at length in Chapter V. A more detailed map showing location of producers is given in the Appendix. Approximately 90 per cent are located within the area enclosed by the heavy black line on the map. Most of the producers shipping to the dairies outside the District are also located within this area. The area has an irregular shape. It is composed of a major compact area and a number of projections to the southwest. The compact area occupies most of Frederick and Montgomery Counties and adjacent parts of Carroll and Howard Counties in Maryland, and most of Loudoun and the northern half of Fairfax County in Virginia. The principal projection is to the southwest, along the line of the Southern Railroad, as far as Gordonsville on the Orange-Louisa County line. Two secondary projections extend westward — one as far as Warrenton, Virginia, and the other as far as The Plains, Virginia, both along railroad lines.

The remaining producers are very widely scattered. About forty-five are located in Hagerstown Valley and across the Potomac in Jefferson County, West Virginia. About a dozen are in Bedford Valley, Pennsylvania, and eight each near Somerset, Pennsylvania, and near Grantsville (Garrett County), Maryland. Nearly, thirty are in Harford and Cecil Counties in Maryland, most of them along (or close to) the highway between Bel Air and Conowingo, Maryland. On the eastern shore of Maryland, there are about fifteen producers. They are all fairly close to the shore. In the Coastal Plain, west of the Chesapeake Bay, there are

fifteen producers -- eight in Prince Georges County, Maryland, and the others scattered as far south as Fredericksburg, Virginia.

The term "Washington Milk Shed" has been here used to denote the area enclosed within the heavy black line, which includes about 90 per cent of the milk producers.

Descriptions of the physical setting, agriculture, and dairy farming relate mainly to this area and the areas bounding it. It is necessary to know the latter in order to understand the factors which determine the boundaries of the Milk Shed. Prince Georges County, Maryland, has been included in the descriptions to bring out the contrasts with southern Maryland. The latter is an area in which, by reason of its proximity to Washington, one would expect a heavy concentration of milk producers, but in which commercial dairy farms are almost non-existent. This county was selected to represent this area for the following reasons:

1. It is located next to Washington, therefore the attraction of the market is the strongest here.

2. All the important soil types that are found in southern Maryland are found in the County.

3. It is the leading tobacco producing County in the area.

The statistics on agriculture are by counties and Minor Civil Divisions. We shall use these for Frederick and Montgomery Counties in Maryland, and Loudoun, Fairfax, Prince William, Fauquier, and Culpepper Counties in Virginia, and for Prince Georges County, Maryland, for comparison.

It is hoped that by thus restricting the description to a contiguous area which includes the bulk of the milk producers shipping

milk to the Metropolitan Washington market, we shall be able to have a better understanding of the conditions under which the producers have to operate.

CHAPTER II

PHYSICAL SETTING

Climate. The description of climate of the area is based on climatic records for the three stations, Frederick (Frederick County), Maryland; Lincoln (Loudoun County), Virginia; and Culpepper (Culpepper County), Virginia, (Map 1). These stations are chosen as representing conditions in the different parts of the Milk Shed. They are located in areas of concentrated production, and their elevations are typical of elevations in the Milk Shed. The fourth station, Cheltenham, Maryland, has been selected as representative of climatic conditions in southern Maryland.

The area has a humid continental climate. The temperature regime is typical of a continental climate — hot summers, average temperatures in winter months near freezing, rapid rise in temperature in spring, and similar rapid fall in autumn. Average monthly temperatures in the three summer months, June, July, and August range between 72 and 77 degrees. July is the hottest month with temperatures 2 to 4 degrees higher than June or August. Average temperatures in the three winter months, December, January, and February are close to the freezing point (32 to 36 degrees). Temperatures in January, the coldest month, range from 32.5 degrees at Frederick, Maryland, in the north, to 34.7 degrees at Culpepper, Virginia, in the south. The annual range of temperature varies from 44.1 degrees at Frederick to 41.0 degrees at Culpepper. The lower range at the latter station is due both to somewhat lower temperature in July and higher temperature in January. According to the Koppen System of

TABLE 1. Climatic data for four selected

Frederick, Md. - Elevation 297 feet
Frost free season: average (33 years) April 21st to

	J	F	M	A	M
Normal temperature - °F.	32.5	33.3	42.5	52.8	63.7
Normal precipitation - inches	3.23	2.92	3.48	3.39	3.44
Snowfall - inches	7.8	8.6	4.7	.8	

Lincoln, Va. - Elevation 500 feet
Frost free season: average (38 years) April 19th to

	J	F	M	A	M
Normal temperature - °F.	33.4	34.0	43.9	53.2	64.3
Normal precipitation - inches	3.00	2.61	3.08	3.31	3.60
Snowfall - inches	7.0	5.8	3.4	.6	

Culpepper, Va. - Elevation 400 feet
Frost free season: average (31 years) April 15th to

	J	F	M	A	M
Normal temperature - °F.	34.7	36.3	45.3	54.4	64.1
Normal precipitation - inches	3.05	2.40	2.90	3.36	4.02
Snowfall - inches	7.6	4.2	3.6	3.9	

stations.

October 17th = 179 days.

J	J	A	S	O	N	D	Annual
72.2	76.6	74.2	67.7	55.9	44.5	35.0	54.2
4.30	4.03	4.35	3.05	3.03	2.35	3.25	40.82
							27.1

October 21st = 185 days.

J	J	A	S	O	N	D	Annual
72.1	76.7	74.7	68.7	57.3	45.7	35.0	55.0
4.73	3.44	4.26	2.64	3.01	2.35	2.76	38.75
							21.4

October 23rd = 191 days.

J	J	A	S	O	N	D	Annual
72.0	75.7	73.9	69.1	56.3	45.2	36.2	55.2
4.97	3.82	4.80	3.24	3.16	2.49	3.02	41.27
							24.1

TABLE 1. Climatic data for four selected

Cheltenham, Md. - Elevation 230 feet. Length of record 42 years
Frost free season: average (37 years) April 18th to

	J	F	M	A	M
Normal temperature - °F.	34.8	35.3	44.7	53.6	63.5
Normal precipitation - inches	3.53	2.93	3.75	3.84	3.39
Snowfall - inches	6.0	4.7	3.2	.9	

Source: Climatological Data.
For the U. S. by Sections, 1942.
U. S. Weather Bureau.

stations.

October 20th = 185 days.

J	J	A	S	O	N	D	Annual
71.4	75.8	74.0	68.4	57.0	45.9	36.3	55.1
4.37	4.31	4.69	3.24	2.87	2.52	3.28	42.72
							19.1

classification of climates, the climate of this area should be considered a C climate.[1] According to Trewarthe's modification of the Koppen System, the boundary between C and D climates passes at the northern and western edge of the area, and the climate should be considered transitional.[2] The soils, over most of the area are grey-brown podsolics, but red-yellow podsolics are encountered at the southern margins in Culpepper and Orange Counties. The distribution of soils, therefore, lends support to the "transitional" view.

Forty inches may be taken as a representative figure for the average annual precipitation in the area. Data for the stations show a range from 38.75" at Lincoln, Virginia, to 41.27" at Culpepper, Virginia. Precipitation is fairly well distributed through the year. No month has less than 2 inches or more than 5 inches of precipitation. Approximately two-thirds of the total precipitation is received in the seven warm season months (April to October). The three summer months, June, July, and August, receive about one-third of the annual total. June and August are the two months with the maximum rainfall. The mid-summer dip in the precipitation curve, so characteristic of eastern United States, is noticeable here, too. Rainfall in July is about an inch lower than in June or August.

The decrease in rainfall in July comes at a time when the temperatures are highest and moisture needs of plants are at their maximum. This decrease and the relatively rapid decline in rainfall from August to September are responsible for most of the complaints about summer

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[1] Boundary between C and D climates is average temperature of 26.6°F. for the coldest month.

[2] Boundary between C and D climates, average temperature of 32°F. for the coldest month. G. T. Trewartha, Elements of Weather and Climate (New York: 1943), p. 310 and plate I.

droughts in the area.

The number of days with snowfall averages 10 to 12 per year. The fall is generally light. Total annual snowfall varies from 27.1 inches at Frederick, to 21.4 inches at Lincoln. The snow cover seldom lasts more than a few days at a time. Growing of winter wheat and barley is possible, due to the fact that winters are not excessively cold, and not due to the protection of a snow cover.

Average length of the frost free season varies from 179 days at Frederick, to 191 days at Culpepper. The average dates are April 21st (last frostin Spring) to October 17th (first frostin Fall) at the former, and April 15th (last frostin Spring) to October 23rd (first frostin Fall) at the latter.

Deviations from the average dates are usually less than two weeks (later or earlier). However, figures for the extreme years show that the frost free season has varied as Frederick from 154 days (in 1906) to 206 days (in 1911). The latest frostin Spring was on May 16, and the earliest in Autumn, on September 23rd.

The length of the frost free season is sufficient for corn to mature. Damage from unseasonable frosts is not a serious problem in this area, for corn or other field crops.[3] Alternate freezing and thawing in winter damages the winter grain crops in some years in areas near the Chesapeake Bay. However, in most years, the damage is not serious. Pastures are generally available for from 7 to 8 months. Data from the records of the D. H. I. A.'s in Virginia Counties show that in most herds

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[3]Spring frosts are a big problem for the orchardists.

the animals were out on pasture for 180-240 days.[4] Animals are often turned out on pasture even in January and February on mild sunny days, primarily for fresh air, because the pasturage available at this time is very small.

The principal climatic problem for the dairy farmer is mid and late summer drought. In order to determine how serious the problem is, the assumption was made that the "potential evapo-transpiration" method of Thornthwaite is at present the best available method of determining from the climatic records whether the precipitation at any particular period is sufficient for the needs of plant growth.[5] Potential evapo-transpiration, moisture surplus, and deficiencies were calculated according to the method described by Thornthwaite from the average temperature and precipitation data for the four stations.[6] Thornthwaite's figure of 10 cm. was used as the reserve of moisture available to the plants from the soil. The results (Table 2 and Figures 2) showed slight deficiency at Frederick and Lincoln, in August and September. At the other two stations the reserve from the soil was sufficient to supply the plants' needs in months when evapo-transpiration exceeded precipitation.

The next step was to determine how frequently did moisture deficiency occur, and how serious was it in different years. In view of the relatively small differences in climate within the area, it was

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[4] "Annual Summary, Loudoun, Fairfax, Culpepper, and Prince William D. H. I. A.'s" (Mimeographed).

[5] C. W. Thornthwaite, "An Approach Towards a Rational Classification of Climate", Geographical Review, 38:55-94, January, 1948.

[6] Ibid. 38:55-94, January, 1948.

TABLE 2. Potential evapo-transpiration and moisture

Frederick, Md.

	J	F	M	A	M
Normal temp. degrees centigrade	.28	.72	5.83	11.56	17.61
(I) Index	.1	.5	1.25	3.58	6.72
Potential evapotranspiration (unadjusted)	-	-	1.63	4.2	7.6
Latitude correction	.85	.84	1.03	1.11	1.23
Potential evapotranspiration (adjusted) - cm.	-	-	1.68	4.7	9.4
Precipitation (cm.)	8.2	7.4	8.8	8.6	8.7
Storage change	-	-	-	-	- .7
Storage	10	10	10	10	9.3
Water deficiency	-	-	-	-	-
Water surplus	8.2	7.4	7.12	3.9	-

Lincoln, Va.

	J	F	M	A	M
Normal temp. degrees centigrade	.8	1.1	6.6	11.8	17.94
(I) Index	.06	.1	1.52	3.67	6.92
Potential evapotranspiration (unadjusted)	-	.15	1.8	4.2	7.9
Latitude correction	.85	.84	1.03	1.11	1.23
Potential evapotranspiration (adjusted) - cm.	-	.1	1.9	4.7	9.7
Precipitation (cm.)	7.62	6.63	7.82	8.4	9.14
Storage change	-	-	-	-	- .56
Storage	10	10	10	10	9.44
Water deficiency	-	-	-	-	-
Water surplus	7.62	6.53	5.92	3.7	-

availability at four selected stations.

J	J	A	S	O	N	D	
22.22	24.28	23.28	20.6	13.5	7.33	2.33	
9.56	10.94	10.26	8.53	4.5	1.78	.32	I= 59.1
10.5	12.0	11.3	9.3	5.2	2.2	.44	
1.24	1.25	1.17	1.04	.96	.84	.83	
13.02	15.0	13.2	9.67	5.0	1.85	.37	
12.62	9.7	12.2	8.23	8.05	6.33	7.93	
-.4	-5.3	-1.0	-1.44	3.05	4.48	.51	
9.6	4.3	3.3	1.86	4.91	9.39	10.00	
-	-	-	-	-	-	-	
-	-	-	-	-	-	6.95	

J	J	A	S	O	N	D	
21.9	24.33	23.33	20.22	13.9	7.72	2.4	
9.36	10.97	10.30	8.29	4.7	1.93	.33	I= 58.36
10.3	11.8	11.1	9.2	5.4	2.35	.46	
1.24	1.26	1.18	1.04	.96	.84	.82	
12.8	14.9	13.1	9.6	5.2	1.97	.37	
11.1	10.95	11.9	8.23	7.3	6.4	8.33	
-1.7	-3.95	-1.2	-1.37	2.1	4.43	2.19	
7.8	3.85	2.65	1.28	3.38	7.81	10.00	
-	-	-	-	-	-	-	
-	-	-	-	-	-	5.76	

TABLE 2. Potential evapo-transpiration and moisture

Culpepper, Va.

	J	F	M	A	M
Normal temp. degrees centigrade	1.50	2.39	7.39	12.44	17.83
(I) Index	.16	.33	1.81	3.98	6.86
Potential evapotranspiration (unadjusted)	.22	.45	2.15	4.6	7.7
Latitude correction	.85	.84	1.03	1.10	1.23
Potential evapotranspiration (adjusted) - cm.	.2	.38	2.2	5.06	9.5
Precipitation (cm.)	7.75	6.1	7.37	8.53	10.2
Storage change	-	-	-	-	-
Storage	10	10	10	10	10
Water deficiency	-	-	-	-	-
Water surplus	7.55	5.72	5.17	3.47	.7

Cheltenham, Md.

	J	F	M	A	M
Normal temp. degrees centigrade	1.56	1.83	7.06	12.0	17.5
(I) Index	.17	.21	1.68	3.76	6.66
Potential evapotranspiration (unadjusted)	.25	.3	2.1	4.4	7.5
Latitude correction	.85	.84	1.03	1.11	1.23
Potential evapotranspiration (adjusted) - cm.	.2	.25	2.1	4.9	9.1
Precipitation (cm.)	9.0	7.44	9.5	9.75	8.6
Storage change	-	-	-	-	-.5
Storage	10	10	10	10	9.5
Water deficiency	-	-	-	-	-
Water surplus	8.8	7.19	7.4	4.85	-

availability at four selected stations.

J	J	A	S	O	N	D	
22.33	24.78	23.44	19.83	13.28	6.94	1.67	
9.62	11.30	10.35	8.03	4.40	1.63	.20	I= 57.68
10.5	12.3	11.4	9.0	5.1	2.15	.27	
1.24	1.26	1.18	1.04	.96	.84	.82	
13.02	15.5	13.45	9.36	4.9	1.7	.22	
10.9	10.2	11.0	7.8	7.7	6.0	8.3	
-2.12	-5.3	-1.88	-	2.8	4.3	2.9	
7.18	1.88	-	-	2.8	7.1	10	
-	-	.57	1.56	-	-	-	
-	-	-	-	-	-	5.18	

J	J	A	S	O	N	D	
22.3	24.83	23.7	20.4	14.06	7.6	1.7	
9.62	11.32	10.55	8.41	4.79	1.89	.2	I= 59.05
10.5	12.3	11.5	9.2	5.5	2.3	.27	
1.24	1.26	1.18	1.04	.96	.84	.82	
13.02	15.5	13.6	9.6	5.3	1.9	.22	
12.0	8.74	10.82	11.8	7.64	5.97	7.01	
-1.02	-6.76	-1.66	2.2	2.34	4.07	1.39	
8.42	1.66	-	2.2	4.54	8.61	10.00	
-	-	1.12	-	-	-	-	
-	-	-	-	-	-	5.40	

decided to do this for one station only. Frederick was selected because of its situation in the heart of an area of concentration of milk producers. Monthly temperature and precipitation data were taken from the climatic records for the twenty years, 1927-46.[7] Potential evapo-transpiration, moisture surplus, and deficiencies were calculated as before.

The data are presented in graphic form in Figure 3. The approximate dates at which moisture deficiency began and ended each year are presented in Table 3. Moisture deficiency was experienced in two-thirds of the years (13 out of 20). In 10 out of the 13, deficiency began between the 20th of June, and the 15th of July. In 7 out of the 13 years, the deficiency ended in September. The mid-summer drop in precipitation coming at a time when temperatures are at their highest seems to be the principal reason for starting the deficiency.

To determine if any correlation could be found between these results and actual conditions, in those years, records of pasture conditions were obtained from the Maryland Crop Reporting Service. These records are based on observations of farmers about the condition of their pastures from month to month. The data for Frederick County are generally based on reports from 15 to 25 farmers. There are obvious limitations to the value of such data, and hence it was decided to show these data graphically along with the other graphs showing moisture availability.[8]

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[7] It was necessary to do the calculations for seven months of the growing season only. Two months, one on either side, were taken as a precaution.

[8] The number of farmers reporting is not the same from year to year. A considerable amount of subjective judgment is involved in reporting. Also the condition of the pasture depends upon soil type, grazing practices, and on whether or not the pasture is seeded, limed, and fertilized.

TABLE 3. Approximate duration of moisture deficiency at Frederick, Maryland, 1927 - 1946.

Year	Approximate date at which deficiency began	Approximate date at which deficiency ended	Approximate duration of deficiency
1927	21st July	28th September	2-1/4 months
1928	No deficiency		
1929	15th July	15th September	2 months
1930	10th June	7th November	5 months
1931	1st September	end of November	3 months
1932	1st July	20th September	2-2/3 months
1933	No deficiency		
1934	1st July	15th August	2-1/2 months
1935	15th July	5th September	1-2/3 months
1936	8th July	end of September	2-3/4 months
1937	No deficiency		
1938	No deficiency		
1939	5th July	end of September	2-5/6 months
1940	5th July	25th August	1-2/3 months
1941	1st July	end of October	4 months
1942	No deficiency		
1943	1st July	end of September	3 months
1944	20th June	7th September	2-1/2 months
1945	No deficiency		
1946	No deficiency		

In interpreting these data, it should be borne in mind that although 100 represents "normal", the figure is never reached in the reports. The highest ever reached in this period was 95. So if we consider normal for the average, it would be close to 80 rather than 100.

The graphs show a fair correlation between moisture availability and the condition of pastures. They also show that the condition of pastures in a particular month reflects the moisture conditions in the month (sometimes a month and a half) before. In the years in which there was no deficiency, pastures remained between 70 and 90 per cent in most months. There were two really bad years during this period, 1930 and 1943, when pastures were reduced to 10-20 per cent in August, September, and October. The climatic data for Cheltenham, Maryland, do not show any significant variation from conditions in the Milk Shed. The regime of temperatures and the temperatures in the hottest and coldest months; the incidence of precipitation and its annual total, and the length of the frost-free period are all similar to those for the stations in the Milk Shed. The temperature and precipitation values are more like those at Culpepper than at Frederick. Rainfall in July is somewhat higher than at the Milk Shed stations. Normal temperature and precipitation figures do now show any moisture deficiency for the station. It appears that climate is not a significant factor in explaining differences in agriculture between the area of the Milk Shed and southern Maryland.

B. Physiography. The character of the underlying geologic formations and especially their chemical composition and resistance to erosion is a very important factor in explaining intra-regional differences in topography and soils in the Milk Shed. Accordingly, a map showing geologic formations precedes the maps showing slopes and

soils. This map has been compiled from the geologic maps of Virginia and Maryland. In the Virginia area, no change has been made, but in Maryland, the map has been simplified and modified to some extent.[9] In the slope map, 3 per cent and 10 per cent have been taken as the dividing figures. The former marks the limit to which crop production can be carried under normal farming practices, without danger of soil erosion; the latter the limit beyond which crop production should be confined to the growing of close-growing crops like hay, and that also with careful conservation practices.[10] The area included in the maps extends up to county lines in order to give an idea of the conditions at the boundaries of the Milk Shed. The Washington Milk Shed lies within the Piedmont.[11] In the north, in Maryland, and in Loudoun and Fairfax Counties of Virginia, the Milk Shed extends over almost the entire width of the Piedmont, from the foot of the Blue Ridge - South Mountain, to the boundary with the Coastal Plain.

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[9]The Peters' Creek formation and Wissahickon Schist separated on the Maryland map have been grouped together here. The Volcanics have been similarly grouped together. The boundaries between Catoctin Greenstone and the Granite-Gneiss complex in the Middletown Valley correspond to the revised boundaries given by Anna J. and George W. Stose (2, p. 12). The Granite-Gneiss complex according to the revision is much more extensive than in the Maryland map.

[10]The figures 3 per cent and 10 per cent have been used by the Soil Conservation Service in their "Land Use Capability Classifications".

[11]The term "Piedmont" has been used here to include the area from the foot of the Blue Ridge, South Mountain ranges to the Coastal Plain. It accordingly includes the two valleys — Middletown and Catoctin. The topography and geologic formations in these valleys are very similar to the crystalline rock area of the Piedmont. Hence, it has been found more suitable to include these in the "Piedmont".

Farther south, however, it is confined entirely to the Triassic Lowland.

The boundary between the older crystalline rocks of the Piedmont, and the younger sedimentary formations of the Coastal Plain is sinuous and not very clearly defined. Along the stream courses where the overlying Coastal Plain formations have been eroded away, rocks of the Piedmont are exposed farther east than in the inter-stream areas. On the other hand, there are several small outlyers of Coastal Plain formations well within the Piedmont. In this area there are two which are of some size: one in Triassic formations, west of Poolesville in Montgomery County, and the other in crystalline rocks near Tyson's Crossroads in Fairfax County.

The Piedmont is considered to be an area composed of one or more peneplains, which has been recently uplifted so that the rivers have been entrenched in their courses. The major streams flow in entrenched meanders, their courses 100-200 feet below the level of the surrounding upland. The valley sides are steep; valley-slopes of 15-20 per cent are common along the Potomac and of 8 to 10 per cent along the other large streams. There is very little development of the flood-plains — only narrow strips (rarely more than ¼ mile in width) are found along the major streams. The narrow, entrenched, stream valleys are in striking contrast to the extensive areas of broad rolling uplands, and are one of the most important evidences that uplift has dominated in the latest crustal movements.

The geologic structure of the area is quite complex. A large number of geologic formations are exposed, which differ greatly in age, composition, and resistance to erosion. Differences in topography within the area are dependent both upon resistance to erosion of the underlying rocks and upon the stage in the cycle of erosion. The most resistant

cambrian sandstones and quartzites form the ridges like the Catoctin Mountains; the pre-cambrian crystalline rocks which are intermediate in resistance generally give rise to a rolling topography and the Triassic sandstones and shales and Ordovician limestones which are the least resistant give rise to undulating or gently rolling lowlands. But, the hill country in the western part of Fauquier County is underlain by similar pre-cambrian rocks as the rolling areas of the Catoctin Valley, north of it. The hills in this area are in the nature of monadnocks (3, P.139) owing their existence to the fact that they were not eroded as much as the surrounding upland in the last cycle of erosion.

Drainage. Most of this area forms part of the Potomac Drainage Basin. The southern part in Fauquier, Culpepper, and Orange Counties is drained by the Rappahannock and its tributaries of which the Rapidan is the most important. The Monocacy is the most important tributary of the Potomac in this area. The effect of a humid climate is reflected in the profusion of small creeks, most of which originate within the area. Most areas on the uplands are adequately drained. Imperfect drainage is a problem in level areas in the Triassic Lowland. Water supply is derived both from wells and springs in those parts of the Milk Shed which are underlain by crystalline rocks. In Frederick Valley and the Triassic Lowland, this is mostly from wells. In most years, the supply is adequate for agricultural purposes. Shortage of water is likely to be experienced over localized areas, only in periods of prolonged drought.

The valleys of the principal rivers show very well the differences in resistance of the underlying rocks. The Potomac flows in a narrow valley with little or no flood-plain in the crystalline rock areas. In the Triassic Lowland, the valley is broader, with flood-plains as much as ½

mile in width, and the slopes are not so steep. As the river enters the Coastal Plain, the narrow valley opens out into a broad estuary in a level to undulating lowland. The Monocacy flows for some distance at the boundary between the cambrian sandstones and quartsitesom the east, and limestones of the Frederick Valley on the west. The western slopes of the valley are gentle, and there is a small flood-plain. The eastern slopes are marked by steep bluffs.

The falls (in the courses of the Potomac and Rappahannock) which originated where the river crossed from the more resistant crystalline rocks of the Piedmont to the less resistant formations of the Coastal Plain (now they are at considerable distances within the Piedmont) are another important result of these differences in resistance of rocks.

On the basis of differences in topography and in underlying rock formations, it is possible to divide the area of the Milk Shed into the following four sub-regions:

1. The Eastern Crystalline Rock Upland.

2. The Triassic Lowland.

3. The Frederick Valley.

4. The Western Crystalline Rock Belt.

   (a) The Hills.

   (b) The Valleys.

With the exception of 3 and 4 b, these sub-regions are parts of larger areas which extend beyond the boundaries of the Milk Shed both to the north and to the south.

1. The Eastern Crystalline Rock Upland. The portion of this Upland that is included in the Milk Shed is a wedge-shaped area, broadest in the north and tapering to a point near the Fairfax - Prince William

County line. This narrowing southward is partly due to the swing of the Triassic rocks eastward, and partly to the absence of dairy farming south of Fairfax County. Its greatest width east-west (22-25 miles) is in the central part of Montgomery County and its maximum length north-south is about 45 miles. Pre-cambrian crystalline schists, gneisses, and an intrusive schistose granite are the most extensive rock formations in this area. They have been deeply weathered, and rock out-crops are visible only along steep slopes, or along deep road-cuts. Among the various small bodies of intrusives, the Serpentines are worth mentioning because the areas underlain by them have a thin soil of low productivity and are locally called "barrens".

In Maryland there is a belt about 3 miles wide underlain by Loudoun sandstones, quartzites, and slates at the western boundary of the pre-cambrian rocks. The belt, however, does not give rise to any significant topographic or soil differences. In this belt, as well as in the adjacent schist areas, topography is strongly rolling and the soils are of the Chester-Glenelg-Manor Association. The Sugar Loaf Mountain, an isolated knoll rising 500-600 feet above the level of the surrounding upland is considered to be an "unreduced monadnock on the peneplain surface" (2, P. 9). The geologic map shows it underlain by a resistant quartzite, akin to the Weverton quartzite which appears as a ridge-former in the Catoctin and the South Mountains.

The Eastern Crystalline Rock Upland is an area of moderately to strongly rolling topography. Broad undulating to gently rolling uplands bordered by narrow steep-sided stream valleys are characteristic. Elevations on the upland vary from 400 to 600 feet over most of the area. In the north-west, in northern part of Montgomery and adjacent parts of

Carroll and Frederick Counties, where Parr's Ridge passes through this area, elevations are higher (600-800 feet) and terrain strongly rolling.

The broad uplands are the most desirable part of the area. Agriculture, settlements, and highways all tend to be confined to the uplands and to avoid the valleys. Some of the railroads, however, follow the stream valleys, especially through the more rolling sections (the B. & O. from Frederick to Baltimore; for instance). A very large proportion of the uplands is cleared for cropping. Land is suitable for crop production, provided moderate soil conservation practices are followed. However, the area has been misused and soil erosion is extensive. The damage from erosion has been particularly severe along the valley slopes. These are generally wooded or in permanent pasture. The small flood-plains are also wooded or in permanent pasture with some small cropped fields at places.

2. The Triassic Lowland. The Triassic Lowland is an) shaped area of varying width which extends from the northern boundary of the Milk Shed in Frederick and Carroll Counties to its southern limit in Orange County, Virginia. The existence of a belt of Triassic rocks in a region of paleozoic and pre-cambrian formations is explained by the existence of a series of faults. The faults at the western boundary, "called the Triassic border fault", are the most prominent and can be followed along most of the length of the sub-region. Sandstones and quartzites which are exposed on the western side of these faults stand out as a pronounced escarpment overlooking the Triassic Lowland. This escarpment continues under various names from the northern part of Frederick County to central Fauquier County (Map 3). The eastern boundary is not so sharply defined, although it is visible on the

landscape. The general surface of the Triassic Lowlands is about 100-150 feet lower than the surface of the Crystalline Uplands, and from 50-100 feet higher than that of the Frederick Valley.

The area is underlain by sedimentary rocks of Triassic age into which have been intruded bodies of igneous diabase. The sedimentaries are mainly sandstones and shales. There are two narrow belts of calcareous conglomerate. One of these extends along the foot of the Catoctin Range from the vicinity of Braddock in Frederick County across the Potomac to Leesburg in Loudoun County. The other is in the south and extends from Brandy Station (Culpepper County) south almost to Orange, Virginia. The soils derived from the conglomerate are quite productive (being calcareous), but the terrain is more rolling than the typical Triassic Lowland terrain, and rock out-crops are common.

The sandstone and shale areas have an undulating to gently rolling topography. The uplands have an elevation of 300-400 feet, and the larger stream valleys are 50-100 feet below the level of the uplands. Valleys are generally broader, the sides are less steep, and there is a greater development of the flood-plain than in the Crystalline Rock Belts. The only flood-plains of any size, along the Potomac, are in the Triassic Lowland, and the contrast between the steep constricted valley of the river in the Crystalline Belt, and the broader, more open valley in the Triassic Belt is striking.

The intrusions are sills and dykes of diabase. The dykes are too small to be shown on the map. The sills also occupy very small areas in Maryland, but extend over considerable areas in Virginia. They usually occur as long, narrow belts within the sedimentaries. At the contact of the diabase and the sedimentary rocks, there are narrow bands of baked shale which have been produced by the contact metamorphism of the

shale. The soils in these areas are poorly drained. A large proportion of the land in the diabase area is under woodland. The soils tend to be plastic and are poorly drained, topography is generally rougher than in the sedimentary rock areas, and out-crops of dark grey rocks are common. These areas are, in most localities, called "nigger-head land" and are considered poor for agricultural purposes.

The soils of the Triassic Lowland are in general not as productive as those of Frederick Valley or of the Crystalline Rock sub-regions. They are shallower and more susceptible to drought. Erosion is a serious problem along the steeper slopes and poor drainage on the level uplands. But, because of the prevailing undulating to gently rolling topography of the Lowland, a large proportion of its area is cleared for farming. The Triassic Lowland has been a historic route of travel. It is followed by the main line of the Southern Railroad and important north-south highways. Existence of good lines of communications at a time when the adjoining areas were not so favored has probably been one of the reasons for the development of this area.

3. Frederick Valley. The name Frederick Valley is here given to the area between the Crystalline Upland on the east and the Triassic Lowland on the west, which is underlain by Ordovician limestones. It is a rather narrow, long, lens-shaped lowland. Its maximum length from the Potomac to its apex near Woodsboro is about 24 miles. Its average width is about four miles, though in the vicinity of Frederick, it broadens to a maximum width of about 6 miles. The limestones underlying the valley have been distinguished into two types. The first called Beekmantown limestone is much less extensive and occurs in a long, narrow belt (about ½ to 1 mile wide) east of Frederick. The other called Frederick limestone is argillaceous and occupies the rest of the valley. There is no marked

difference in topography between the areas underlain by the two types. In the area of the purer limestone, the soils are generally not as deep as in the argillaceous limestone area and rock out-crops are frequent. The valley is an area of low elevation (300-350 feet) and level to undulating topography. The principal stream is the Monocacy which enters it from the north and flows south to the Potomac. A number of small creeks join the Monocacy. The valley of the stream is relatively broad, and its slopes are gentle. The creeks flow in inconspicuous channels. Because of its favorable topography, fertile limestone soils and occupation by people of German descent, the valley is an area of very intensive land use. It is served by a number of important highways and two railroad lines.

4. The Western Crystalline Rock Belt. The Triassic Lowland interrupts the continuity of the Crystalline Rocks which are again exposed to the west of it and occupy the western part of the Milk Shed. The area of the Western Crystalline Rock Belt, shown in the maps, is an area of varied topography. The only part included in the Milk Shed is the basin-like upland area which goes under the name of Middletown Valley in Maryland, and Catoctin Valley in Virginia. The whole area (shown in the maps) is here described in order to bring out the differences in topography within the Milk Shed and its boundaries in this sub-region. The principal formations exposed in the belt are:

1. Cambrian sandstones and quartzites of which the Loudoun and Weaverton formations are most important.

2. Catoctin greenstone , a pre-cambrian metabasaltic lava flow.

3. A pre-cambrian granite-gneiss complex called Marshall Granite in the Virginia Geologic map.

The granite-gneiss complex and the metabasalt occupy the bulk of the area. The topography associated with these is rolling to hilly. In

general, the metabasalt gives rise to rougher terrain than the granite-gneiss complex.

Sandstones and quartzites are exposed along the eastern and western boundaries (where they appear as forming ridges) and again in the south.

(a) The hills. At the eastern boundary of the belt is the escarpment (facing east toward the Triassic Lowland) formed by cambrian sandstones and quartzites. The Weverton Quartzite is the more resistant of the two, and the ridge is the highest and broadest in the north where this formation comes to the surface.

In Maryland, the ridges are called the Catoctin Range. It is distinguished as a ridge separate from the main body of the South Mountain, in the vicinity of Myersville, in Frederick County. In this area, it is more than 3 miles across and has an elevation of over 1,700 feet, which is about 1,300 feet above the level of the Triassic Lowland to the east. It becomes progressively narrower and lower in elevation, southwards. Three miles north of Point of Rocks, it is only about a mile across and a little over 1,000 feet high.

The ridge is weakest in Loudoun County, between the Potomac and Aldie. It is only about 600-800 feet high, about a mile across, has a wide gap at Oakland, and practically disappears for about a mile north of Aldie. South of Aldie, however, it again appears as a pronounced escarpment called Bull Run Mountain. It is 800-1,000 feet high, about one mile across, and extends as far as New Baltimore. South of New Baltimore, the out-crop of Loudoun formation is terminated by a cross-fault and the boundary with the Triassic Lowland is formed by Catoctin greenstone. This belt of Catoctin greenstone continues to the southern end of the Milk Shed. It is a narrow belt and is interrupted by intrusions of Loudoun formation.

It has a rolling topography and the soils are productive, although stony at places due to the nearness of the hills.

The ranges, South Mountain in Maryland, and Blue Ridge in Virginia, are also capped by the Cambrian sandstones and quartzites that form the Catoctin Range. The crests of the South Mountain vary in elevation from 2,000 feet in the northern part of Frederick County, to about 1,000 feet near the Potomac. The range also becomes narrower to the south from about 5 miles across north of Myersville to less than a mile near the Potomac. There is a short extension of the South Mountain in Virginia which is called Short Hill. It is about 1,000 feet high and terminates near Hillsboro in Loudoun County. The Blue Ridge has a width of about one mile near the Potomac but increases to about 3 miles in width, near the boundary of Fauquier and Loudoun Counties. Its elevation, within the same distance, increases from 1,200 to 2,000 feet. Like the South Mountain, Blue Ridge also has a short extension in Maryland (called Elk Ridge) which terminates near Rohrersville in Washington County.

The lower slopes of the ranges are used for pastures, the remaining area is wooded. The gaps are used by lines of communication. Several of the railroads follow the Potomac. Other important gaps are at Braddock, Aldie, and Thorofare in the Catoctin-Bull Run Range, and at Paris and Markham in the Blue Ridge. The hills in the southern part of this belt are monadnocks. Their elevation ranges from 800 to 1,000 feet which is about 400-500 feet above the elevation of the surrounding upland. All three formations — Loudoun sandstone and quartzite, Catoctin greenstone, and the granite-gneiss complex are exposed and underlie both the hills and the uplands. Most of the area is utilized for pastures. The hilly topography and existence of large estates seem to be the main reasons for this type of land use.

(b) The valleys. The Middletown Valley in Maryland and the Catoctin Valley in Virginia combine to form an elongated basin-shaped area enclosed on all sides by the hills described above. The topography of this area is rolling. The most extensive geologic formation is the granite-gneiss complex. Catoctin greenstone is next. The maximum length of the area is about 55 miles. The Middletown Valley is the shorter and narrower part; its length from near Myersville to the Potomac is about 20 miles and its width averages 7-8 miles. The Catoctin Valley is about 35 miles long (from the vicinity of Marshall to the Potomac). In the north, from the Potomac to Hillsboro, it is 7-9 miles wide, but as Short Hill terminates near Hillsboro, the valley broadens and is 10-12 miles from here to Goose Creek. South of Goose Creek, it rapidly narrows because the hills close in from both sides.

The upland surface is generally 400 to 600 feet above sea level, the stream courses are 100 to 200 feet lower. The principal streams like the Catoctin Creek in Middletown Valley and Goose Creek in the Catoctin Valley flow in entrenched meanders.[12] The upland surface is generally rolling — moderately rolling over most areas, strongly rolling over others. Level to undulating areas are limited in extent.

The soils over the greater part of the valleys are quite productive. A large proportion of the land in both valleys (about 80 per cent) is cleared and is under crops or pastures. There is greater emphasis on crop production in the Middletown Valley and on pastures (and beef cattle raising) in the Catoctin Valley.

Prince Georges County. Excepting a small area in the extreme

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[12]There are two creeks called "Catoctin Creek". One is in the Middletown Valley and the other in the Catoctin Valley.

northwestern part, which is in the Piedmont, the whole of Prince Georges County is in the Coastal Plain. It is underlain by unconsolidated sedimentary formations. Most of these are mixtures of sands and clays in varying proportion. In some there are large quantities of gravel. The surface varies from level to strongly rolling. There are large areas of level or gently undulating uplands in the southern part of the County. The drainage pattern is dendritic. The streams are not deeply incised in narrow valleys, but flow in rather broad valleys with flood-plains (usually marshy as along the Patuxent). The larger streams (e.g. the Patuxent) have deep estuaries.

There is a distinct correlation between the character of the geologic formations and topography and soils. In the southern half of the County, there are large areas of level to gently undulating uplands. These are underlain by a formation called Lafayette. This is a terrace (Pliocene) formation composed of silt, sands and gravels. The topography is excellent for crop production, but as it has a hard pan under the surface, the uplands are poorly drained, and are mostly in woodland. A triangular area in the northeastern part of the County is underlain by the "Aquia" formation which is composed largely of glauconitic greensands. This area has a gently undulating surface, is well drained, and as the glauconite has a high potash content, it gives rise to some of the most productive soils in southern Maryland. In the northwestern part of the County, there is a belt varying in width from 4 to 10 miles, underlain by the Patapsco formation. This formation consists of a heterogeneous mixture of brilliantly colored clays, and sands, and gravels. There is relatively little soil development on this, and the area is of low productivity. Over the rest of the area of the County, the surface is moderately rolling, drainage is adequate, and soils are moderately productive. Several formations have

been distinguished but they do not give rise to distinctive features as the ones noted above.

C. Soils. The map showing principal soil associations (Map 4) has been compiled from diverse sources. For Maryland, the map published in 1933 was used as a base, and the boundaries were revised.[13] For the Virginia area, a Soil Survey map could be used for Fairfax County only. Information on Loudoun and Fauquier Counties, which have been surveyed but maps not published yet, was obtained by personal communication.[14] Advance sheets were used for Culpepper County. No detailed information was available for Prince William, and the boundaries through this County were drawn on the basis of information from Counties on either side or left undrawn. The soil profile descriptions are condensed from standard descriptions issued by the Soil Survey. The Milk Shed seems to be located in the transitional zone between the grey-brown podzolic and red-yellow podzolic groups of soils. The former occupy most of the area; the latter are found over extensive areas only in the southern part of the Milk Shed in Fauquier, Culpepper, and Orange Counties. The boundary between the two groups is not sharply defined. Small bodies of soils of the red-yellow group are found in this area as far north as Montgomery County, Maryland, which is clearly within the grey-brown podzolic region. On the other hand, soils of the Penn series have been mapped far beyond the southern limit of the Milk Shed (in Albemarle County, for instance). It is often difficult to decide whether the soils in a particular area belong to the one group

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[13] Principal Soil Series in Maryland. Boundaries revised by R. P. Thomas and M. F. Merschberger, Soil Scientists, at the University of Maryland.

[14] From Mr. H. C. Porter, for Loudoun County, and James H. Petro, for Fauquier County.

or the other.[15]

As the area is transitional between the two soil groups, each group has some of the characteristics of the other. The grey-brown podzolics are more leached than those farther north, whereas the red-yellow podzolics are less leached than those in the typical areas farther south. All the zonal soils of the area show the strong influence of leeching which is active most of the year because of the humid climate. They are all (including those like Pauquier, Myersville which are derived from basic rocks) acidic in reaction (more or less) and benefit from the application of lime. The sub-soil is more compact and of finer texture than the surface soil, because of the accumulation of finer (clayey) material which is washed down from the surface. Development of hard-pan, however, is due to special conditions only (as in Leonardtown soils of the Coastal Plain) and is not general. The most extensive soils in the area are residual soils which have been formed by decomposition "in place" of the parent material. Colluvial soils are found in limited areas in the foothills. Alluvial bottom soils are also not extensive as the streams have very narrow flood-plains. Terrace soils also occupy very small areas in the Milk Shed. They are extensive only in the Coastal Plain. Most of the zonal soils are well drained. Poor drainage is a problem on level uplands in the Triassic Lowland, and in the Coastal Plain. Loams and silt loams are the predominant textural classes in the Milk Shed. Sandy loams and loamy sands predominate in the Coastal Plain.

Differences in parent material, topography, mode of formation, and

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[15]The soil scientists surveying soils in the area can at times not agree among themselves whether a particular soil is of the grey-brown or the red-yellow group.

age give rise to a large number of soil series and soil types. The number of soil series and types which have already been distinguished in those areas of the Milk Shed that have been mapped, is very large and tends to increase as mapping becomes more detailed. A description of individual soil types or even of individual series is beyond the scope of this work. The catenary method has, therefore, been adopted for description. Soil series derived from similar parent materials and having important characteristics in common, have been grouped together into soil associations. One series (the best developed, or the best known) has been chosen for description and the differences of the other series of the association from this series have been pointed out. The soils are described by physiographic sub-regions. In this way, the relationship between geologic formations, topography, and soil types is more clearly demonstrated. It will be seen from a comparison of Maps 2 and 4, that there is a fairly close correlation between geologic formations and soil associations. The correlation should not be expected to be perfect because of the influence of the other factors mentioned above, and also because of differences in the methods, accuracy, and objectives of mapping geologic formations and soils. The influence of topography, for instance, is well illustrated in the gradations from soils of the uplands to the stony land in the hills, shown in the southern part of the Catoctin Valley.

1. Soils of the Eastern Crystalline Rock Upland. As this is an area of rolling topography and the rocks have been deeply weathered, most of the soils are well drained, and are free from rocks or stones (except along the slopes or in areas of diabase dykes or other intrusions). Soils are deepest and the profiles best developed on the gently undulating uplands. Along the slopes, the soils are shallower -- depth depending upon the steepness of the slope and extent of erosion. The surface soils

have at many places been entirely eroded away. Most of the soils are loams and silt loams; slaty loams or gravelly loams are found over limited areas. Soils of the Chester-Glenelg-Manor Association occupy most of the area of the Milk Shed. Soils of the Mason-Tatum Association are found in the areas underlain by crystalline rocks in the eastern part of Fauquier and Culpepper Counties. This part, however, is not included in the Milk Shed.

The name "Chester Series" is perhaps the best known among the soils of the northern Piedmont. The use of the name is now much more restricted than it used to be. The name is now applied only to soils which occur on the smoother uplands and have a well developed soil profile. The typical profile is now described as follows:

A. Horizon - thickness 7-13 " - Light brown to brownish yellow loam, mellow and friable with a high percentage of silt, fine weak crumb structure, strongly acid.

B. Horizon - thickness 2½-3 ft. - Yellowish orange to yellowish brown clay loam with some micaflakes. Friable and lumpy in structure.

C. (Parent material) - depth 4½" + - Soft, disintegrated gneiss, schist, or granite.

The soil is well drained and is considered one of the most productive in the Milk Shed. Manor is the typical soil of the steeper slopes and strongly rolling areas. It is generally shallow (surface soil 6 - 8", sub-soil very variable in thickness, 12 - 30"). It is derived mainly from micaceous schists, hence has a high mica content. It is an erodible soil and erosion has been severe over extensive areas. Most of the areas of this soil are classified as loams. Gravelly loams and slate loams are other important types.

"Glenelg" series is intermediate between Chester and Manor series.

The profile is shallower, topography more rolling, and mica content higher than the Chester. A large proportion of the soils formerly classified as Chester and some of the deeper soils of the Manor series are now classified as Glenelg. Soils with pronounced red sub-soils are found over certain areas. They are called "Elioak". Soils of the "Conowingo" series are found in small areas. They are derived from Serpentines and are called "barrens" because of their low productivity. The soils of the Cardiff series occur in small areas, principally as narrow ridges at the western margin of the sub-region. They are slaty and shallow, large areas are in pastures. Most of the areas of the Chester series and a large proportion of those of the Glenelg series have been cleared for cultivation. But in the southern part of Fairfax County, a large proportion (over 75%) of the area mapped as Chester, grey phase, by the Soil Survey in 1915, is in woods. This area needs to be re-classified as the soils seem to be more like the Mason-Tatum than Chester in productivity and land use. The area has been separated on the map by a dotted line. The soils of the Mason-Tatum association are red-yellow podzolic soils, derived from pre-cambrian crystalline rocks, and are found to the south of the area of the Chester-Glenelg-Manor Association. From geographic position and parent material, they would appear to be the red-yellow counterpart of the Chester-Glenelg-Manor Association. But most of the area of these soils is in woods, and the farms are mostly small subsistence farms. The texture of the soils is good; topography comparable to the Chester-Glenelg-Manor areas; and drainage is adequate over large areas. One would expect to find the areas in a much higher state of development than they actually are. The principal reason for their present low state seems to be the very low fertility of the soils (the word "fertility" is used here in its technical sense of availability of plant nutrients).

2. Soils of the Triassic Lowland. The soils of the Triassic Lowland can be classified into two associations:

(1) Soils derived from sedimentary rocks: Penn - Bucks and associated series.

(2) Soils derived from the intrusives: Iredell-Mecklenburg and Montalto series.

The soils derived from sedimentary rocks are the more important from the agricultural standpoint. But even these are, in general, less productive than the grey-brown soils derived from crystalline rocks. Over most of the area, the soils are shallower and are more susceptible to drought. On the level or gently undulating uplands, they are imperfectly drained. But principally because of their favorable topography, they are very important agricultural soils. Outside of the producers in the Catoctin Valley, most of the Washington milk producers in Virginia are located on these soils. The problems created by these soils are therefore very important from our point of view. A very distinctive feature of all these soils is the purplish red (called "Indian Red") color of the sub-soil.

Penn series is described because it is the best known series of the association and also appears to be the most extensive. Soils of this series are generally loams and silt loams, occupying areas of moderately rolling topography. They are well drained (excessively drained at places), and are highly erodible. "Erosion is very active and most of the surface soil has been lost from many areas of these (Penn and Lansdale) series". (2, P. 205). The typical profile is described as follows:

A. Horizon - thickness 8-11" - Pale brown to moderately brown, silt loam, friable, fine weak crumb structure, strongly acid.

B. Horizon - thickness 8-14" - Weak reddish brown (Indian red) clay or silty clay, firm but friable, medium nuciform (nut-like) structure, strongly acid.

C. Horizon - depth 24" + - Partially decomposed sandstones and shales.

The Bucks series is the most productive in the association. The soils are deeper (A. horizon - thickness 8-14"; B. horizon - thickness 26-32"), occupy areas of gentler topography, and are well drained. The soils derived from the Calcareous conglomerate are given the name "Athol" series in Frederick and Loudoun Counties. They are higher in fertility than the Penn, but the frequent rock out-crops are their disadvantage. Much of their area is used for pastures. The imperfectly drained members of this association listed here in the order of increasingly poor drainage are: Readington, Croton, and Stanton.

Soils derived from the Intrusives. Iredell, Mecklenburg, and Montalto series. The soils of these areas are only of moderate productivity. The Iredell soils (locally called "black-jack" land because of the prevalence of "black-jack" oak) are the poorest of the three. They are plastic, and poorly drained, and are therefore better adapted for pastures than for crops. The soils of the Montalto series are fairly well drained, although they also tend to be plastic, but are generally stony. Large areas of this series are also in pastures. Soils of the Mecklenburg series are well drained, productive soils suitable for growing crops. A number of Washington, D. C. producers in the Triassic Lowland in Virginia, are located in areas of these soils.

3. Soils of the Frederick Valley. The soils of the Valley have been derived from limestones and are deep and fertile. As the area has a level to gently rolling topography, they are suitable for intensive crop production with ordinary or moderate soil conservation practices. Drainage

is adequate. Two principal series are distinguished -- Duffield and Hagerstown -- the distinction being based on differences in parent material. The Duffield series is derived from argillaceous, Frederick limestone that underlies most of the Valley. The Hagerstown series is derived from the purer Loysburntown limestone which is exposed in a narrow belt east of Frederick. The former is described below:

A. Horizon - thickness 0-12"	- Loose, very friable, pale brown to light brownish-grey silt loam, fine weak crumb structure, medium to strongly acid.
B. Horizon - thickness 3 feet to several feet	- Yellowish brown, very friable, silt loam, medium to strongly acid, changing to yellowish red silty clay at depths of 15-24". With increasing depth, acidity decreases and fragments of shale are found in increasing quantities.
C. Horizon	- Unweathered thin bedded limestone.

The soils of the Hagerstown series differ from the Duffield in being free, or almost free, from shale fragments. The color of the surface soil is a darker brown, and the lower sub-soil is reddish. There are frequent rock out-crops, especially near the streams.

4. Soils of the Western Crystalline Rock Belt. Topography plays a very important role in determining differences in soils within this Belt. A number of series have been distinguished in soils of the hills and colluvial slopes. But as these soils are not of importance for agriculture, they have not been differentiated in the map. We shall confine the discussion to the soils of the uplands which are the ones important from the agricultural standpoint.

In the Middletown Valley the upland soils are of the Myersville-

Fauquier association. The Fauquier series is mapped at the flanks of the Valley, in areas of strongly rolling topography. The soils are shallower and of a somewhat redder color than the Myersville. The latter series is the more important agriculturally. It occupies the central part of the Valley. Topography is gently to moderately rolling. The soil is well drained, and has a very deep sub-soil. It is one of the most productive soils in the Milk Shed. A description of the profile is given below:

A. Horizon - thickness 8-12" - Moderate brown to brownish grey silt loam, fine weak crumb structure, slightly acid.

B. Horizon - thickness 4-6 ft. - Yellowish to reddish brown silt loam, slightly acid, crumb structure, schist fragments in the lower B, increasing with depth.

C. Horizon - thickness 6-20 ft.- Partially disintegrated buff colored schist.

Over the greater part of the Catoctin Valley, the soils have been called "Chester-Myersville". The two series will most probably be separated in the new Soil Survey maps of the area (when published). Both are productive soils; the Myersville soils somewhat more productive than the Chester. It is deeper, less acidic, and has a less micaceous sub-soil. In physical appearance, it has a darker brown color than the Chester. At the extreme southern end of the Milk Shed in Culpepper and Orange Counties, a large number of the milk producers are located on soils of the Davidson series. The soil is a clay loam, with a strong reddish-brown sub-soil. It is deep (A. 3-15"; B. 4-10 feet) well drained, has a favorable topography and is a productive soil.

At the southwestern border of the Milk Shed, there are three important associations of the red-yellow podzolic group: Cecil-Appling, Hayesville-Halewood, and Culpepper-Albemarle.

The areas appearing here are but northern extremities of much larger areas farther south. The Cecil-Appling and Hayesville-Halewood are derived from crystalline rocks, are fairly productive, and are very important agricultural soils farther south. The Culpepper-Albemarle are derived from Arkosic sandstone (with mixture of crystalline rocks) and are not so productive. Unfavorable (strongly rolling to hilly) topography is a disadvantage over large areas of Culpepper. The Albemarle is not well drained.

The alluvial flood-plain soils, though small in extent are productive soils, because they are being continually enriched by overflow. Two strips along the Potomac are large enough to be shown on the map. The soil in these is called Huntington Silt Loam — a dark brown silt loam, of high productivity. It is subject to overflow, but is well drained at other times. Most of the land is cleared and is in crops or pastures.

The Land Use Capability Classification of Land developed by the Soil Conservation Service is very useful to the economic geographer. It gives an approximate estimate of the land resources of an area.

Land is divided into several classes, depending mainly upon slope erodibility, drainage conditions and fertility. The suitability of each class for agricultural land use and the conservation practices or improvements required are indicated. The classification is here given in brief:

Land Suitable for Continuous Cropping.	Class I	- level to gently undulating, well drained, suitable for cultivation under normal farming practices.
	Class II	- moderately rolling or inadequately drained, or in need of improvement of fertility. Suitable for cultivation with moderate

improvements.

Land Suitable for Continuous Cropping.

Class III - strongly rolling or imperfectly drained or of low fertility. Suitable for cropping, but conservation practices or improvements have to be intensive.

Class IV - should remain in pasture. An occasional crop of hay may be raised.

Higher classes - not suitable for crops or pastures.

In the accompanying tables are shown the percentages of the different Land Use Capability classes in Maryland. These percentages are calculated from figures made available by the Soil Conservation Service. These figures are given by regions, very similar to the sub-regions used in this work. The Triassic Lowland includes the Maryland part of the Lowland; the Piedmont Upland includes all the area in Maryland between the Triassic Lowland and the Coastal Plain. The "Eastern Crystalline Rock Upland" of the Milk Shed forms the southern part of this. It also includes the Frederick Valley. Southern Maryland includes the five counties which cover the Coastal Plain west of the Chesapeake Bay. Figures for Frederick Valley have been obtained from "Physical Features of Frederick and Carroll Counties" (2, P. 190).

The table shows the Frederick Valley to be the best endowed with good cropland. The Middletown Valley is next. The Triassic Basin appears somewhat better than the Piedmont. The Coastal Plain has rather low percentage in Class I and Class II land, but it has a very high percentage of Class III land (due to the large areas in which fertility needs to be improved). The percentage of land of the cultivable classes is actually higher in the Coastal Plain than any of the other sub-regions, except Frederick Valley.

Table 4. Land capability classes by physiographic sub-regions in Maryland.

Class	Piedmont uplands	Triassic basin	Frederick valley	Middletown valley	Southern Maryland
Total land (acres)	1,426,621	144,384	47,022	56,392	1,214,891
	Per cent	Per cent	Per cent	Per cent	Per cent
Class I - land	2.3	3.6	17.8	7.8	1.5
Class II	28.8	34.9	67.0	35.5	27.7
Class III	25.7	24.6	8.5	22.8	41.3
Class IV	13.5	8.0	4.0	12.2	1.0
Class VI, VII, VIII, and unclassified	29.7	31.9	2.7	21.7	28.5

* Includes Frederick Valley.

Source: Maryland Soil Conservation Service.

Soils of Prince Georges County. The soils of the Coastal Plain are derived from unconsolidated sedimentary formations — sands, clays, and gravels. Their texture is coarser than that of the soils of the Milk Shed. Sandy loams, gravelly loams, and loamy sands predominate in contrast to the silt loams and loams of the latter. These soils have been developed under a mixed hardwood and coniferous (scrub-pine and loblolly pine mostly) forest, whereas those in the Milk Shed have been developed under a hardwood forest vegetation. They are, in general, more strongly acid than soils in the Milk Shed. Most of the soils on the rolling uplands or slopes have suffered from erosion which has been severe over large areas.[15a]

The principal soil associations distinguished in Prince Georges County correspond to the geologic formations which have been described earlier. Soils of the Sassafras association are the most extensive in the County (as in southern Maryland). They are found on rolling uplands and along the slopes. The gravelly loam is the most extensive type in the County. The soils are of moderate productivity and are very important for the cultivation of tobacco. A profile description follows:

A. Horizon - thickness 11-14" - brown or greyish brown loam, weak, very friable, very strongly acid, very fine crumbs or thin platy structure.

B. Horizon - thickness 18-30" - yellowish brown silt loam, becoming heavier into a silty clay, loam at depth of 15-18" very strongly acid.

[15a] The Soil Erosion Map of Maryland shows the largest proportions of severely eroded areas in southern Maryland. Large areas are in woods after having gone through one or more cycles of soil exhausting tobacco culture. Other large areas lie idle.

C. Horizon - depth 36" + - loose, stratified sand gravel many feet thick, made up of a relatively high proportion of quartz.

The Leonardtown soils are developed on the level uplands from which the "Lafayette" formation has not been eroded away. The soil is a silt loam, of moderately good texture and structure. Its principal drawback is the hardpan which is encountered at a depth of 2-3 feet. Due to this hardpan, the soil is poorly drained, and is mostly in woods. Where drained, it is used mostly for grains and grasses.

The Collington and associated soils are derived from the glauconitic greensands ("Aquia" formation). They are sandy loams, of high fertility (because of the potash content of the glauconite) and of favorable texture and structure. They are extensively used for tobacco and general crops. The Patapsco formation, as said above, has not weathered to give rise to an appreciable surface soil. Most of the area of the formation is of low agricultural value.

CHAPTER XII

AGRICULTURE

The purpose of this chapter is to give a general idea of the agriculture in this area, and to show how dairy-farming fits into the general agricultural picture. The chapter is, accordingly, intended to provide the back-ground for a better understanding of the next two chapters. It is divided into three parts. Agricultural practices are described in the first part. In the second part there is a brief review of the historical evolution of agriculture in the area, and a discussion of recent trends. The third part is devoted to bringing out difference in agriculture between different parts of the Milk-Shed. The discussions on trends and differences in agriculture are based largely on statistics from the Censuses of Agriculture.

A. Agricultural Practices. The area of the Milk Shed forms part of the eastern section of the Corn and Winter wheat region of North America.[16] Winters in the region are mild enough for winter wheat to be grown successfully. Length of the frost free season, and summer temperatures are adequate for corn to be grown for grain. Corn, winter wheat and hays are the principal crops, and have been for a long time. Dairying is important near cities, poultry production is developed in localised areas. In the Applachian Ridge and Valley portion of the region, fruit production (principally apples, and to a lesser extent peaches) is important. The principal enterprise in most of the region, however, is general crop-and-livestock farming; wheat being the principal

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16. O.E. Baker. Agricultural Regions of North America - Part III., Economic Georgraphy. July 1927.

cash crop and beef cattle the most important livestock. In the area of the Milk Shed also, this was the dominant enterprise before dairying became important. Expansion of dairy-farming in the Milk Shed, has taken place very largely by farmers switching over from the general crop-and- livestock to the dairy enterprise. This change does not involve a radical change in crop production. Corn, small grains and hays continue to be the principal crops on dairy farms. It is true that more acreage is devoted to raising corn for silage and to barley. Also, hays like alfalfa and lespedeza replace clover and timothy to some extent. But these changes are such that an average farmer can easily make them. The change in livestock husbandry is much greater, because dairy cattle require much more and more constant attention than do beef cattle. But even then, the changes are much less than would be experiences by farmers changing over from a specialised cash crop like cotton or tobacco. It is important to keep this fact in mind, because this is one of the reasons for the lack of development of dairy-farming in the tobacco region of Southern Maryland.

Cropping Practices in the Milk-Shed. The most prevalent crop rotation consists of corn-small grains-hay with one or more years of pasture. The rotation can be extended by leaving the fields in pasture for longer periods, or it may be shortened to three years, by plowing up the land to corn after the hay crop. The four year rotation with corn-small grains-hay and one year of pasture is probably the most common today.

Land in which corn has to be planted in the spring is manured the previous fall or winter. The ground is prepared for the crop by plowing, [illegible] in April. A considerable proportion of the farmers (and their

number is increasing) also fertilize the corn with a moderate application (usually 200-400 lbs.) of a complete fertilizer. Planting begins about the 1st of May, and lasts through the month. Some planting (or replanting) is done as late as the first part of June. Harvesting for silage begins in the last week of August, but most of it is done in September. The farmers harvest as much corn for silage as they feel they need for their livestock, and leave the remainder for grain. Harvesting for grain extends from the latter part of September to the end of October. On the dairy farms, corn is harvested either with a binder or with a corn-picker. A considerable proportion of the smaller general or grain farmers still cut the corn by hand.

After corn has been taken off, the fields are disked, or plowed, then harrowed and rolled two or three times, and are then ready for planting small grains. Barley is usually planted in September, and wheat in October. As the planting time for barley is earlier, it is commonly sown in fields from which corn has been harvested for silage. Wheat usually follows grain corn. Small grains generally receive heavier applications of fertilizers than does corn. Most good farmers apply 300-600 lbs. of a complete fertilizer (3-12-6 is the most popular). Barley is harvested in June, and wheat somewhat later in early July. The grains are mostly cut with a binder and threshed later. The combine is coming into general usuage for harvesting grain. It considerably reduces the labor requirements.

The most common hay is a mixture of clover and timothy. Timothy seeds are drilled with the small grains in the fall, clover seeds are broadcast in the grain field in the latter part of the winter, in February or March. Clover and timothy come up after the grains are cut, but the stand is light and is generally not harvested that year. Farmers usually graze it lightly.

The main crop of hay is harvested the third year in the rotation. The harvesting period extends from the last week of May through the first half of July. Two cuttings are often taken. On a large proportion of the farms tractors are used for mowing the hay. Raking is done with a side-delivery rake, and loading with a hayloader. Some of the farmers use a hay-baler. The old horse and hand methods, though still followed, are steadily giving way to the more mechanized methods.

After the hay crop has been harvested, the fields are usually grazed for the rest of that year. A second crop of hay may be harvested the next year (this will be mainly timothy), or the fields may be left in pasture throughout that year. If the three year rotation is practised, the land is plowed to corn the fourth year; if longer rotations are used, the fields may be left in pasture for longer periods. In areas of more fertile soils, as in Frederick Valley, farmers may have two consecutives of small grains in the rotation.

Alfalfa. Alfalfa is grown generally by the better farmers or by those located on more fertile soils. The soils of this area are deficient in lime and usually require heavy liming and fertilization, before a successful stand can be obtained. In areas near the Chesapeake Bay, trouble is also experienced with alternate freezing and thawing in winter.

Alfalfa may be grown in the rotation, in which case a five year rotation, with one year of corn (for silage), one year of barley, and three years of alfalfa is the most common on dairy-farms. Or, it may be grown in a separate field by itself. In the latter case, the stand lasts from four to six years (longer in some areas). Some farmers may leave the field in alfalfa longer, and use it for pasture. When the stand gets low, the field may be plowed up in corn, or re-seeded in alfalfa.

The seed may be broadcast, in the small grain field, in March or April, or it may be seeded in a carefully prepared seedbed in late summer. When alfalfa forms part of the rotation described above, 500-1000 pounds of ground limestone are applied to the silage corn, and another application given with the barley crop. When the crop is grown by itself, a heavier application may be given when starting the crop and followed by applications in subsequent years, as necessary. The most popular fertilizers used for the crop are 0-12-12 and 0-14-6. Three cuttings are usually taken, the first cutting begins in late May, or early June, and the last one is in late August or early September.

Lespedeza and Pastures. Lespedeza has come to be a very important crop in parts of the Milk Shed. It is grown both for hay and for pasture. Its use for hay is important in those areas where the soils are of only medium fertility. In Fauquier and Culpepper counties acreage under lespedeza equals or exceeds that under mixed clover and timothy hay. (Table 7). Its principal value as pasture is that it makes pasturage available in mid and late summer, a time when the need for pasturage is greatest. The most important pasture grass in this area is blue-grass. It comes in naturally, without seeding, on fertile land and has high nutritive value. But it has a big draw-back; it becomes dormant in the middle or latter part of May, with the result that the feed supply of livestock is seriously reduced. This creates a particularly serious problem for the fluid milk producers, who are always trying to maintain production at a high level, because when pastures get low in summer, milk production falls off. If pastures are available at that time, milk production holds up much better. Lespedeza begins to be available for pasture in July and lasts til frost. It thus comes pasturage when it is needed most.

Largely through the efforts of the Extension Services, seeded pastures are also becoming increasingly popular. The principal purpose of seeded pastures is also to maintain pasture-supply at a steady level, and to increase the pasture period. Pasturage is the most economical feed supply for the livestock and the extra cost of improving it are justified by the returns. In seeded pastures a mixture of legumes and grasses is recommended, Ladino Clover, White Clover, Orchard Grass, Lespedeza and Red Top are most important. Recommendations, of course, vary with conditions on the farm. By seeding a mixture of carefully selected grasses a farmer can obtain adequate pasturage for his stock from early spring through early fall.

Yields. Crop yields vary with differences in topography and soils, with weather conditions from year to year, and with the care and fertilization given to the crops. In this area, limestone soils of the Frederick Valley are considered to be the most fertile, and yields are highest there. The soils derived from the crystalline rocks are next, and those from Triassic rocks rank third.

The better farmers with liberal use of fertilizers and manure and following good farming practices can in normal years obtain 70-100 bushels of corn, 25-35 bushels of wheat, 35-45 bushels of barley and about 2 tons of mixed clover and timothy hay. Average yields, however are lower. They range between 35 and 50 bushels for corn, 15 and 22 bushels for wheat and 1 and 1½ tons of mixed hay. Alfalfa yields vary between 3 and 4 tons (three cuttings) with the good farmers, and about 2 tons with the average farmers. Corresponding figures for lespedeza are 1½ to 2 tons and about 1 ton.

Fertilization. The common practice in this area was to manure the land on which corn had to be grown the coming year, apply the fertilizer

with the small grain and let the grass take care of itself. With the increasing realization of the value of fertilization, applications of fertilizers are heavier and more frequent. The great majority of the farmers now apply fertilizer when planting corn. Applications with the small grains are heavier. Pastures are often top-dressed with superphosphate. Fertilizers are of higher grade and more complete. Notice in the table below, that the grade of the best-seller is constantly getting higher. 3-12-6 is, at present, the most popular variety.

The trend towards increased use of lime and fertilizers is very well shown by the following table showing the sales of lime and fertilizers in Maryland, from 1935 to 1948. The quantities in this table are totals for all kinds of lime materials used, and all grades of fertilizers. In this brief period, the sales of lime increased almost five times, and those of fertilizers, over 40 per cent.

TABLE 5. Sales of Lime and Fertilizer in Maryland. 1935-48.

	Agricultural Lime Materials used in Maryland	Fertilizer Total Sales	Best Seller
Year	Tons		
1935	59,721	164,842	2-9-5
1936	85,304	164,817	"
1937	116,964	186,285	"
1938	100,047	166,418	"
1939	98,592	164,585	"
1940	126,093	160,315	2-12-6
1941	129,296	171,941	"
1942	141,303	182,720	0-14-7
1943	194,183	198,841	2-12-6
1944	228,498	207,485	3-12-6
1945	229,531	218,144	"
1946	274,200	244,743	"
1947	293,884	255,949	"
1948		233,252	"

Source: Maryland Fertilizer Feeds for 1948
Mimeographed Bulletin of State of Maryland
Inspection and Regulatory Service,
College Park, Maryland

Mechanization. Another important trend is ever increasing mechanization. Tractors and power driven machinery are fast displacing horses and horse-drawn equipment. The continuous decline in the number of horses (Fig. 7) is one symptom of this movement. Horses are still found on a large number of farms (about half of all farms in the Milk Shed counties reported horses in 1940), but the number of farms without any horses constantly increases as new operations yield to power driven machinery. Of course, one great advantage of the latter is the savings in labor-time. A study made by the Maryland Experiment Station[17] showed that the time required for producing the major crops of this area was much less on farms where tractors were being used than on those on which horses were being used. The farms studied were divided into quartiles, and the most efficient quartile (using the least number of hours per acre of crop) was made up largely of farms where all or a large proportion of the work was being done by power driven machines.

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17. Weighted Average Labor. Requirements per Acre.

Crop	Number of Man Hours		
	All farms	Most efficient farms	Least efficient farms
Corn for Grain	56.1	39.5	73.7
Corn for Silage	40.9	23.4	62.6
Wheat	12.2	8.5	17.4
Barley	10.9	6.6	17.7
Mixed Hay (Clover and Timothy)	8.3	5.3	12.2

All figures except "Corn for Silage" are farms on the Piedmont Plateau.
A.B. Hamilton, C.C. Abshier and E.H. DeVault
Labor Requirements for Selected Crops in Maryland
Bulletin No. 415, University of Maryland
Ag. Exp. Sta.

B. History and Trends. The first extensive settlements in this area were made in the first half of the eighteenth century. Two major streams of people participated in these settlements. 1. People moving south from Pennsylvania -- mainly Germans (more properly German speaking peoples), Scotch-Irish, and English Quakers. 2. The English moving up the rivers from their Tide-water colonies in Southern Maryland and Virginia.

The Pennsylvania stream was dominant in the Maryland of the Milk Shed, and in Loudoun County. In the remaining Virginia counties, the stream up from Tide-water was more important. Besides these two streams there were other elements which contributed to the settlement of the area. Colonies of Germans on the Rapidan and Rappahanock were prominent in the settlement of Orange and Culpepper and Fauquier Counties.

Large grants of land were common in the early days. The whole of the Virginia portion of the Milk Shed was a part of the grant to Lord Culpepper by King Charles II and large plantations early came to occupy a large proportion of the area. Lord Baltimore was the Lord Proprietory of the Maryland Colony and held title to all the land that was included in his charter. He established in Maryland, a system of "Manors". These Manors also consisted of large acreages (at least 1,000 acres) of land managed by one person (or family) and were in this respect very similar to the plantations in Virginia.

Frederick and Montgomery Counties were being settled about the middle of the 18th Century. (28. p. 359-60 and 640 - 2). In Frederick County, the Pennsylvania Germans and the Scotch-Irish were the most numerous settlers. There were large estates held by the Tide-water English -- grants from the Lord Proprietory, but the small self-sufficing family farm soon became dominant. The Pennsylvania Germanssoonbecame noted for their industry,

frugality, careful soil and livestock husbandry, and prosperous condition -- traits which had distinguished them earlier in Pennsylvania and have distinguished them since. It should be noted that the great majority of them were not "sect people" (Amish, Mennonites, Dunkards, etc.) but were of the Lutheran Reformed and related Protestant churches.

The German element was much less important in the settlement of Montgomery and Loudoun counties. In these counties, the Scotch-Irish and English Quakers, moving south from Pennsylvania and the English moving up from the Tide-water were the principal elements. Large estates were common, some of them in Loudoun County continue to this day.

In the remaining Virginia counties the English and other people from Tidewater, dominated. Large estates have been an important part of the economy of the area throughout its history.

The composition of the population has been much modified by the later movements of people. Immigration from Europe has continued (at varying rates). Some of the settlers who first settled in the Applachian valleys later moved east to the Piedmont area. The area was one of the principal centres of emigration to new lands to the West and South, and the emigration process was at times more rapid than was desirable for the prosperity of the area. The lure of new lands to the West, and South was one of the principal factors which retarded the adoption of improved agricultural practices, and kept large sections of the area in a run down condition. (26 p. 118-9). The latest movements of population have been connected with the growth of Washington, D. C. People from this area and other parts of the country have moved into the city. The last phase of this is the movement of people out from the city, into the suburbs, and "into the country". This has vitally effected the agricultural economy of the area, and will be discussed in greater detail later. (Chapter V)

These later movements, however, have not altered the basic composition of

the farm population. People descended from German, Scotch-Irish or English parents (more frequently mixtures of these) and the American Negroes continue to form the largest numbers among the farm population. The characteristics of these people and their response to their environment (natural and cultural) is a basic element in the agricultural picture of the area.

Tobacco, the great staple of the "Old South" was, for a long time the principal cash crop over a large part of this area (excepting Frederick, and Loudoun counties), as it was on the Coastal Plain. The system of agriculture associated with tobacco production in the Colonial period and afterwards has been widely condemned as ruinous of soil resources.[18]

The system as a product of the frontier conditions which prevailed in the first century of settlement of Tide-water areas. Land was plentiful, and cheap, labor and capital scarce. The labor, provided at first by indentured laborers and later by Negro slaves, was ignorant and inefficient. It was often supervised by overseers who were little interested in improving agricultural practices. It was cheaper to clear a new field than to manure and try to renovate an old one.[19]

Tobacco was the only source of cash income, and attention was concentrated on growing tobacco, Livestock husbandry, and the growing of other crops was neglected. Tobacco was grown for export to England, and later

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[18] Throughout the Colonial period and afterwards, agriculture was based upon a single crop produced by exploitative methods which caused yields to decline and lands to reach a condition in which the planters declared them "exhausted". Abandonment took place on a wide scale and the planters always accepted expansion (moving to new areas) as a matter of course. A.O. Craven: Soil Exhaustion as a Factor in the Agricultural History of Virginia and Maryland 1606-1860, p. 162.

[19] Ibid p. 34.

to the Continental European countries. There were wide fluctuations in prices, and the fortunes of the planters varied with them. The activities of Government (British) and English tobacco merchants have been cited as other factors contributing to the economic ills of the planters.[20]

Careful, steady, soil-conserving agriculture is not associated with systems based on the export of one commodity, especially when those systems prevail in frontier lands, under conditions of widely fluctuating prices. The system (of growing tobacco) although severely criticised by all thinking observers of the times, remained essentially unchanged, so long as the tobacco market lasted and there was no alternative staple. (Many of its essential features appear to be preserved in the tobacco growing system of Southern Maryland even today). Efforts of such men as Washington and Jefferson had little effect on changing agricultural practices in their areas.

The great stimulus for improvement came with the opening up of the export markets for wheat. Exports of wheat to Europe and the West Indies had begun to be important towards the close of the Colonial Period, and they increased in importance after the Revolution. But it was the "interior" (as opposed to the Tide-water) areas, that benefited most from the export trade, and made noticeable improvements. By about 1820 there were distinct contrasts in conditions in the two areas.[21]

"When one turns to the counties in Western Maryland, such as Washington, Frederick, and Montgomery, or to certain valleys in the northern portions of the state, he finds decided contrasts. There enough prosperity had come with the foreign demand for wheat and flour to enable leading farmers to begin improvement.....And the same was true in those portions of Virginia

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[20] Ibid p. 49-52. and Lewis C. Gray, History of Agriculture in Southern United States to 1865., Vol. I. Chapter XII, p. 259-76 and p. 423-5.

[21] In 1819 both sides of the Chesapeake Bay in Maryland are described as "dreary and miserable in aspect". Craven. op. cit., p. 84 quoting Agricola in American Farmer, I, 99.

where wheat had found its opportunity. Loudoun, Fauquier, portions of Culpepper and Albemarle etc., in the interior, and most of the upper valley, all presented an improved appearance".[22]

Tobacco had not been as important in the "interior" areas as it had been on the Coastal Plain. Due to the presence of large elements of independent family-size farmers (Germans in Frederic County, English Quakers and Scotch Irish in Loudoun and Montgomery Counties) there was greater emphasis on self-sufficing agriculture and on growing of grains and grasses.

These areas did not have as good transportation as the Coastal Plain. They had to depend more on local production. They could not depend on exports (tobacco) and imports (necessary articles), as much as could the Planters on the Coastal Plain. Also, the soils were heavier and the tobacco produced was of thicker leaf. The same heavy soils, on the other hand, were better adapted to wheat than were the soils of the Coastal Plain.

The wheat trade had provided the <u>stimulus</u> for improvement. The <u>means</u> were provided by such advances in agricultural techniques as the invention of the steel plow (which could plow deep) and the appreciation of the value of marl, gypsum and clover in improving soil-fertility. The admirable work of men like Edmund Ruffin and of Agricultural Societies and Journals greatly strengthened the movement towards better agricultural practices. But it was only after the introduction of Peruvian Guano, in the 1840's that improvements became rapid. Guano was almost a complete fertilizer, whereas marl and gypsum supplied one element (calcium) principally. Improvements in yield were more rapid with its use, and were sustained.

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[22]Ibid. p. 85-6. quoting Richmond Enquirer, June 2, 1820.

In the century before the 1920's the secular trend in the agriculture of this area, as in that of the country as a whole, was one of increasing production. The increase was faster at times than at others. At times there were setbacks, but these were only short lived and the general trend towards expansion continued. The area suffered during the Civil War. Losses of life were heavy, crops were damaged, property was destroyed and the economic life of the area disrupted. The emancipation of slaves was a severe blow to the plantation owners. Some parts suffered severely, and agricultural production decreased markedly. But within a few years it was restored to its previous level and resumed its steady increase.

It was only during the 1920's and the 1930's that there was a decided decline in crop production. This downward trend has, however, been reversed since World War II.

A series of graphs (Figs. 4a-e, 5a-e, 6 and 7) have been made to show the trends in crop-production and livestock husbandry in the area. In order to secure a comparison between the different crops and kinds of livestock, and between different census years, crop production and numbers of livestock have been shown in terms of crop units and livestock units. (See Appendix A). Crop production and livestock unit graphs have been made for five counties -- four counties to represent the Milk Shed and Prince George's County (to represent Southern Maryland). The four counties selected in the Milk Shed are: Frederick and Montgomery in Maryland, and Loudoun and Fairfax in Virginia. Crop graphs (Figs. 4a-e) have been plotted from 1850-1945. Because of our interest in dairy-farming numbers of milk cows have been plotted for all seven Milk Shed Counties and Prince George's County from 1850-1945 (Fig. 6). Livestock graphs

(Figs. 5a-e) are from 1910-1945. It was considered desirable to make a separate graph (Fig. 7) showing the total decline in the number of horses and mules in the eight counties--this being one of the two outstanding developments in the livestock husbandry of the area (the other, of course, is increase in dairy cows).

The first thing that strikes one from the crop graphs is that there has been no major change in the crops grown in the area, in a period of approximately 100 years. Corn, wheat and hays in the Milk Shed Counties, and tobacco, corn, wheat and hay in Prince George's County remain the principal crops throughout the period. In the first three census years, figures are available for production only, acreage figures are not available. The figures for 1869 reveal the set back caused by the Civil War. However, by 1879 production in the Milk Shed counties was about equal (higher in Frederick) to production in 1859, and the only county in which the effect was noticeable was Prince George's County. The decline shown for this county is due to the emancipation of slaves, which caused a severe economic blow to the plantation owners and disturbed the tobacco economy much more than it did general farming.

Trends in Milk Shed Counties. The period from 1879 to 1899 is one of general increase in crop production. Total cropland harvested, and acreages and production of the principal crops showed increases in all counties. 1909 figures show a recession in all counties, except Fairfax. 1919 is again a year of high production, due to the effect of World War I. The peak in crop production in these counties, is shown either in 1899 or in 1919. 1929 figures show a decline in total cropland harvested and in acreages under the principal crops except hay. This decline is continued in 1939, and the trend is reversed only in 1944, by the increase (country-

wide) in agricultural production which accompanied World War II.

Among the recent trends we should note the increases in corn for silage, barley and hays other than clover and timothy, because these are largely the result of increase in dairy-farming in the area. Corn for silage is first separated in the 1920 Census. Acreages harvested for silage show rapid increase in the 25 years 1919-44 in all counties. In Frederick, Montgomery and Fairfax Counties, acreages increased three to four times. In Loudoun County, the increase was less marked (about 80 per cent). The proportion of the corn crop harvested as silage ranged between 20 and 25 per cent in these counties, in 1944. Oats used to be a crop of some importance in the area, but acreages under oats have steadily declined (in part to the decline in the number of horses). During the 1930's barley showed a phenomenal increase, and emerged as the second important small grain. Acreages increased from about 1500 acres to 13,750 in Frederick, 1300 to 5600 in Montgomery and 2300 to 6100 in Loudoun County, (acreage in Fairfax county remained small) in the ten years 1929-39. Between 1939 and 1944, however, there was a slight decrease in all counties. It appears that the crop is seeking its level.[23]

Alfalfa has shown a considerable increase during the last 25 years, although the acreage is small in comparison with clover and timothy. It has increased most in Frederick and Loudoun Counties (Table 7). Lespedeza is the other hay crop which has become important in recent years. Its greatest increases have been in Montgomery, and Fairfax Counties (also Prince George's County).

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[23] This is corroborated by annual acreage figures for Maryland.

The influence of soil fertility on these trends should be noted. Alfalfa and barley both do best on rich (soils with high fertility) soils, and have accordingly increased most in Frederick and Loudoun Counties. Lespedeza is a crop that thrives fairly well in soils of medium fertility, and has therefore made greater headway in Fairfax, Montgomery and Prince George's Counties.

Production of Tobacco in Prince Georges County shows much greater fluctuations than do the crop-trends in the Milk Shed counties. Production was very high in 1849 but showed declines in 1859 and 1869. 1879 and 1899 were years of high production, and 1889 and 1909 were ones of low production. Similarly wide year to year fluctuations are shown by the statistics collected by the Maryland Crop Reporting Service (33. p. 2-3). Notice that the Census figures do not show a decline in tobacco production in 1929 or 1939. They give the impression of an uninterrupted increase from 1909 to 1944. The annual figures although marked by fluctuations also bring out the secular trend towards increased tobacco production during this period from 1909 to 1944. This trend towards an increase in in strong contrast to the decline in wheat and corn production during the 20's and 30's.

Livestock Graphs. (Figs. 5a-e). In these graphs, the group dairy cows represents "Cows and heifers 2 years old and over, kept for milk production" for the census years 1910-40. For 1945, however, this figure was not available, and the figure "Cows and heifers milked" had to be used instead. Increase in dairy cows between 1939 and 1944 is therefore somewhat higher than the number milked during the year. The group "Other Cattle" includes young dairy stock (heifers under 2 years, and calves), dairy bulls and all beef cattle. All these had to be grouped together because it was not possible to obtain comparable figures for the different

classes of animals from the Censuses in different years. This group (other cattle) is largely composed of dairy animals, because the number of beef cattle is small in comparison with dairy cattle (except in Loudoun County). Horses and mules have been grouped together, because the number of mules is too small (10 per cent or less of the total for horses and mules) to be shown separately. The trend in this group is essentially the trend for horse numbers. In the groups swine, sheep and chicken, animal and birds 3 months old and over, are included. Numbers reported in these groups are at times affected considerably by the date of enumeration.[24]

A steady increase in the number of dairy cows (and other cattle) and an equally steady decline in the number of horses and mules are the two most prominent trends shown by these graphs. The totals for all livestock units show an upward trend in all counties. This is due principally to the fact that the increase in the number of cattle more than counterbalances the decrease in the number of horses and mules. Thus between 1909 and 1944 the number of horses and mules, in units, declined about 8000 in Frederick County, 5,900 in Montgomery County, 5,800 in Loudoun and 3,300 in Fairfax County. Increases in cattle (in units) were: 25,300 in Frederick, 14,200 in Montgomery, 16,400 in Loudoun and 5,800 in Fairfax County, more than three times as much in all counties except Fairfax.

Increases in the importance of chicken also contribute a little towards the increase in livestock units. The number of hogs shows a downward trend although the decline is not so marked as in case of horses and

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[24] The increase in swine numbers between 1939 and 44 is largely due to this fact. The 1945 census was taken as of January 1st, and large numbers of pigs waiting to be slaughtered were included. These were not included in the 1940 census which was taken as of April 1st.

mules, nor as steady. Sheep are a relatively minor item in the livestock inventory. Except in Loudoun County, their number is too small to be shown on the graphs.

Trends in Prince Georges County are somewhat different from those in the Mild Shed counties. The number of dairy cows had remained almost stationary, between 1910 and 1940, but there was a noticeable decline between 1940 and 1945. Unlike the Milk Shed counties, this county is not experiencing any increase in dairy-farming. The sharp increase in other cattle between 1939 and 44 (1,980 to 5,040 units) is largely due to the increase in beef cattle.[25] Also, in this county, horses and mules have decreased much less than they have in the Milk Shed counties. (see below)

Graph Showing Dairy Cow Numbers 1850-1945: In all counties of the Milk Shed the secular trend is towards an increase. In the early period, the increase is slow and at times erratic, but the long-term upward tendency is clear. This tendency is no more than a result of the steady expansion of agriculture in the latter half of the 19th century. The pronounced increase of recent years has been due mainly to the expansion of the market for fluid milk in Metropolitan Washington (In Frederick County it is also due to the demand from Baltimore). This latter increase begins to be marked after 1920 in some counties, in others, it appears, only after 1930. The counties showing the greatest increases (in numbers) are: Frederick, Montgomery, Loudoun and Fauquier. Increases in Fairfax and Prince William Counties are small. Prince George's County has shown a slow, but steady decline since 1920.

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[25] Checked by personal interview with the county agent.

Decline in Numbers of Horses and Mules: (Fig. 7): Between 1910 and 1920 there was little change in numbers. Any tendency towards a decline was offset by expansion in agriculture. It was during the 20's when the use of the tractor became general that the decline became most marked. The decline has since been less rapid, but has continued.

The decrease has been the greatest in the Milk Shed Counties next to Washington. Montgomery and Fairfax, 59 percent and 56 percent respectively. The Counties farthest from Washington have the lowest decline --43 per cent each -- in the Milk Shed. Horses and Mules have persisted better (decrease 38 per cent) in Prince George's County, than in the Milk Shed counties. The importance of horses in tobacco culture is one important reason for the slower decline.

C. Differences in Agriculture within the Milk Shed. The differences in topography and soils within the different parts of the Milk Shed have been described above. This section is devoted to a description of the differences in agriculture and land use. These differences are due, in part to influence of the physical factors, and in part to that of the cultural factors. The area is treated here again by Physiographic Subregions. In this way it is easier to bring out the relative importance of the Physical and the cultural factors in explaining differences in Agriculture and land use. The description is based very largely on statistics for counties and minor civil divisions from the Census of Agriculture of 1940. Land Use, Crop, Livestock, Dairying, and Type of Farm Statistics have been taken for the seven counties of the Milk Shed, and for Prince Georges County.

The County statistics have been supplemented by data for Minor Civil Divisions., as necessary. The 1940 figures had to be used, because

TABLE 7. Land use and principal crops in eight counties. 1940 census.

Land use	Frederick (acres)	% of (1)	Montgomery (acres)	% of (1)	Loudoun (acres)	% of (1)
1. Total land area of county	424,960		316,160		330,880	
2. Land in farms	345,906	81.4	218,714	69.2	279,168	84.4
3. Average size of farm	99.6		106.1		162.7	
		% of (2)		% of (2)		% of (2)
4. Land in crops (harvested and failure)	191,165	55.3	81,996	37.0	95,062	34.0
5. Cropland idle or fallow	9,148	2.2	15,192	7.0	2,615	1.0
6. Plowable pasture	59,924	17.3	53,558	24.4	116,412	41.6
7. Woodland	42,796	12.4	43,756	20.0	47,300	16.9
8. All other land	42,873	12.4	29,212	11.0	17,779	6.3
Principal crops		% of (9)		% of (9)		% of (9)
9. Cropland harvested	169,622	100.0	79,938	100.0	94,538	100.0
10. Corn for grain	47,817	25.2	19,938	24.9	28,159	29.8
11. Corn for silage	5,360	2.9	3,101	3.9	3,921	4.1
12. Winter wheat	54,790	28.8	19,299	24.1	21,644	22.9
13. Barley	13,747	7.3	5,612	7.0	6,099	6.4
14. All hay	51,160	26.9	23,610	29.5	24,785	26.2
15. Clover and timothy, alone or mixed	45,635	24.0	18,541	23.1	15,266	16.1
16. Alfalfa	3,572	1.8	1,354	1.6	3,308	3.5
17. Lespedeza	93	-	667	.8	2,984	3.1
18. Tobacco	42	-	34	-	-	-

Source: 16th Census of U. S. Agriculture, 1940. Vol. I, part 3.

Fairfax (acres)	% of (1)	Prince William (acres)	% of (1)	Fauquier (acres)	% of (1)	Culpepper (acres)	% of (1)	Prince George (acres)	% of (1)
266,240		220,000		422,400		248,960		310,410	
123,909	46.5	124,288	56.0	358,169	84.8	178,684	71.8	185,611	59.8
83.5		119.0		164.1		145.3		86.0	
	% of (2)		% of (2)		% of (2)		% of (2)		% of (2)
33,536	27.0	35,573	28.6	85,428	23.3	52,571	29.4	48,180	26.0
7,495	6.0	3,730	3.0	6,065	1.6	2,097	1.2	23,810	12.9
29,988	24.2	40,764	32.7	164,259	45.9	67,815	38.0	33,912	18.2
44,515	35.9	38,158	30.7	79,549	22.2	43,887	24.5	62,298	33.5
8,375	6.8	6,063	4.9	22,868	6.3	12,314	6.8	17,411	9.3
	% of (9)		% of (9)		% of (9)		% of (9)		% of (9)
33,107	100.0	35,208	100.0	85,064	100.0	52,488	100.0	46,431	100.0
8,047	24.3	10,684	30.3	25,469	29.9	16,113	30.7	13,828	29.8
2,031	6.1	1,617	4.5	4,852	5.7	1,407	2.6	606	1.3
4,013	12.0	6,610	18.7	13,588	16.0	8,185	15.5	5,558	11.9
581	1.5	1,103	3.1	2,373	2.7	2,396	4.5	527	1.1
13,936	42.0	13,067	37.1	28,675	33.8	21,805	41.5	7,977	17.8
6,111	18.4	5,439	15.4	11,894	14.0	7,155	13.6	3,281	7.0
1,042	3.1	226	.6	569	.7	1,110	2.1	311	.7
2,655	8.1	5,056	14.3	9,327	10.8	10,229	19.4	1,514	3.0
-	-	-	-	-	-	-	-	11,823	25.4

TABLE 8. Livestock and dairying in eight counties. 1940

Livestock units (1940)	Frederick	Montgomery	Loudoun
Dairy cows	32,602	15,500	15,162
Other cattle and calves	12,950	7,700	11,560
Horses and mules	11,485	5,150	6,180
Swine	5,204	2,578	3,095
Sheep	440	510	1,763
Chickens	4,825	2,650	1,770
Percentage of all cattle and calves to total livestock units	66	67	67
Dairying (1939)			
Cows and heifers milked	26,753	11,939	11,491
Milk produced (gallons)	17,145,614	7,850,250	6,652,377
Milk production per cow (gallons)	641	657	579
Milk sold as whole milk (gallons)	14,615,064	6,586,235	4,724,641
Per cent - milk sold as whole milk / milk produced	82.6	83.9	71
Milk sales per acre of cropland (gallons)	77	80	50
Percentage of whole milk sold by farms with 15 cows and over	68	92	94
Number of such farms	700	254	190
Average sales of whole milk per such farm (Gallons)	14,173	24,043	24,282
Average number of cows per such farm	22	33.9	34.9
Size of herds in which milk production per cow was greatest	50 - 74 cows	75 - 99 cows	50 - 74 cows
Average production per such herd (gallons)	751	831	798

Source: 16th Census of U. S. Agriculture. Vol. I, part 3.

census.

Fairfax	Prince William	Fauquier	Culpepper	Prince Georges
9,298	5,854	13,394	10,510	4,738
3,148	3,823	12,460	5,730	1,978
2,300	2,180	6,800	3,060	4,430
2,395	1,695	2,348	1,500	2,299
80	205	793	418	210
1,670	1,084	2,168	1,360	1,647
66	65	68	71	42
7,182	4,390	10,135	7,666	3,416
5,129,744	2,518,627	4,946,477	3,452,450	1,481,565
714	573	488	450	433
4,027,970	1,608,211	2,706,406	1,782,673	670,407
78.5	63.8	54.6	51.6	45.2
120	45	32	34	14
95	92	95	98	87
155	68	154	129	24
24,748	21,875	16,741	13,857	24,351
31.7	31	29.3	31	39.5

75 cows and over	50 cows and over	50 - 74 cows	50 - 74 cows	75 cows and over
955	803	722	739	707

TABLE 9. Type of farm - number and value of products

	Frederick		Montgomery		Loudoun	
	Number	Average * value $	Number	Average value $	Number	Average value $
All farms	3,466		2,062		1,716	
Part-time or primarily subsistence farms **	1,119	344	1,005	283	769	447
All commercial farms ***	2,268		957		922	
Dairy farms ****	1,355	3,171	330	5,604	231	6,452
Livestock farms	185	2,158	166	2,282	467	4,089
Poultry farms	210	1,096	176	1,764	49	1,228
Field crop	432	1,972	226	1,405	152	1,426
Vegetable crop	26	1,044	21	916	1	-
Fruit and nut farms	47	2,666	12	5,371	12	6,970
Horticultural specialty farms	4	18,783	17	8,111	5	4,255
Per cent dairy farms/ all farms	39.1		16.0		13.4	
Per cent dairy farms/ all commercial farms	59.7		34.4		25.0	

* Total value of farm products produced per farm of that type.

** Farms with farm products used by farm households as major source of income.

*** All farms minus primarily subsistence farms and farms with no products produced.

**** The terms - dairy farms, livestock farms, etc., have been modified from the terms - farms with dairy products (livestock and livestock products, etc.) as major (50 per cent or more) source of income used in the census.

Source: 16th Census of U. S. Agriculture, 1940. Vol. II, part 2.

produced in eight counties. 1940 census.

Fairfax		Prince William		Fauquier		Culpepper		Prince Georges	
Number	Average value $	Number	Average value $	Number	Average value $	Number	Average value $	Number	Average value $
1,484		1,044		2,183		1,230		2,158	
958	405	652	384	1,375	357	872	529	406	283
498		368		771		349		-	
179	6,587	92	5,263	151	4,886	75	6,993	32	8,004
62	2,544	111	3,179	355	4,148	172	2,518	43	2,516
133	1,622	113	1,151	117	1,312	56	2,162	95	1,636
54	1,217	46	603	126	1,013	36	1,570	1,223	1,630
28	4,056	2	-	1	-	-	-	137	1,529
17	2,289	1	-	11	4,340	1	-	13	1,357
14	3,335	1	-	-	-	1	-	32	1,026
12.0		8.8		6.9		6.0		1.4	
36.0		25.0		19.6		21.5		2.0	

information on such essential items as milk production could not be obtained for Minor Civil Divisions from the 1945 Census. The data are presented in Tables 7-9 and Maps 5-10. These tables and maps give a thumbnail sketch of the agriculture of the area, particularly in its relation to dairy-farming. Before we begin the description, it is necessary to point out a few things about the meaning of the data, and about their interpretation.

1. The M.C.D. statistics generally give a fairly good idea of the relationship between agriculture and the factors -- physical and cultural. But if there are marked differences in topography, soils or the cultural factors within the area covered by an M.C.D., the results can be of only limited value. In Virginia some of the townships extend over two physiographic sub-regions, and the results have to be interpreted with caution. In Maryland, however, most townships are small and the areas covered fairly homogeneous.

2. The proportion of land in farms that is being used for crops has been used here as an indication of the intensity of land use. The figure used included Crop failure, but as crop failure acreages in this area are so small as to be negligible, it may be considered to be practically synonymous with cropland harvested.

3. Plowable Pasture plus Cropland. (Map 6): In most townships, acreages under cropland idle or fallow are very small, and plowable pasture acreages form 90 to 95 per cent of the combined totals. It is only in townships of the Eastern Crystalline Upland in Fairfax and Prince William Counties that there are considerable areas of cropland idle or fallow. From the Census definition of Plowable pasture it would appear that most of this land is potential cropland. However, the areas in which the map shows

very high percentages, have strongly rolling to hilly topography, and it is doubtful if much of this land could be used for crops without serious danger of soil erosion

4. The units (Appendix A) used in Table 8 are the same as used before in Graphs 5a-e.

5. The proportion of the milk produced which is sold as whole milk (Table 8 b. and Map 9) is important from our viewpoint. Almost all of this is shipped to urban markets, as manufacture of cheese or condensery products is not important in this area. The figure is a good index of the importance of commercial dairy-farming. Milk which is not sold as whole milk is either used on the farms where produced, or is sold as cream to creameries. In either case it is produced on farms which are not dairy-farms. There may be a few cows kept on them, for the use of the family (or families), and the surplus marketed in the flush season, or dairy-farming may be a side interest.

6. The map "Gallons of milk sold per acre of cropland" (Map 10) also shows the importance of commercial dairy-farming in the total agriculture of the area. A high value indicates that a high proportion of the cropland is being used for raising feed for animals, and a low value that the proportion so used is small. The map does not measure the absolute magnitude of the commercial dairy enterprise, but only its magnitude in comparison with the other types of farming. Very high values may be shown in townships, in which total milkproduction is small. The high values only indicate that the other types of farming are not important (do not take much cropland) and/or large quantities of feed are imported.

7. Table 9 shows the number of the different types of farms and the average value of products produced by each type. The value figures give an indication of the economic importance of that type of farm to the county. They do not compare net returns to farmers for two reasons.

a. Current outlays(on feed, labor, materials, etc.) and capital

investments vary considerably on the different types of farms.

b. The figures are affected by the price levels for the different farm products in the particular year.

But the figures do show what the different types of farmers have available for spending. The average value of products produced on dairy farms is higher than on most types of farms. This is due in part (but not entirely) to the heavier current expenditure and capital outlay on the dairy farms. The value is highest in Prince George's County and the lowest in Frederick County. The dairy farms in Frederick County are, of course, smaller than in the other counties (also brought out in Table 11). In Prince George's a selective process seems to be at work. It appears that only the bigger farmers with greater resources, can afford to stay in dairy-farming, in the midst of a tobacco producing region.

It will be seen that in every county, there is a very large number of farms which produce products primarily for use on the farm. (see notes under Table 9). This group includes both the part-time farmers (who have other jobs) and the subsistence farmers, and there is no way of separating the two. It is known, however, that in counties near Washington, Fairfax, Montgomery and Prince George's, the majority of these are part-time farmers, whereas in counties, like Culpepper and Fauquier, the greater number is of subsistence farmers. In view of the fact that these farms are of minor importance from the stand-point of commercial agriculture, the ratio Dairy Farms/ All Commercial Farms has been calculated to indicate the relative importance of dairy-farming. The proportion is highest in Frederick County, where about 60 per cent of all the commercial farms are dairy farms. In the other counties of the Milk Shed the proportions range between 20 and 35 per cent. They are highest in the Counties near Washington (Montgomery and Fairfax) and decrease away from the City.

Livestock farms, field crop farms, and poultry farms are the three other types of farms which are important. The livestock farms are mostly beef cattle farms. Their proportion is the highest in the Virginia counties, Loudoun, Fairfax and Culpepper. The correlation between the proportion of livestock farms and the proportion of farmland in plowable pasture and idle cropland should be noted. On the field crop farms in the Milk Shed grains are the most important crop. In Prince George's County the most important crop is tobacco. Prince George's County also has the largest number of vegetable farms. Market gardening used to be quite an important industry in this county, because of proximity to Washington, and lighter soils suitable for vegetables. But with the increase in transportation of vegetables by trucks over long distances, the industry has been losing ground. (There were 263 "truck farms" reported in the county in 1930, only 121 in 1945).

The Four Sub-regions.

1. The Eastern Crystalline Upland. The most intensive farming and dairying in this sub-region is developed in the eastern part of Frederick County. Here the proportion of farmland in crops is highest in the sub-region (50 to 60 per cent, map 5) and the proportions under plowable pasture plus cropland idle or fallow about the lowest. Urbana township, with a large area covered by Sugar Loaf Mountain has a lower percentage (43%) under crops and a higher percentage under plowable pasture and idle cropland. Milk production and sales are among the highest in the Milk Shed. 90 per cent or more of the milk produced is sold as whole milk, the quantities ranging around 90 gallons per acre of cropland.

This very high intensity of cropping and dairying cannot be explained entirely on the basis of soils or topography. In these respects these townships are not significantly different from adjacent townships in

in Montgomery County. Yet the proportion under crops is 10 to 15 per cent higher in these. The larger proportion of farmers of German descent (with their intensive farming methods) is probably the principal explanation for the difference. The Montgomery County section of this sub-region ranks next in intensity of agricultural land use. The proportions of farmland under crops range between 34 and 46 per cent, and those under plowable pasture plus idle cropland 24 and 34 per cent in most townships. The proportion under crops are lower near the Potomac, because large areas have strongly rolling topography, and also near Washington. The proportion of whole milk sales to milk production is high in most townships. In the townships in the central and western part of the county, total milk production is also quite high, but in the eastern part of the county, total milk production is low. Very high values of sales per acre of cropland are due mainly to heavy imports of feed. (See Chapter IV, page 105).

In Virginia the boundary of the Milk Shed takes a sharp swing to the West and only a very small area of the Eastern Crystalline upland is in the Milk Shed. The portion which is included in the Milk Shed seems comparable in land use and dairy development to the Montgomery County part of the Sub Region. In the section outside the Milk Shed agriculture is in a rather low state. A large proportion of the land is in woods (50 per cent or more). Proportions under crops (about 20 per cent) and under plowable pasture plus idle cropland (20-28%) are both small. A large proportion of the farms are primarily subsistence farms. Dumfries township in the extreme south-eastern part of Prince William County is at the bottom of the list by all indices of agricultural development that we have used here. About 2/3 of the farm land is in woods, and only 7 % is in crops. As already discussed in the section on soils, the principal reason for the poor condition of agriculture in this part of the Eastern Crystalline upland is the low fertility of the soils.

(Grey-phase of Chester series in Fairfax County and Mason-Tatum soils further south).

2. The Triassic Lowland: The northernmost part of the Triassic lowland which is in Frederick County, ranks second only to Frederick and Middletown valleys in the intensity of land-use. 55 to 60 per cent of the farmland is in crops and 20 to 30 percent in plowable pasture. Dairying is also highly developed. Milk production and sales are high, 80 to 90 percent of the milk is sold. In the remainder of the sub-region the proportion of farmland in crops is not very high (25-35%). The proportion under plowable pasture and idle land is somewhat higher (30-40%. Lower productivity of the soil is in part (but only in part) the explanation. The influence of soil fertility is well demonstrated in Poolesville township of Montgomery County. In this township proportion under crops is 32 per cent, under plowable pasture plus idle land 43 per cent yields of corn. 36 bushels per acre and of mixed clover and timothy hay 1.0 ton to the acre. In the two townships in the Eastern Crystalline Upland, which surround it, the corresponding figures are: 40 and 46 per cent in crops, 30 and 34 per cent in plowable pasture and idle land, yields of corn 40 and 43 bushels, and of mixed hay 1.2 and 1.3 tons to the acre.

3. Frederick Valley. Frederick Valley is without question the most intensively cropped area in the Milk Shed. Almost all of the area of the valley is cleared (Photograph 2) and the proportion lying unused is very small. 60 to 75 percent of the land is in crops, and most of the remainder in plowable pasture (15 to 25 per cent). Dairy farming is also very intensive. Total milk production and sales are among the highest in the Milk Shed. 90 to 95 per cent of the milk produced is sold. Sales per acre of cropland range from 90 to 110 gallons per acre.

4. The Western Crystalline Rock Belt: There are considerable variations in the agricultural economy within different parts of this sub-region. The Catoctin and South-Mountain parts in Frederick County are occupied largely by small general and subsistence farmers. The average size of the farms is 70-75 acres. Cropland per farm averages 25-30 acres and value of land and buildings $3,000 to $3,500 per farm. (1940 Census). It appears that these farmers are using as much (probably more) of land for crops as can be used with safety. The proportion of farm land in crops ranges from 35-40% and that under plowable pasture averages about 10%. 30-40% of the land is in woods. Beside the general and subsistence farms there are a few orchards (apples mainly, some peaches) along the slopes of the mountains, a few dairy farms and some beef-cattle farms.

In the Southwestern part of Loudoun and adjoining Northwestern part of Fauquier County, there are a number of large estates, owned by wealthy people. These estates are maintained primarily for pleasure. Race horses and beef cattle are the principal livestock raised. Some have dairy herds too. The influence of these estates is marked in the M.C.D. statistics which are given below. The first two M.C.D.'s represent the estates areas. Mount Gilead represents the best developed part of the Catoctin Valley and Middletown that of the Middletown Valley.

Table 10: Differences in Land Use and Size of Farms: Four Selected Townships

	Mt rear, Loudoun County	Scott, Fauquier County	Mount Gilead, Loudoun Co.	Middletown, Frederick County
Percentage of farmland in crops	29	24	42	66
Percentage in plowable pasture	48	56	40	20
Average value of land and buildings per farm	$29,[illegible]	$30,644	$15,260	6,754

The topography in the estates area is rolling to hilly and that accounts, in part, for the less intensive land use. Farther South in Fauquier and Culpepper Counties, most of the farms are general (crop and livestock) or livestock farms (raising beef cattle).

The only partsof this Sub-region that are in the Milk Shed are the two valleys -- Middletown and Catochin. Proportion under crops range around 40%, and in plowable pasture also around 40% in the Catochin Valley. In the Middletown Valley, proportion under crops is 15-20 percent higher and porportion under plowable pasture 10-20 percent lower. In both valleys very little land is waste land.

The discussion has so far been based largely on the influence of the physical factors. Certain patterns, however, remain unaccounted for, and it would be well to conclude by pointing out the role of the human factor in explaining differences in Land Use. We have noted that the Frederick County townships of Eastern Crystalline Upland have 10-15 per cent more land in crops than in the adjacent townships in Montgomery County. In the Frederick County portion of the Triassic lowland, also land use and dairy farming is much more intensive than in the remaining portion of the Sub-region. Again, in Middletown Valle, cropping is more intensive than in the Catoctin Valley, across the Potomac. In all these instances, differences in topography or soils do not explain the differences in land use. The principal explanation seems to be the character of the farming population. In Frederick County, a large proportion of the farmers are of German descent. The family-size farm has been dominant, almost from the beginning. Plantations and large estates were never very important in this county. The "German" farmers are known for their intensive crop-production practices, and attention to livestock and dairying.

In the other sections farmers are mostly of English descent, or, as in Montgomery and Loudoun County, mostly of Scotch-Irish and English, with some of German descent. They have, in general, not been as intensive farmers as the Germans in Frederick County. Tobacco was grown over large areas, and methods were extensive and soil exhausting. Large estates have been an important feature of the agricultural picture and several of them persist to this day.

CHAPTER IV

THE HEALTH DEPARTMENT AND THE WASHINGTON D.C. DAIRY FARMS

A. Introductory

The job of a Health Department is to protect the Public Health. Its job, so far as the production and distribution of milk is concerned, is to see that the milk is produced from healthy cows in clean surroundings, is handled with cleanliness through all the stages of transportation, and processing, and that it reaches the consumer as a clean, wholesome, unadulterated product. This requires prescribing regulations about conditions to be maintained at the various stages of milk production and distribution, and enforcing these regulations by a system of inspection. If the regulations are proper and adequate, and are well enforced, the public will get a pure and wholesome product. This has been the case in Washington, D.C. The consumer has received milk and cream of high standard of purity. (The average bacterial count of milk sold in the District of Columbia had reached a low of 18,500 before the war and 65 per cent had a bacterial count of less than 10,000 per c.c., which is the requirement for certified milk , This is certainly an admirable achievement)

But the powers of the health departments to make and enforce their regulations have extremely important secondary consequences. Their regulations prescribe conditions to be maintained at the farm, on the trucks, and in the dairy, and if they are effectively enforced, they can change the entire picture of the industry. This too has been the case in Washington D.C. and it is impossible to understand conditions on farms shipping milk into the District or the structure of the Milk Market, without understanding the regulations of the District of

Columbia Health Department. I have described the Health Department regulations and the Dairy Farms together because I feel that the best way to understand conditions on the dairy farms is to see the farms in the light of the regulations under which they are operated.

B. Regulations

The Health Department was given its powers of regulations and inspection by an Act of Congress passed in 1925. The purpose of the Act was to insure a safe and wholesome supply of milk, cream and ice cream for the District of Columbia. Its principal provisions are summarized below. The most important ones are given in their original wording.

> Sec. 2. "That no person shall keep or maintain a dairy or dairy farm within the District of Columbia, or produce for sale any milk or cream therein, or bring or send into said District for sale, any milk, cream, or ice cream without a permit so to do from the Health Officer of said District and then only in accordance with the terms of the said permit."

These permits are good for the calendar year only, and must be renewed on the 1st of January of every year.

The cows from which the milk or cream is produced must be free from tuberculosis.

> Sec. 7. "That the health officer of the District of Columbia, under the direction of and with the approval of the Commissioners of said District, is hereby authorized and empowered to make and enforce all such reasonable regulations, consistent with this Act, from time to time, as he may deem proper, to protect the milk, cream, and ice cream supply of the said District of Columbia: Provided, however, that such regulations shall be published once at least thirty days in some daily newspaper in the District of Columbia of general circulation before any penalty be executed for violation thereof."

Public — No. 496 — 68th Congress
S. 2905
An Act to regulate within the District of Columbia the sale of milk, cream, and for other purposes. Approved February 27, 1925.

Several sections are devoted to defining the "enforcement powers" of the Health Officer. These include the authority to inspect dairy farms, dairies, and records of dairies as to receipts and disposal of milk and cream; to revoke permits when regulations are violated; to seize any unauthorized milk or cream, which may come into the District, to demand its removal or to have it destroyed.

Milk, cream, raw milk, pasterized milk, Pasteurization, certified milk, reconstructed, skimmed milk and Ice cream are defined and the following minimum standards are fixed:

> Pasteurized milk: 3.5 per cent butterfat, 11.5 per cent total solids, shall not contain more than 40,000 bacteria, total count, per c.c. when delivered to consumer, and shall be free from colon bacilli and other pathogenic organisms and all visible dirt. Diary farms producing milk shall have a score of not less than 70; the cows, a score of at least 90; and the dairies processing and distributing it, a score of at least 85, on the rating cards in use by the D. C. Health Department at the time.
>
> Cream: minimum butterfat 20 per cent, and "shall be free from pathogenic organisms and visible dirt".

Cream for sale as fluid cream must be pasteurized. Fluid milk may be sold either raw or pasteurized, provided no milk is pasteurized twice. Although raw milk is allowed to be sold, and the regulations in the Act are not much stricter than those for pasteurized milk, the proportion of raw milk sold in the District is so small as to be insignificant. Its sales are not encouraged, because pasteurization is considered much safer.

> Sec. 4. "That nothing in this Act shall be construed to prohibit interstate shipments of milk or cream into the District of Columbia for manufacturing into ice cream: Provided, that such milk or cream is produced or handled in accordance with the specifications of an authorized medical milk commission or a state board of health."

This last provision is significant. It took the ice cream industry out of the control of the Health Department. Milk and cream from sources not inspected by the District Health Department could still be imported (for ice cream manufacture, of course). The Health Department had to check all the time that they are not used for fluid uses. The provision tempered the authority of the Health Department somewhat, made violation of the Act easier.

The regulations which the Act had authorized the Health Department to frame, were issued by the Health Department in November 1925, but they are worded mostly in general terms. The specific requirements for conditions to be maintained on the dairy farms, and dairies are listed on the respective Score Cards. The farm score card (Appendix B,1) was supplemented by "Interpretation of Dairy-Farm Score Card", which was issued in February 1932. This last document gives all the details of the requirements to be met, and is the Bible of the Health Inspectors or the Association (Maryland and Virginia Milk Producers' Association) Field men.

C. Specific Regulations and Their Effects on the Physical Characteristics of Dairy Farms

1. Dairy Barns and Surroundings: The dairy farm must have a separate stable (dairy barn) for housing all cows milked. No calves, young heifers, bulls, or other stock are allowed in this barn. There should be no building except the milk-house within 50 feet of the barn; and no manure or standing water or any other condition that may cause contamination is allowed within 50 feet. Hog pens or runs must be at least 100 feet away. The result is that almost all D.C. dairy-farms have at leasttwo barns -- one for the cows that are being milked, and

the other for the other stock like dairy stock, beef cattle and horses.

2. The requirements are quite detailed and specific as to the construction of the dairy barn. The floor must be made of impervious material; it must be properly graded, and have a proper gutter (dimensions specified). There must be a concrete lane 50 feet long leading to the entrance of the barn, so the cows may not carry mud into the barn. The walls must be made of smooth non-absorbant material 3½ feet from the floor, and smooth, tight material above that; the ceiling must be similarly made of tight material. The nature of the stanchions, manger, the number of cubic feet of air space per cow (600 cu. ft.), the area of glass windows (4 sq. ft.) per cow, lighting, ventilation, in short everything about the construction of the barn is specified in minute detail. The construction of the milk-house is also specified with similar exactitude. Going through this "interpretation" one cannot help getting the impression that the person or persons who wrote this up must have had a very definite type of dairy barn and milk-house in mind, and wrote the requirements to suit what they had in mind.

Most of the dairy barns and milk-houses were, in fact, built from blue prints which were prepared by the Health Department, in cooperation with State Universities, and the Producers' Association. Accordingly, there is a remarkable uniformity in the lay-out and design of construction of the dairy-barns and milk-houses. Driving through the area, one can very easily pick out the D. C. dairy farm from one's car window. Their characteristic buildings just make them stand out from the other farms in the area.

The dairy barns are generally two-story structures. The ground floor is used for the cows, and the upper story for storage of hay and other feeds. The lower floor is of concrete, well-graded and with

wide gutters. The newer barns have doors on both sides, and the lane between the two rows of cows is wide enough for a truck to be driven through the barn. (Photograph 7) In this way manure can be hauled out much more easily, and with considerable saving in time. This is a big advantage because manure has to be hauled out at least once every day, and the floor cleaned and limed. The walls are in most cases built of cinder or concrete blocks, and interspersed with an abundance of glass windows. The ceiling is made of tongue and groove board or other tight material, in order to prevent dust of feed particles from falling through from above.

On almost all farms, there are one or more silos. The number depends upon the number of cows milked (most of them have two). The silos, however, do not open into the dairy barn. There is some space between the silo and the barn, which may be used as a feed room. If the farmer mixes his own feed, his feed room is of sufficient size. It may be located on the ground floor or on the upper story.

Milk House. The regulations require the milk house to be between 10 and 50 feet of the dairy barn. The lower distance is now preferred, and on most of the farms, the milk house is 10-12 feet from the barn. Requirements about the type of construction of the walls, floor, ceilings, lighting, ventilation are very similar to those for the dairy barn, and are just as detailed. The milk house must have a minimum of three rooms -- a cooling room, a wash room, and a boiler room; the first two with minimum dimensions of 7 feet by 8 feet. The cooling room is equipped with a surface tube cooler for cooling the milk and a refrigerated box (generally called ice box), in which the milk cans are placed, before they are picked up by the trucker. Some of the farms have "walk-in-refrigerators" (small refrigerated chambers). These save

the trouble of putting the cans in the ice box and picking them up.

The wash room has all the equipment needed for washing and sterilizing the utensils -- a two or three compartment wash-tank, a steam sterilizer (Photograph 12) for the utensils, and a smaller hot-water cabinet for sterilising milking machine parts (which are used on the great majority of the farms), and cleansing equipment like brushes, alkali powder, etc. All the utensils and milking machines are kept in this room.

The boiler room is for housing the boiler, which is necessary to generate steam for sterilising the utensils. It also frequently houses the motors with which the ice box and the cooler are operated; and serves as a room for throwing odds and ends. Towels used for wiping cows' udders may sometime be seen drying in this room. It is hot and dry in here. So, why not!

Maintaining Cleanliness and Handling the Milk. The dairy barn has to be cleaned and limed every day. The manure has to be hauled out daily, and must be taken at least fifty feet away. Most farmers have manure-spreaders and spread the manure on the fields daily. The cows have to be kept clean and close clipped at the flanks. Before milking, their udders have to be washed with water and wiped with a separate, individual, dry towel. Thus four towels are needed for each cow every day. The towels, and the concrete lane are the two features of D.C. dairy farms that have received most publicity. The pails used for milking must be of the small-top design. Great emphasis is placed on this requirement. But milking machines are now used on most of the farms, and the emphasis has lost much of its significance. Immediately after milking each cow, the milk must be removed to the milk house and cooled over the surface cooler. The dairy workers set up the surface cooler

before they start milking, but in many cases do not bring in the milk until the milking machine pail is full.

The shorter distance between the barn and milk house is to facilitate the milkers in complying with the requirement. After being cooled over the surface cooler, milk goes into the cans, which are placed in the ice box or the refrigerated chamber, until they are picked up for transportation. Milk must be cooled below 50°F. within an hour of milking, and must be maintained at that temperature. Its temperature, as it reaches the receiving platform (of the dairy or the receiving station) should not be more than 55°F. and it is the milk producer's responsibility to see to it.

This insistence on such low temperatures -- 50°F. at the milk house, and 55°F. at the receiving platform, makes it necessary for the Producer to have mechanical refrigeration, and for the trucker to pick up the milk from the producer's milk house. The producers cannot place their milk cans on a small platform along the highway as is done in many areas.

The utensils -- milk cans, milking machines and pails, stripping cups, cooler parts, etc. (all those with which milk comes in contact) have to be cleaned with alkali powder in warm water right after use, and have to be sterilized. The milking machine parts are sterilized in hot water (temp. 180°F. for 30 minutes) and the others in the Steriliser with live steam maintained at 180°F. for 30 minutes. All washing and sterilizing is required to be completed by 12 noon daily. The milk house with all the cooling equipment, sterilizers, milking machines, and great lengths of tubes and hose verily presents the appearance of

TABLE 11 Producers shipping milk into the District of Columbia

	All producers	Maryland	Virginia	Pennsylvania and West Virginia
Number of producers	1,472	836	598	38
Number of cows milked	53,408	29,548	22,661	1,199
Average per producer	36.2	35.3	37.8	31.6

Number of cows milked in the herd	Producers	Cows	Producers	Cows	Producers	Cows	Producers	Cows
Less than 15	34	405	19	223	11	137	4	45
15 - 19	100	1,690	68	1,148	28	474	4	68
20 - 29	428	10,532	248	6,137	168	4,107	12	288
30 - 39	399	13,316	218	7,266	172	5,735	9	315
40 - 49	262	11,245	150	6,416	108	4,658	4	171
50 - 59	104	5,451	59	3,087	42	2,209	3	155
60 - 69	70	4,365	36	2,224	34	2,141	-	
70 - 79	35	2,577	22	1,620	12	880	1	77
80 - 99	29	2,482	13	1,099	15	1,303	1	80
100 and above	11	1,284	3	376	8	908	-	

* The figures for cows milked are average figures for 1947. In case of first nine months of the year.

Source: Health Department of the District of Columbia.

classified according to the number of cows milked in the herd.*

Frederick County, Maryland	Montgomery County, Maryland	Loudoun County, Virginia	Fairfax County, Virginia	Prince William County, Virginia	Fauquier County, Virginia	Culpepper County, Virginia
422	260	202	105	53	101	61
13,647	10,233	7,784	3,790	1,818	3,538	2,642
32.3	39.4	38.5	36.1	34.3	35	43.3

Producers	Cows	Producers	Cows	Producers	Cows	Producers	Cows	Producers	Cows	Producers	Cows	Producers	Cows
11	147	8	91	3	32	1	14	3	41	2	24	1	12
40	670	15	255	9	158	6	98	5	85	4	65	3	51
157	3,860	47	1,109	57	1,397	35	857	12	291	30	722	15	376
107	3,575	66	2,207	65	2,195	28	927	15	494	32	1,051	12	387
63	2,705	65	2,760	26	1,133	21	898	12	507	20	866	10	429
22	1,148	23	1,194	13	690	7	361	2	108	8	419	5	268
12	740	14	859	14	872	2	125	1	60	2	125	10	630
7	517	11	814	3	220	-		2	145	2	148	3	220
2	175	10	838	10	887	2	160	1	87	-		2	169
1	110	1	106	2	200	3	350	-		1	118	-	

producers who started shipping milk in 1948, they are averages for the

the inside of a factory rather than that of a farm.[25a]

Other requirements: Water Supply: The water supply should be free from contamination and the inspectors make sure that drains from the barns, or milk houses, or other drains, do not in any way affect it. An ample supply of running water is essential in view of all the washing and cleaning of equipment and buildings that is required. A properly built privy or flush type toilet is also essential. The privy has to be at least 50 feet away from the dairy barn and 100 feet from the milk house or water supply and has to be kept properly cleaned.

The attendants have to wear sanitary milking suits while milking. All attendants have to pass a physical examination indicating that they are free from typhoid, diphtheria, and syphilis, before the dairy farm is given a permit, and the tests have to be repeated at least once a year. If any of the attendants or a member of their families contracts a communicable disease, the Health Department has to be notified within 24 hours.

D. The Role of the Premium System

The regulations are strict. Dairy farmers have in the past complained strongly against several of them. Complaints against the inspectors being too fastidious and unsympathetic have been frequent. Where the farmers have to remodel their establishment so radically, and have to go through an elaborate time-consuming routine daily, such complaints are to be expected.

But the regulations are backed by a system of paying premiums (by the distributors), based on the score obtained by the producer on the

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[25a] A far cry indeed, from the equipment of an Indian peasant farmer.

the dairy-farm score card. The premiums being paid at present are shown in the following table:

TABLE 12 - SCHEDULE FOR PAYING PREMIUMS

Dairy Farm Score	With cattle score under 95 (cents per cwt.)	With cattle score 95-97 (cents per cwt.)	With cattle score 98 or over (cents per cwt.)
Under 80	0	0	0
80-84.9	0	3	9
85-89.9	2	8	14
90-94.9	8	14	20
95-97.9	20	26	32
98 or over	31	37	43

Note:1.The cattle scores are based on cows being free from tuberculosis, or any noticeable disease, and kept clean and properly clipped. There is not much variation in them.

2. The weighted average premiums of all members of the Maryland and Virginia Milk Producers' Association amounted to 35 cents per hundred weight. In the same year 79.8 percent of the D. C. producers had farm scores 95 and above.

3. The schedule of paying premiums has remained unchanged since November 1, 1937. The price of milk has almost doubled in the intervening period. Labor and other expenses (maintenance of equipment,etc.) required for keeping the scores high have also gone up considerably. Accordingly the farmer today gets much less for his extra efforts and expenses in maintaining high scores than he did in 1937.

It is this system of paying premiums based on farm and cattle scores rather than the stringency of inspection that accounts for all the farms being properly equipped with the costly equipment, and trying to comply with the details of the regulations. The producer who does not have the steam steriliser and the cooling equipment cannot ship milk because his farm score cannot come up to 70 without them (See Appendix B). But consider two producers who <u>have</u> equipment, but one has a score of 89 because of inefficient help or the equipment not being top-notch; the

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Source: Maryland and Virginia Milk Producers Association

other has a score of 98. Both have cattle scores under 95. The latter is getting 29 cents per hundred pounds of milk more than the former. This difference calculated on 700 lbs. of milk per day (which is fairly close to the average daily production of the Association members) amounts to $740.95 a year, a difference sufficient to pay one full-time dairyman four to five months, or a half-time man for almost a year.

Stepping down from the top category to the next makes a difference of 11 cents per cwt. or $261.05 per year. Of course, the producer watches every decimal point on his score card.

E. Economic Effects of Regulations on Dairy Farms

Size. The small man is out. He cannot afford to make the large investment needed for the buildings and the equipment. It is estimated that at present prices it costs a person $350-$500 per cow to equip completely for shipping milk, i.e., build the dairy barn, milk house, and buy and install all the milk handling equipment (milking machines, cans, sterilization and cooling equipment). For a producer with a herd of twenty milking cows, the cost would range between $7,000 and $10,000. (The lower figure is considered to be somewhat low.) Not all farmers have that much capital to spend on the dairy buildings and equipment alone.

It is true that the present costs are too high, and most barns were not built at these costs. Before the war, the costs ranged between $150-$250. But at that time the price of milk was also 50-60 per cent of what it is today. Most of the fixed and recurring costs favors the larger unit. The costs of buildings and equipment do not rise in proportion to the size. The milk house in which milk from

forty cows can be handled does not cost twice as much as the one in which milk from twenty cows can be handled. (And, of course, the regulations prescribe a minimum size.) The cost of the 48 in. cooler or the 6 h.p. boiler is more than that of the 24 in. cooler or the 3 h.p. boiler, but the ratios are much less than 2:1.

In cooling milk and in sterilising and washing utensils, a very large proportion of the time is spent in getting things ready, i.e., setting up the equipment. The cooler has to be set up and the boiler has to be fired, whether 50 gallons of milk are poured or 6 cans sterilised, or 100 gallons of milk are poured and 10 cans sterilised.

In dairy farming a two-man unit is always preferred to a single-man unit. But in case of the D.C. dairy farms, the two-man unit is almost essential. The operations of maintaining cleanliness, and handling milk take so much time that one man cannot care for a sufficient number of cows to justify his heavy overhead.[25b] Also, he cannot afford to take any chances. If for instance, he is sick and cannot get a suitable substitute to sterilize the utensils and cool the milk properly, he may get a warning that his milk is of too high bacterial count, or his milk may even, at times, be "cut off" (refused) by the distributor. He must, therefore, have at least one other man (or equivalent) capable of doing all the work properly.

The figures indicating the numbers of cows milked per producer (Table 11) show that in 1947, 14 per cent of the producers milked 20 cows or less. As twenty cows is about the maximum number that one man can handle, it is reasonable to assume that the percentage of one-

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[25b] One man may be here understood to mean a man with family in which the help given by children is not of importance.

man-dairy farm, among the D.C. producers is not more than 14 or 15 per cent. I have taken the average number of cows milked in 1947 as a measure of size and classified the Washington, D.C. producers into nine size groups. (Table 11) The number of producers in each size group has been given for the milk shed as a whole, for the producers in the individual states, and for the counties. The figures for the milk shed, Maryland and Virginia, have been plotted on Fig. 8. This graph shows a frequency distribution curve which is skewed to the left -- the two groups 20-29 cows and 30-39 cows having the largest numbers of producers in them.

Variations by states and counties, though not very large, are still significant. The average number of cows milked for Maryland producers, is lower than the average for Virginia or the whole milk shed producers. The lower average is due primarily to the large number of smaller producers in Frederick county. This county has 50 per cent of the producers in the state, but has over 60 per cent of those in the three lowest size groups. The very large producers are also fewer in Maryland. There are 13 producers with 80-99 cows and 3 with 100 or more in Maryland compared to 15 and 8 respectively in Virginia. There does not seem to be any correlation between size and distance from Washington.

Specialization. The D.C. milk producers are very highly specialized dairy farmers. Evidence of this comes both from field observation and from census data. On most of the farms visited attention was devoted almost entirely to producing milk for the market, and the milk cheque was by far the most important source of income. The few chickens and hogs kept, were primarily for the use of the family (or families). Sale of calves and dairy animals, and of grains (mostly wheat) were other sources of income. The former must, however, be considered as

income from the dairy enterprise. On a few of the farms visited there were some beef cattle kept, but these farms were much bigger than the other farms visited.

Data from the 1940 Census (22. Vol. II, Part 2) show that in all the milk-shed counties, except Frederick, dairy-products accounted for 80-84% of all the products sold from "dairy farms".[26a] As the Washington, D.C. producers form the majority of the dairy farmers in all these counties, except Frederick, these figures may be taken as representative of Washington producers. Of the remaining 15-20 per cent, half (or 8-10 per cent of the total income) was accounted for by the sale of livestock products mostly calves and other dairy animals. Sale of field crops, representing 5-10 per cent of the total farm receipts, was almost the other source of income.

In Frederick County the proportion of income derived from sale of dairy products was lower, mainly because sweet corn is an important cash crop in this county. Receipts from sale of field crops (of which sweet corn is most important) represented 16 per cent of the total farm receipts in this county, sale of dairy products formed 68 per cent of the total, and of livestock products (mostly dairy animals) 11 per cent.

This almost exclusive specialization in milk production results from the operation of a number of factors, of which the following seem to be the more important: (The order does not reflect relative importance.)

1. The very factors which make for a large unit, also tend towards making it more specialized. The amount of labor required in caring for the cows, handling the milk, and performing the other necessary tasks

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[26a] Farms with dairy products as major source of income.

is so much that the producer has a tendency to concentrate his attention on the one enterprise to the exclusion of the others.

ii. This concentration of attention is worthwhile if the enterprise is profitable. It is not possible to say whether dairy farming is more profitable than livestock farming or grain farming or any other type of farming. However, it is sufficient to point out that the increase in dairy farming in all the counties of the Milk Shed during the last three decades indicates that the farmers have found dairying somewhat more attractive than the other types of farming.

Income from the sale of milk fluctuates less than that from most other farm products. This fact is well known, and is substantiated by comparison of prices received by milk producers,(members of the Association) and prices received by farmers for the three groups of products: grains, meat animals, and tobacco, in the period 1930-1943. This is shown in the graph below (Figure 9).

Prices for milk remained higher than those of other products for most of the period, and with the coming of the war, they did not increase as rapidly. Tobacco was at the other extreme with the widest fluctuations.

Also, income from the other products is received at long intervals (once or twice a year in most cases). The milk check comes in every month or fifteen days. This is no small attraction.

iii. The larger unit is better managed, if it is specialized. On a large proportion of the D. C. dairy farms, the operator is essentially a manager, and has several men working for him. He can be a more efficient manager if he concentrates his attention on one type of farming (dairy farming is complex enough by itself), than if he divides attention among several.

F. Livestock Husbandry on Dairy Farms. Breeds. In areas of market milk production Holstein is the dominant breed. It is the most important breed in this milk shed also. But the proportion of cows of the Guernsey breed is much larger than it is in most eastern market milk areas. The main reason for this is the higher butter fat content of the "standard" milk sold in this market. Most distributors have been putting out milk with a butter fat content of 4 per cent (± 0.2 per cent) for a long time, and they like the producers' milk to average about the same amount of butterfat.[26] Accordingly, on most herds, the majority of cows are Holsteins, but there is also a sizeable proportion of cows (1/3 to 1/4) producing milk of higher butter fat content. The latter are in most cases Guernseys, but they may be Jerseys. The Jersey breed is third in importance in the area, but the number of Jerseys is much smaller than that of Guernseys. The presence of cows of these two breeds is commonly referred to as the "yellow streak" in the herd. Ayrshires, Brown Swiss and Milking Shorthorns are other breeds of some importance.

All kinds of cross-breeds may be encountered in the herds, but cross-breeds between the Holstein and Guernsey are by far the most numerous. These are bred to combine the merits of the two breeds. On farms where all the replacements are raised, the herd is likely to be purer, as to breeds, and often of better quality than on farms where replacements are bought. Most of the cows are grades. Registered pure-bred cows are too expensive for most farmers. A large proportion of the farmers, however, use a pure-bred sire for breeding.

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[26] The average butterfat content of all milk shipped by producers in the Metropolitan Washington market varied between 3.8 and 4.2 per cent during the seven years of operation of the Federal Order.

They may have a few pure-bred cows in the herd, but they are seldom registered.

Herds of Registered Pure-bred Cows are few in number and are maintained either by very efficient farmers or on farms where the owner has another source of income and can afford to keep the expensive animals. The breed of the cows is dependent very largely on the market price policies. Milk of 4 % butter-fat is taken as the basis for quoting the price of milk in this market. There is a differential of 6 cents per 1/10 percent of butter-fat which is added to or substracted from this quoted price, according as the milk tests higher or lower than 4%. Thus assuming the present price of milk to be $5.60 per cwt for 4% milk; and the butter fat differential at 6 cents, milk with a butter fat test of 4.6% will be worth $5.96 per cwt, and milk with butter fat test 3.4% is worth $5.25 per cwt.

Prior to February 1936, the butterfat differential in this market was 7 cents, which with a fluid milk price of $2.80 to $3.00 was sufficient to compensate the richer milk producer for his lower milk production per cow. Beginning February 1936 the butterfat differential was reduced to 6 cents and has remained unchanged since. With the sharp increases in prices that followed after 1941, the producer with higher butterfat content milk has been at an increasing disadvantage. The present prices and differential rates are all in favor of the producer with large milk production of lower butter fat content. The point will be clearer from the following example:

Guernsey Cow: Milk production 6000 lbs. Butterfat test - 4.6%

Holstein Cow: Milk production 9000 lbs. Butterfat test - 3.4% [27]

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[27] The milk production figures are slightly above the average but are easily obtained in most good grade herds.

	1935	1947
Receipts from a year's production of Guernsey cows	60(3.93 +42 = 3.35) = $201.00	60(5.78 + .36 = 6.14) = $368.40
Receipts from a year's production of Holstein cow.	90 (3.93-42 = 3.51) = $315.00	90(5.78-36 = 5.42) = $487.80

Note: The prices used are weighted average prices paid members of the Association for all milk; F.O.B. Washington, 4% milk, including premiums.

On these figures we must allow for the higher feed cost for the Holstein, and somewhat higher costs of handling and transportation of the larger volume of milk, Labor, overhead, and other costs per cow, are the same for both breeds. In view of these allowances, the Holstein cow had probably no advantage over the Guernsey in 1935. But in 1947 she was decidely the more profitable cow, bringing in almost 1/3 more money than did the Guernsey.

Of course, the changing price policies are themselves a response to the changing condition of demand, which we shall discuss more fully in Chapter VI.

Replacing the Herd. About 20 per cent of the milking cows have to be replaced every year (51 p. 146). Most farmers prefer to raise their own replacements because they do not feel that purchased heifers are of as good quality as the ones they raise themselves. Danger of introducing disease, high prices and uncertainity of performance of purchased heifers are other factors which favor raising own replacements. But the farm must have sufficient land (for raising feed) and other facilities (barn space, labor, etc.) for raising heifers. Those farmers who buy their replacements do so because their farm organization is not suited to raising their own. A large proportion of replacements are bought in the areas near the city, (Montgomery and Fairfax Counties) than in the other parts of the Milk Shed, because land, labor, and other costs are higher here. By far the greatest number of sales

are between farms in the same area. Important sources of importation are "Wisconsin", "Canada", and "Southern Virginia". These are however popular expressions, which are not to be taken literally. Wisconsin probably means the Mid-Western Dairy areas and Canada, Ontario and Quebec dairy areas.

Feeding Practices. Feeds for dairy animals are commonly classified as concentrates, silages, and roughages (dry and green). Concentrates consist of grains, and grain parts (like bran); high protein concentrates like oil seed meals; and minerals. Corn silage is the most important silage in this country. Hays, pasture grasses and clover (if fed) are the principal roughages.

Most farmers like to feed concentrates with a protein content between 16 and 20%. (Somewhat higher ratios in winter). The desired proportion of proteins is obtained by mixing grains with high protein concentrates like soy bean meal, Cotton seed meal, peanut meal or linseed meal. The farmers may buy these concentrates or 32 per cent dairy feed and mix with their home-grown feeds.themselves if they are equipped with feed grinding and mixing equipment. If they do not raise enough grains themselves, they may buy 16 or 18 per cent dairy feed ready mixed. Corn and barley are the principal grains fed. Oats and wheat are fed in smaller quantities. The dairy farmers raise wheat as much for its straw, as for the grain. Corn silage is the principal silage, but grass silage is slowly increasing in importance. The latter has the advantage of being available for feeding earlier in the summer. Grasses can be ensiled about the end of May, whereas corn is not ready for ensiling till about the last week of August. But extra equipment is needed to handle grass silage. The yields are lower, and the silage is generally not as palatable as corn silage. The lower yields are counterbalanced to some extent by the higher protein content, (especially high if legumes are ensiled) which makes it possible to save on feeding high

protein concentrates. Grass silage is increasing slowly, and the increase is likely to continue for some time.

Feeding of concentrates to milk cows is continued throughout the year, although the amounts fed are reduced during spring and summer when pastures are available. A considerable number of the farmers continue to feed hay also through spring and summer. These practices are necessary for attaining the two objectives of good dairymen--high production per cow, and fairly even production throughout the year. The latter is just as important to the market milk producer as the former, as will be clear from the following paragraphs.

Consumption of milk does not vary much, in the course of the year, in most markets. But production has a tendency to vary markedly unless special efforts are made to reduce the variations. In climates with cold winters the typical regime of milk production used to be as follows: Cows freshened in spring, pastures were abundant and nutritious, and large quantities of milk were produced for two or three months. Then as the lactation period advanced and the pastures got low, milk production rapidly fell off (high temperatures and flies in late summer are contributory causes). By fall or early winter many cows were dry and milk production was at its lowest. The regime, although considerably modified still persists in most northern markets, and is the basic cause of the "surplus problem." Considerable expense, effort and constant vigilance is needed to change this regime to one of fairly even production demanded by fluid milk markets. Cows have to be coming fresh at all seasons of the year, and an especially larger proportion has to freshen in early fall when milk production is lowest. Barn feeding is required all through the winter, and also in mid and late summer when pastures are low. Special effort has to be made to grow pasture grasses like lespedeza which are available

for pasturage in mid and late summer.

All these practices are expensive, and only a trained dairyman can keep production from jumping up in spring and falling in the fall. The milk producer has, therefore, to be compensated for his expense and effort required in maintaining even production. The price plans prevalent in most markets, have reducing seasonal variations in production as one of their principal aims. Producers who have evened out their production are preferred and receive higher average prices for their milk than do those with uneven production.

In the Washington market, seasonal variations had been considerably reduced by the operation of the Base-Surplus Plan and the efforts of the Maryland and Virginia Milk Producers' Association, and of State Extension Services. Due to the rapid increase in demand for milk in the market after 1941, the prewar surplus rapidly disappeared. By July 1942, , production from local producers was not sufficient to meet the market demand, and milk and cream had to be imported from "emergency sources" (produced on farms not inspected by the District Health Department). The Base-Surplus plan was discontinued, there being no surplus, and the producers received the same price for milk throughout the year (apart from the "subsidy"). The effect on seasonal variation is shown in the accompanying graph (Fig. 10). Whereas in 1940, production in the month of highest production (May) was 5 per cent above the 11 months average, and in the month of lowest production (July) 7 per cent below; in 1945 production in the highest month(May) was 19 per cent above the year's average, and that in the lowest month (December) 18.5 per cent below. The removal of the incentive to even production provided by the Base-Surplus plan, was the principal reason for this. Shortage of trained help during the war was a contributing factor.

According to the present plan of the Association, a certain amount is deducted in the months of high production, and the amount so deducted is paid back on shipments in the months of low production. In 1948 50 cents per 100 lbs. were deducted on shipments in April, May and June, and 55 cents per 100 lbs. added on shipments in October, November and December. Thus, producers received $1.05 more per 100 lbs. on their shipments in fall than they did in spring. The amount of deduction has to be carefully calculated. It should be sufficient (and no more) to bring production over the year in line with demand. The Association's policy is still in the making. (They changed the plan somewhat in 1949). However, they have again succeeded in bringing a third of their members on their "Honor Roll" (producers with production in the lowest month 90 per cent or more of their production in the highest month.).

Raising Feed: Home-grown Vs. Purchased Grains: Most dairy farmers try to raise all their feed and buy only the high protein concentrates (cotton seed, soybean, linseed meal, or peanut meal) and other special ingredients (wheat, bran, minerals, etc.) which they cannot raise. They may have to buy some grains or some hay, if their crop is below expectation, or due to some similar circumstance, but they do not plan on it. A small minority (5-10%) place greater reliance on purchased feeds. There is a much larger proportion of these latter in Montgomery and Fairfax Counties than in the other counties. Due to the proximity to Washington, and the pressure of suburbanization, labor and land are more expensive in these counties. Soils, too, are only of medium fertility. A A number of the farmers in these counties raise only roughages and silage and rely entirely on purchased concentrates. Others may raise part of their grain and buy the remainder. Many of these farmers contend that after they take into account all the cost of labor, equipment, and other costs of raising grains the purchased grains are cheaper than they can

raise themselves. Others give their particular circumstances as the main reason. They may not have enough land for the size of the herd, or they may not have been able to get enough help or suitable help to do both farming and dairying. Realization of the extent and danger of soil erosion is another important factor. Soils of the Manor and Glenelg series in the Crystalline Upland and of the Penn series in the Triassic Lowland are easily eroded and require careful cropping practices. Large areas are best suited for grasses, and not for row crops. The progress of the Soil Conservation movement and realization of the possibilities of production from grasses are also contributary factors.

The best information on feeding practices, costs of feed and milk production per cow is available from the records of the Dairy Herd Improvement Associations. These data are particularly helpful for Virginia counties of the Milk Shed where 1/3 to 1/2 of the dairy farmers are members of the Associations. The data used here are from the records of 112 members of the 5 Associations on Loudoun County for the period January 31, 1948 to February 1, 1949. These members represent about half of the dairy farmers in the county. It may be contended that these farmers are the more efficient, or the richer, or the more interested of the dairy farmers of the county, and there is some truth in the contention. But 50 per cent is a fairly large sample and the results should give a fair idea of the conditions in the county.

The number of days the cows were on pasture varied from a lowest of 151 days to a highest of 252 days, but in case of most farmers, the range was between 180 and 220 days. There were wide variations in the amount of grains, hays, and silage fed. 2500 - 3500 pounds of grain, 2000- 3200 pounds of hay and 3000-4000 pounds of silage per cow per year seemed to be the most representative figures.

Variations in costs of feed per 100 pounds of milk produced, however, were not so great as variations for the actual amounts fed. About 90 per cent of the herds had feed costs ranging from $2.30 to $3.50 per 100 pounds of milk. The average for all the herds was $2.86. This figure amounted to almost half (47%) of the receipts from the sale of milk. Cost of grains was the most important single item. The average for all the herds was $1.50 per 100 lbs. of milk or a little more than half (53%) of the total cost of feed.

From these figures it appears that the cost of feed is the single most important cost of production, and in this, concentrates are the most important item. Average milk production per cow in the herd ranged from 4400 lbs. to over 11,000 lbs. The averages for the Associations ranged from 7845 lbs. to 8777 lbs. The average for all the herds in the county was 7886 pounds. In comparison, the average production for all cows in the county was 5460 pounds in 1944.

Stock Improvement: It is generally agreed among all persons connected with dairy-farming in the area that the milk and butter fat production per cow has been improving in the area of the Milk Shed. This opinion is carroborated by Census and other data. Milk production per cow on dairy farms in 1929 is given in the following table:

Table 13. Milk Production per Cow (Gallons per year)

	1929	1939	1944
Frederick County	602	641	705
Montgomery County	629	657	716
Loudoun County	555	579	635
Fairfax County	667	714	777
Prince William County	560	574	669
Fauquier County	456	488	506
Culpepper County	396	450	543

Source: Census of Agriculture

The trend is also evident from the records of the Maryland

and Virginia Milk Producers' Association.* In 1930 the number of cows in the herds of its members averaged 25,000; milk production per day averaged 47,395 gallons or 1.9 gallons per cow. In 1940 there were 37,000 cows and milk production per day was 76,910 gallons or 2.1 gallons per cow. By 1943 the number of cows had risen to 54,500 daily milk production to 128,541 gallons and average per cow to 2.36 gallons per day. The increase is in part the short term response to increase in demand. The heavier feeding and greater numbers of the high producing Holsteins in the herds are important factors in explaining. The figures below show how an increase in the demand for milk was accompanied by a rapid increase in production. Heavier feeding seems to be the principal reason for increased production, as the number of cows added in these years was comparatively small.

Year	Number of Cows	Average Milk Production per day (gallons)	Daily Average per cow (gallons)
1940	37,000	76,910	2.1
1941	39,000	92,518	2.36
1942	42,000	101,461	2.41

But the long term effort towards improvement of dairy cows is the most important factor in explaining the secular trend towards increased production. The two note-worthy movements in this connection are the work of the Dairy Herd Improvement Associations and the recent Artificial Insemination programme. D.H.I.A.'s are cooperative associations of farmers formed for the purpose of improving the pro-

* Nineteen year Record of Maryland and Virginia Milk Producer's Association.

production of dairy cows. Officially the State Extension Services help by providing guidance. But actually the County Agent is the guiding spirit of the Association, especially in the earlier stages of organization. The Associations employ testers who test each individual cow's milk production and her profitability in view of her feed consumption. This enables the farmer to distinguish the profitable animals from the non-profitable. The number of Associations and of their members in 1948 are shown in the following table. It will be noticed that the movement is stronger in Virginia than it is in Maryland.

Table 14. D.H.I.A.'s in the Milk Shed

Maryland	Association	Number of members herds
Frederick County	3	69
Montgomery	1	32
Virginia		
Loudoun	5	117
Fairfax	3 reporting 2	61
Prince William	1	26
Fauquier	3	52
Culpepper	3 reporting 2	41

The Artificial Insemination programme was started in this area in 1946. The first year was the crucial trial and error period and the conception rates were low. During the next year (1947-48) the initial difficulties were largely overcome and the work was established on a firm footing. At present there are two Central Stations, one at College Park from which semen is supplied to the Maryland counties and the other at Culpepper , Va. which supplies Fairfax, Loudoun and Culpepper Counties. In each of these counties there is an Association, similar to the D.H.I.A. The membership in these Associations ranges from 80-120. The numbers of

cows bred in 1948 was a little over 1000 in each of the Maryland counties, approximately 1000 in Fairfax County, and about 1500 each in [illegible] and Culpepper counties. In Loudoun County, another Association was being formed in the early months of 1949 and the number of cows bred in 1949 was expected to double.

CHAPTER V

LOCATION OF THE MILK PRODUCERS - CAUSES AND TRENDS

The general pattern of location of the producers shipping milk into the District, was described in the first chapter. But discussion of this pattern, and the reasons for its existence were postponed. Now that we know the area- its physical and cultural setting, as well as the agriculture and dairy-farming in it- we are in a better position to understand the pattern of location of the milk producers. In this chapter we shall (i) bring out the factors which determine the boundaries (outer and inner) of the milkshed, (ii) explain the relationship between the physical and cultural factors and location of producers within the milkshed.

The facts of location are results of human decisions. These decisions are influenced by factors of location, and the influence is very great. But they are not controlled by them. As in all human decisions, such factors as circumstances, personalities, accidents play a very important role in these decisions. For instance, one farmer in a locality feels that he can make more money by shipping milk into the Washington market. He has the capital to make the necessary improvements on his farm and makes the change. His neighbor may feel the same way, but if he lacks the capital to make the improvements, he may continue to ship to another market. The decision may be taken by a group of farmers, instead of by an individual farmer. (We shall see later that such decisions are often taken by groups). Accordingly we may find one farmer or farmers in one community shipping to one market, while the farmer next to him, or farmers in the next community are shipping

to another market. Such examples are particularly marked where two or more milksheds overlap.

Favorable location is only one of the factors in determining whether the farmer (or farmers) will succeed in shipping milk to the market at a profit and become an integral part of it, or not. Other important factors are: managerial ability, success in making the right kind of arrangements for transporting and selling milk, and the condition of the market at the particular time. We could look at the situation from the market end. In the Washington market, the demand for milk has more than doubled during the last twenty years. This increase has been met by increasing the average size of the herd on the dairy farms, and to a lesser extent by increasing the number of milk producers. This is largely the result of the policies followed by the individuals, and organizations that have controlled the market in this period. The increase in demand could also have been met by a much larger increase in the number of milk producers shipping to the market. In that case, the pattern of location would most probably have been different from what it is today.

Again consider a dairy wanting to buy some more milk, or the Producers' Co-operative wanting to sign up some more members. There may be several choices open to them, each almost as good. The particular area which they choose will depend very largely upon where they succeed in making satisfactory arrangements. And in concluding these arrangements, personalities, and particular circumstances are just as important as locational advantages.

Farmers in a particular locality may get started at a particular time, because they had a locational advantage. The advantage may disappear, and yet they may continue, because they can still compete under the new circumstances.

The advantages or disadvantages of location are to a certain degree self-feeding. The cost of hauling milk from or sending field men and inspectors to an only farm on a particular route is very high. If the number increases the costs are materially reduced. Accordingly in many cases, groups of farmers get started at the same time. If some of them discontinue for one reason or another, the remaining may find it difficult to continue, and the difficulty increases as their numbers decrease. On the other hand, if a few farmers get started and succeed and others follow, the competitive advantage of all of them increases. With these thoughts in mind, let us examine the boundaries of the milk shed.

A. The Outer Boundaries: Like the milk sheds of most north-eastern cities, the Washington milk shed is located in an area of overlapping milk sheds and competing milk markets. There are no large cities within the milk shed. Frederick (pop. 19,400 in 1947) is the only city of any size within the milk shed, and can be called a secondary market. The milk producers supplying milk to dairies in Frederick are mostly located in Frederick Valley.

Competition from adjacent markets, however, is an important influence in setting the outer boundaries. The most important competitors are Baltimore and Philadelphia to the North. Richmond, Charlottesville, and Fredericksburg in the South, Hagerstown, Martinsburg and Winchester to the West are other markets which offer competition.

The relatively short extension of the milk shed to the North and N-E-N is due mainly to competition from Baltimore. Competition from this market is the main factor in setting the northern boundary (of the milk shed). This boundary extends from north-eastern Frederick County to the north-eastern corner of Montgomery County. There is considerable

overlap between the two milk sheds in the boundary zone. Driving through the area one may find one producer shipping to Washington and the next one shipping to Baltimore. One factor, influencing the choice of markets is the ability of the farmer to build the dairy-barn and buy all the equipment necessary to meet Washington regulations. The regulations of the Baltimore Health Department, have been getting stricter, but even now, they are not as strict as the Washington regulations. The old bank-type barn (so common in this area) is still permissible. The producers can set their milk at platforms along the highway, where it is picked up by trucks. They do not have to cool it to such low temperatures as the Washington producers have to do. The western boundary is placed in the map (map 1.) at the foot of the South Mountain and Blue Ridge. There are, however, about fifty producers in the valley west of these mountains. The principal markets for milk in this area are local markets- Hagerstown, Winchester, Martinsburg and Philadelphia. Shipments to Washington represent only a small part of the milk sold in this area. The producers in Bedford and Somerset Counties in Pennsylvania and in Garrett County, Maryland are far outside the milk shed. They are located at distances of from 160-190 miles from Washington. They all ship their milk to the receiving station at Cumberland, Maryland which is 30-50 miles from their farms, and about 135 miles from Washington. The milk comes to the market in tank trucks.

The existence of a small group of producers, so far from the market, and in an area where most of the milk is produced for other markets is the result of the efforts of a Washington dairy. This dairy does not buy milk from the Association. They have tapped such a distant source either because they cannot get enough milk within the milk shed, or because they feel more secure (against possible pressure on these producers for joining the Association) in obtaining milk from producers well out of

The area of the Association members. Whatever be their motive, the existance of these producers in the market is an example of the effect of individual or group decisions, which we have mentioned above.

The group of approximately 30 producers in Harford and Cecil Counties of Maryland ships milk to Washington for similar reasons. They are located right in the Baltimore milk shed. The milk comes through Baltimore on its way to Washington. These producers have been shipping to a Washington dairy for a long time. It is their arrangement with that dairy and with the transportation company, plus the fact that they can get (or have got in the past) a higher net price by shipping to Washington, that keeps them in the market.

The Eastern shore producers are also in an area where shipments to Washington are a minor part of the total milk sales. Milk from this area goes to Philadelphia, Baltimore, or is used for manufacturing purposes. Most of these producers are located fairly close to the shore between Chestertown and Easton, Md. Their milk comes over the ferry to Annapolis and from there to Washington.

In the South, the milk shed extends much farther than it does in the North. The nearest competing markets, Fredericksburg (pop. 12,500) and Charlottesville (pop. 19,500) are small. Richmond (pop. 228,000) is a much larger city, but is located about 100 miles from Washington. A part of the milk produced in the Virginia section of the milk shed is shipped to these markets, but the boundaries seem to be set not by competition from these markets, but by other factors. South of Loudoun and Fairfax Counties the milk producers are confined to the vicinity (within 2-4 miles on either side) of the railroad lines. The influence of the railroad could scarcely be better marked, than it is in

this part of the milk shed. In the western part of Fauquier and Culpepper Counties, dairy-farming is limited by rough topography, and emphasis on livestock farming. In the south-western part of Loudoun and adjacent areas in Fauquier, the existence of large estates is a factor retarding milk production. Milk production is limited on the east by the existence of poor soils. The Mason-Tatum group of soils are very low in plant nutrients, and the Chester Soils (Grey Phase) are also of low productivity. The influence is well illustrated by the differences in the numbers of producers along the railroad lines. There are few producers along the southern railroad as long as it runs through the area of the Chester Soils (Grey phase). As it enters the Triassic Lowland the number increases markedly. But it is the small number of dairies in the Coastal Plain area of southern Maryland that presents the major problem in the analysis of location. The area is next to Washington ("at its doorstepe" to use a common expression) and has good communications with the city. Yet there are only 8 producers in Prince Georges County, and one or two in the other counties of Southern Maryland who ship milk into the District.

Most of them (including the U. S. Govt. Dairy farm at Beltsville) are financed by non-farm income. The absence of real dairy-farmers is almost complete.

The explanation is to be found partly in the economic and social conditions in the area and partly in its physical setting. In southern Maryland, agriculture centers round growing tobacco, as it has (centered) since the early settlement of the area. The variety of tobacco grown is an air-cured, thin leaf variety which is prized for its good burning quality. Most of it is used in the manufacture of

cigarettes.[29] The area is characterized by large acreage of land remaining unused- in woods "pasture" or as "idle and fallow". According to the 1945 Census, about half (49 percent) of all farm land in the 5 southern Maryland counties was classified as "cropland". But only 26% was actually used for crops, the remainder was idle or in pasture (much of the pasture is of very poor quality and is pasture only in name).

Fully 2/5 (39%) of all farm land was in woods--a very high percentage, which should not exist under a good system of agriculture. It has been estimated that inthese counties there are 196,000 acres of land readily available for growing tobacco (59, p. 198) yet the area actually planted to tobacco varies between 40,000 and 45,000 acres.

These large acreages of unused land are due mainly to the nature of tobacco culture, and to the system of farming. Tobacco is a very time consuming crop, and a farmer can take care of only a very few acres. According to the estimates of the Maryland Ag. Exp. Station, it takes 309 man-hours of work to grow and prepare for market an acre of tobacco (60, p. 3). One farmer can generally handle between 5 and 7 acres.

Besides their small acreage of tobacco, the farmers raise corn, hay and wheat. Corn and hay are grown for feeding the livestock on the farm, and are considered subsistence crops. Wheat is sold, but the quantities grown are small and wheat is not an important cash crop (tobacco

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[29] Maryland tobacco had been grown for export, mainly to Continental European countries. Till World War I, nearly all of it was exported. After the war, the rapidly expanding cigarette industry began to be an increasingly important customer. The exports declined rapidly after 1927 and the cigarette industry has become the principal user of tobacco. Prices, in recent years, have been very good, because the demand for cigarettes has been booming.

is supreme!).

There are several rotations followed. The ones most common are: a. tobacco followed by wheat and hay; b. tobacco followed by wheat and vetch and c. tobacco followed by two or three years of weed growth. Tobacco is given all the care and fertilization. The other crops are generally not given adequate care. Very little farm machinery is used in growing or preparing tobacco. The work is done with the help of horses and mules, or as in stripping and curing, entirely by hand. About half of the tobacco farmers are tenants. About a quarter of all farmers are negroes. Share-renting is the prevalent system. The turn-over of tenants is quite rapid, which is an important reason for the run-down aspect of the farms and of the area in general.

The present picture is depressing in many respects. The system is wasteful of both natural and human resources. Driving through the area, one is struck with the large proportion of woodland and poor scrub -- land which has reverted to trees (and bushes) after its fertility was exhausted by a few years of tobacco-culture. As mentioned earlier, the area has the worst soil-erosion problem in Maryland. A very large proportion of the farmers have a low standard of living. In Charles County, which can be considered typical of the southern Maryland area, the farm operator family level of living index was 93 in 1945. This was about 1/3 lower than such dominantly dairying counties of Maryland as Frederick (132) and Carroll (135).[30]

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[30] M. J. Hagood: Farm Operator Family Level of Living Indexes for Counties of the United States, 1940 and 1945. U. S. Department of Agriculture, Bureau of Agricultural Economics, Washington, D. C. May 1947 (Mimeographed).

Absolute dependence on a crop whose yields, demand and prices are subject to wide fluctuations is a precarious situation, no matter how one looks at it. If, for instance, the cigarette manufacturers decided not to use this tobacco (or a more economical method of securing the burning quality was discovered) the area would be faced with the task of making some fundamental re-adjustments. Such a possibility may never arise, but it is something that all thinking agricultural leaders have to keep in mind.

The Prospect for Change. A system of diversified crop-and-livestock agriculture is often recommended as a cure for the ills of an area like this. But, so long as the demand for tobacco lasts, and the price is sufficient to maintain a standard of living to which these people are accustomed, a major change in agriculture is unlikely. The prices for tobacco fluctuate more than do those of grains, meat animals or dairy products (Fig. 9) and (33, p. 90-4). But the prices within the last several years have been good, and the tobacco farmers have been satisfied. The Crop and Livestock Graphs (Figs. 4e, 5e, and 6) and annual tobacco acreage statistics show that in the last 25 years or so the emphasis on tobacco has, if anything, increased. Acreages under tobacco have had a tendency to increase. Livestock numbers were declining, till the recent rise in beef cattle numbers.

The present system is backed by a tradition of almost 300 years, and by the attitudes and social and economic institutions that have evolved with it. The tenancy system for instance, has been developed to suit a cash-crop economy. Where a large proportion of the tenants have little equity and in many cases little sense of responsibility, the system works best if the crop is non-perishable, and cannot be consumed in large

quantities (like cotton or tobacco). For a diversified crop-and-livestock agriculture, a new tenancy system, and probably a new type of tenant will be needed.

In all probability there will be no rapid expansion of dairy-farming in the near future. The tobacco farmers will not switch over to a combination tobacco and dairy enterprise for the following reasons:

1. Dairying and tobacco cannot very well be combined together. Both take large amounts of time and demand unreserved attention. Dairy cows have to be milked and cared for regularly. They cannot wait if the farmer is busy with other work. Tobacco has to be planted, replanted, and cured when the weather conditions are just right. The farmer waits for the right weather and when it comes he does not like to spend a large proportion of his time doing other work. Farmers like the Amish with large families and a community spirit, may be able to combine dairying with tobacco but not the average southern Maryland farmer.

2. For getting good quality Maryland tobacco, cow manure must not be used on the field. The pH of the land should be between 5.0 and 5.5 (60, p. 17). Both these conditions are very unfavorable to getting high yields of grasses and grain crops, which require land in a high state of fertility. The farmers will have to have two sets of fields, one for the tobacco rotation and one for the grain and grass rotation. The farmers in the area realize that the demand for, and the higher price paid for their tobacco is due to itsquality, and they jealously guard the quality and its reputation. It is difficult to persuade them to do anything which might affect or might be believed to affect the quality of their tobacco. This increases the difficulties of making any change in the agricultural practices followed.

Most southern Maryland farmers do not seem to be willing to do the work required for dairy-farming. The point is well expressed in

the remark, "You cannot get these people to get up at 4 o'clock in the morning to milk cows, and to work Saturdays, Sundays and everyday in the week!" Dairy farming is no doubt hard work and it is confining. One has to be accustomed to it to be able to do it. These people are not accustomed to it, to be able to do it. These people are not accustomed, and at present there is no incentive to get accustomed.

3. Most of the tenant farmers lack the capital to invest in livestock, and buildings, needed even for producing milk for manufacturing purposes (not to speak of meeting D. C. requirements). The investment must be made by the landlords, and for that a different tenancy system will have to be worked out.

The tobacco farmers cannot be made into fluid milk producers, in a short time. But livestock husbandry can be increased, by inducing them to keep more beef cattle, and dairy cows for producing milk for manufacturing purposes. The investment need for these is much less than for shipping fluid milk, less labor is required, and the farmer does not have to be as specialized. The recent increases in beef cattle and forage crops like Lespedeza, in the southern Maryland Counties is probably an indication that the beginning is being made.

Milk production in the area can also be increased, by an increase in the number of dairy-farms. There is, however, no indication that dairy-farms are increasing. Instead, they appear to be decreasing (if the decline in number of D. C. producers is an indication of the trend). Among the difficulties which dairy-farms producing market milk have to face, three seem to be most important.

1. Soils: The soils of the area are not considered as well adapted to the growing of grains and grasses as the grey-brown soils of the Piedmont. Most of them are sandier than the Piedmont soils, and are more

acidic in re-action. Opinions differ as to the suitability of soils for growing grains and grasses. I have heard both points of view expressed. Some believe that the soils are lighter, and not as suitable as the soils of the Piedmont. Others think that if the soils were properly cared for, they would produce just as well as the Piedmont soils.[31] It appears to me that a factor to consider besides the inherent fertility of the soil, is the condition in which it is now. And in this, there is room for less argument. There is no question, that the present fertility levels of these soils are lower than those of the grey-brown soils of the Piedmont. These soils have been misused by a soil exhausting agriculture, and it will take considerable investment in labor, fertilizers and manure, before they can be brought up to a high state of fertility. They are being so brought up by the Amish people in St. Mary's County,[32] if the requisite amount of effort, and manure and fertilizers are put in, they can be made suitable for grain and forage crops in other areas too.

2. Difficulty of getting labor: Several of the dairy-farms, that are in this area, have to get their dairy-men from outside. They cannot find, among the local people, persons who are willing and capable of doing the work.

3. A few dairy-farms scattered in this area, would have no transportation advantage (to the Washington market) over farms which are

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[31] Of course the different soil types vary as regards their suitability for grains and grasses. The Collington Soils are considered quite suitable for them. The Leonardtown soils, where drained, are also better adapted to these crops than to tobacco. The most expensive soils, however, are of the Sassafras Associations, and arguments concern them, mainly.

[32] County Agent's letter, and conversation with Extension men.

located much farther away, but are in areas of concentrated dairy-farming. The higher cost of hauling the longer distance is offset by the larger volumes available within short distances.

B. The Inner Boundary. The inner boundary of the Milk Shed seems to be formed by distance from Washington. Within the circle drawn at a radius of 10 miles from the capital (map 11), there are only 14 milk producers, and only 25 in the next 5 mile zone. The city seems to exert a repelling influence, which has a tendency to keep the farms at a minimum distance from it.

The principal reasons for this effect, of course, are: increase in population and increase in suburban and "in the country" living. Large areas within the 10 mile circle have been built up, and expansion continues. The houses of the commuters can be seen for long distances on all the principal roads going out of the city.

The farmers near the city are under constant pressure, to leave, go out of business, or move to a new location. Perhaps the greatest factor is the attraction of the high prices at which they can sell the land for residential or other urban uses. Few farmers think they can afford to keep land in farming which is worth several times as much, in non-farm uses. They can sell the farm, and buy another one, at much lower prices farther from the city. These farmers have to compete with the city for labor. Their labor costs are higher, than those of farmers away from the city, because wages in the city are higher than on the farm. They also have difficulty in getting suitable help; because, to the average worker near the city, work on the farm is not as attractive as work in the city. The hours are longer, work is hard, and there are few days off.

Taxes are higher near the city. In Maryland property tax rates in Montgomery and Prince George's Counties, which are next to Washington, are 50 to 60 cents (per $ 100) higher than the rates in the counties in the next tier (from the city). The farmers located within the metropolitan area have to pay 30-40 cents more than the county rates. In Prince George's County farmers located within the suburban area had to pay in 1948-49 $ 2.28 per $ 100, as compared with $ 1.97 for farmers in the rest of the County.[33] These higher tax rates are necessary to provide essential services for the people living in the suburbs. But they do raise the cost of farming in competition with other areas.

C. Location within the Milk Shed: Map 11 has been made to show the approximate location of producers within the milk shed. The map was prepared from the data obtained from the Health Department, and with the help of the Health Department Inspectors, and the County Agents. This map is for interpretation with maps 2, 3, and 4. The railroad lines have been shown on this map, in order to bring out the close relationship between them, and the location of the milk producers.

In Frederick County, the influence of topography and soils on location of producers is very clear. Frederick Valley which has the most favorable topography and the best soils in the County, also has the greatest concentration of milk producers. Middletown Valley similarly stands out although the concentration is not as great. Most of the remaining producers in this County, are in the eastern part. These, and the producers in the adjacent parts of Carroll and Howard Counties are located in the "Eastern Crystalline Rock Upland" on soils of the Chester-Glenelg-Manor Association. A much higher proportion of the dairy-farms

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[33] Information from E. Miller, Department of Agricultural Economics, University of Maryland. Figures are for fiscal year 1948-49.

in this area ship milk to Baltimore, than in Frederick Valley. This is an important reason for the smaller numbers of D. C. producers in this area. Most of the producers are located within short distances of the railroads, or along paved highways.

In Montgomery County, the principal influences are: distance from the city, topography and soils, and the railroad. There are only 3 producers within the 10 mile circle, and about 15 within the next 5 mile zone. The south-eastern and eastern sections of the County have been rapidly occupied by suburban development. Another factor in explaining the small number of producers in this part of the County is the presence of poorer soils (of Manor and of Leonardtown series). Near the Potomac, topography is strongly rolling, and milk producers are few. In the area underlain by the Triassic rocks, in the south-western part of the County also, there are comparatively few producers. The soils in this area are not as productive as the soils of the crystalline upland. (See page 38). Most of the producers in the County are located in the central and western parts of the County, on areas of Chester-Glenelg-Manor soils. A large proportion are within short distance from the railroad. Others are along the important highways.

In Loudoun and Fairfax Counties producers are clustered along most of the length of the railroad from Alexandria to Purcellville.[34] The greatest concentrations are in the central part of the Catoctin Valley and in the Triassic lowland section. Both are areas of favorable topography. The soils of the former (Chester-Myersville) are quite fertile; those of the latter are only of moderate fertility. Most of the producers are within

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[34] This was a line on which freight service only was provided. It has not been in operation for several years now.

5-6 miles of the railroad. The linear pattern of location of producers west of Aldie, should be noted. This is one important group of producers whose pattern of location corresponds to the location of a highway, instead of a railroad.

South of Fairfax County, the railroad seems to be the dominating influence. Most of the producers are located within 2-4 miles of the railroad lines. The soils are of the Penn-Bucks, and Iredell-Mecklenburg Associations in Prince William and Fauquier and northern half of Culpepper County, and of the Davidson series in the southern part of Culpepper and Orange Counties. Two things seem to stand out, as regards the relationship between soils, topography, location of transportation lines, and the location of the milk producers, within the milk shed.

(1) Most of the producers are located in areas of the best soils and/or most favorable topography.

(2) The pattern has been set by the location of the railroads, the modifications since made by the highways have been minor in comparison. Almost all of the producers' milk has been transported by trucks, for the last 20 years. Railroads had ceased to be of importance in transporting milk to this market by the close of the twenties.[35] The close correspondence between the location of railroad lines and of milk producers is a legacy of the past and is one indication that the milk shed has remained relatively stable for a long time.

D. Location - Trends. The number of producers shipping milk into the District of Columbia has changed relatively little during the last 20 years. In 1928, 1557 producers had a permit to ship milk into the

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35. "Whereas approximately 75 per cent of the milk came into Washington by railroad in 1921, it is estimated that 98 per cent of it is brought in by trucks at the present time (1931)". (73, p. 9).

market (Table 15, page 149). The number decreased to a low of 1261 in 1933. Since then it was slowly increased to 1472 in 1948.

Changes in the pattern of location though noticeable, are also not very great. The earliest information that was available about the location of the producers was from the statement (77) prepared by the U. S. Department of Agriculture in 1936 for the formulation of a Federal Order of this market. In this publication, there appears a map giving the number of producers in the counties of the milk shed (77, p. 40). These figures have been used to make map 12. Map 13 was made by plotting the differences in numbers by counties between 1936 and 1948 (figures for the latter year were obtained from the Health Department).

In 1936 there were a little over 1300 producers shipping milk into the District (map shows 1301, Health Department figures show 1305). Except for the 20 producers in West Virginia (19 of them in Jefferson County) the producers were all located in Maryland and Virginia, and the numbers in the two States were almost exactly equal: Maryland - 646, Virginia 645. By 1948 the number of producers in Maryland had increased to 836. But the number in Virginia had decreased to 598. The number in West Virginia had decreased to 16 and about 22 producers in Pennsylvania were shipping into the market.

It appears that the milk producers were more widely scattered in 1936, than they were in 1948. In 1936, there were 35 producers in the Piedmont of Virginia, outside the area which we have called the "milk shed" in this work. "These producers were scattered over a number of counties). By 1948, their number had been reduced to less than 20. The number of producers in the Shenandoah Valley in Virginia decreased from 11 in 1936 to 1 in 1948. The 11 producers in South-western Virginia

had all gone out by 1948. The number of producers in southern Maryland declined from 21 to 10; and in Harford, Cecil and Baltimore Counties (Baltimore milk shed counties) from 31 to 23.

Expansion took place in some directions. Number of producers on the Eastern Shore increased from 6 to 14. In Hagerstown Valley the number increased from 21 to 32, and about 30 producers from Bedford and Somerset Counties, Pennsylvania, and Garrett County, Maryland, came into the market.

Changes within the "Milk Shed". The greatest increase was in Frederick County (from 334 in 1935 to 422 in 1948). Numbers also increased in Montgomery, Carroll and Howard Counties. In Virginia increases were shown for Loudoun and Culpepper Counties, and decreases for the other three counties — Fairfax, Prince William and Fauquier. The most pronounced decrease was in Fairfax County. The principal reason for this seems to be the increasing suburbanization of the County.[36]

These figures though they cover only a short period, and only the District of Columbia, producers, do point out the following two tendencies.(i) A general tendency towards greater concentration in the milk shed, and contraction in the outlying areas, especially in the South,(ii) relative stability, in comparison with the changes that have taken place in the demand of milk in the intervening period.

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[36] The County Agent in Fairfax County was quite perturbed over this trend. He did not seem to like to see farmers going out of business because of pressure from the city.

CHAPTER VI

THE WASHINGTON MILK MARKET

General Remarks about the Character of the Market. The organization and development of an industry like the fluid milk industry, is influenced to a great extent by the character and the development of the city in which it operates. This is particularly true in a city as distinctive as Washington.

Washington has only one industry - Government. The prosperity of the city depends upon a high level of employment in the Federal Government. In recent years, the industry has been expanding rapidly, and so has been the population of the Washington Metropolitan area. The major problem of the business interests in the area has been to expand their facilities (or scale of operations) to meet the increasing demands.

The city is governed by the U. S. Congress. The tussle between the rival political interests in Congress and the mood of the people in the nation as a whole at a particular time are likely to be reflected in the affairs of the city.[37] This is especially true in matters of legislation. A bill which may be vital to the interests of the people living in Washington may be delayed in passage, because the Congressmen are not so interested in it and because the necessary support from all the groups within the Congress cannot be secured.

In a city, with its own government, legislation is often sponsored by local interested groups. Legislation affecting Washington may be sponsored by national interested groups. These characteristics of the city are reflected in the history of the market milk industry. The industry has a remarkable record of freedom from any violent friction or dis-

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[37] If the people in the nation are excited about a certain problem (say the price of used cars) the city is ideal for holding a Congressional hearing on the subject.

orders like strikes, for over twenty-five years. This period includes the depression period of the thirties when prices were dropping to the bottom and strife between producers and distributors was everywhere. The prices in the Washington market remained much more stable than they did in most large markets in the country. One of the major reasons for this stability and relative peace was the fact that the demand was rapidly expanding. Between 1930 and 1940, the population of Metropolitan Washington increased almost 50 per cent (from 621,000 in 1930 to 908,000 in 1940). Between 1940 and 1947, the increase again amounted to approximately 33 per cent (1,205,200 in 1947). Total milk handled in the market increased almost in the same proportion - from 201,846,000 pounds in 1930 (73, Table VIII) to 432,788,000 pounds in 1946 (67, Jan. 1947). The big problem in recent years has been to supply all the milk that is demanded. With the beginning of World War II, and the sudden expansion of Governmental activity, the population of the city increased from 908,000 in 1940 to approximately 1,215,000 in 1942. The milk producers supplying the market could not increase their production enough to be able to supply all the demand, especially as the increase in demand came when farm labor was getting scarcer every day. It was found necessary to import "emergency" (produced on farms not inspected by the D. C. Health Department) milk and cream. The emergency supplies continue, but local producers have increased production to such an extent that they will not be needed much longer.

The Act, under which the D. C. Health Department has formulated and enforced its regulations, was passed in 1925. There has been only one amendment of the Act since then. Things change with time and many of the regulations are out of date. Yet, the chances of securing amendments to suit the welfare of people living in Washington are much smaller than in any other city.

Attempts to get the Act amended come mainly from interested groups. Two examples will illustrate the point. In 1939 Rep. Schulte (Indiana) introduced a number of bills to amend the Act. The principal purpose of these bills was to allow cream for fluid consumption to be brought into the District, from any source which produced Grade 'A' milk according to the U. S. Public Health Service rating. Under present regulations milk for fluid cream has to meet the same Health Department regulations as milk for use as fluid milk. If the bill was passed, fluid cream could come from any area in the country, provided the milk from which it was made was Grade 'A' milk. The protection which the local producer enjoys in fluid cream marketing would, in that case, have been lost. (Fluid cream sales represented, in terms of fluid milk equivalents, about one-fifth of all milk handled in the market in 1945). There was vehement protest against the bill which was, of course, led by the local producer interests (the Association).

Recently (January 1949) Rep. Murray (Wisconsin) introduced a bill which authorized dairy plants in the District to bring and sell within the District, Grade 'A' milk and cream from any state in the United States.[38] It also authorizes the sale of reconstituted milk as "bottled milk". The bill has been referred to the Committee on the District of Columbia, for the present.

The bill, if passed, (which is very unlikely) will throw the market open to shipments of Grade 'A' milk from any place in the United States. It will strike at the root of the authority of the Health Department, and affect the structure of the market fundamentally. It will eliminate the protection enjoyed behind Health Regulations. There can be no doubt that, should there be the slightest likelihood of its being passed, the local producers will muster all their strength to oppose it.

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[38] 81st Congress, 1st Session. H. R. 1555, In the House of Representatives, January 17, 1949.

Constituents of the Market. After these introductory remarks about the peculiarities of the market, we can turn to its actual description. The market has two major constituents.

1. The Maryland and Virginia Milk Producers' Association, Inc.
2. The Distributors.

The Maryland and Virginia Milk Producers' Association, Inc., is a non-profit co-operative organization of the milk producers shipping milk into the Washington market. The larger proportion (over 80 per cent) of its members have permits to ship milk into the District of Columbia; the remainder ship to the dairies in the suburban area. Members of the Association represent about 87 per cent of the D. C. producers, and 89 per cent of all the producers in the Metropolitan Washington market.

The Association was first organized in 1904 as the "Milk Producers' Association of Maryland Virginia and District of Columbia". The principal aim of this Association was to secure better prices for the producers' milk by representation to, and conference with the distributors. It did not handle any milk, nor had any powers to act as a bargaining agency.

The Association was organized as a marketing organization, under its present name, in 1920. It was at first incorporated as a non-profit co-operative under the General Corporation Laws of Maryland, and later converted into a Co-operative Association in 1923.

The early history of the Association is marked by unfriendly relations with the distributors, and a struggle to find (and know) its place in the market. Soon after it was organized, the Association got interested in handling surplus milk.[39] The members and the officers were

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[39] the word is used here in the sense of milk which is not needed for fluid uses, and has to be disposed of in manufacturing.

not satisfied with the prices the dealers were paying them for the surplus. A plant was leased in August 1921, and one month later the members were directed to send one third of their milk to the surplus plant. The dealers felt that the Association was trying to encroach on their field and refused to buy any milk from a number of the members.

The result was that all the milk of the members had to be diverted to the surplus plant. The daily losses of converting this milk into cream for manufacturing purposes were very heavy, and producers began to go back to the distributors. After three weeks, the Association officers expressed their inability to accept any more milk from the members, and advised them to find their own market. The Association had lost the strike.

A new effort was made to organize on a more firm basis. A new contract, which was much more binding on the members than the old one had been, was drawn up. Members were signed up on it, on condition that the new contract would not come into force until the Association controlled 85 per cent of the milk coming into the market. This percentage was reached and the contract came into force in October 1923. Opposition by the dealers continued. The Association members had to pay heavy brokerage fees (up to 4 cents per gallon) to handle all the surplus milk, but this time they weathered the storm. On April 1, 1927, a contract was signed with the dealers, by which the dealers agreed to handle all the surplus. The Association then closed its surplus plants and later disposed of them.

This early history of struggle and antagonism between the Association and the distributors showed both parties their strength and weaknesses. If the dealers did not like the Producers' Association, they could not kill it. The Association lost the strike, but survived. On the other hand, the Association officers learned that they could not

handle milk themselves, and had better leave this part of the job to the dealers.

The Association has since been successful in bargaining without a head-on disagreement for over 20 years. In this period, it claims that it has been able to pay its producers for all the marketable milk that they have shipped.

Each member of the Association signs a contract which remains in force for 3 years, and is automatically renewed every year, unless terminated by either party. The member agrees to sell all milk produced by him through the Association, retaining only the quantity needed for consumption on the farm. He also agrees to pay the Association a brokerage fee of 1 cent per gallon or 11.6 cents per cwt. ($\frac{1}{2}$ cent per gallon for producers shipping to the receiving station at Frederick, Maryland.) The Association, in turn, guarantees sale of, and payment at market prices on all marketable milk shipped by the producer. Thus, if a distributor refuses to buy a producer's milk or goes insolvent or the milk cannot be marketed for some reason, the Association pays the producer for the milk. It claims that it has always been able to fulfill this term of the contract.

The Association is financed by the brokerage fee. Working expenses take 25 to 30 per cent (sometimes more) of the fee. The remainder goes into a revolving fund which, in 1947, amounted to $1,333,000. Each member is paid back the unexpended portion of the brokerage paid by him, at the end of six years.

The purpose of the Reserve Fund is to enable the Association to fulfill its guarantee, and to allow it to meet any contingency that may arise. It also gives it greater bargaining power, because there is something to fall back upon.

Besides marketing the members' milk, the Association has the following important functions:

a. It buys and sells equipment and supplies co-operatively.

b. It has field men (6 of them at present) who keep in constant touch with the producers and try to help them with their problems. If a producer wants to remodel an old building or build a new one, the field man advises him with plans, specifications, and the requirements to be met. If he is having trouble with the Health Department (too high bacterial count, for instance) or with the distributor, the field man tries to help him remove the cause of the trouble. In this role, they are Association's extension men.[40]

But they also serve as a vital link between the Association officers and the members. They keep the members informed about the current policies, and help maintain their confidence and faith in the Association. At the other end, they keep the officers informed about the way, the members are thinking.

c. Since February 1935, the Association collects all money from the sale of milk and pays the producers from its own office. Thus all the members of the Association are part of a pool.

d. It arranges for the transportation of milk and pays the truckers' freight charges. These are deducted from the producer's milk cheque.

e. It has a monthly organ called "Market News" which is used to publish current prices, market trends, feed situation and other items of interest. It is also a convenient medium to air the current official policy.

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[40] It appears that the Washington producer is over-advised, and over-scrutinized than otherwise. First, there are the Inspectors of the Health Departments. The Association has its field men. Some of the distributors have their own field inspectors. If the cream from the producer's milk is sold in Pennsylvania, inspection from that state is additional to all these.

f. It fights for keeping the price levels in the market as favorable to its members as possible and for the preservation of its eminent position in the market. From the foregoing description of the Washington market it is clear that an Association which represents over four-fifths of the producers in the market would not spare any efforts to make sure that the present protection which its member-producers enjoy in the market is maintained. The passage of a bill like Representative Murray's would be of tremendous consequence to its members. It would take away the protection they have and would render their heavy investments in buildings and equipment largely unnecessary. The Association must make sure that such bills do not get very far. By virtue of the fact that it represents more than 80 per cent of the producers in the market, it is in a position to ask for the introduction and termination of a Milk Marketing Agreement and Control Order whenever it feels that such an order is necessary to get a higher price, or to keep the market under control. Such orders have operated in the market from September 1936 to February 1937 and again from February 1940 to April 1947 - both times at the Association's request. The former was terminated when its legal basis - the AAA - was declared unconstitutional; the latter was terminated when the Association felt it was no longer necessary. The Association has a democratic constitution, and an elected Board of Directors. But the most important man is the paid Manager or Secretary-Treasurer, who does most of the work. He is, in this case, the Chief Executive.

There are nine dairies which hold permits to distribute milk in the District of Columbia. They distribute milk both in the District and in the Metropolitan area. With the exception of one, which is located near Olney, Maryland (about 13 miles from the D. C. line) they are all located in the District. We have mentioned before, that there are

three dairies in the Metropolitan area, which sell all their milk outside the District. One of them, located in Alexandria, distributes milk in Alexandria City, and the other parts of the Metropolitan area in Virginia. The other two are located in Maryland and distribute milk in Maryland. Besides these dairies, there are four producer-distributors (farmers who sell their own milk). Two distribute milk in the District and two in the suburban areas.

The producer-distributors are very small, and the proportion of milk sold by them (less than 1 per cent of the total sales in the market) is so small as to be insignificant. They have never been of much importance in the market, and have been steadily losing ground. In 1936, there were 14 producer-distributors within the District alone (77, p. 54). Today, there are only two. The producer-distributors do not seem to be able to withstand the competition of the larger dairies.

There are important differences among the dairies in size, age ownership and sales outlets. The largest and the oldest traces its origin to more than a hundred years ago, but the majority of them have not been in operation for more than twenty or twenty-five years. Most of them are owned by local corporations or individuals (some are family enterprises). Two of the largest, however, form part of national organizations. Most of them distribute milk in both wholesale and retail. Others sell all their milk in wholesale. Eight of them buy milk from the Association. The other four (called "Independents") buy from other sources - from producers who are not members of the Association and since 1942, from "emergency sources".

Two dairies have a receiving station each. The larger and the older station is located at Frederick, Maryland. Producers located in Frederick County and adjacent areas ship their milk to this station. The other station is at Cumberland, Maryland. We have mentioned above

that this station belongs to one of the "Independent" dairies and that the producers are located in Bedford and Somerset Counties, Pennsylvania and Garrett County, Maryland.

Before truck transportation became important, receiving stations were vital to the milk supply of a large city. The farmers took their milk a short distance (5-10 miles) to the receiving stations, where it was cooled, and transported to the city. With the increased use of truck transportation, they have lost much of their importance, because more and more milk is hauled direct to the city. However, even in a market like Washington, where all the milk is hauled by trucks, receiving stations perform a useful function by reducing transportation costs. The Frederick station, for instance, serves not only as a receiving station, but also as a plant for separating cream and for handling the market "surplus". The dairy which owns this plant tries to manufacture all the fluid cream they need at Frederick. It brings the cream to the market, instead of bringing milk and separating it in their plant at Washington. It also handles all the "surplus" for the Association. The "surplus" is separated into 40 per cent cream which is sold to ice cream manufacturers or other buyers. The skim milk is manufactured into powdered skim milk. The receiving station differential (difference between the price paid to farmers shipping direct to Washington and those delivering at Frederick) is 18 cents per cwt. This difference is less than the cost of hauling the milk from Frederick to Washington. But the distributor can afford this, because only a part of the milk is actually transported to the city.

The principal products sold by the dairies are: fluid milk, milk drinks, fluid cream and cottage cheese. Some dairies sell butter, cheese, eggs, besides these fresh-milk-products. Some dairies have only one brand of fluid milk; others have two or three. A populer brand with butter fat content between 3.6 and 3.8 per cent (a little higher than the

3.5 per cent required by the law); a brand with butter fat content around 4.0 per cent which may be given some fancy name as "Hi-Test" or "Cream Top", and homogenized milk, with or without vitamin D, are the most common brands. The milk drinks are: chocolate drink, butter milk and skim milk. Cream is sold in two concentrations: table cream with butter fat content of 20 per cent and whipping cream with butter fat between 35 and 40 per cent. A considerable proportion of the cream is made from "daily surplus".

In the Washington market, wholesale sales (sales to eating establishments, institutions, hotels, bakeries, etc. and sales through stores) are much greater in volume than retail (house to house delivery) sales. In 1946, three-fifths of the fluid milk and about four-fifths of the fluid cream was sold in wholesale. Popularity of store sales; the large numbers of people who eat one or more of their meals out, and the existence of a number of Government institutions, in and around Washington (the various Military Bases, for instance) seem to be the principal reasons for the importance of wholesale sales.

The "Independents". The four dairies who do not buy milk from the Association are called "Independents". They buy their supplies from about 200 local producers, the majority of which are located in Maryland,[41] and from "emergency sources". The principal role of the "Independents" is to provide competition to the Association and to prevent the market from becoming an absolute monopoly. The competition provided by them was quite keen before the introduction of the Federal Order in 1940. The order was requested by the Association, primarily to eliminate this competition. One of the "Independents" is a large dairy. The other three are comparatively small.

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[41] The hold of the Association is stronger in Virginia than in Maryland.

B. Regulation : The Job of the Health Departments in the City. In order to insure that milk reaches the consumer as safe and wholesome milk, regulation by the Health Departments is as necessary in the city as it is at the farm. This part of the job is not as expensive as inspection on the farms, because only a few dairies have to be inspected. But the inspection has to be more frequent, (D. C. dairies are inspected once a week or oftener) and greater vigilence is necessary. One of the big problems is to make sure that only milk and cream from approved sources are used by the dairies. Each can of milk (or cream), therefore, has to have on it the name of the producer or the source of origin. The receiving stations have to post a list of all the producers delivering to them and are inspected like the other dairies.

The regulations of the D. C. Health Department are just as specific about conditions to be maintained in processing and distribution as they are about conditions in production and transportation of milk. The dairies are scored on a score card (Appendix B.2) which is as comprehensive and as detailed as the Dairy Farm Score Card. The major items covered in this case also are: surroundings, construction, equipment, sterilization of equipment, processing, water supply, health of employees and transportation of processed milk. Samples of milk are taken at all stages of processing once a month, and analyzed for total bacterial count, butter-fat content and total solids content. Samples are also collected from the vehicles. This testing is necessary - to insure that the product is safe and unadulterated, as it reaches the consumer, and also because the Congressional Act specifies the maximum bacterial count and minimum butter fat and total solids contents.

At the present time, the Health Departments are the only regulatory agencies in the District and the Maryland part of the Metropolitan area. In the Virginia part, there is also the Virginia State Milk Com-

mission which fixes minimum prices to be paid producers and minimum resale prices. The only dairy affected, buys milk from the Association and, at present, there is no difference between the prices received by the Association in the District, and the prices fixed by the Virginia Milk Commission.

C. Some Distinctive Features of the Marketing of Milk

The problems connected with marketing milk for distribution in urban markets are in many ways different from those of marketing any other commodity. The product is extremely perishable, not only because it cannot be stored for more than a few days, but also because neither the producers nor the distributors have the facilities to store more than two or three days' supply. The product has to be kept moving, from the farm to the consumer, without interruption. Any interruption causes great losses to the producers and the distributors, and serious hardships to the consuming public.

The distributor must make arrangements for relatively long periods (some months) to obtain a minimum quantity of milk daily. He must be reasonably sure of the quality of the milk and of the price he will have to pay for it. Otherwise he cannot very well satisfy his customers, who desire uniform quality, stable price and certainty of supply. The producer at the other end must be sure that his milk will be sold, and of the approximate price that he will get for it.

These are some of the reasons why the producers and distributors have contracts lasting over relatively long periods, and why the price of milk is not determined by bidding on the open market every day.

The distributors may make their arrangements with individual producers or with producers' bargaining co-operatives. In most markets in this country, a proportion large or small, of the producers are organised into co-operatives.

Negotiations between the distributors and the producers' co-operatives are in the nature of collective bargaining, and are similar

to those between management and unions. As in the case of the latter, the consumer has no direct voice in them.

Economic reasoning is used in these negotiations, but the decisions reached are not always governed by it. Possibilities of securing agreement and of keeping the market stable are considerations even more important than economic reasoning. The point will be clear from the discussion under Classified Use Plan.

The Base Surplus Plan. The plan is, in its essence, a system of fixing quotas. Each producer is allotted a certain quantity of milk which is paid for at the basic (high) price. All shipments above the allotted base are called "surplus" and are paid for at a lower price.[42]

In most markets the shipments are divided into only two categories; in others there may be more. The surplus may be divided into two classes, or the producer may have two bases, one on fluid milk and the other on fluid cream.

The principal purpose of the plan is to reduce seasonal fluctuation in milk production and thus reduce the burden of handling large quantities of market surplus during the flush season. The base of a producer is generally fixed as a certain percentage of his shipments in the months of low production. The producer with relatively even production gets a higher average price for his milk than one with a large seasonal variation, because a higher proportion of the former's milk is paid for at the basic price. This incentive to more even production is necessary in view of the efforts and expenses required for maintaining even production.

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[42] The word "surplus" is used to mean two different things. To the producer "surplus" is milk above his "base". In the market "surplus" is milk which cannot be sold in fluid uses and has to be converted into manufacturing uses.

The most difficult part of the plan is the allotment of bases and there is almost infinite variation in the ways in which they are allotted. The period used for fixing bases varies all the way from one month in some markets to a full year in others. Bases are computed at times, on shipments in a single season, at others on average shipments of two or more years. In the Washington market, October, November and December were the months used. Bases were frequently adjusted (mostly once a year, sometimes oftener).[43] The proportion of the producer's fall shipment that was fixed as his base varied with the sales of fluid milk. During most of the time, the proportion was between 80 and 90 per cent. The new producers had to serve a probation period, in which their bases were very low (30-50 per cent of fall shipments). The probation period was one year most of the time, but for some time it was two years.

The Classified Use Plan. The principle of the Classified Use Plan is that the distributor does not pay the same price for all the milk he buys, but different prices, depending upon the use to which milk is put. As in the Base-Surplus Plan, there are innumerable variations in the details of the plans adopted in the different markets. The number of classes into which milk is divided; the differentials in prices of different classes; the methods of calculating the prices of different classes — all vary from market to market. In general, we could say that milk sold as fluid milk (called Class I milk) is paid for at the highest price, and milk converted into manufactured products at the lowest prices. Milk used for fluid cream, milk drinks and cottage cheese is classified in different ways.

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[43] During a period of 18 years of operation (1924-1942) of the Plan, bases were adjusted twenty-two times.

The plan has logical bases. All the milk that comes into the market cannot be sold as fluid milk. Some is used for fluid cream, milk drinks, cottage cheese and the remainder has to be used for manufacturing purposes. The cost of hauling fluid milk is four to five times higher than that of hauling its equivalent in 20 per cent cream, and twenty to twenty-five times higher than its equivalent in butter. Milk for manufacture into products does not have to meet the sanitary regulations that milk for fluid uses has to meet. In many markets regulations for fluid cream are also much lower than for fluid milk. Accordingly, milk for fluid uses commands the highest (Class I) price, that used for fluid cream is sold at a lower price in most markets, and that used for manufacturing gets the lowest price.

But the actual classification and class prices, prevailing at any particular time, are not always strictly logical. In the Washington market, fluid cream has to be produced under the same sanitary regulations as fluid milk. Most of the dairies separate cream in their plants in Washington. One dairy separates it at its receiving station at Frederick, and hauls the cream to Washington. The only differential that can be justified in the price of milk for the two uses is the small difference in freight between hauling milk and cream from Frederick to Washington.

Yet much of the time in recent years, milk for fluid cream has been priced lower than that used as fluid milk.[44] The argument is that cream is a luxury, whereas milk is a necessity. What is really meant is, that the demand for fluid cream is more elastic than that for fluid

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[44] It has been classified with fluid milk, with manufacturing cream and separately as Class II.

milk. Hence if milk for fluid cream was priced higher, cream prices would rise, sales would decline, a higher proportion of the producer's milk would go into manufacturing uses and he would receive an even lower average price.

The question of classifying milk used in milk drinks is another one on which no conclusive answer can be given. Both the producers and the distributors have their arguments and there is a certain amount of truth in both. Milk used in milk drinks has been shifted around from Class I to Class II to Class III, the classification depending upon where the contracting parties could agree at the time.

The history of the market is full of illustrations of prices being fixed, where the two parties could agree, and not on a basis of economic justification. Prior to February 1, 1935, the receiving station differential was 46 cents. It was reduced to 40 cents on that date, and by September 1936, it had been reduced to 25 cents.[45] It is obvious that this reduction was not made because of any radical reductions in transportation costs. We have already seen that the butter-fat differentials and premiums are largely a matter of convention, and do not vary with variations in costs of making a higher score or producing richer milk. Even in Class I price, the element of bargaining is fairly strong. The Association uses certain indices as guides, but as far as I know no "cost of production survey" has been published for the milk sheet and it is probable that an adequate survey has never been made.

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[45] Maryland-Virginia Milk Producers' Assn. The Washington Milk Market. January 1938.

TABLE 15.

TRENDS IN THE WASHINGTON MILK MARKET

Year	Number of Producers Shipping to D. C.	Number of cows in their herds	Number of cows per herd	Number of Association Members	Number of cows in their herds (approx.)
1929	1456	30,587	21.0	973	*
1930	1340	30,574	22.8	1019	25,000
1931	1341	32,584	24.3	1224	28,500
1932	1295	32,708	25.3	1196	29,000
1933	1261	33,087	26.3	1144	28,500
1934	1280	34,522	27.0	1133	29,500
1935	1302	36,200	27.8	1144	31,000
1936	1305	36,202	27.7	1114	30,000
1937	1303	37,651	29.0	1137	32,000
1938	1318	38,120	28.9	1156	33,500
1939	1315	40,208	30.6	1186	34,500
1940	1362	41,814	30.7	1262	37,000
1941	1426	47,037	33.0	1313	39,000
1942	1455	49,758	34.2	1370	42,000
1943	1461	50,115	34.3	1387	47,000
1944	1362	47,082	34.6	1392	47,000
1945	1404	49,280	35.1	1360	46,000
1946	1400	52,000	37.1	1456	50,720
1947	1470	53,020	36.7	1530	52,020
1948	1472	53,408	36.2	1560	54,500

* Not Available

Milk Deliveries per day, Association Members (Gallons)	Production per cow, per day. (Gallons)	Deliveries per member, per day. (Gallons)	Total Milk Shipped by producers, per day. (Gallons)	Price of Milk per cwt.
41,839	*	43.0	64,758	3.86
47,395	1.9	46.5	65,855	3.77
60,095	2.1	49.1	66,611	3.45
60,374	2.1	50.5	70,876	3.03
56,833	2.0	49.7	74,610	2.84
58,613	2.0	51.7	75,715	2.82
59,938	1.9	52.4	75,903	2.93
61 ,042	2.0	54.8	78,031	2.98
64,963	2.0	57.1	84,012	3.21
67,144	2.0	58.1	90,351	2.93
68,950	2.0	58.1	88,665	2.85
76,910	2.1	60.9	94,976	2.94
92,518	2.4	70.5	111,201	3.15
101,461	2.4	74.1	123,320	3.71
97,431	2.1	70.2	102,127	4.32
107,477	2.3	73.4	117,925	4.95
109,336	2.4	79.9	127,145	4.95
113,124	2.2	80.7	*	5.12
124,736	2.4	83.0	*	5.78
128,541	2.4	82.4	*	6.13

D. Recent Trends in the Washington Market

Table 15 has been designed to show, in summary form, the major trends in the Washington market, in the last twenty years.[46] It is apparent from the table that the dominant trend is one of expansion. Due to the rapid increase in population in the Metropolitan Area, the quantity of milk handled in the market more than doubled between 1929 and 1945. Part of the milk in the latter year was "emergency milk" not produced by local producers. But even receipts from local producers almost doubled from 64,758 gallons per day in 1929 to 127,150 gallons per day in 1945. Yet the number of producers in the market increased only from 1456 to 1608 (78,p.70). The membership of the Association increased from 973 to 1360. But the deliveries by the members increased from 41,840 gallons per day to 113,124 gallons of milk per day -- an increase of 170 per cent compared with a 40 per cent increase in membership. The increase in demand has been met largely by expansion of production by the producers already in the market. Average deliveries per member of the Association increased from 43.0 gallons in 1929 to 79.9 gallons in 1945. This increase has taken place partly by increased production per cow. But addition to herds has been an even more important factor. The figures about the number of cows in Association members' herds are only approximate. Hence the D.C. producers' figures

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[46] The table is not what it should be, because certain statistics are not available. The total volume of milk shipped into the market could not be obtained after 1946. The shipments by District producers are not available separately, hence the Association figures had to be used. On the other hand, the Association's figures on numbers of cows are only approximate, and D.C. figures had to be used.

have been used. The number of cows per D.C. producer increased from 21.0 in 1929 to 35.1 in 1945.

In other words, even in spite of the increased demand in the market, large numbers of new producers have not been able to enter the market. This, in spite of the fact, that since 1942, a deficit has existed in the market, and emergency supplies have been necessary. These emergency supplies have come almost entirely from plants.[47]

Emergency supplies became necessary because the increase in the population of the area was so rapid between 1940 and 1942, that the local producers could not increase their production enough to meet all the demand. The fluid milk equivalents of the emergency supplies are shown along with receipts from local producers in Fig. 15.

The emergency receipts increased from about 1.5 million pounds (milk equivalent) in July 1942 to a peak of over 10 million pounds per month in the fall and winter of 1945-46. In the latter months, 25-30 per cent of the total receipts in the market, came from emergency sources. This was also the period in which the market had the worst milk shortage in recent years.

Wide seasonal fluctuations in receipts from local producers (Fig. 10) was the principal reason for this shortage. Fluctuations in emergency receipts were also due mainly to fluctuations in receipts from local producers, as the former made up the deficiency in the market. As mentioned in Chapter IV, removal of the incentive to even production provided by the Base-Surplus Plan was the main reason why production became so uneven. Most of the emergency receipts were fluid milk and

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[47] The data compiled by the P.M.A. (78,p.70-5) show that until Nov. 1945 all the receipts were obtained from plants. Beginning Nov. 1945 small amounts were received from local producers, not having a regular permit from the Health Departments.

fluid cream. The bulk of the fluid milk receipts were from Maryland, Pennsylvania, and Delaware -- states close to the market. In 1944 and 1945, when the imports were very high, over 90 per cent of the fluid milk receipts were from those three states. (78,p.71-6) The fluid cream came mostly from the mid-western dairy states. Maryland was also an important supplier. This is, of course, what we expect in view of the differences in transportation costs on fluid milk and its equivalent in fluid cream.

If this period can give an indication of the possible effect on the market's milk supply, if the sanitary regulations were relaxed, it would appear, that the bulk of the fluid milk will continue to come from the nearby states, and that a considerable quantity of the fluid cream will come from the mid-western dairy states. However, we should be cautious about interpretation, because this was an abnormal period.

Since the Spring of 1946, the emergency receipts have been steadily declining, because the local producers have increased their own production. The Association bought 11,000 to 16,000 gallons a day in the years 1943-47 (excepting 1946, when 25,000 gallons were bought). In 1948, they bought only 3,000 gallons a day.

With the onset of the depression, the price of milk declined rapidly. The weighted average price for milk for the country as a whole declined from $2.57 per cwt. in 1929 to $1.28 per cwt. in 1932. Prices in the Washington market declined much less. The average blended prices received by Association members decreased from $3.80 in April 1929 to $3.28 in April 1932 -- a 14 per cent decrease. But the break came in May and the blended price dropped to $2.73 per cwt. -- a decline of about 30 per cent from 1929 prices, compared with 50 per cent for the country as a whole.

Prices began to rise only after 1939, slowly at first, but rapidly after 1941. Part of the rapid rise in blended price in the period 1940-42 was due to the elimination of the surplus. The peak in prices was reached in 1948 when the blended price received by Association members was about $6.20 per cwt. This represented an increase of 110 per cent from the blended price of $2.94 in 1940. The prices have since declined about 60 cents per cwt.

An important development in the market was the introduction of the Milk Marketing Agreement and Order in February 1940. The Order was introduced at the request of the Association. At that time, the Association was finding it difficult to maintain its prices, because the "Independent" dairies could buy milk from non-member producers at much lower rates (6-7 cents per gallon less). The Association, therefore, requested for the Order, in order to require all dealers to pay the same prices. The motive of the Association is very clear from the Brief they presented, while requesting for the order (69,p. 2).

As the Association represents more than 60 per cent of the producers in the market, the Order was put in.[48] A Market Administrator was appointed, and the prices fixed by him were almost the same (Class I price was the same) as those being charged by the Association. The Association, thus succeeded in getting Government help to keep down competition. Its share of the fluid sales in the market, had been around 75 per cent from 1933-39. In 1940, it increased to 80.4 per cent. By 1942 it increased to 86 per cent.

The market was under the Order for seven years from February 1940 to March 1947. The Order included the District and Maryland part of

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[48] According to the Agricultural marketing Act of 1937, an order can be put in, if 60 per cent or more of the producers request for it.

the Metropolitan Area. After Nov. 1945 it included the Virginia part also. The Order was amended six times. Most of the amendments were made to grant the producers price increases, which were necessary in view of the rising price-levels in that period. The Order was terminated, beginning April 1, 1947, because the Association did not feel it was necessary any longer.

E. Concluding Remarks

The dairy farms supplying this market are large, and the average size has been increasing. This is a protected market; the protection being afforded by the strict sanitary regulations. Partly because of the large investment needed to comply with the regulations, and partly due to the policies followed by those already in the market, the small farmers have been discouraged from entering the market. The present stringency of the regulations, however, does not seem to be absolutely necessary. The regulations should be amended so as to allow farmers with less capital to be able to ship milk into the market. Such amendment will not have harmful effect on the health of the people. (Seven years of emergency receipts do not appear to have had any harmful effects.)

The producers are organized into a powerful Association. The Association has been able to get good prices for its members and has also succeeded in eliminating miscellaneous deductions, and other irregularities which reduce the producer's net receipts. Most of the producer's milk is at present being used for fluid uses and the prices are quite satisfactory to them.

The market has been expanding and prices have been good. If normal peace-time conditions continue, the population of the Washington Metropolitan Area will probably continue to increase slowly. The industry, can in that case, look forward to the present level of demand being maintained, or slowly raised.

As construction and equipment costs go down, it is probable that new dairy barns will be built, and the number of producers in the market will increase. Whether it will increase sufficiently to cause stiff competition and price cutting in the market, it is not possible to say.

The "emergency receipts" have continued so far. The production of local producers will probably increase this year so much as to render such imports largely unnecessary. Will these receipts continue and become a permanent feature of the market or will they be discontinued? The Health Department's decision, one way or the other, will arouse protest.

If the District continues to be governed by Congress, it is not likely that the Health Department Regulations will be so modified, in the near future, as to make Washington an open market for the imports of even Grade 'A' milk and cream, from any part of the country. When such an amendment does take place (if it ever does) the effects on the market will depend on the conditions at the time. It is not necessary to say anything about them here.

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APPENDIX

CROP AND ANIMAL UNITS

Crops		Units
Corn	Bushel	0.98
Wheat	"	1.50
Oats	"	0.52
Barley	"	0.77
Tobacco	Pound	0.23
Alfalfa hay	Ton	20
Other hays	"	14

Animals	Animal Units
1 Dairy Cow:	1.1 unit in 1910 and 1920; 1.2 in 1930, 1940 and 1945.
Other cattle:	0.6 units
Calves:	0.5 units
Horse or Mule:	1.0 units
Swine (all ages):	1/4 units
Sheep:	1/7 units
Chicken:	1/100 units in 1910, 1/60 in 1920, '30, '40 and '45.