

**A statistical study of the relation of pellagra to use of certain foods and to location of domicile in six selected industrial communities / J.F. Siler, P.E. Garrison and W.J. MacNeal.**

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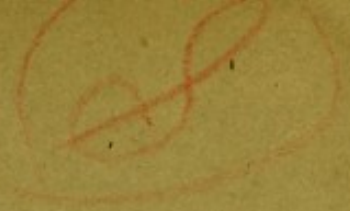
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Pellagra 2



A Statistical Study of the Relation of Pellagra  
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NEW YORK

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A STATISTICAL STUDY OF THE RELATION OF  
PELLAGRA TO USE OF CERTAIN FOODS  
AND TO LOCATION OF DOMICILE IN  
SIX SELECTED INDUSTRIAL  
COMMUNITIES \*

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Our most intensive epidemiologic studies have been carried out in six cotton-mill villages in Spartanburg County, S. C., selected as fairly representative of the many mill villages in that part of the country. In each of these villages the family of each operative was visited at his home and a complete record was taken on a uniform printed card, of the location of the house, the sex, age, relationship, occupation, period of present residence and association with pellagra, of each inhabitant. On the reverse side of the same card was recorded the frequency of use of certain important elements of the diet and the condition of the house in respect to screening and general condition.

Whenever a case of pellagra was found, the usual complete history of the individual was taken, and this included a record of the previous residences of the individual, the time of the first attack and a very complete record of his diet. These records make possible statistical studies of the distribution of pellagra in these populations to ascertain its correlation with various other things, as, for example, age, sex, occupation, use of particular foods, location of the domicile or sanitary condition of the home. They seem to us to be of peculiar value for the study of the influence of foods on pellagra and for an inquiry as to the possible bearing which location of domicile may have in the causation of this disease. In the present paper we purpose to present, first, a study of the relation of pellagra to certain foods, and second, a study of the relation between the domicile of existing cases of pellagra and the domicile of the new cases which originated in

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these villages. The two studies have been carried out by much the same method, and because of their interrelationships and the sharp contrast in their results, it has been thought best to present them in a single contribution.

THE RELATION OF PELLAGRA TO THE USE OF  
PARTICULAR FOODS

In view of the apparent importance of nutrition as an etiological factor in pellagra, and because of the confident belief of many authorities that the disease is due to deficiency in diet, either general or special, or that it is a specific food intoxication, we have undertaken a careful investigation of the dietary habits, not only of pellagrins and their families, but also of all the remaining population of the same class living under the same conditions, in certain selected

[illegible]

Fig. 1.—Census card used in the house-to-house canvas.

industrial communities. Approximately five thousand persons have been included in these studies. The facts were ascertained for each family by personal interview with a member of the family, usually the housewife. We recorded the diet served in the family as a whole, and each member of the household is considered as belonging to the dietary group of his family. For each pellagrin, the individual diet was recorded in detail, but for the comparative study which we present in this section, each of these persons is considered as belonging to the dietary group of his family, not only because this makes them strictly comparable to the other individuals, but also because the individual peculiarities in the diet of pellagrins, particularly the omission of corn from the diet, may often be regarded as secondary to the development of the disease.



In obtaining the data a uniform printed card was used and the record was made concerning the frequency of the use of shipped corn-meal, locally grown corn-meal, and the quality of the meal used; concerning the use of grits, corn-sirup, corn whisky, wheat flour, fresh

Name .....	Locality .....
House No. ....	Street .....
Corn Products Used : Corn meal, grits, syrup, whiskey.	
Source of Supply of Meal :	
Exclusively, mostly, rarely, never.	
Shipped and ground in nearby State .....	
Local corn, ground locally .....	
Use of Corn Products :	
Daily, habitually, rarely, never.	
Corn meal .....	
Hominy or grits .....	
Character of Meal :	
Shipped meal .....	good, musty .....
Local meal .....	good, musty .....
Daily, habitually, rarely, never.	
Wheat flour .....	
Fresh meat .....	
Cured meat (bacon) .....	
Lard .....	
Canned meats or vegetables .....	
Milk .....	
Eggs .....	
Butter .....	
House :	
Screened .....	effective .....
Sanitation : good, poor.	
Remarks : .....	

Fig. 2.—Reverse side of the census card.

meats, cured meats, canned meats, vegetables and fruits (tinned foods), and concerning leaf-lard, compound lard, vegetable oils, milk, butter and eggs. In respect to the frequency of use, we recognized seven classes: first, daily use which is self-explanatory; second, habitual use,



meaning as often as twice a week on the average; third, part time daily, which means daily use during certain seasons of the year; fourth, part time habitually, or habitual use during certain seasons; fifth, rarely, which means use less frequently than twice a week; sixth, part time rarely; and seventh, never.

#### DIETARY ELEMENTS DISMISSED FROM CONSIDERATION

Certain of these articles were not very commonly used and there is evidently no important reason for giving them detailed consideration. This applies particularly to corn-grits and corn-sirup. Corn whisky was not used by many, possibly in part because of legal restriction of the liquor traffic in the territory studied. For the most part, it was used only by the adult males, a class of the population in which pellagra was not very prevalent. It has not, therefore, seemed worth while to assemble and analyze the data in regard to it. Wheat flour was used daily by every family in the population studied. No distinction between pellagrins and non-pellagrins could be ascertained in respect to this dietary element. The recorded data in respect to lard are difficult to analyze because so many different brands were used and we have not, as yet, obtained reliable information concerning their composition. The remaining foods concerning which information has been gathered, namely, shipped corn-meal, local corn-meal, fresh meat, canned (tinned) foods, milk and eggs will be considered.

#### METHOD OF PRESENTATION

The general method of analyzing these data consists in dividing the population into several groups, distinguished from each other by the frequency with which the particular food was used, and then comparing the relative number of cases of pellagra in the different groups. Four distinct possibilities present themselves. We may consider as a unit each family present in the village at the time of our census, and compare the families in which pellagra existed with the total families present, or we may consider each individual in the same population as a unit and compare the total existing pellagrins with the total population. These two analyses might be expected to agree with each other fairly well, and should indicate the possible relation of diet to the presence of pellagra, both new and recurrent cases being considered together. Third, we may consider as a unit each family of which we have record, which lived in the particular village in 1912 or 1913 and compare the families in which *new cases* of pellagra appeared, with the total families, and fourth, we may examine the same population in a similar way, considering each individual person as a unit. The last two analyses might be expected to agree with each



other and should reveal the relation of these dietary constituents to new cases of pellagra. The latter would probably be a more accurate indication of the importance of the particular foods as predisposing factors, or as vehicles of the directly active etiological agents. Because of the manifest importance of this dietary phase of the subject of pellagra, we have undertaken to study our data in all four of the ways mentioned.

#### SHIPPED CORN-MEAL

The records in regard to the use of shipped corn include 853 families, present in the six villages in the year 1913, in 137 of which one or more pellagrins existed at the time. The distribution of these 853 families in respect to the frequency of use of shipped corn-meal is indicated in Table 1.

TABLE 1.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	47	14	8	11	5	2	15	102
W	44	18	4	16	2	0	11	95
P	116	51	22	12	2	1	18	222
Sa	38	15	10	10	6	3	19	101
A	33	22	14	6	1	2	4	82
Sp	130	40	27	14	8	1	31	251
Total..	408	160	85	69	24	9	98	853

It will be noted that this foodstuff was a staple article of diet, used daily by nearly half the families and never used by only about 11 per cent. of them. There was evidently not much difference between the various villages in the use of this food. At the larger mills, P and Sp, more than half the families used it daily, while in one village, Sa, only 38 of 101 families did so. The other villages are intermediate in this respect.

The distribution of the 137 families in which pellagra was present, in respect to frequency of use of shipped corn-meal, is indicated in Table 2.

By grouping together those families using shipped corn-meal habitually, part time daily and part time habitually under the heading, *Habitually*, and the groups using it rarely, part time rarely and never, together under the heading *Rarely*, Tables 3 and 4 are obtained.



TABLE 2.—FAMILIES CONTAINING ONE OR MORE CASES OF PELLAGRA DISTRIBUTED ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	5	3	1	2	0	0	2	13
W	10	6	1	1	0	0	1	19
P	10	9	5	2	0	0	2	28
Sa	11	4	2	3	1	2	6	29
A	7	5	4	0	0	0	1	17
Sp	13	6	2	5	1	1	3	31
Total..	56	33	15	13	2	3	15	137

TABLE 3.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Total Families			Pellagrin Families		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	47	30	25	5	5	3
W	44	36	15	10	7	2
P	116	65	41	10	11	7
Sa	38	31	32	11	8	10
A	33	29	20	7	5	5
Sp	130	62	59	13	12	6
Total .....	408	253	192	56	48	33

TABLE 4.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	10.6	16.7	12.0	12.7
W	22.7	19.4	13.3	20.0
P	8.6	16.9	17.1	12.6
Sa	28.9	25.8	31.3	28.7
A	21.2	17.2	25.0	20.7
Sp	10.0	19.4	10.2	12.4
Total.....	13.7	19.0	17.2	16.1



The large villages, Sp and P, show relatively fewer families with cases of pellagra, while in the village Sa, in which shipped corn-meal was less frequently used, nearly 29 per cent. of the families contained one or more cases. In three of the villages, P, Sa and A, the families using shipped meal rarely or never were most frequently afflicted with pellagra. In only one village, W, is the percentage of pellagrins highest in the group using this food daily, and for the total families of the six villages this group shows relatively the least pellagra. The figures are rather irregular and inconsistent, but on the whole they seem to us to indicate that families containing one or more pellagrins tend in some instances to restrict their use of shipped corn-meal. The tables do not reveal any positive correlation between the use of this food and the occurrence of pellagra.

The 853 families just considered included 5,151 persons, among whom 196 were pellagrins. The distribution of these 5,151 persons in respect to the frequency of use of shipped corn-meal is shown in Table 5.

TABLE 5.—DISTRIBUTION OF TOTAL INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	286	75	38	71	40	13	65	588
W	275	92	20	90	14	0	74	565
P	737	331	121	74	16	5	82	1,366
Sa	244	101	49	63	35	20	123	635
A	171	138	102	81	3	7	23	525
Sp	800	225	151	88	44	4	160	1,472
Total..	2,513	962	481	467	152	49	527	5,151

On the whole, approximately half these persons were members of families in which shipped corn-meal was used daily. In the large villages, P and Sp, more than half the persons were members of such families, while in the village A, less than one-third of the population took this food daily, and in Sa, considerably less than half. The distribution of the 196 pellagrins in this population in respect to the frequency of use of shipped corn-meal is given in Table 6.

A consideration of the pellagra morbidity in each village for each of the seven degrees of frequency in the use of shipped corn-meal is omitted because of the small size of certain of the groups. By assembling the figures into groups representing three degrees of frequency, namely, daily, *habitually* and *rarely* (including never) it is possible to obtain groups of some size (Tables 7 and 8).



TABLE 6.—DISTRIBUTION OF PELLAGRINS ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	8	3	1	3	0	0	4	19
W	11	7	3	2	0	0	1	24
P	10	11	8	4	0	0	4	37
Sa	16	4	2	3	2	3	13	43
A	12	7	7	0	0	0	1	27
Sp	19	9	5	6	1	1	5	46
Total..	76	41	26	18	3	4	28	196

TABLE 7.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Total Population			Individual Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	286	186	116	8	6	5
W	275	196	94	11	9	4
P	737	421	208	10	15	12
Sa	244	199	192	16	9	18
A	171	222	132	12	7	8
Sp	800	357	315	19	16	11
Total .....	2,513	1,581	1,057	76	62	58

TABLE 8.—PELLAGRA MORBIDITY IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	2.80	3.22	4.31	3.23
W	4.00	4.59	4.26	4.25
P	1.36	3.56	5.77	2.71
Sa	6.56	4.52	9.37	6.77
A	7.02	3.15	6.06	5.14
Sp	2.38	4.48	3.49	3.13
Total.....	3.02	3.92	5.49	3.81



The comparative study of pellagra morbidity in these groups for each of the six villages shows no definite consistent tendency for it to vary with the frequency of use of shipped corn-meal. In three villages, I, P and Sp, and in the total population of the six villages considered together, the pellagra morbidity varies inversely with the frequency of ingestion of this food, that is, those who eat it every day have the least pellagra, and those persons taking it rarely show the greatest morbidity. In the other three villages the relationship is irregular. The total pellagra morbidity in the larger villages, P and Sp, in which shipped corn-meal was most extensively used, is the lowest, namely, 2.71 and 3.13 per cent., respectively, while the greatest relative morbidity is shown by the villages Sa and A, in which shipped corn-meal was least used. This consideration of individuals leads, therefore, to the same general conclusion as did the consideration of the families, namely, that there is slightly more pellagra in those who use shipped corn less frequently. As has been suggested, this may be due to a tendency of some pellagrins to restrict their ingestion of this food. At any rate it is clearly evident that this examination of our recorded data has failed to reveal any close connection between the use of shipped corn-meal and the existence of pellagra in the population of these six mill villages.

In order to ascertain more exactly the probable importance of shipped corn-meal in the causation of pellagra, we have undertaken a study of cases of the disease which originated in these six mill villages during the period of our observations (1912 and 1913). In this study we have included all families residing in the particular village at the time of our census in 1913, and in addition all other families on our records in which cases of pellagra originated in the respective village in 1912 or 1913. The population considered is therefore not exactly the same as that utilized above, but it is very largely identical with it. The records include 865 families, and in 85 of these families one or more cases of pellagra developed in 1912 or 1913.

The distribution of these 865 families according to the frequency of use of shipped corn-meal is indicated in Table 9.

Table 9 is very similar to Table 1, but includes a few more families which had moved away from the respective village after one or more of their members had contracted pellagra there. The distribution of the 85 families in which cases of pellagra originated in 1912 or 1913 in these villages is given in Table 10.

Assembling the families into three groups in respect to frequency of use of shipped corn-meal, the figures in Table 11 are obtained.

There is evidently no consistent relationship between the frequency of the use of shipped corn-meal and the occurrence of new cases of



TABLE 9.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	49	15	8	11	6	2	15	106
W	45	18	4	16	2	1	12	98
P	116	51	22	12	2	1	18	222
Sa	40	15	10	10	6	3	19	103
A	33	22	14	6	1	3	4	83
Sp	131	40	27	14	8	1	32	253
Total..	414	161	85	69	25	11	100	865

TABLE 10.—DISTRIBUTION OF FAMILIES IN WHICH NEW CASES OF PELLAGRA OCCURRED IN 1912 OR 1913, ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	7	3	1	2	1	0	2	16
W	6	1	0	1	0	1	2	11
P	8	4	5	1	0	0	1	19
Sa	6	2	0	0	1	2	1	12
A	3	4	2	0	0	1	0	10
Sp	8	3	1	2	0	0	3	17
Total..	38	17	9	6	2	4	9	85

TABLE 11.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Total Families			Families with Incident Pellagra		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	49	32	25	7	6	3
W	45	36	17	6	2	3
P	116	65	41	8	5	6
Sa	40	31	32	6	3	3
A	33	29	21	3	4	3
Sp	131	62	60	8	5	4
Total .....	414	255	196	38	25	22

pellagra to be seen in these tables. The figures for the six villages combined suggest rather that new cases were slightly more frequent in families using this food product rarely or never. Here also, the lowest incidence of pellagra is in the large villages, P and Sp, the only ones in which shipped corn-meal was used daily by more than half the families.

TABLE 12.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	14.3	18.8	12.0	15.1
W	13.3	5.6	17.6	11.2
P	6.9	7.7	14.6	8.6
Sa	15.0	9.7	9.4	11.7
A	9.1	13.8	14.3	12.0
Sp	6.1	8.1	6.7	6.7
Total.....	9.2	9.8	11.2	9.8

TABLE 13.—DISTRIBUTION OF INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	300	89	38	71	44	13	65	620
W	272	86	20	89	14	6	77	564
P	736	324	119	72	16	5	79	1,351
Sa	248	99	47	60	34	20	112	620
A	165	135	99	81	3	12	23	518
Sp	794	219	149	84	43	3	165	1,457
Total..	2,515	952	472	457	154	59	521	5,130

The 865 families just considered included 5,130 persons who did not have pellagra at the beginning of the year 1912, so far as we have been able to ascertain. Persons known to have contracted pellagra previous to 1912 have been excluded from this number. Of these 5,130 persons, 110 contracted pellagra during the years 1912 and 1913. The distribution of the 5,130 individuals of this population in respect to the frequency of the use of shipped corn in their families is shown in Table 13.

Table 13 resembles Table 5, but the population considered is not quite the same. Old cases of pellagra existing previous to 1912 are



excluded from this table and some other persons have been included who, although not residing in these villages at the time of our census in 1913, nevertheless did reside there in 1912 or 1913 when some member of their family contracted pellagra. The 110 persons who contracted pellagra in these villages in 1912 and 1913 were distributed according to frequency of use of shipped corn by their families as follows:

TABLE 14.—DISTRIBUTION OF INCIDENT PELLAGRINS ACCORDING TO FREQUENCY OF SHIPPED CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	10	3	1	3	1	0	4	22
W	6	1	0	1	0	3	2	13
P	9	4	6	2	0	0	1	22
Sa	6	2	0	0	1	3	2	14
A	6	4	4	0	0	1	0	15
Sp	11	3	3	2	0	0	5	24
Total..	48	17	14	8	2	7	14	110

By assembling these figures into the groups representing the three degrees of frequency of use of shipped corn-meal, Tables 15 and 16 are obtained.

It is clearly evident, from these tables, that the occurrence of new cases of pellagra in these mill villages shows no definite consistent tendency to vary with the frequency of use of shipped corn-meal. On the contrary, in every one of these six villages the incidence of the disease actually observed was highest in that portion of the population which rarely or never used this foodstuff. In the total population of the six villages the occurrence of new cases of pellagra was almost twice as frequent in those using shipped meal rarely as in the groups using it daily or habitually. These results lend no support to the conception that pellagra is caused by the ingestion of shipped corn-meal in these particular mill villages and they seem to us to render very insecure the theory that imported or shipped corn may anywhere be regarded as the essential cause of pellagra.

#### LOCAL CORN-MEAL

The recorded data in regard to the use of local or home-grown corn-meal relate to 866 families present at the time of our census, of which 134 contained one or more cases of pellagra at that time. The distribution of these 866 families in respect to the frequency of use of local corn-meal is given in Table 17.



TABLE 15.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF SHIPPED CORN-MEAL

Village	Total Population			Incident Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	300	204	116	10	7	5
W	272	189	103	6	2	5
P	736	412	203	9	6	7
Sa	248	193	179	6	3	5
A	165	219	134	6	4	5
Sp	794	346	317	11	5	8
Total .....	2,515	1,563	1,052	48	27	35

TABLE 16.—INCIDENCE OF PELLAGRA IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	3.33	3.43	4.31	3.55
W	2.21	1.06	4.85	2.30
P	1.22	1.46	3.45	1.63
Sa	2.42	1.55	2.79	2.26
A	3.64	1.83	3.73	2.90
Sp	1.39	1.44	2.52	1.65
Total.....	1.91	1.73	3.33	2.14

TABLE 17.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	5	7	1	11	5	2	72	103
W	8	3	1	16	3	0	77	108
P	8	4	4	12	2	1	192	223
Sa	10	7	2	10	6	3	60	98
A	0	1	4	7	1	2	67	82
Sp	5	3	2	13	7	1	221	252
Total..	36	25	14	69	24	9	689	866



## MILL VILLAGE I

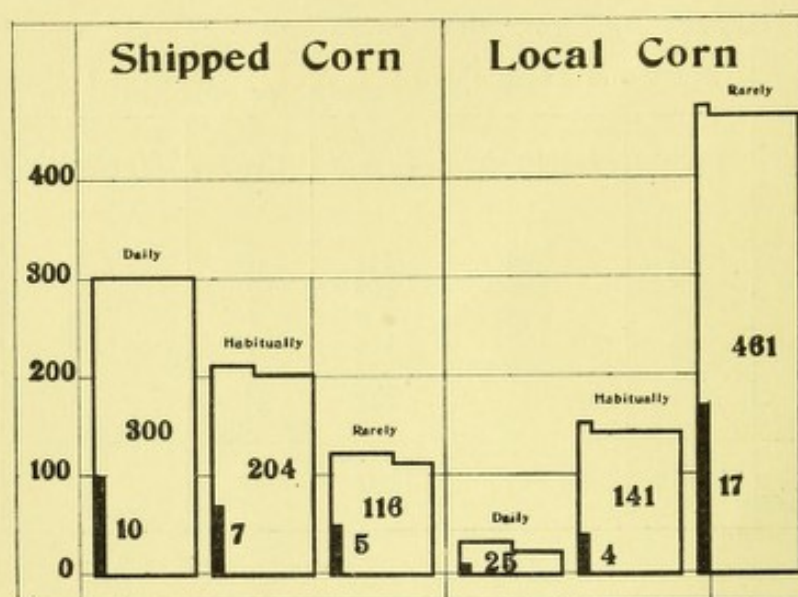


Fig. 3.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE W

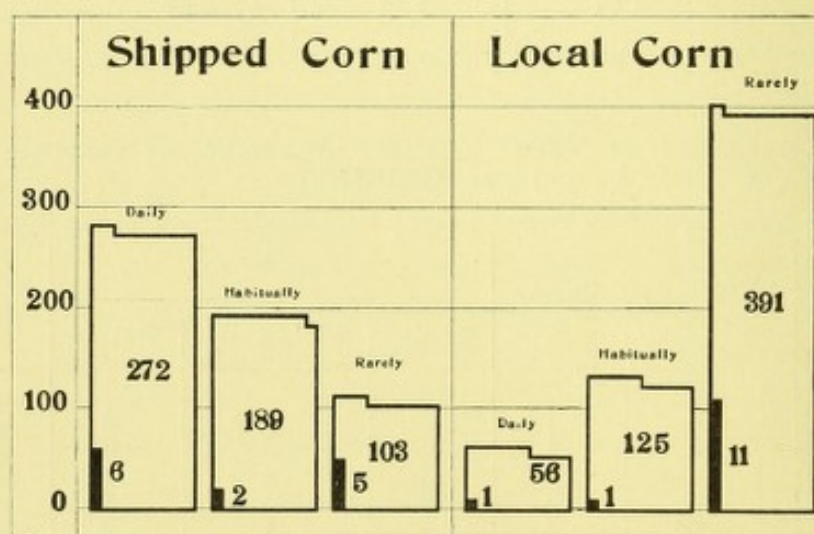


Fig. 4.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



## MILL VILLAGE P

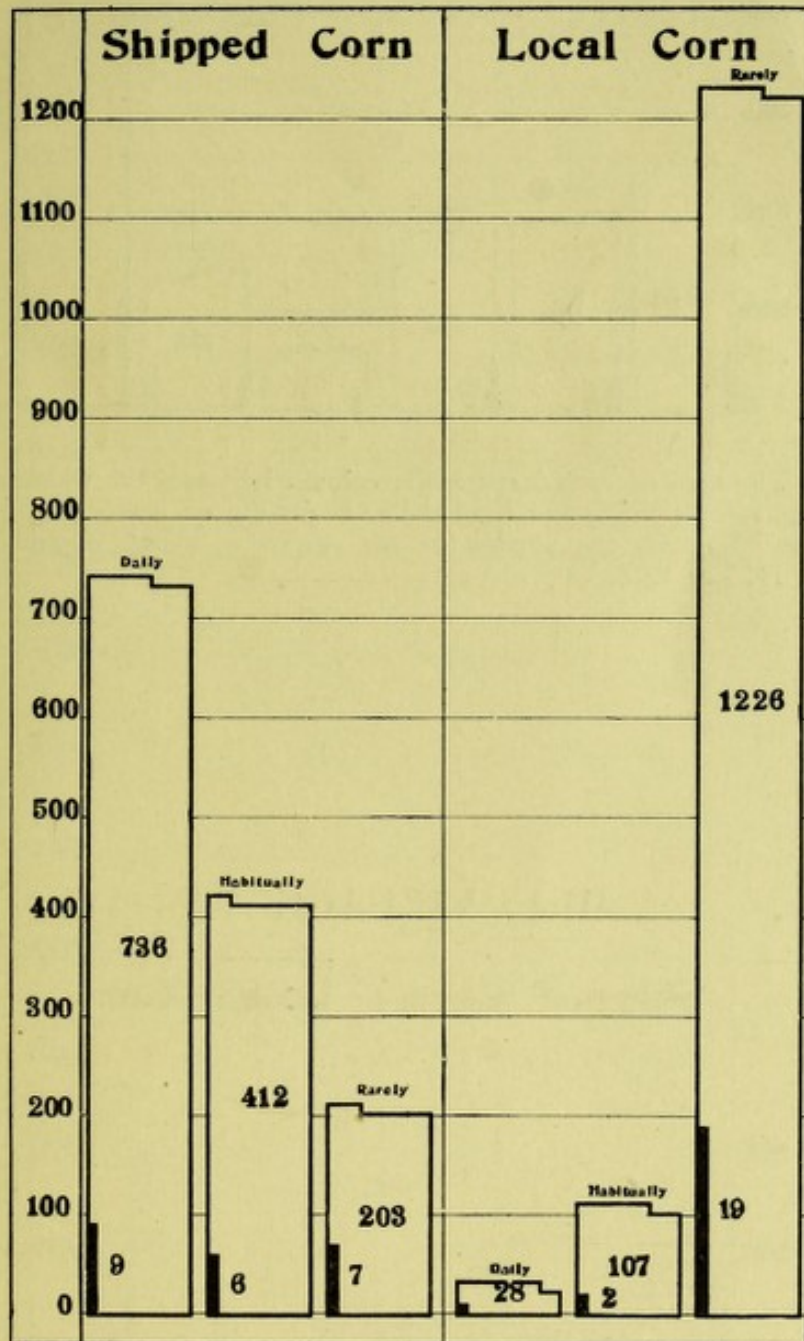


Fig. 5.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



## MILL VILLAGE SA

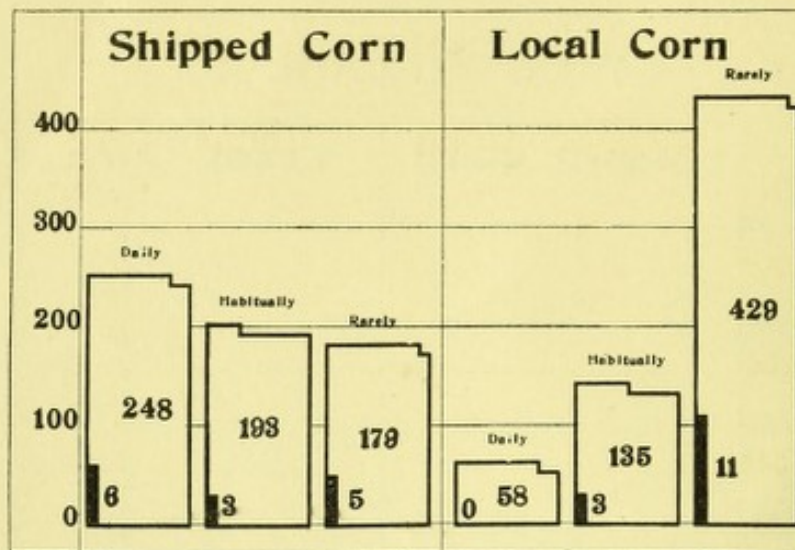


Fig. 6.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE A

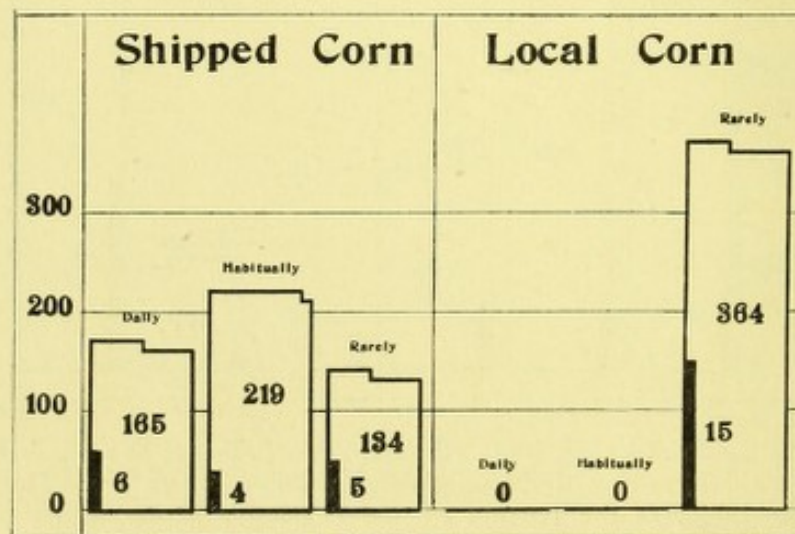


Fig. 7.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



## MILL VILLAGE SP

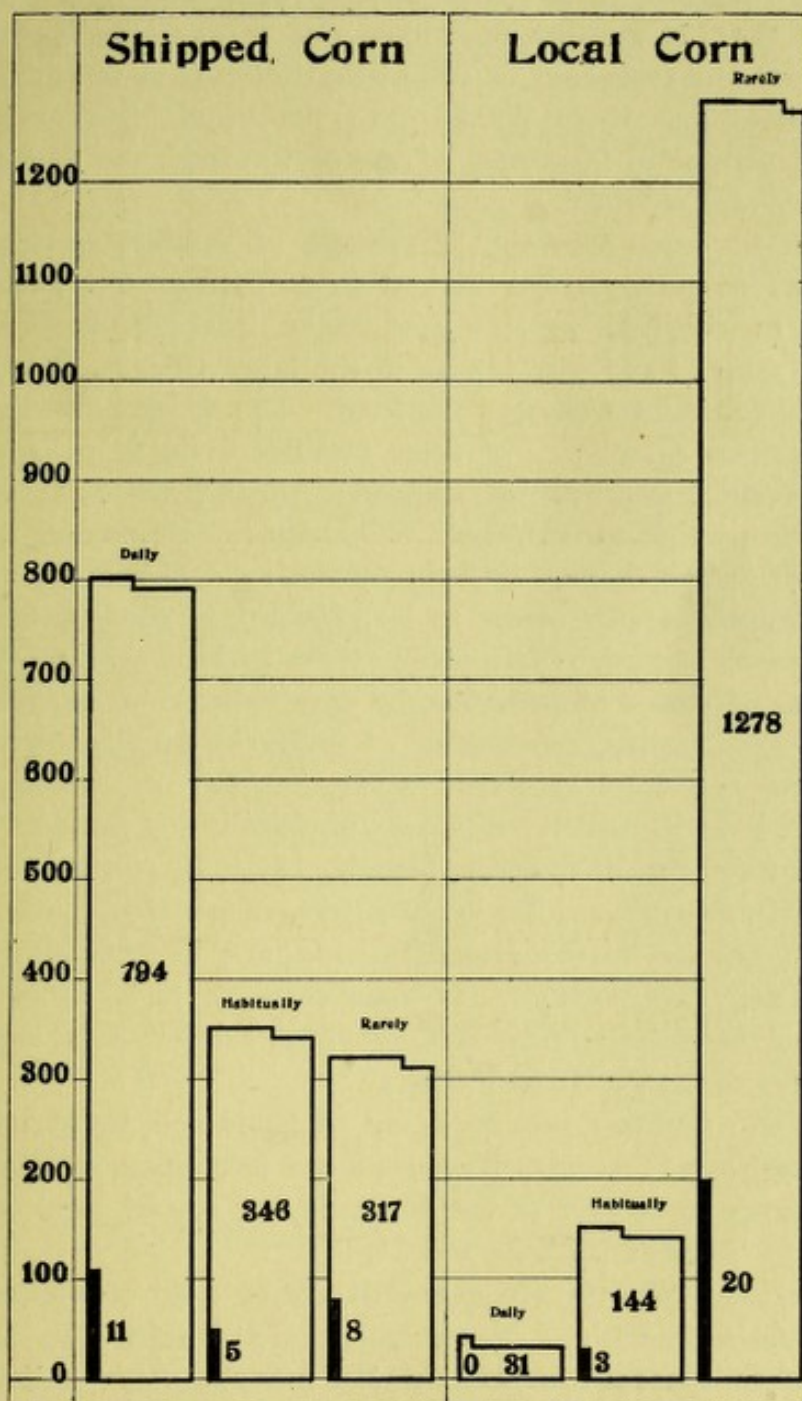


Fig. 8.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



It will be noted at once that local corn was not very extensively used. More than three-quarters of the total families never used it. It was most largely used in the village Sa, and used by relatively least number of families in the large villages of P and Sp. The distribution of the 134 families containing one or more cases of pellagra in respect to the frequency of use of local corn is shown in Table 18.

By assembling these figures into the usual three summarized groups in respect to frequency of use of the food, the figures shown in Table 19 are obtained.

It will be noted that the percentage of families having one or more cases of pellagra was highest in the village Sa, namely, 24.5 per cent., in which, as we have seen above, local corn-meal was most extensively used; and was lowest in the large villages, P and Sp, in which this foodstuff was used the least. This is undoubtedly due, in our opinion, to a tendency of some families living in pellagrous districts to restrict their use of shipped corn and substitute for it, in whole or in part, local corn-meal. The theories concerning causation of the disease which may be held by the local physicians or by the people themselves also seems to be reflected to some extent in the food data. In respect to frequency of use of local corn-meal in relation to the existence of pellagra, the data indicate no particular connection. The highest percentage of pellagrin families occurred in those using this food rarely or never, but the percentage in those who never used it, namely, 15.4, was practically the same as the general percentage for all families, namely, 15.5. In general those families using local corn-meal daily had pellagra less frequently, but the number of families in this group (namely, 36) is, after all, too small to be of much significance. It does show, however, that families using local corn-meal daily and avoiding shipped meal altogether, nevertheless did suffer from pellagra.

These 866 families were made up of 5,089 persons of whom 194 were pellagrins. The distribution of the 5,089 persons and of the 194 pellagrins in respect to the frequency of use of local corn-meal is shown in Tables 21, 22, 23 and 24.

It is evident that the frequency of use of local corn-meal has no definite consistent relation to the pellagra morbidity. In the whole population of the six villages, the 201 persons using it daily show a somewhat smaller proportionate number of cases than the larger group using it rarely or never. Yet, in two villages, I and P, the highest morbidity was among those using this food daily; in two others, Sa and Sp, the highest morbidity was among those using it habitually, and in the remaining two villages, W and A, those persons using local corn rarely or never had the most pellagra. This food



TABLE 18.—FAMILIES CONTAINING ONE OR MORE CASES OF PELLAGRA, DISTRIBUTED ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	1	0	1	2	0	0	10	14
W	1	0	0	1	0	0	18	20
P	1	1	0	2	0	0	24	28
Sa	1	4	0	3	1	2	13	24
A	0	0	2	0	0	0	15	17
Sp	0	0	0	4	0	1	26	31
Total..	4	5	3	12	1	3	106	134

TABLE 19.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Total Families			Pellagrin Families		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	5	23	75	1	2	11
W	8	22	78	1	1	18
P	8	18	197	1	3	24
Sa	10	23	65	1	8	15
A	0	9	73	0	0	17
Sp	5	23	224	0	4	27
Total .....	36	118	712	4	18	112

TABLE 20.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	20.0	8.7	14.7	13.6
W	12.5	4.5	23.1	18.5
P	12.5	16.7	12.2	12.6
Sa	10.0	34.8	23.1	24.5
A	....	0.0	23.3	20.7
Sp	0.0	17.4	12.1	12.3
Total.....	11.1	15.3	15.7	15.5

TABLE 21.—DISTRIBUTION OF TOTAL INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	25	26	8	71	40	13	413	596
W	56	22	4	90	14	0	389	575
P	30	20	21	74	16	5	1,210	1,376
Sa	59	47	8	63	35	20	404	636
A	0	11	18	45	3	7	352	436
Sp	31	20	12	84	37	4	1,282	1,470
Total..	201	146	71	427	145	49	4,050	5,089

TABLE 22.—DISTRIBUTION OF PELLAGRINS ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	1	0	3	3	0	0	13	20
W	1	0	0	2	0	0	20	23
P	3	1	0	4	0	0	29	37
Sa	1	8	0	3	2	3	23	40
A	0	0	2	0	0	0	25	27
Sp	0	0	0	5	0	1	41	47
Total..	6	9	5	17	2	4	151	194

TABLE 23.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Total Population			Individual Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	25	137	434	1	3	16
W	56	126	393	1	2	20
P	30	110	1,236	3	5	29
Sa	59	145	432	1	13	26
A	0	59	377	0	0	27
Sp	31	141	1,298	0	5	42
Total .....	201	718	4,170	6	28	160



was most commonly used in the village Sa, in which pellagra was very prevalent, and was used hardly at all in village A, in which pellagra morbidity was almost as high.

It remains now to study the population free from pellagra at the beginning of the year 1912 and the cases which developed in this population during 1912 and 1913, concerning which we have data in regard to the frequency of use of local corn-meal. The distribution of the total families (875) in this population and of the families in which new cases of pellagra occurred (84) are shown in Tables 25, 26, 27 and 28.

TABLE 24.—PELLAGRA MORBIDITY IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	4.00	2.19	3.69	3.36
W	1.79	1.59	5.09	4.00
P	10.00	4.55	2.35	2.69
Sa	1.69	8.97	6.02	6.29
A	....	0.00	7.16	6.19
Sp	0.00	3.55	3.24	3.20
Total.....	2.99	3.90	3.84	3.81

TABLE 25.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	5	7	1	11	6	2	75	107
W	8	3	1	16	2	1	79	110
P	8	4	4	12	2	1	192	223
Sa	10	7	2	10	6	3	62	100
A	0	1	2	7	1	3	67	81
Sp	5	4	2	13	7	1	222	254
Total..	36	26	12	69	24	11	697	875

Approximately 80 per cent. of the families here considered did not use local corn-meal, so that the groups using it are composed of only a few families each. It is perfectly evident, however, that new cases of pellagra occurred in one or more families in every group without any definite consistent relation to the frequency of use of local corn-meal.

TABLE 26.—DISTRIBUTION OF FAMILIES IN WHICH NEW CASES OF PELLAGRA OCCURRED IN 1912 AND 1913, ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	1	0	1	2	1	0	11	16
W	1	0	0	1	0	1	8	11
P	1	0	0	1	0	0	17	19
Sa	0	1	0	0	1	2	8	12
A	0	0	0	0	0	1	9	10
Sp	0	1	0	2	0	0	13	16
Total..	3	2	1	6	2	4	66	84

TABLE 27.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Total Families			Families with Incident Pellagra		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	5	24	78	1	3	12
W	8	21	81	1	1	9
P	8	18	197	1	1	17
Sa	10	23	67	0	2	10
A	0	9	72	0	0	10
Sp	5	24	225	0	3	13
Total .....	36	119	720	3	10	71

TABLE 28.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	20.0	12.5	15.4	15.0
W	12.5	4.8	11.1	10.0
P	12.5	5.6	8.6	8.5
Sa	0.0	8.7	14.9	12.0
A	....	0.0	13.9	12.3
Sp	0.0	12.5	5.8	6.3
Total.....	8.3	8.4	9.9	9.6



In the 875 families just considered, there were 4,999 persons who were not pellagrins, so far as we could ascertain, at the beginning of the year 1912. Of these 4,999 persons, 109 contracted the disease during 1912 and 1913. The distribution according to the use of local corn-meal in their families, of the 4,999 total individuals and of the 109 who became pellagrins in 1912 and 1913, is shown in Tables 29, 30, 31 and 32.

TABLE 29.—DISTRIBUTION OF INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	25	26	8	71	44	13	440	627
W	56	22	4	89	14	6	381	572
P	28	19	21	72	16	5	1,200	1,361
Sa	58	41	8	60	34	20	401	622
A	0	0	0	0	0	12	352	364
Sp	31	26	12	81	37	3	1,263	1,453
Total..	198	134	53	373	145	59	4,037	4,999

TABLE 30.—DISTRIBUTION OF INCIDENT PELLAGRINS ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	1	0	3	3	1	0	14	22
W	1	0	0	1	0	3	8	13
P	1	0	0	2	0	0	19	22
Sa	0	2	0	0	1	3	8	14
A	0	0	0	0	0	1	14	15
Sp	0	1	0	2	0	0	20	23
Total..	3	3	3	8	2	7	83	109

There is a suggestion of an inverse relation between the use of local corn-meal and the occurrence of new cases of pellagra in this population as a whole, those using it daily showing an incidence of new cases of 1.52 per cent., whereas those using it rarely or never show an incidence of 2.24 per cent. In village A, in which local corn-meal scarcely entered into the diet, the highest incidence of new cases was



TABLE 31.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF LOCAL CORN-MEAL

Village	Total Individuals			Incident Pellagrins		
	Daily	<i>Habitually</i>	<i>Rarely</i>	Daily	<i>Habitually</i>	<i>Rarely</i>
I	25	141	461	1	4	17
W	56	125	391	1	1	11
P	28	107	1,226	1	2	19
Sa	58	135	429	0	3	11
A	0	0	364	0	0	15
Sp	31	144	1,278	0	3	20
Total .....	198	652	4,149	3	13	93

TABLE 32.—INCIDENCE OF PELLAGRA IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	<i>Habitually</i>	<i>Rarely</i>	Total
I	4.00	2.84	3.69	3.51
W	1.79	0.80	2.81	2.27
P	3.57	1.87	1.55	1.62
Sa	0.00	2.22	2.56	2.25
A	....	....	4.12	4.12
Sp	0.00	2.08	1.56	1.58
Total.....	1.52	1.99	2.24	2.18

observed. In two villages, however, namely, I and P, the incidence was highest in the group using local corn-meal daily. Probably several conflicting factors disturb the relationships. In general we believe that people who use local corn daily are likely to be particular about their diet in other respects, and often are in better financial condition than the average of the population. These associated factors would doubtless operate to diminish the incidence of pellagra in this group. On the other hand, certain families, after one of their members has contracted pellagra, not only tend to restrict their use of shipped corn, but in some cases they tend to substitute local corn for it. As we shall see in a subsequent section of this report, the members of such families seem to be especially likely to develop the disease, and this may be a factor in the high incidence in those using this food daily in certain villages. In any event, it is clear that this study of the use of local corn has failed to reveal any consistent relation between it and pellagra.



## ANY CORN-MEAL

Corn-meal was used by the vast majority of the population studied. Most of those who never used shipped corn-meal did use local corn-meal. It therefore seems desirable to examine the data concerning the use of any corn-meal. The records in respect to this foodstuff include 858 families present in the six villages at the time of our census in 1913, of which 137 contained one or more cases of pellagra. The distribution of the 858 total families and of the 137 pellagrin families in respect to the use of corn-meal is shown in Tables 33, 34, 35 and 36.

TABLE 33.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	63	26	13	0	0	1	2	105
W	67	24	3	0	0	0	0	94
P	137	59	27	0	0	0	2	225
Sa	59	26	14	0	0	0	1	100
A	40	23	19	1	0	0	0	83
Sp	149	49	29	2	1	0	21	251
Total..	515	207	105	3	1	1	26	858

TABLE 34.—FAMILIES CONTAINING ONE OR MORE CASES OF PELLAGRA, DISTRIBUTED ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	8	3	3	0	0	0	0	14
W	11	6	2	0	0	0	0	19
P	14	10	5	0	0	0	0	29
Sa	15	7	4	0	0	0	1	27
A	7	5	5	0	0	0	0	17
Sp	16	6	3	2	1	0	3	31
Total..	71	37	22	2	1	0	4	137

Corn-meal was used by all but 26 of the 858 families, and by 515 of these families it was used daily. In one village, Sp, there were 21 families who avoided the use of corn-meal, probably as a prophyl-



lactic measure against pellagra. In every one of the six villages the existence of pellagra was relatively less frequent in the families using corn-meal daily than in those using it rarely. This is probably due to a tendency on the part of some pellagrin families to restrict their use of corn-meal. It certainly does not indicate any consistent positive correlation between use of corn-meal and presence of pellagra in these families.

TABLE 35.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO THE USE OF ANY CORN-MEAL

Village	Total Families			Pellagrin Families		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	63	26	16	8	3	3
W	67	24	3	11	6	2
P	137	59	29	14	10	5
Sa	59	26	15	15	7	5
A	40	24	19	7	5	5
Sp	149	52	50	16	9	6
Total .....	515	211	132	71	40	26

TABLE 36.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	12.7	11.5	18.8	13.3
W	16.4	25.0	66.7	20.2
P	10.2	16.9	17.2	12.9
Sa	25.4	26.9	33.3	27.0
A	17.5	20.8	26.3	20.5
Sp	10.7	17.3	12.0	12.4
Total.....	13.8	19.0	19.7	16.0

These 858 families included 5,095 individuals, of whom 196 were pellagrins. Their distribution in respect to the use of corn-meal is shown in Tables 37, 38, 39 and 40.

It is evident that nearly everybody in these villages used corn-meal to some extent. Only 123 persons were members of families in which this foodstuff was not used and 97 of these persons were in one village, Sp. The inverse relation between the existence of pellagra and the use of corn is clearly shown in Table 40. In every village there were relatively more cases of pellagra in the population using this food rarely or never than in the group using it daily. Of



TABLE 37.—DISTRIBUTION OF TOTAL INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	381	141	70	0	0	2	6	600
W	415	128	17	0	0	0	0	560
P	850	377	147	0	0	0	11	1,385
Sa	367	183	77	0	0	0	9	636
A	212	152	86	4	0	0	0	454
Sp	910	278	159	9	7	0	97	1,460
Total..	3,135	1,259	556	13	7	2	123	5,095

TABLE 38.—DISTRIBUTION OF PELLAGRINS ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	12	3	5	0	0	0	0	25
W	14	8	3	0	0	0	0	38
P	18	12	8	0	0	0	1	38
Sa	20	12	5	0	0	0	0	27
A	12	7	8	0	0	0	5	46
Sp	22	9	6	3	1	0	0	20
Total..	98	51	35	3	1	0	6	194

TABLE 39.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Total Population			Individual Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	381	141	78	12	3	5
W	415	128	17	14	8	3
P	850	377	158	18	12	8
Sa	367	183	86	20	12	6
A	212	156	86	12	7	8
Sp	910	294	256	22	13	11
Total .....	3,135	1,279	681	98	55	41

the 123 persons recorded as never using corn-meal, six (or 4.9 per cent.) were pellagrins, a relative morbidity greater than that observed in persons using corn-meal daily. It should be noted, however, that this group is made up of persons who were not using corn-meal at the time of the census and had not used it for the preceding two years. Doubtless most if not all these persons had at some time used corn-meal. The information in regard to diet in these tables refers therefore to the diet at the time of observation, namely, 1912 and 1913, and not necessarily to the diet at the time when pellagra originated.

TABLE 40.—PELLAGRA MORBIDITY IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	3.15	2.13	6.41	3.33
W	3.37	6.25	17.65	3.46
P	2.12	3.18	5.06	2.74
Sa	5.45	6.56	6.98	5.97
A	5.66	4.49	9.30	5.95
Sp	2.42	4.42	4.30	3.15
Total.....	3.13	4.30	6.02	3.81

TABLE 41.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	65	27	13	0	0	1	2	108
W	68	24	4	0	0	0	1	97
P	137	59	27	0	0	0	2	225
Sa	61	26	14	0	0	0	1	102
A	40	23	19	1	0	0	0	83
Sp	150	50	29	2	1	0	21	253
Total..	521	209	106	3	1	1	27	868

The use of any corn-meal by incident cases of pellagra would appear to be of particular interest. The total population of these six mill villages, for which we have available data for a study of this topic, includes 868 families, in 85 of which new cases of pellagra developed in 1912 and 1913. The distribution of these families in respect to the use of any corn-meal is shown in Tables 41, 42, 43 and 44.



TABLE 42.—DISTRIBUTION OF FAMILIES IN WHICH NEW CASES OF PELLAGRA OCCURRED IN 1912 OR 1913, ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	10	4	2	0	0	0	0	16
W	7	1	1	0	0	0	1	10
P	11	4	5	0	0	0	0	20
Sa	6	4	2	0	0	0	0	12
A	3	4	3	0	0	0	0	10
Sp	10	4	1	0	0	0	2	17
Total..	47	21	14	0	0	0	3	85

TABLE 43.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Total Families			Families with Incident Pellagra		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	65	27	16	10	4	2
W	68	24	5	7	1	2
P	137	59	29	11	4	5
Sa	61	26	15	6	4	2
A	40	24	19	3	4	3
Sp	150	53	50	10	4	3
Total .....	521	213	134	47	21	17

TABLE 44.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	15.4	14.8	12.5	14.8
W	10.3	4.2	40.0	10.3
P	8.0	6.8	17.2	8.9
Sa	9.8	15.4	13.3	11.8
A	7.5	16.7	15.8	12.0
Sp	6.7	7.5	6.0	6.7
Total.....	9.0	9.9	12.7	9.8



The incidence of new cases of pellagra in families shows no consistent relation to the frequency of use of corn-meal by these families. In four villages, W, P, Sa and A, and in the total families in the six villages, the families using corn-meal rarely or never developed new cases of pellagra relatively more frequently than those using this foodstuff daily, whereas in two villages, I and Sp, this relation was reversed. In the 27 families not using corn-meal during 1912 and 1913, there were three (or 11.1 per cent.) in which new cases of pellagra developed. This percentage is very similar to the analogous figures in the groups using corn-meal daily, habitually or rarely, and suggests that frequency of use of corn-meal in 1912 and 1913 had no direct relation to the development of new cases of pellagra in these families.

The 868 families just considered included 5,051 persons who were not pellagrins at the beginning of the year 1912. Of these 5,051 persons, 108 developed the disease during 1912 and 1913. The distribution of these persons according to the frequency of use of any corn-meal is shown in Tables 45, 46, 47 and 48.

TABLE 45.—DISTRIBUTION OF INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	396	153	69	0	0	2	6	626
W	410	121	20	0	0	0	3	554
P	845	369	145	0	0	0	11	1,370
Sa	365	176	76	0	0	0	8	625
A	206	149	83	0	0	0	0	438
Sp	902	278	156	6	6	0	95	1,443
Total..	3,124	1,246	549	6	6	2	123	5,056

The incidence of new cases of pellagra was highest, in each of the six villages, among those persons using corn-meal rarely or never; and in the total population considered together, the incidence in this group was more than twice that of the group using corn-meal daily. The difference is more pronounced than that shown in the study of the families as units, and this means that families using little or no corn-meal not only developed new cases of pellagra more than the families using this food daily, but also developed multiple cases in the same family more frequently. The figures indicate very clearly that restriction or omission of corn-meal as an article of diet failed as



TABLE 46.—DISTRIBUTION OF INCIDENT PELLAGRINS ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	14	4	4	0	0	0	0	22
W	6	1	3	0	0	0	1	11
P	13	4	6	0	0	0	0	23
Sa	6	5	4	0	0	0	0	15
A	6	4	5	0	0	0	0	15
Sp	12	4	3	0	0	0	3	22
Total..	57	22	25	0	0	0	4	108

TABLE 47.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF ANY CORN-MEAL

Village	Total Individuals			Incident Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	396	153	77	14	4	4
W	410	121	23	6	1	4
P	845	369	156	13	4	6
Sa	365	176	84	6	5	4
A	206	149	83	6	4	5
Sp	902	290	251	12	4	6
Total .....	3,124	1,258	674	57	22	29

TABLE 48.—INCIDENCE OF PELLAGRA IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	3.54	2.61	5.19	3.51
W	1.46	0.83	17.39	1.99
P	1.54	1.08	3.85	1.68
Sa	1.64	2.84	4.76	2.40
A	2.91	2.68	6.02	3.42
Sp	1.33	1.38	2.39	1.52
Total.....	1.82	1.75	4.30	2.14



a prophylactic measure against pellagra in this population and suggest very strongly that it cannot be relied on for the control of pellagra.

The group of the population recorded as never using any corn-meal is of particular interest, and especially those families and the four persons in this group in whom pellagra developed in 1912 and 1913. One of these cases occurred in village W and the other three in village Sp, two of them in one family. The family in village W consisted of a man and wife, both about 65 years old, and three grown daughters. Corn-bread had been a staple article of diet until the summer of 1911, after which time it was no longer used. The youngest daughter, Case 78, developed pellagra in 1910 when she was 17 years old. The oldest daughter, Case 77, developed pellagra in the summer of 1911 when she was 27 years old. Both of these were pellagrins before the period of our observations. In June, 1912, about a year after the exclusion of corn-meal from the diet, the third sister, then aged 25, developed a typical erythema, and a diagnosis of pellagra was made. This recurred in July, 1913, without other symptoms. This case, 668, is regarded as incident in 1912, one year after the exclusion of corn-meal from the diet, and is therefore classed in the group of the population not using corn-meal. In the village Sp there are two families to be considered. One of these consisted of a mother, aged 41, and her son, aged 19. Corn-meal was not used, and our record clearly places this family in the class designated as never using this food. The record does not go into the matter in detail, and we do not know with certainty how long it had been excluded from the diet. The woman, Case 742, developed erythema for the first time in August, 1913, and this was accompanied by digestive disturbance and nervous symptoms. The remaining family consisted of a man and wife and three children. The wife, Case 25, developed pellagra in April, 1910, while residing at Columbia, S. C. She was then 38 years old. At that time she consulted one of the most eminent authorities on pellagra in this country and, at his advice, corn-meal was rigidly excluded from the diet of the whole family and none of it has been allowed in the house since 1910. The family moved to Spartanburg in the fall of 1911. The attack of pellagra recurred in the woman in 1911, 1912 and 1913. Early in June, 1912, two of the children, a girl aged 13 and a boy aged 6, developed typical erythema of the hands, and stomatitis. The boy also showed the eruption on his feet and had some diarrhea. In 1913 the boy remained free from symptoms of the disease, but it recurred in his sister with typical erythema, diarrhea and nervous excitability. These two children have been placed in the class not using corn-meal at the time of incidence of pellagra.



The theory that pellagra is caused by the excessive use of corn-meal is not supported by this study. Although every person in the population here considered probably ate corn-meal at some time in his life, there were found two cases of pellagra in which the use of

### MILL VILLAGE I

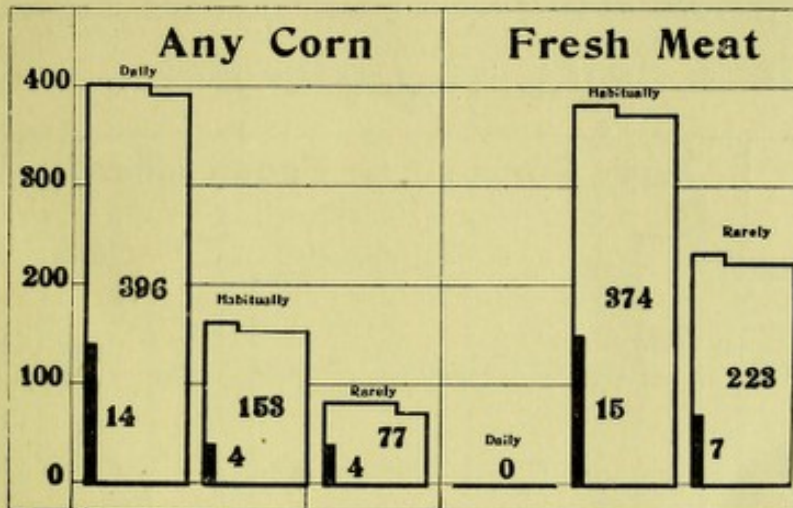


Fig. 9.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

### MILL VILLAGE W

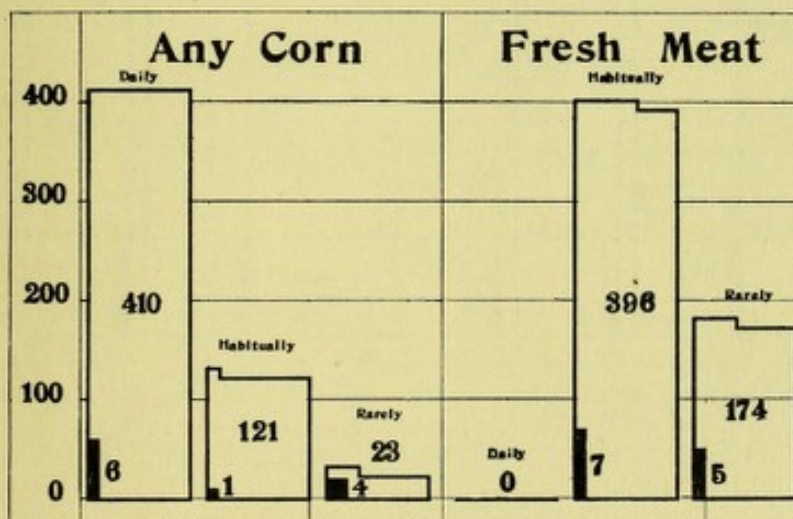


Fig. 10.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

this foodstuff could be excluded with almost absolute certainty for a period of two years preceding the development of the first sign of the disease, and there were two other cases in which corn-meal had

been excluded from the diet for a year previous to the development of the disease. The total persons in the population studied who have been classed as not using corn-meal amounted to only 123, and it may truly be said that non-pellagrins were placed in this group with much less careful scrutiny than were incident pellagrins. Of these 123 persons, four developed the disease in 1912 and 1913, an incidence of 3.25 per cent. This rate of incidence is greater than that observed among

### MILL VILLAGE P

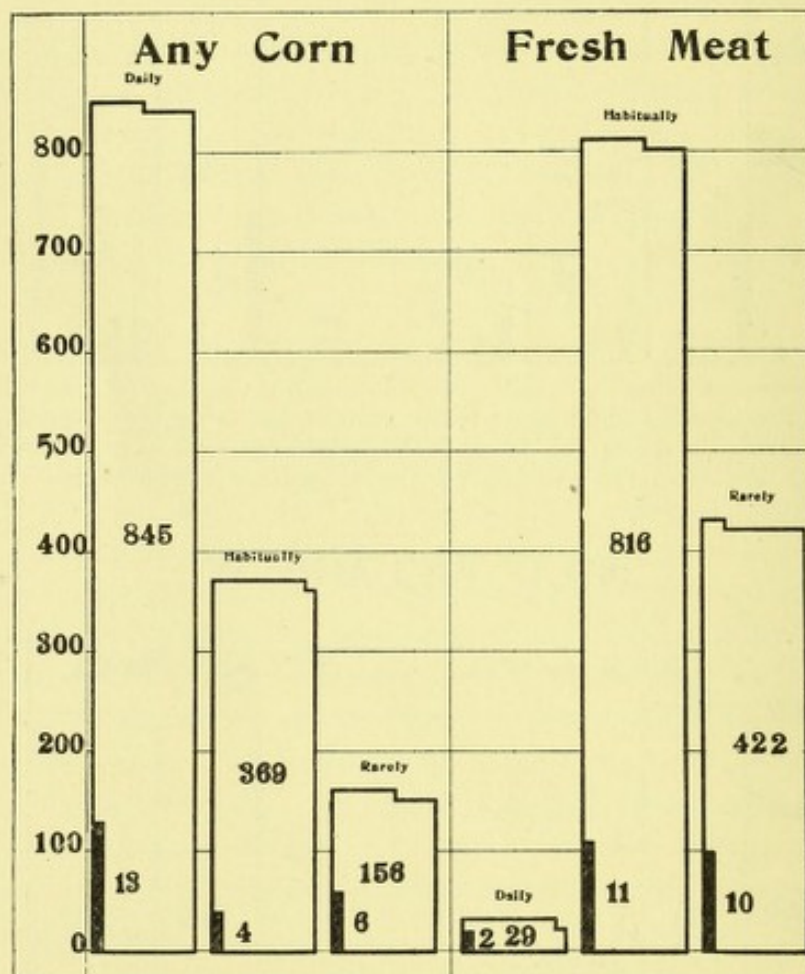


Fig. 11.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

those using corn-meal daily (1.82 per cent.) or habitually (1.75 per cent.). In this population, therefore, the occurrence of new cases of pellagra seems to bear an inverse relation to the frequency of use of corn-meal.

Without committing ourselves to a final opinion, we may offer some suggestions in explanation of these facts. In the first place it seems certain that corn-meal cannot rightly be regarded as the essen-



tial cause of pellagra. The high incidence in those using little corn-meal we believe to be due to their close association with previous pellagra patients. It is chiefly in those families already having one case of pellagra that the use of this food has been intentionally restricted.

### MILL VILLAGE SA

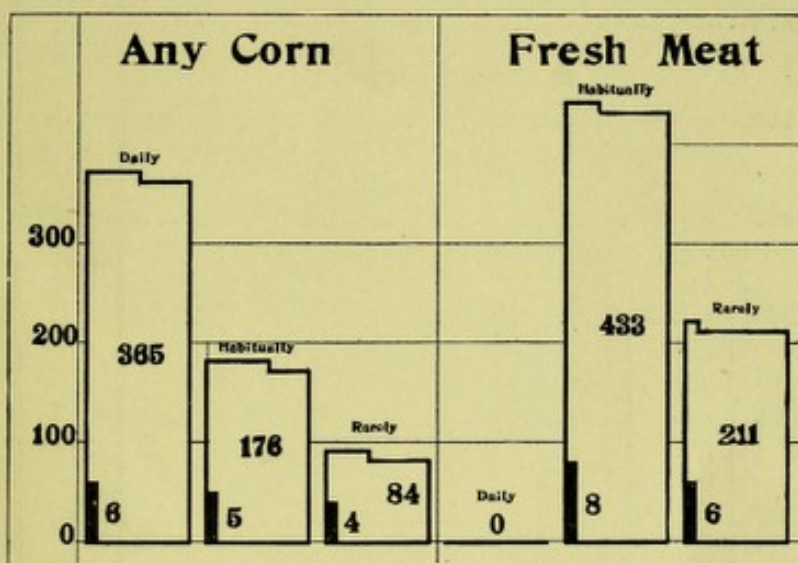


Fig. 12.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

### MILL VILLAGE A

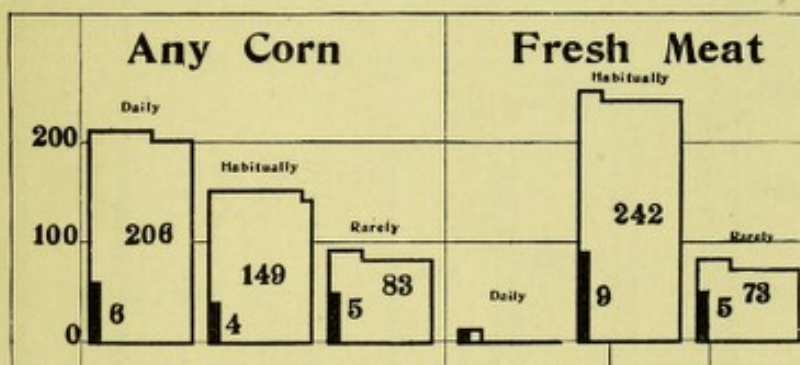


Fig. 13.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

This study has failed to reveal evidence of causal relationship of corn-meal to pellagra, and has shown that restriction of the use of corn-meal in the population studied has not proved effective as a prophylactic measure against pellagra.

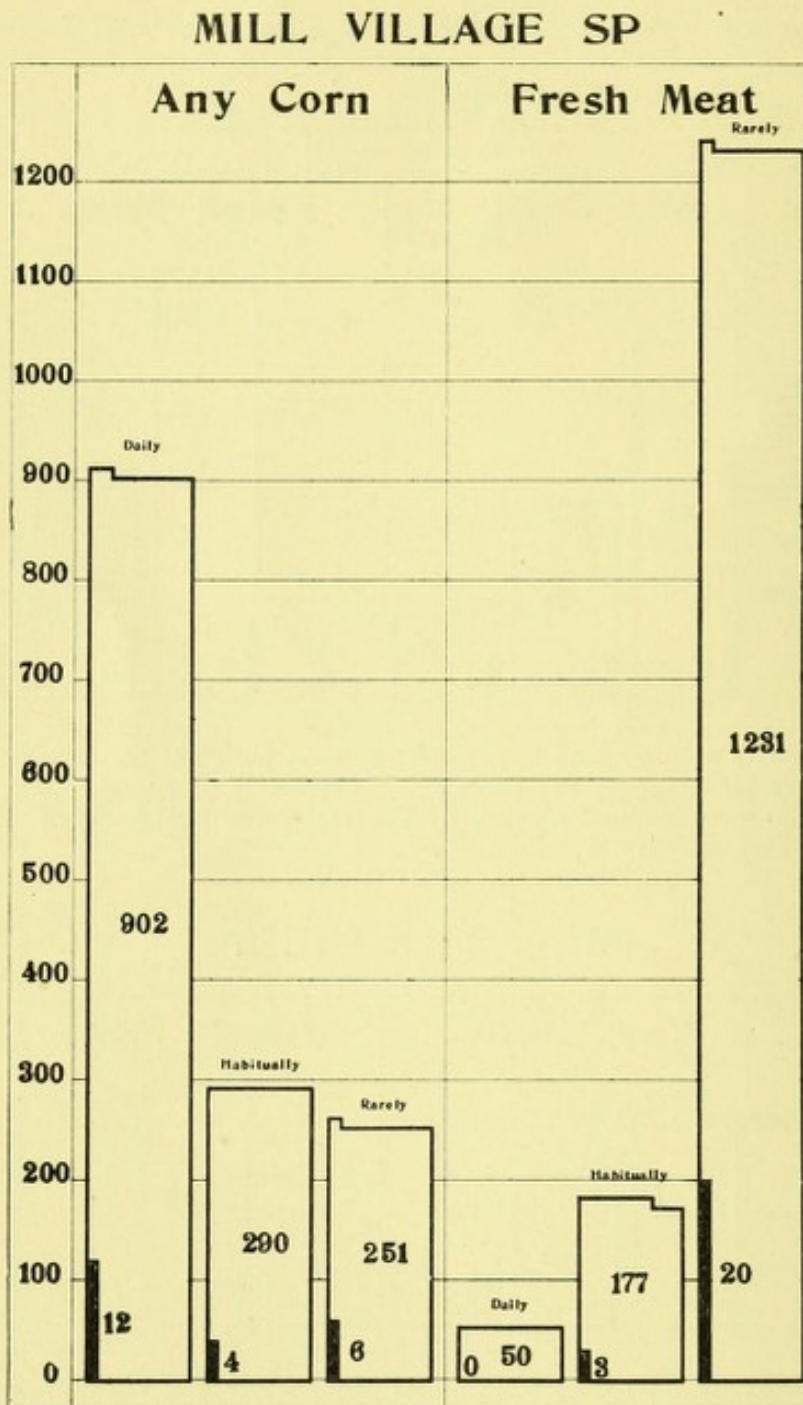


Fig. 14.—The area of each large white column indicates the number of non-pellagrins using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



## FRESH MEATS

The recorded data in regard to the frequency of use of fresh meat by families present at the time of our census in these six mill villages relate to 861 families, of which 140 then contained one or more cases of pellagra. The distribution of these families according to frequency of use of this food is shown in Tables 49, 50, 51 and 52.

TABLE 49.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	14	33	2	40	4	2	95
W	0	6	7	2	52	15	12	94
P	4	88	47	1	65	13	12	230
Sa	0	8	31	0	62	6	0	107
A	1	14	15	2	33	7	11	83
Sp	8	21	204	1	9	0	9	252
Total..	13	151	337	8	261	45	46	861

TABLE 50.—FAMILIES CONTAINING ONE OR MORE CASES OF PELLAGRA, DISTRIBUTED ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	1	4	0	8	1	0	14
W	0	1	3	0	10	2	3	19
P	1	12	6	0	7	3	1	30
Sa	0	4	9	0	15	1	0	29
A	1	4	4	0	8	0	0	17
Sp	1	1	26	1	2	0	0	31
Total..	3	23	52	1	50	7	4	140

The daily use of fresh meat was rather uncommon in this population, only thirteen families falling in this group. Almost half the families (420) used this food habitually, part time daily or part time habitually, and about half of them (428) used it rarely or never. In two of the villages we failed to find any families in which fresh meat was used daily. The families containing cases of pellagra occur in all the groups and are relatively most numerous in the group using



fresh meat daily and least numerous in the summarized group using this food rarely or never. In those families avoiding fresh meat altogether, only 4 out of a total of 46 had cases of pellagra, or 8.7 per cent., a lower percentage than in any other group.

TABLE 51.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Total Families			Pellagrin Families		
	Daily	<i>Habitually</i>	<i>Rarely</i>	Daily	<i>Habitually</i>	<i>Rarely</i>
I	0	56	39	0	9	5
W	0	60	34	0	11	8
P	4	154	72	1	19	10
Sa	0	70	37	0	19	10
A	1	49	33	1	12	4
Sp	8	31	213	1	4	26
Total .....	13	420	428	3	74	63

TABLE 52.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	<i>Habitually</i>	<i>Rarely</i>	Total
I	....	16.1	12.8	14.7
W	....	18.3	23.5	20.2
P	25.0	12.3	13.9	13.0
Sa	....	27.1	27.0	27.1
A	100.0	24.5	12.1	20.5
Sp	12.5	12.9	12.2	12.3
Total.....	23.1	17.6	14.7	16.3

The 861 families just considered included 5,133 persons, of whom 199 were pellagrins. The distribution of these persons according to the frequency of use of fresh meat in their families is shown in Tables 53, 54, 55 and 56.

It is evident that only a few (82) persons in this population used fresh meat daily, while 263 did not use it at all. About half the population (2,591 persons) used fresh meat as often as twice a week during part of the year at least, while the remaining population used this food less frequently. In certain mill villages, I, W, Sa and A, fresh meat could be had at local markets in the village only during the colder season of the year; during the summer the inhabitants were com-



TABLE 53.—DISTRIBUTION OF TOTAL INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	102	182	13	233	28	11	569
W	0	43	43	16	339	70	64	575
P	29	550	281	4	403	73	71	1,411
Sa	0	62	183	0	375	32	0	652
A	2	88	75	23	163	32	67	450
Sp	51	115	1,198	2	60	0	50	1,476
Total..	82	960	1,962	58	1,573	235	263	5,133

TABLE 54.—DISTRIBUTION OF PELLAGRINS ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	2	7	0	12	1	0	22
W	0	2	6	0	11	2	3	24
P	2	15	10	0	8	3	1	39
Sa	0	6	10	0	18	4	0	38
A	1	8	7	0	11	0	0	27
Sp	1	1	44	1	2	0	0	49
Total..	4	34	84	1	62	10	4	199

TABLE 55.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Total Population			Individual Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	0	348	221	0	14	8
W	0	398	177	0	13	11
P	29	957	425	2	23	14
Sa	0	437	215	0	24	14
A	2	274	174	1	19	7
Sp	51	177	1,248	1	4	44
Total .....	82	2,591	2,460	4	97	98



pelled to get their meat at more distant markets. In the large villages, P and Sp, the local markets sold fresh meat throughout the year. It was in these two villages that the lowest morbidity from pellagra was observed, namely, 2.76 and 3.32 per cent.

TABLE 56.—PELLAGRA MORBIDITY IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	<i>Habitually</i>	<i>Rarely</i>	Total
I	....	4.02	3.62	3.87
W	....	3.27	6.21	4.17
P	6.90	2.41	3.29	2.76
Sa	....	5.49	6.51	5.83
A	50.00	6.93	4.02	6.00
Sp	1.96	2.26	3.53	3.32
Total.....	4.88	3.74	3.98	3.88

When we turn our attention to the morbidity in each of the dietary groups, the relation of pellagra to the use of fresh meat is much less evident. In one village, Sp, the morbidity increases progressively with the decrease in frequency of use of fresh meat, daily 1.96, habitually 2.26, rarely 3.53 per cent., but in the same village there were 50 persons who did not use this food at all and none of them had pellagra. In the other villages the correlation is even more confused, and in the total population of the six villages the pellagra morbidity is actually highest in the group of 82 persons who used fresh meat daily, namely, 4.88 per cent., while of the 263 persons who never used it, only 4 suffered from the disease (1.52 per cent.). The recorded data do not seem, therefore, to indicate any consistent correlation between the existence of pellagra and deficiency of fresh meat in the dietary of this population.

The population to be considered in relation to incident cases of pellagra included 884 families, in 85 of which new cases of pellagra developed in 1912 and 1913. The distribution of these families according to frequency of use of fresh meat is shown in Tables 57, 58, 59 and 60.

There is not a consistent correlation between the frequency of use of fresh meat and the origin of new cases of pellagra in these families. In two villages, Sa and Sp, the incidence is highest in the summarized group using fresh meat rarely, but in three villages, I, W and A, it is lowest in this group. In the total families the occurrence of new cases of pellagra seems to be correlated directly with the frequency of use of fresh meat. Even in those 56 families never



TABLE 57.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	17	34	2	40	4	12	109
W	0	7	7	2	53	16	12	97
P	4	88	47	1	65	13	12	230
Sa	0	9	31	0	63	6	0	109
A	1	15	15	2	33	7	11	84
Sp	8	22	206	1	9	0	9	255
Total..	13	158	340	8	263	46	56	884

TABLE 58.—DISTRIBUTION OF FAMILIES IN WHICH NEW CASES OF PELLAGRA OCCURRED IN 1912 OR 1913, ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	4	5	0	6	1	0	16
W	0	2	1	0	6	1	1	11
P	1	7	6	0	4	2	0	20
Sa	0	2	4	0	5	0	0	11
A	1	5	2	0	2	0	0	10
Sp	0	1	15	1	0	0	0	17
Total..	2	21	33	1	23	4	1	85

TABLE 59.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Total Families			Families with Incident Pellagra		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	0	59	50	0	10	6
W	0	62	35	0	8	3
P	4	154	72	1	11	8
Sa	0	72	37	0	7	4
A	1	50	33	1	7	2
Sp	8	32	215	0	2	15
Total .....	13	429	442	2	45	38

using fresh meat, there was only one in which an incident case of pellagra appeared, or 1.8 per cent., a very much lower rate of incidence than was observed in any other group.

In the 884 families just considered, there were 4,853 persons, of whom 109 contracted pellagra in 1912 and 1913. The distribution of these persons according to the frequency of use of fresh meat in their families is shown in Tables 61, 62, 63 and 64.

TABLE 60.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	....	16.9	12.0	14.7
W	....	12.9	8.6	11.3
P	25.0	7.1	11.1	8.7
Sa	....	9.7	10.8	10.1
A	100.0	14.0	6.1	11.9
Sp	0.0	6.3	7.0	6.7
Total.....	15.4	10.5	8.6	9.6

TABLE 61.—DISTRIBUTION OF INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	131	184	13	230	28	11	597
W	0	45	38	16	335	74	62	570
P	29	464	280	4	348	72	70	1,267
Sa	0	65	179	0	368	32	0	644
A	2	88	73	0	154	0	0	317
Sp	50	117	1,181	2	58	0	50	1,458
Total..	81	910	1,935	35	1,493	206	193	4,853

New cases of pellagra developed in all the groups, and there is no consistent correlation between the incidence of these cases and the frequency of use of fresh meat. Of the 81 persons in families using this food daily, 3 acquired pellagra during the two years, a higher incidence (3.70 per cent.) than was observed in any other group. In the 193 persons who did not use fresh meat at all, only 1 new case of pellagra was observed, an incidence of 0.52 per cent., much lower than in any other group. In fact, in the village in which this one case



TABLE 62.—DISTRIBUTION OF INCIDENT PELLAGRINS ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	6	6	0	9	1	0	22
W	0	2	1	0	5	3	1	12
P	2	7	8	0	4	2	0	23
Sa	0	3	6	0	5	0	0	14
A	1	7	5	0	2	0	0	15
Sp	0	2	20	1	0	0	0	23
Total..	3	27	46	1	25	6	1	109

TABLE 63.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF FRESH MEAT

Village	Total Population			Incident Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	0	374	223	0	15	7
W	0	396	174	0	7	5
P	29	816	422	2	11	10
Sa	0	433	211	0	8	6
A	2	242	73	1	9	5
Sp	50	177	1,231	0	3	20
Total .....	81	2,438	2,334	3	53	53

TABLE 64.—INCIDENCE OF PELLAGRA IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	....	4.01	3.14	3.69
W	....	1.77	2.87	2.11
P	6.90	1.35	2.37	1.82
Sa	....	1.85	2.84	2.17
A	50.00	3.72	6.85	4.73
Sp	0.00	1.69	1.62	1.58
Total.....	3.70	2.17	2.27	2.25

occurred there were 62 persons who did not use fresh meat, so that the incidence for that village alone was only 1.61 per cent. for this group. One finds here no support for the idea that deficiency of fresh meat in the diet is a cause of pellagra. On the contrary, it would appear quite certain that in the population here studied those avoiding fresh meat contracted this disease least.

TABLE 65.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	2	17	58	0	0	0	10	87
W	3	27	48	1	0	0	12	91
P	4	58	136	0	0	1	27	226
Sa	1	21	75	1	0	0	8	106
A	3	21	54	0	0	0	3	81
Sp	3	15	178	0	0	0	54	250
Total..	16	159	549	2	0	1	114	841

TABLE 66.—FAMILIES CONTAINING ONE OR MORE CASES OF PELLAGRA DISTRIBUTED ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	4	9	0	0	0	0	13
W	0	1	12	1	0	0	3	17
P	0	9	16	0	0	1	5	31
Sa	0	6	20	1	0	0	2	29
A	0	3	14	0	0	0	0	17
Sp	0	0	24	0	0	0	7	31
Total..	0	23	95	2	0	1	17	138

#### CANNED GOODS

The data in regard to the use of canned goods (tinned foods) include 841 families present at the time of census, 138 of which contained one or more cases of pellagra at that time. The distribution of these families according to frequency of use of tinned foods is shown in Tables 65, 66, 67 and 68.



There is evidently no consistent positive correlation between the frequency of use of canned goods and the existence of cases of pellagra in these families. In fact the indication, if anything, would appear to be the reverse. The 16 families using this kind of food daily had no pellagra, while, of the 114 families avoiding canned goods altogether, no less than seventeen (14.9 per cent.), contained one or more cases of the disease.

TABLE 67.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Total Families			Pellagrin Families		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	2	17	68	0	4	9
W	3	28	60	0	2	15
P	4	58	164	0	9	22
Sa	1	22	83	0	7	22
A	3	21	57	0	3	14
Sp	3	15	232	0	0	31
Total .....	16	161	664	0	25	113

TABLE 68.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	0.0	23.5	13.2	14.9
W	0.0	7.1	25.0	18.7
P	0.0	15.5	13.4	13.7
Sa	0.0	31.8	26.5	27.4
A	0.0	14.3	24.6	21.0
Sp	0.0	0.0	13.4	12.4
Total.....	0.0	15.5	17.0	16.4

The 841 families just considered contained 4,966 persons, of whom 192 were pellagrins. The distribution of these persons according to the frequency of use of tinned foods in their families is shown in Tables 69, 70, 71 and 72.

Evidence of correlation between the existence of pellagra in a family and the frequency of use of canned goods is not to be found in these tables. The 89 persons using canned foods daily had no pellagra. In the 643 persons who avoided such foods, 18, or 2.80 per cent., were pellagrins.

TABLE 69.—DISTRIBUTION OF TOTAL INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	9	111	337	0	0	0	60	517
W	12	168	292	3	0	0	71	546
P	24	416	788	0	0	5	148	1,381
Sa	2	141	462	5	0	0	32	642
A	20	114	286	0	0	0	11	431
Sp	22	88	1,018	0	0	0	321	1,449
Total..	89	1,038	3,183	8	0	5	643	4,966

TABLE 70.—DISTRIBUTION OF PELLAGRINS ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	5	14	0	0	0	0	19
W	0	1	17	1	0	0	3	22
P	0	12	21	0	0	1	6	40
Sa	0	9	25	2	0	0	2	38
A	0	4	22	0	0	0	0	26
Sp	0	0	40	0	0	0	7	47
Total..	0	31	139	3	0	1	18	192

TABLE 71.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Total Population			Individual Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	9	111	397	0	5	14
W	12	171	363	0	2	20
P	24	416	941	0	12	28
Sa	2	146	494	0	11	27
A	20	114	297	0	4	22
Sp	22	88	1,339	0	0	47
Total .....	89	1,046	3,831	0	34	158



For the study of the occurrence of new cases of pellagra in relation to the use of canned goods, we have data on 853 families, in 85 of which one or more new cases of the disease developed in 1912 or 1913. The distribution of these families in respect to frequency of use of tinned foods is shown in Tables 73, 74, 75 and 76.

TABLE 72.—PELLAGRA MORBIDITY IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	0	4.55	3.53	3.68
W	0	1.17	5.51	4.03
P	0	2.88	2.98	2.90
Sa	0	7.53	5.47	5.92
A	0	3.51	7.41	6.03
Sp	0	0.00	3.51	3.24
Total.....	0	3.25	4.12	3.87

TABLE 73.—DISTRIBUTION OF TOTAL FAMILIES ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	2	17	61	0	1	0	10	91
W	3	27	50	1	0	0	13	94
P	4	58	136	0	0	1	27	226
Sa	1	22	76	1	1	0	8	109
A	3	21	54	0	0	0	3	81
Sp	3	15	180	0	0	0	54	252
Total..	16	160	557	2	2	1	115	853

The occurrence of new cases of pellagra in a family does not appear to have been influenced in any consistent way by the frequency with which the family used canned goods. The 16 families using canned goods daily had no new cases of the disease during the two years. Of the 115 families avoiding the use of these foods, 8 (7 per cent.), had new cases of pellagra during 1912 or 1913.

The 853 families just considered included 4,874 persons, of whom 109 persons contracted pellagra in 1912 or 1913. The distribution of these persons according to frequency of use of tinned foods is shown in Tables 77, 78, 79 and 80.

TABLE 74.—DISTRIBUTION OF FAMILIES IN WHICH NEW CASES OF PELLAGRA OCCURRED IN 1912 OR 1913, ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	2	12	0	1	0	0	15
W	0	0	9	1	0	0	1	11
P	0	8	10	0	0	1	1	20
Sa	0	2	8	1	1	0	0	12
A	0	2	8	0	0	0	0	10
Sp	0	0	11	0	0	0	6	17
Total..	0	14	58	2	2	1	8	85

TABLE 75.—SUMMARIZED DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Total Families			Families with Incident Pellagra		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	2	18	71	0	3	12
W	3	28	63	0	1	10
P	4	58	164	0	8	12
Sa	1	24	84	0	4	8
A	3	21	57	0	2	8
Sp	3	15	234	0	0	17
Total .....	16	164	673	0	18	67

TABLE 76.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	0	16.7	16.9	16.5
W	0	3.6	15.9	11.7
P	0	13.8	7.3	8.8
Sa	0	16.7	9.5	11.0
A	0	9.5	14.0	12.3
Sp	0	0.0	7.3	6.7
Total.....	0	11.0	10.0	10.0



TABLE 77.—DISTRIBUTION OF INDIVIDUALS ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	9	108	367	0	3	0	60	547
W	12	168	291	3	0	0	71	545
P	24	352	778	0	0	5	144	1,303
Sa	2	140	452	5	7	0	32	638
A	20	112	277	0	0	0	0	409
Sp	22	88	1,002	0	0	0	320	1,432
Total..	89	968	3,167	8	10	5	627	4,874

TABLE 78.—DISTRIBUTION OF INCIDENT PELLAGRINS ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Daily	Habitually	Rarely	Part Time			Never	Total
				Daily	Habitually	Rarely		
I	0	2	18	0	1	0	0	21
W	0	0	11	1	0	0	1	13
P	0	9	11	0	0	1	2	23
Sa	0	2	9	2	1	0	0	14
A	0	2	13	0	0	0	0	15
Sp	0	0	17	0	0	0	6	23
Total..	0	15	79	3	2	1	9	109

TABLE 79.—SUMMARIZED DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF CANNED GOODS

Village	Total Individuals			Incident Pellagrins		
	Daily	Habitually	Rarely	Daily	Habitually	Rarely
I	9	111	427	0	3	18
W	12	171	362	0	1	12
P	24	352	927	0	9	14
Sa	2	152	484	0	5	9
A	20	112	277	0	2	13
Sp	22	88	1,322	0	0	23
Total .....	89	986	3,799	0	20	89

TABLE 80.—INCIDENCE OF PELLAGRA IN EACH OF THE SUMMARIZED GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Total
I	0	2.73	4.22	3.84
W	0	5.85	3.31	2.39
P	0	2.56	1.51	1.77
Sa	0	3.29	1.86	2.19
A	0	1.79	4.69	3.67
Sp	0	0.00	1.74	1.61
Total.....	0	2.03	2.34	2.24

There is no evident consistent correlation discovered here between the use of canned goods and the development of new cases of pellagra. The 89 persons in families using these foods daily remained free from pellagra. Of the 627 persons who avoided altogether the use of canned goods, 9, or 1.44 per cent., developed the disease in the course of the two years 1912 and 1913. There is no significant difference in incidence of pellagra between the groups using these foods habitually and the groups using them rarely. This study has failed therefore to discover any evidence that the use of canned goods causes pellagra, and suggests that these foods had no part in the causation of this disease in this particular population.

## MILL VILLAGE I

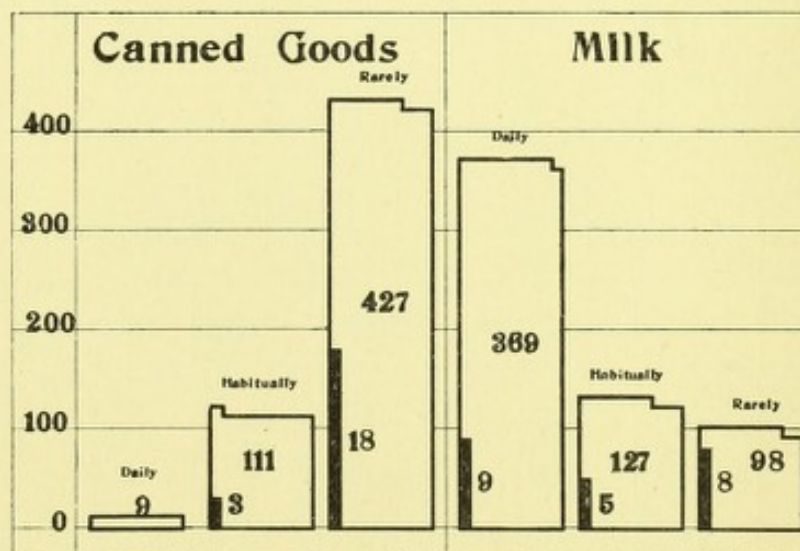


Fig. 15.—The area of each large white column indicates the number of non-pellagrins individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



## MILL VILLAGE W



Fig. 16.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE P

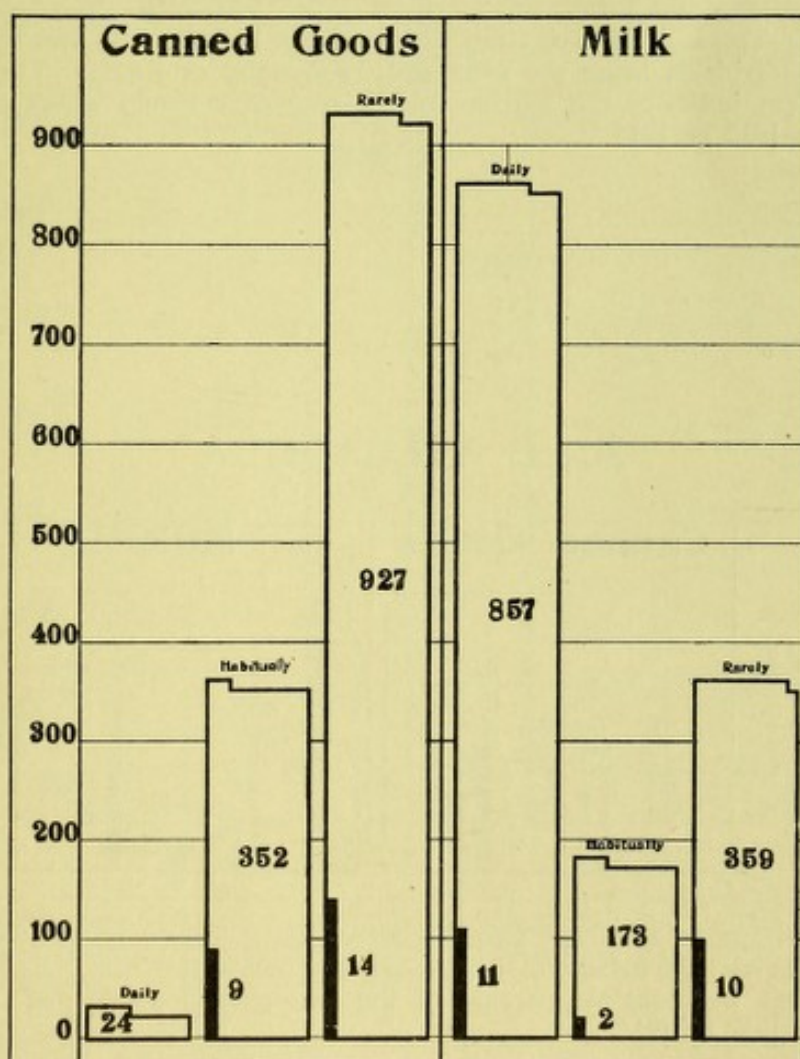


Fig. 17.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE SA

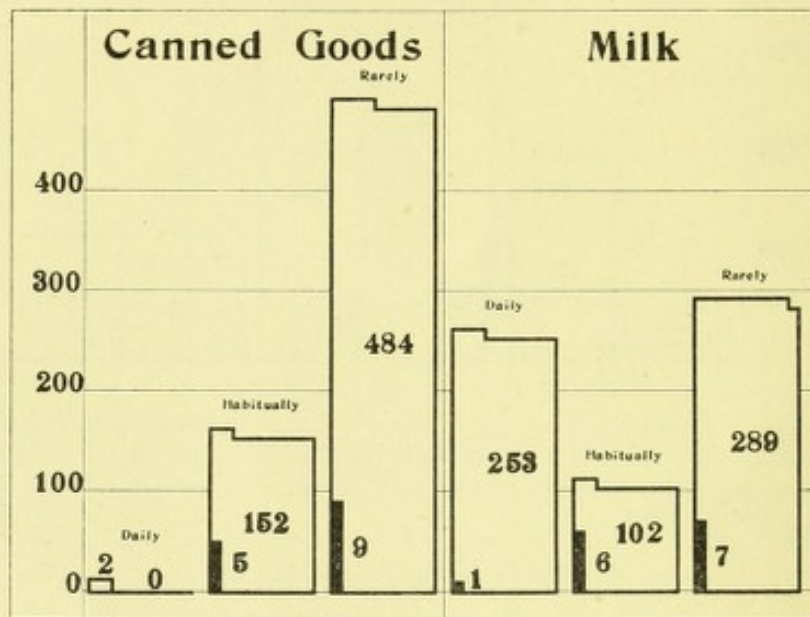


Fig. 18.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE A

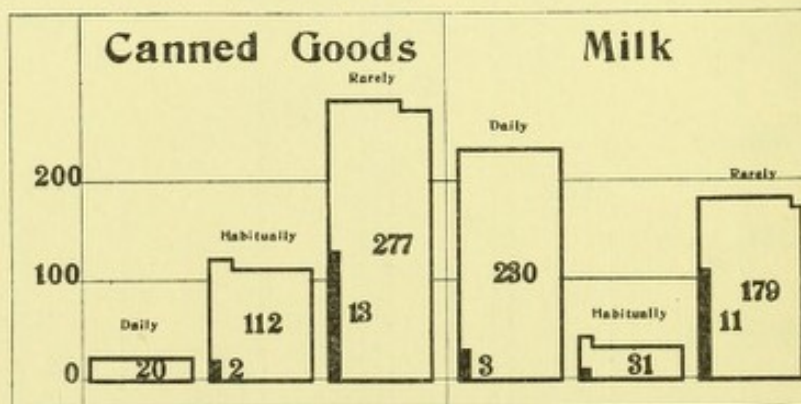


Fig. 19.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.



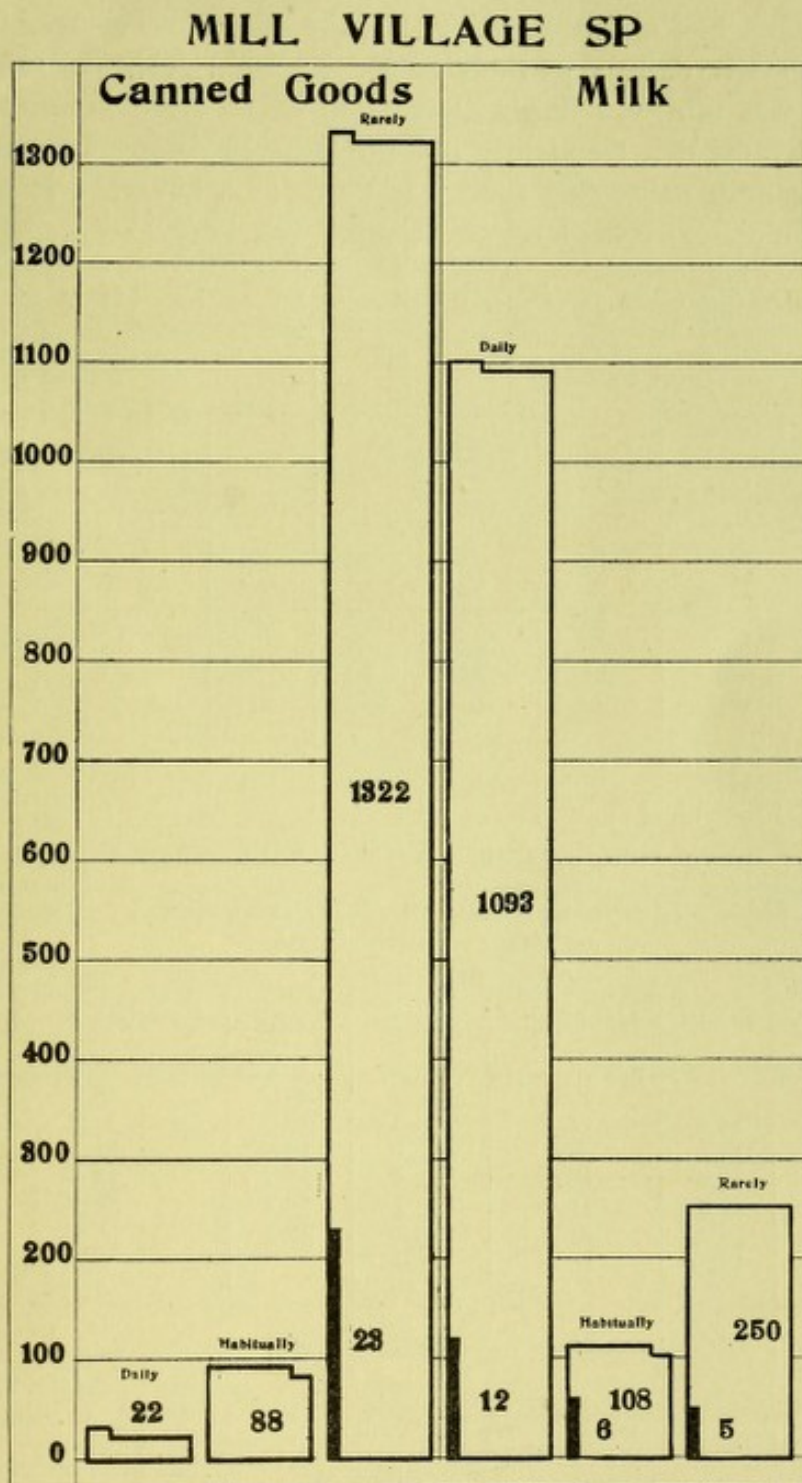


Fig. 20.—The area of each large white column indicates the number of non-pellagrin individuals using the food daily, *habitually* or *rarely*. The included black column indicates the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILK

Of the six mill villages used for the detailed study of the foods, only one, Sp, had a market dairy. In the other five villages the families using milk daily kept their own cows, as a rule. In only a few instances was milk purchased daily from neighboring families. Those who used milk less frequently did not possess cows. In many families using milk daily, this food was taken as a beverage in the form of buttermilk. Drinking of sweet milk was very exceptional.

TABLE 81.—DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF MILK

Village	Total Families					Pellagrin Families				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	63	21	10	2	96	9	3	0	2	14
W	53	17	8	14	92	7	5	1	6	19
P	137	32	40*	21	230	16	6	5*	4	31
Sa	46	16	18	27	107	13	5	4	7	29
A	39	7†	13	24	83	6	3†	4	4	17
Sp	187	18	29	22	256	20	3	2	6	31
Total .....	525	111	118	110	864	71	25	16	29	141

\* Includes one family using milk part time rarely. † Includes one family using milk part time habitually.

TABLE 82.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never*	Total
I	14.3	14.3	0.0	100.0	16.7	14.6
W	13.2	29.4	12.5	42.9	31.8	20.7
P	11.7	18.8	12.5	19.0	14.8	13.5
Sa	28.3	31.3	22.2	25.9	24.4	27.1
A	15.4	42.9	30.8	16.7	21.6	20.5
Sp	10.7	16.7	6.9	27.3	15.7	12.1
Total .....	13.5	22.5	13.6	26.4	19.7	16.3

\* This group corresponds to the one designated as *Rarely* in the preceding summary tables.

The recorded data concerning the population present at the time of our census relate to 864 families, in 141 of which one or more cases of pellagra existed at the time. The distribution of these families in respect to the frequency of use of milk is shown in Tables 81 and 82. Only one family used milk part time habitually; one, part time rarely, and none part time daily. These groups are therefore not given separate consideration in the tables.



Milk was used daily by considerably more than half the total families; and in only two of the villages, Sa and A, was this food daily used by less than half the population. The groups using milk habitually, rarely and never are well represented, each including more than 100 families. Table 82 (of percentages) suggests that pellagra was, on the whole, somewhat less common in families using milk daily. Furthermore, the 110 families avoiding altogether the use of milk included 29, or 26.4 per cent., in which pellagra existed, a figure distinctly above the average for the total families considered.

TABLE 83.—DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF MILK

Village	Total Population					Individual Pellagrins				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	371	127	53	13	564	11	5	0	4	20
W	327	102	55	69	553	9	7	1	7	24
P	865	177	233*	134	1,409	19	6	7†	8	40
Sa	268	103	126	159	656	16	7	7	8	38
A	236	40‡	46	129	451	9	6§	4	8	27
Sp	1,104	104	144	115	1,467	25	7	6	8	46
Total .....	3,171	653	657	619	5,100	89	38	25	43	195

\* Includes five persons using milk part time rarely. † Includes one person using milk part time rarely. ‡ Includes eight persons using milk part time habitually. § Includes one person using milk part time habitually.

TABLE 84.—PELLAGRA MORBIDITY IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never*	Total
I	2.96	3.94	0.00	3.08	6.06	3.55
W	2.75	6.86	1.82	10.14	6.45	4.34
P	2.20	3.39	3.00	5.97	4.09	2.84
Sa	5.97	6.80	5.56	5.03	5.26	5.79
A	3.81	15.00	8.70	6.20	6.86	5.99
Sp	2.26	6.73	4.17	6.96	5.41	3.14
Total .....	2.81	5.82	3.81	6.95	5.33	3.82

\* This group corresponds to the one designated as *Rarely* in the preceding summary tables.

The 864 families just considered included 5,100 persons, of whom 195 were pellagrins at the time of our census. Inasmuch as the four groups using milk daily, habitually, rarely and never each contain more than 600 individuals, while the other groups are very small, it seems best to present the figures in four groups (Tables 83 and 84).



The correlation between frequency of use of milk and freedom from pellagra is not definitely consistent; but, in five of the villages, those avoiding the use of milk altogether had relatively more pellagra than those using this food daily. The figures for the total population also show a marked difference, 2.81 per cent. of those using milk daily being pellagrins against 6.95 per cent. of those never using milk. It would appear, therefore, that pellagrins used milk somewhat less frequently, on the whole, than the population which was free from this disease.

For the study of the relation of milk in the diet to the origin of new cases of pellagra, we have records of 877 families of which 86 developed one or more incident cases of the disease in 1912 or 1913. There were no families in the groups "Part Time Daily" and "Part Time Habitually," and only one family of five persons in the group "Part Time Rarely." It therefore seems unnecessary to present the usual detailed tables of the seven groups. In Tables 85 and 86 the one family of five persons using milk part time rarely has been classed with those using milk rarely. One new case of pellagra developed in this family.

TABLE 85.—DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF MILK

Village	Total Families					Families with Incident Pellagra				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	63	21	11	5	100	8	3	1	4	16
W	54	18	9	14	95	5	2	1	3	11
P	137	32	40*	23	232	10	2	2*	6	20
Sa	46	16	19	28	109	1	5	2	4	12
A	39	6	13	25	83	3	1	1	5	10
Sp	188	19	29	22	258	9	4	2	2	17
Total .....	527	112	121	117	877	36	17	9	24	86

\* Includes one family using milk rarely for part of the year only.

In Table 86 the group designated "Rarely or Never" is strictly comparable with the summarized group designated as *Rarely* in the presentation of data concerning other foods. There is a fairly consistent correlation shown in this table, indicating that the families in which milk was not used were the ones in which new cases of pellagra most commonly appeared, while, on the other hand, those families using this food daily developed new cases the most infrequently. This difference would appear to have some significance.

The 877 families just considered included 5,067 persons free from pellagra at the beginning of 1912. Of these 5,067 persons, 110 con-



tracted the disease during 1912 and 1913. One family of five persons used milk rarely for part of the year only. All the other persons fell strictly within the groups shown in Tables 87 and 88.

TABLE 86.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	12.7	14.3	9.1	80.0	31.3	16.0
W	9.3	11.1	11.1	21.4	17.4	11.6
P	7.3	6.3	5.0	26.1	12.7	8.6
Sa	2.2	31.3	10.5	14.3	12.8	11.0
A	7.7	16.7	7.7	20.0	15.8	12.0
Sp	4.8	21.1	6.9	9.1	7.8	6.6
Total .....	6.8	15.2	7.4	20.5	13.9	9.8

TABLE 87.—DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF MILK

Village	Total Individuals					Incident Pellagrins				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	369	127	56	42	594	9	5	1	7	22
W	328	99	57	65	549	7	2	1	3	13
P	857	173	228*	131	1,389	11	2	2†	8	23
Sa	253	102	127	162	644	1	6	2	5	14
A	230	31	43	136	440	3	1	1	10	15
Sp	1,093	108	141	109	1,451	12	6	3	2	23
Total .....	3,130	640	652	645	5,067	43	22	10	35	110

\* Includes five persons using milk part time rarely. † Includes one person using milk part time rarely.

TABLE 88.—INCIDENCE OF PELLAGRA IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	2.44	3.94	1.79	16.67	8.16	3.70
W	2.13	2.02	1.75	4.62	3.28	2.37
P	1.28	1.16	0.88	6.11	2.79	1.66
Sa	0.40	5.88	1.57	3.09	2.42	2.17
A	1.30	3.23	2.33	7.35	6.15	3.41
Sp	1.09	5.56	2.13	1.84	2.00	1.59
Total .....	1.37	3.44	1.53	5.43	3.47	2.17



It is evident that in the whole population those persons using milk daily contracted pellagra the least. Of the 3,130 persons in this group, only 43 acquired the disease during the two years. In the whole population also, it is clear that those avoiding the use of milk suffered most from the development of new cases of pellagra. The incidence of the disease in the latter group, 5.43 per cent., is nearly four times that in the former, 1.37 per cent. In every one of the six villages the group using milk daily showed a lower incidence than the average for that village, and those never using milk showed a higher incidence than the average. The correlation is quite inconsistent in the groups using milk habitually and rarely. The tendency toward correlation between the occurrence of new cases of pellagra and the deficiency of milk in the diet is nevertheless distinctly evident, on the whole, and suggests that the use of milk (including buttermilk) as a food has some value in the prevention of pellagra.

TABLE 89.—DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF EGGS

Village	Total Families					Pellagrin Families				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	37	42	13	0	92	3	6	2	0	11
W	14	52	23	6	95	3	7	8	1	19
P	35	125	55	9	224	3	17	5	1	26
Sa	26	46	31	3	106	10	9	9	1	29
A	13	35*	30	5	83	1	8*	8	0	17
Sp	28	90	129	5	252	2	14	14	1	31
Total .....	153	390	281	28	852	22	61	46	4	133

\* Includes one family using eggs part time habitually.

## EGGS

The recorded data concerning the use of eggs relate to 852 families present in the six villages at the time of our census, of which 133 contained one or more pellagrins. The distribution of these families according to the frequency of use of eggs is shown in Tables 89 and 90.

The tabulated data show very clearly that there was no significant variation in existence of pellagra in families correlated with a difference in frequency of use of eggs. The percentage of families with pellagra in the different groups is remarkably uniform.

The 852 families contained 5,068 persons, of whom 186 were pellagrins at the time of our census. The distribution of these persons according to frequency of use of eggs in their families, is shown in Tables 91 and 92.



TABLE 90.—PELLAGRIN FAMILIES IN TOTAL FAMILIES IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	8.1	14.3	15.4	....	15.4	12.0
W	21.4	13.5	34.8	16.7	31.0	20.0
P	8.6	13.6	9.1	11.1	9.4	11.6
Sa	38.5	19.6	29.0	33.3	29.4	27.4
A	7.7	22.9	26.7	0.0	22.9	20.5
Sp	7.1	15.6	10.9	20.0	11.2	12.3
Total .....	14.4	15.6	16.4	14.3	16.2	15.6

TABLE 91.—DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF EGGS

Village	Total Population					Individual Pellagrins				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	225	253	64	0	542	3	9	4	0	16
W	75	317	144	32	568	5	8	10	1	24
P	198	786	337	62	1,383	3	22	8	1	34
Sa	157	267	209	19	652	15	9	13	1	38
A	65	187*	169	28	449	1	16†	10	0	27
Sp	151	505	789	29	1,474	3	15	27	2	47
Total .....	871	2,315	1,712	170	5,068	30	79	72	5	186

\*Includes eight persons using eggs part time habitually. † Includes four persons using eggs part time habitually.

TABLE 92.—PELLAGRA MORBIDITY IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	1.33	3.56	6.25	....	6.25	2.95
W	6.67	2.52	6.94	3.13	6.25	4.23
P	1.52	2.80	2.37	1.61	2.26	2.46
Sa	9.55	3.37	6.22	5.26	6.14	5.83
A	1.54	8.56	5.99	0.00	5.13	6.01
Sp	1.99	2.97	3.42	6.90	3.55	3.19
Total .....	3.44	3.41	4.21	2.94	4.09	3.67

It is evident from the tables that no consistent correlation has been discovered between the distribution of cases of pellagra and the frequency of use of eggs.

In regard to the relation between use of eggs and the origin of new cases of pellagra, we have data on 861 families, of which 77 developed one or more new cases in 1912 or 1913. The distribution according to frequency of use of eggs is shown in Tables 93 and 94.

TABLE 93.—DISTRIBUTION OF FAMILIES ACCORDING TO FREQUENCY OF USE OF EGGS

Village	Total Families					Families with Incident Pellagra				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	38	43	13	0	94	3	7	2	0	12
W	15	53	24	6	98	2	5	4	0	11
P	37	125	55	9	226	5	9	3	0	17
Sa	27	47	31	3	108	4	2	5	1	12
A	13	34	30	6	83	0	5	4	1	10
Sp	28	90	129	5	252	1	8	5	1	15
Total .....	158	392	282	29	861	15	36	23	3	77

TABLE 94.—FAMILIES WITH INCIDENT PELLAGRA IN TOTAL FAMILIES IN EACH OF THE GROUPS, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	7.9	16.3	15.4	....	15.4	12.8
W	13.3	9.4	16.7	0.0	13.3	11.2
P	13.5	7.2	5.5	0.0	4.7	7.5
Sa	14.8	4.3	16.1	33.3	17.6	11.1
A	0.0	14.7	13.3	16.7	13.9	12.0
Sp	3.6	8.9	3.9	20.0	4.5	6.0
Total .....	9.5	9.2	8.2	10.3	8.4	8.9

There is no evidence of any relationship between the use of eggs by a family and the development of a new case of pellagra in that family.

The 861 families just considered included 4,724 persons free from pellagra at the beginning of 1912. Of these 4,724 persons, 99 contracted the disease during 1912 and 1913. The distribution of these persons according to frequency of use of eggs in their families is shown in Tables 95 and 96.



In these tables it again appears that pellagra originated with almost equal frequency in all the groups, and there is no evidence that its origin was influenced at all by the presence or absence of eggs in the diet. The high incidence, 3.43 per cent., in the 175 persons never using eggs does not appear worthy of much consideration because of the small number of persons concerned and the irregularity of the figures for the different villages.

TABLE 95.—DISTRIBUTION ACCORDING TO FREQUENCY OF USE OF EGGS

Village	Total Families					Incident Pellagrins				
	Daily	Habitually	Rarely	Never	Total	Daily	Habitually	Rarely	Never	Total
I	235	256	64	0	555	4	9	4	0	17
W	15	80	140	31	266	2	7	4	0	13
P	210	774	333	61	1,378	5	10	4	0	19
Sa	153	266	202	19	640	5	2	6	1	14
A	64	174	163	36	437	0	7	4	4	15
Sp	149	499	772	28	1,448	1	9	10	1	21
Total .....	826	2,049	1,674	175	4,724	17	44	32	6	99

TABLE 96.—INCIDENT PELLAGRINS IN TOTAL POPULATION IN EACH GROUP, PER CENT.

Village	Daily	Habitually	Rarely	Never	Rarely or Never	Total
I	1.70	3.52	6.25	....	6.25	3.06
W	13.33	8.75	2.86	0.00	2.34	4.89
P	2.38	1.29	1.20	0.00	1.02	1.38
Sa	3.27	0.75	2.97	5.26	3.17	2.19
A	0.00	4.02	2.45	11.11	4.02	3.43
Sp	0.67	1.80	1.30	3.57	1.38	1.45
Total .....	2.06	2.15	1.91	3.43	2.06	2.10

*THE RELATION BETWEEN LOCATION OF A DOMICILE OF AN INCIDENT CASE OF PELLAGRA AND THE DOMICILE OF AN ANTECEDENT CASE*

The data accumulated by the house-to-house census in the various mill villages, and our records of the cases of pellagra there, permit us to examine the geographical relationship of the houses in which pellagra has developed to houses in which a case of the disease already existed. We have chosen to divide the non-pellagrin population of

# MILL VILLAGE I

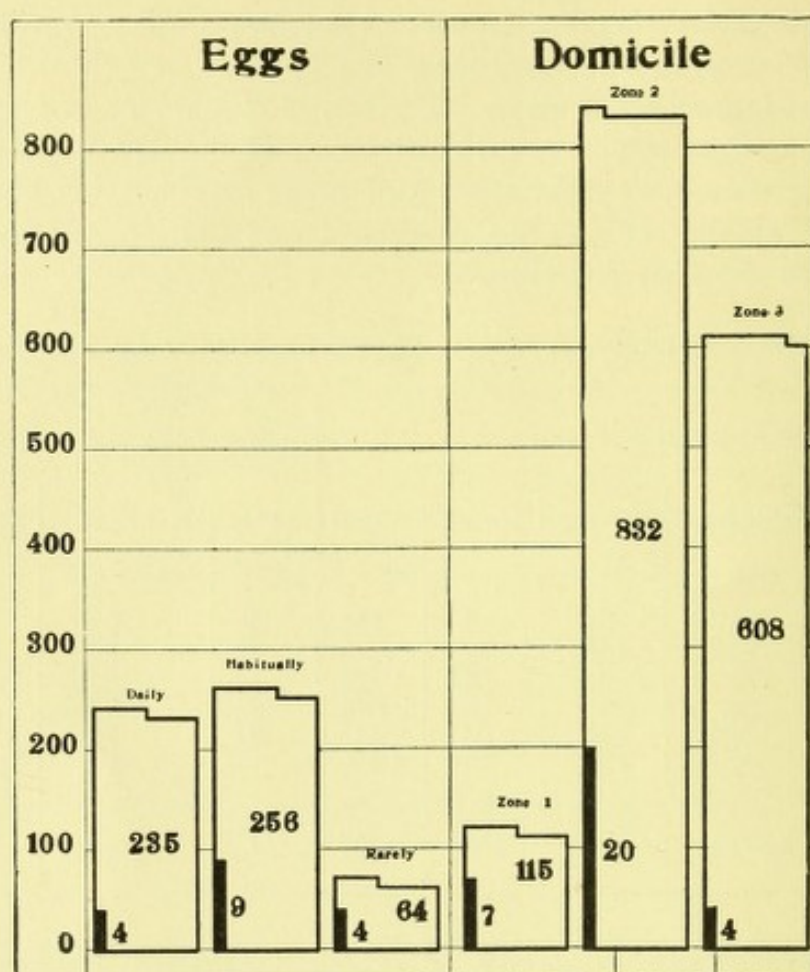


Fig. 21.—The area of each of the three white columns at the left indicates the number of non-pellagrins using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrins living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.

# MILL VILLAGE W

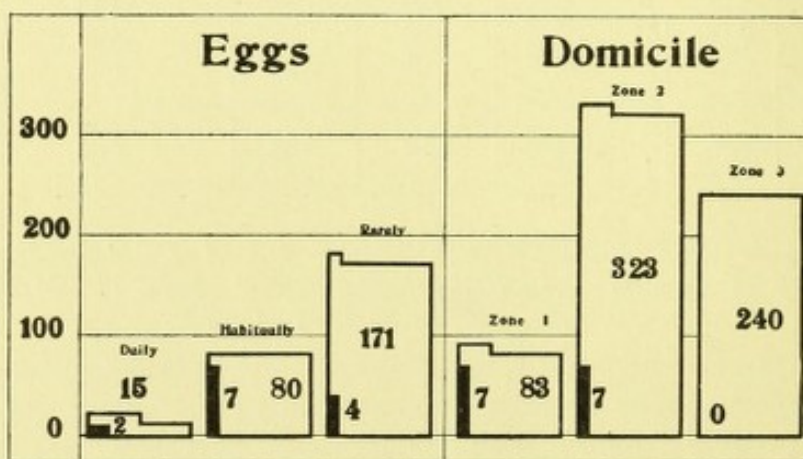


Fig. 22.—The area of each of the three white columns at the left indicates the number of non-pellagrins using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrins living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.



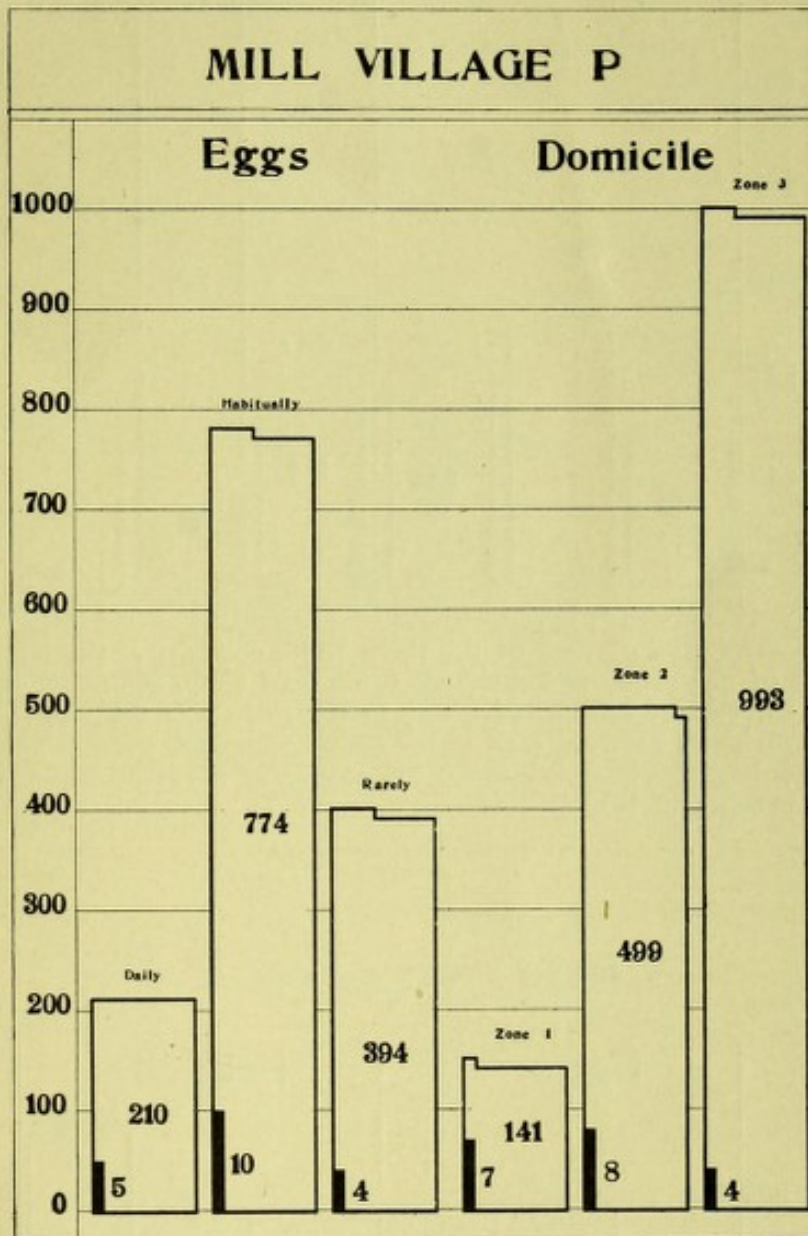


Fig. 23.—The area of each of the three white columns at the left indicates the number of non-pellagrins using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrins living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE SA

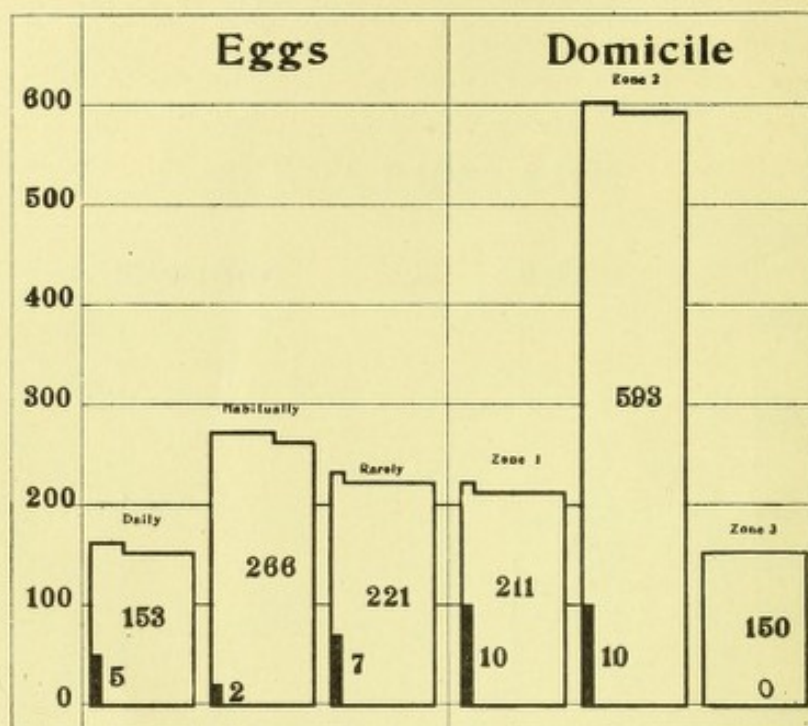


Fig. 24.—The area of each of the three white columns at the left indicates the number of non-pellagrin individuals using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrin individuals living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.

## MILL VILLAGE A

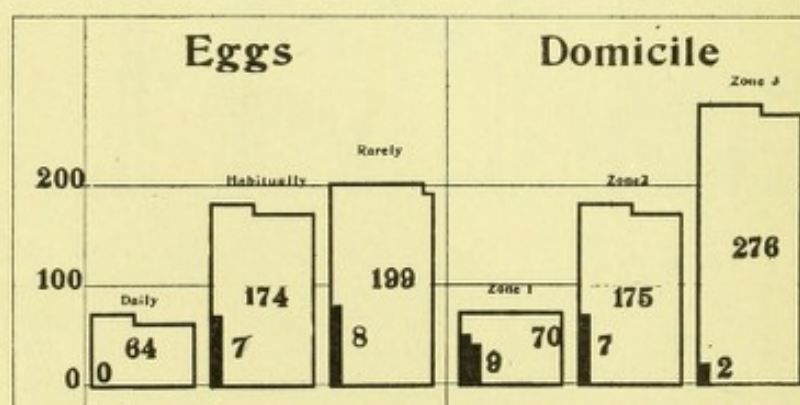


Fig. 25.—The area of each of the three white columns at the left indicates the number of non-pellagrin individuals using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrin individuals living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.



each village into three parts or zones in respect to domicile: first zone, those persons free from pellagra living in the same building in which a patient with pellagra resided during 1912 or the first part of 1913; second zone, those persons, not included in the first zone, who resided in a house adjacent to the house of a pellagrin; third zone, those persons living in houses at distances greater than next door to the domicile of a pellagrin. The second zone included the houses

### MILL VILLAGE SP

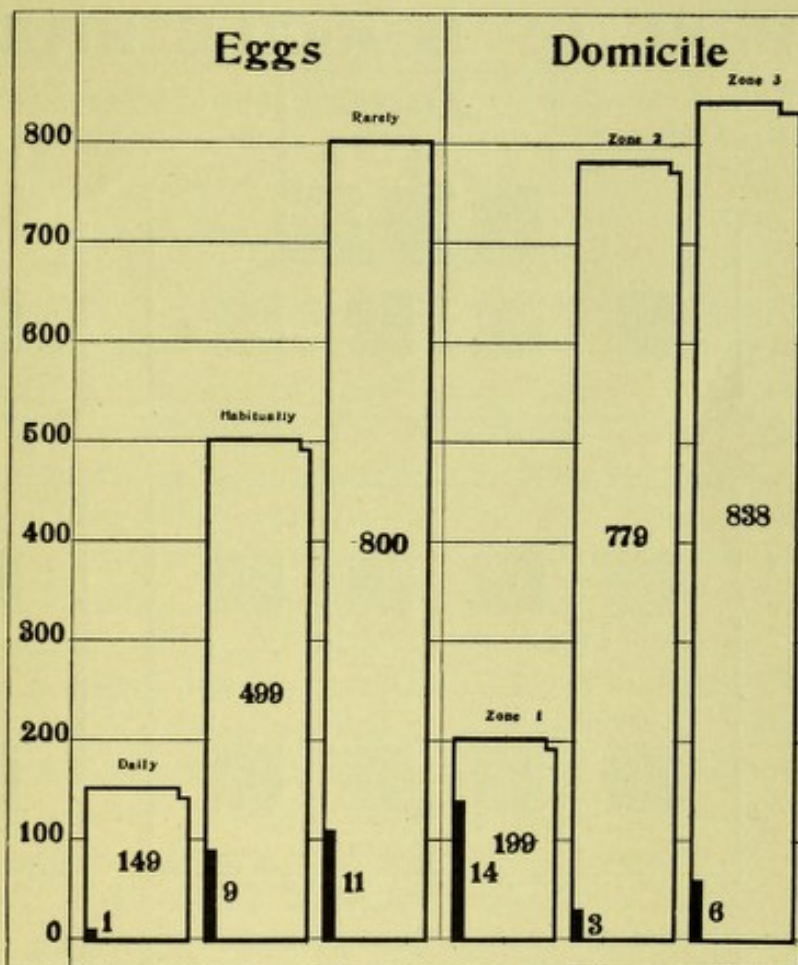


Fig. 26.—The area of each of the three white columns at the left indicates the number of non-pellagrin individuals using eggs daily, *habitually* and *rarely*. The three columns at the right indicate in the same way the number of non-pellagrin individuals living in each of the three domiciliary zones. The included black column indicates in each instance the portion of the respective group which contracted pellagra in 1912 or 1913.

at either side, directly in front, across the street, and directly behind, provided the intervening space was not greater than that of the ordinary mill-village lot (about 100 feet) and also the four houses adjacent on diagonals from the original house. The scheme of the study may be quickly grasped by reference to Figure 27. Each house containing a patient with pellagra during 1912 or early in 1913, whether the



patient moved in there or the case originated there, was considered in turn as the center of such a diagram, and the total persons free from pellagra at the beginning of exposure ascertained for each case as far as our records show them. By adding together the totals for each zone we were then able to ascertain the total number of non-pellagrin population living in the same house with a pellagrin and the total number of cases of pellagra known to develop in this population during 1912 and 1913; in the same way the total number of instances in which

## SCHEME OF DOMICILE STUDY

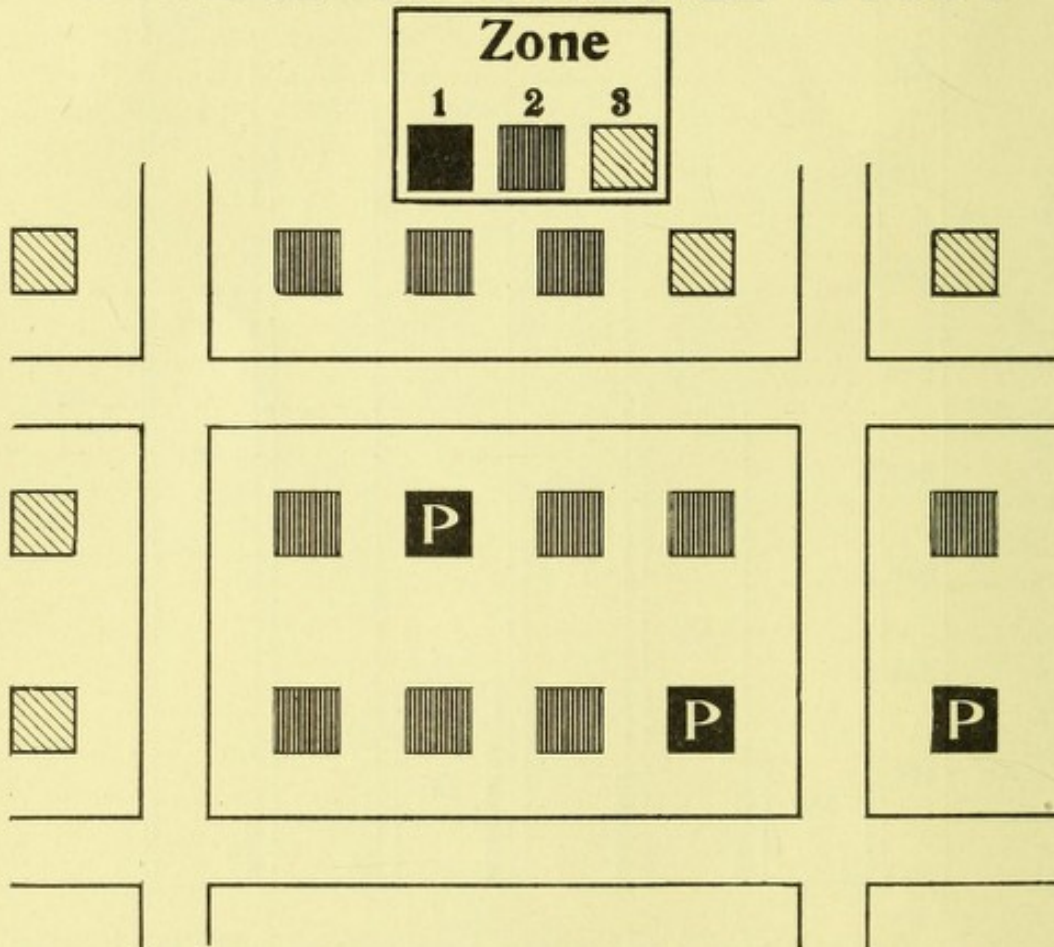


Fig. 27.—The black squares with white letters indicate houses in which cases of pellagra already existed. These houses belong to Zone 1. Houses situated next door belong to Zone 2. All houses situated farther away belong to Zone 3.

a person free from the disease had been domiciled next door to a case of pellagra and total number of instances in which pellagra had arisen under these circumstances; and in the same way for the third zone, we were able to ascertain the number of persons living at a greater distance than next door from a case of pellagra and the total instances in which pellagra had developed during 1912 and 1913 in this population.



Certain difficulties presented themselves from time to time in making this statistical study. It was essential that our knowledge of the cases and of the population employed should be very complete. We therefore limited the antecedent cases to be used to known pellagrins and we excluded from this study those pellagrins who had shown no symptoms of the disease for two years. It was also decided to omit from consideration mere visitors, provided the duration of the visit were less than two weeks. Furthermore, we did not consider as antecedent cases those pellagrins who had moved into the village or had developed symptoms of the disease for the first time within a period of three months preceding the time of our census and search for cases.

Certain arbitrary rules had to be adopted also in regard to the exposed population. Zone 1 included all non-pellagrins known to have lived in the same house with an antecedent case, as defined above, for a period of at least two weeks during 1912 or 1913. Cases of pellagra developing in this zone were considered as incident cases possibly secondary to the antecedent case only when the disease developed after an interval of at least two weeks from the beginning of the domiciliary relationship and within three months in summer or six months in the colder season after the termination of such relationship. Zone 2 included the non-pellagrins living in a house next door to an antecedent case. Those persons who lived next door to several houses in which pellagra existed were considered in relation to each of these houses in turn and added to the population of Zone 2 each time. The population of Zone 2 does not, therefore, mean the number of different persons living next door to a pellagrin, but it designates the number of instances in which a non-pellagrin lived next door to a house containing a pellagrin for a period of at least two weeks during the years selected. Incident cases of pellagra developing in Zone 2 were regarded as possibly secondary to the antecedent case only when symptoms of the disease developed not earlier than two weeks from the beginning of the supposed exposure and not later than from three to six months after its termination. Cases developing in Zone 2 next door to two or more houses containing antecedent cases were credited as secondary to each such case, so that the incident cases in Zone 2 represent not the actual number of persons developing the disease in this zone but the number of instances in which this relationship was followed by the development of incident pellagra. As explained above, the persons who did not contract the disease were treated in a similar way in compiling the statistics. Finally, Zone 3 included all the population living for a period of at least three months in spring and summer or six months in the colder season in houses farther removed than next door from any known case of pellagra;



and any case of pellagra developing in such persons, or in any one not falling within Zone 1 or Zone 2, according to our arbitrary rules, was credited to Zone 3. New cases of pellagra definitely recorded as such, concerning which our information was too incomplete to warrant a final placing in one of these zones, have been temporarily placed in Zone 3. Obviously, it would sometimes happen that a person would first be in Zone 3 and later come to be included in one of the other zones because of change of residence on his part or because a pellagrino would appear next door to him or in his own household. It seemed necessary to adopt such arbitrary rules and to adhere to them throughout this statistical study. Our purpose, of course, was to ascertain whether the proximity of residence to cases of pellagra would show any correlation to the incidence of the disease in these mill villages.

TABLE 97.—DOMICILE RELATIONSHIP, VILLAGE I, ZONE 1

Antecedent Case Present Between October, 1911, and June, 1913			Other Members of the Household			
Case	House	Residence Period	Adults	Children	Total	Incident Pellagrins
514	39	Dec., 1911-May, 1912	17	5	22	1
114	41	Apr., 1911-July, 1913	4	1	5	0
145	44	Jan., 1912-July, 1913	3	3	6	2
148 } 149 }	40	1910-July, 1913	3	3	6	1
337	617	Apr. '12-Mar. 31, '13	2	3	5	0
592	617	Mar. 31, '13-July, '13	2	3	5	0
280	611	Feb., 1913-July, 1913	1	1	2	0
330	66	Jan., 1911-July, 1913 Pellagra developed July, 1912	3	4	7	0
164	59	Mar., 1910-July, 1913	1	4	5	0
153 } 154 }	54	Nov., 1911-July, 1913	2	2	4	1
150	48	July, 1912-Sept., 1912	12	2	14	1
Total for this portion of the table.....			50	31	81	6

The method of procedure in this study may be illustrated by a sample portion of the original tabulations, from which the data concerning exact location of each house have been purposely omitted (Tables 97, 98 and 99). These fragments of our detailed tables indicate the method employed in compiling the data. It is impossible to print here the complete tabulations because of their extent. The summary of these data is shown in Table 100.



TABLE 98.—DOMICILE RELATIONSHIP, VILLAGE I, ZONE 2

Antecedent Case Present Between October, 1911, and June, 1913			Population Resident in Adjacent Houses				
Case	House	Residence Period	Residence Period	Adults	Children	Total	Incident Pellagrins
514	39	Dec., 1911-May, 1912	Dec., 1911-July, 1913	2	1	3	0
			May, 1912-Sept. 10, 1912	2	1	3	0
			May, 1911-July, 1913	3	2	5	0
			Feb., 1909-July, 1913	2	3	5	0
			Total .....	9	7	16	0
114	41	Apr., 1911 - July, 1913	Apr. 1908-July, 1913	2	1	3	0
			Feb., 1913-July, 1913	3	0	3	0
			<i>Antecedent Pellagra in Household</i>	..	..	..	..
			Nov., '11 - July, 1913	2	4	6	0
			Jan., 1910-July, 1913	3	1	4	0
			Feb., 1909-July, 1913	2	3	5	0
			Oct., 1912-July, 1913	5	3	8	0
			Total .....	17	12	29	0
145	44	Jan., 1912-July, 1913	Mar., '12 - Feb., 1913	4	4	8	0
			Jan. 1911-July, 1913	3	5	8	2
			Mar., '13-July, 1913	4	0	4	0
			Feb., 1913-July, 1913	3	0	3	0
			Dec., 1912-July, 1913	3	4	7	0
			Aug., '12-Mar., 1913	5	5	10	0
			June, '13,-July, 1913	2	0	2	0
			<i>Antecedent Pellagra in Household</i>	..	..	..	..
			Apr., 1913-July, 1913	2	2	4	0
			Mar., '13-July, 1913	2	0	2	0
			Apr., 1913-July, 1913	2	1	3	0
			Dec., '11-Mar., 1913	3	0	3	0
			July, '12-Mar., 1913	5	4	9	0
			Total .....	38	25	63	2
148 } 149 }	40	1910-July, 1913	<i>Antecedent Pellagra in Household</i>	..	..	..	..
			Jan., 1911-July, 1913	4	4	8	1
			Dec., 1912-July, 1913	2	5	7	1
			Mar., '13-July, 1913	4	0	4	0
			Feb., 1913-July, 1913	3	0	3	0
			Apr., 1913-July, 1913	2	2	4	0
			Mar., '13-July, 1913	2	0	2	0
			Apr., 1913-July, 1913	2	1	3	0
			Mar., '13-Apr., 1913	2	2	4	1
			1910-Feb., 1913	5	4	9	0
			Total .....	26	18	44	3
Total for this portion of the table.....			.....	90	62	152	5



The result of this compilation of data in regard to location of domicile is very striking. Of the 819 non-pellagrin individuals who lived in the house in which pellagra existed at the time, 54 acquired the disease during 1912 and 1913. Of the 3,201 instances in which non-pellagrin individuals lived next door to a house in which pellagra was present, the disease developed in this exposed population in 55 instances during 1912 and 1913. Of the 3,105 persons who lived in houses farther away than next door to a pellagrin, 16 contracted the disease during the two years. The respective percentages are 6.59

TABLE 99.—DOMICILE RELATIONSHIP, VILLAGE 1, ZONE 3

Residence Period	Adults	Children	Total	Incident Pellagrins	Excluded from Zone 3 by Presence of Pellagra in Same or Adjacent House
Jan., 1913 - July, 1913	12	1	13	0	1911 to Aug., 1912.
May, 1911-July, 1913	3	2	5	0	1911 to Aug., 1912.
April, 1913-July, 1913	4	2	6	0	July, 12, '12, to Sept., 1912.
Nov., 1911-July, 1913	5	0	5	0	July, 12, '12, to Sept., 1912.
Oct., 1910 - July, 1913	2	1	3	0	July, 12, '12, to Sept., 1912.
Dec., 1911-July, 1913	2	1	3	0	1911 to March, 1912.
Feb., 1913 - July, 1913	2	2	4	0	1911 to March, 1912.
1909-July, 1913	2	3	5	0	1911 to March, 1912; July, 1912, to July, 1913.
Nov., 1911-Dec., 1912	2	1	3	0	.....
Jan., 1913 - July, 1913	2	4	6	0	.....
Jan., 1913 - May, 1913	2	1	3	0	.....
May, 1913 - July, 1913	2	1	3	0	.....
Apr., 1908 - July, 1913	2	0	2	0	June, 1912, to July, 1913.
Nov., 1909-July, 1913	3	4	7	2	July, 1912, to July, 1913.
Feb., 1910-July, 1913	4	0	4	0	1911 to March, 1912; June, 1912, to July, 1913.
Apr., 1908-July, 1913	2	1	3	0	1911 to March, 1912; June, 1912, to July, 1913.
Apr., 1911-July, 1913	5	0	5	0	June, 1912, to July, 1913.
Jan., 1912 - Jan. 1913	3	0	3	0	July, 1912, to July, 1913.
Nov., 1911-July, 1913	2	4	6	0	.....
Nov., 1911-Sept., 1912	2	4	6	0	.....
Apr., 1913 - July, 1913	2	1	3	0	.....
Total for this portion of the table	65	33	98	2	

for Zone 1, 1.72 for Zone 2 and 0.52 for Zone 3. As far as these mill villages are concerned it is clearly evident that a high degree of correlation existed between proximity of domicile to an existing case of pellagra and the origin of new cases in the population of such a domicile. In other words, the new cases of the disease developed almost exclusively in small foci, within which one or more old cases of the disease already existed.

The figures presented above have been subjected to a critical scrutiny with especial attention to the accuracy and the completeness



TABLE 100.—INCIDENCE OF PELLAGRA IN THE POPULATION OF DIFFERENT ZONES ACCORDING TO LOCATION OF DOMICILE IN RELATION TO DOMICILE OF AN ANTECEDENT PELLAGRIN

Village	Zone 1			Zone 2			Zone 3		
	Instances of Exposure	Incident Pellagrins	Incidence Per Cent.	Instances of Exposure	Incident Pellagrins	Incidence Per Cent.	Instances of Exposure	Incident Pellagrins	Incidence Per Cent.
I	115	7	6.09	832	20	2.40	608	4	0.66
W	83	7	8.43	323	7	2.17	240	0	0.00
P	141	7	4.96	499	8	1.60	993	4	0.40
Sa	211	10	4.74	593	10	1.69	150	0	0.00
A	70	9	12.86	175	7	4.00	276	2	0.72
Sp	199	14	7.04	779	3	0.38	838	6	0.72
Total .....	819	54	6.59	3,201	55	1.72	3,105	16	0.52



of our records and to the possibility of association with other cases of pellagra besides the antecedent cases here considered. In regard to Zone 1, this scrutiny has shown a high degree of accuracy and completeness. In many instances the household in which an old case of pellagra existed had been examined and detailed record of it made previous to the development of the secondary cases. The development of new cases presented opportunity to verify and extend the records already made. In Zone 2, the cases have not, on the whole, been so completely studied and in some of these the location of previous residences is incompletely known and, in some instances, the possibility of close association with other pellagrins by visits is clearly indicated by the records. In Zone 3 there are only 16 incident cases and they will be considered briefly in order.

Patients 152 and 157, at village I, were father and son. They had been living in the same house for three years, during which time no patient with pellagra had resided in the immediate vicinity. The nearest case was at a distance of five houses, in the village. Both of these persons developed pellagra about the same time, in June, 1912. The father of the older patient, grandfather of the boy, is said to have pellagra. He lives at a distance of about a mile in the country. We have no further information in regard to him. The wife and mother in this family has been in poor health for some years, but there is no definite history and no evidence of pellagra in her. The two cases have been placed in Zone 3. As far as relation of domicile is concerned, one cannot be considered secondary to the other. A third case in village I is Patient 153, a little girl aged 5. Her family had lived in the village part of the time ever since her birth. During the spring and summer of 1911 they lived on a farm some distance from the village and moved to the present residence the last of November, 1911. The little girl suffered from diarrhea since early in the spring of 1912 and developed the erythema in March, 1912. We have not been able to obtain information concerning the associations at the farm. The case therefore falls in Zone 3. The fourth case in village I is Case 280, a woman aged 28, living in a house removed from cases of pellagra by one intervening house. Her father-in-law, Patient 316, died of pellagra in August, 1911, in the house next door but one from the house in which this patient was living. In Case 280, erythema developed for the first time in July, 1912. Evidence of living next door to a pellagrin is absent in this case and it is therefore placed in Zone 3.

In village W there are no cases in the third zone to be considered.

In village P there are four cases in Zone 3. Case 54 was in a boy aged 12, who developed pellagra for the first time in May, 1912.



He had lived in the same house in this village since March 6, 1912, having come from Lee County, Va. There was no recognized case of pellagra among the persons living in any of the adjacent houses at this time. In a house next door but one, there was a little girl who had suffered from pellagra for about a year. In the spring of 1912 three cases of pellagra in children originated in this immediate vicinity; one in the younger sister of this original case, one in a girl aged 10, who lived next door, and one in this boy we are now considering, Case 54. The three families lived in adjacent houses, the house in which the 10-year-old girl lived being between the house of the original case and this Case 54. These three children all developed pellagra about the same time and it is therefore impossible to regard the case of this boy as secondary to that in the girl living next door to him. He has been placed in the third zone. In Case 630, a girl aged 8, pellagra developed for the first time in July, 1912, while the patient was living in a house in Zone 3. Her mother, Patient 299, died of pellagra in June, 1911. The child lived with her mother in the same house in which the child developed the disease later. Her mother, however, was taken from this house shortly before she died, to her father's house, grandfather of Patient 630, a short distance away in the same village, where she died. The grandfather developed pellagra during 1911. The evidence of close association between the child, its mother and grandfather, is, of course, very clear; but inasmuch as the domicile in which the erythema developed is further away than next door from the grandfather's house and the mother was removed from this domicile about a year before the child developed the disease, the case is placed in Zone 3. Patient 640 was a woman aged 27 who had been living in the same house since 1910. She developed pellagra for the first time in June, 1913. The house is next door but one to a house containing two cases of the disease which developed in 1912. In the same house where this woman lived there was a boy, Patient 521, who had pellagra in the summer of 1911. He had lived in this house since 1908 and moved away in September, 1911. Patient 557 was, of course, associated with this boy in the same house during 1911, but inasmuch as the record shows that she developed her erythema in June, 1913, nearly two years after the other patient had left, she is placed in Zone 3. Patient 634 was a woman aged 35. She developed erythema for the first time the latter part of July, 1913. She had been living in the same house since February, 1912, and there was no case of pellagra within a radius of four houses. Previous to February, 1912, she had lived on the other side of the river near her father's house. The exact location of her residence there has not been ascertained. Her father, Patient 300, developed pellagra in 1911 and died of pellagra



in August, 1912. The evidence of association between these two cases has not been definitely ascertained, but even if it were fully known, the domicile in Case 634 would, nevertheless, remain in Zone 3. This woman died of pellagra, Sept. 23, 1913.

In village Sa we find no cases of pellagra which developed in houses at a greater distance than next door from a previous case.

In village A, two persons developed the erythema for the first time while living in houses which did not contain a case of pellagra and which were not adjacent to such houses. One of these, Patient 594, was a woman aged 30, who had lived in her present residence since October, 1912. She developed erythema for the first time in June, 1913. Her residence previous to October, 1912, had not been definitely ascertained. During the winter of 1912 and 1913, that is, from November, 1912, to January, 1913, Patient 570 lived in the same house. Patient 570 is believed to have developed erythema for the first time in June, 1913, after leaving this house, but her sister states that she had suffered from pellagra also during the summer of 1912. The exact information in regard to this point is lacking. As we do not know with certainty of any association in the household or of any next-door relationship to a previous case, we have placed Case 594 in the third zone.

Case 579 was in a boy aged 4. He had been living in his present residence since December, 1912, and developed erythema for the first time in June, 1913. During this interval, from December to June, there was no recognized case in the same house or in any of the adjacent houses, excepting one. In this one exceptional house, three cases of pellagra developed in 1913, one on May 1, one on June 19 and one on June 25. Two of these cases were in young children. In our study of relation of domicile we decided not to consider a case as a center of origin unless the patient had resided in this particular village previous to April, 1913. It is therefore impossible to include this case, 579, in our Zone 2. This child, however, played with the other children a large part of the time, and there is no question that association with other pellagrin children in the immediate neighborhood was very close.

In the village Sp there are six cases to consider. Patient 747 was a woman aged 44 who had been living in her present residence since 1907. She was observed to have pellagrous erythema in October, 1913. She refused to give us information concerning her history, except to say that she had been ailing for three years. There was no antecedent case of pellagra within a radius of four houses and, in the absence of more complete information, this case has been credited to Zone 3. Case 748 was in a woman aged 44, who was living directly across the



street from Case 747. She had been in this house since 1906. Erythema developed for the first time in August, 1913. This patient was also very reluctant in giving her history. It is perhaps justifiable to consider her as a case developed next door to Case 747, but in the absence of more complete information we have placed her in Zone 3. Patient 548, a girl aged 5, had been living in her present residence since September, 1913. The nearest antecedent case of pellagra was three doors away. The little girl developed erythema for the first time about June 1, 1913. Her parents both worked in the mill, and she played with the neighbors' children most of the time. We were unable to find that she actually lived in the house with a case of pellagra or in a house next door to such a case. Patient 718, a woman aged 42, had been living in her present residence since April, 1912, and she developed erythema for the first time in May, 1913. Her previous residence had been across the street from a case of pellagra. Her residence in 1913 was an apartment house in which there were no other cases of the disease. The association in the previous house was too remote to come within the limits which we have set for ourselves in this study. She has been placed, therefore, in Zone 3.

This brief examination of the cases originating in a house farther away than next door from an antecedent case of pellagra shows that in most of the instances there is evidence of previous close association with cases of pellagra or that our information is too incomplete to warrant a final opinion in regard to this question. It serves to strengthen rather than weaken the indication shown by the tabulated figures. We are forced to conclude that the origin of pellagra in persons living at a distance from previous cases of the disease in these particular mill villages was relatively very uncommon in 1912 and 1913.

#### *DISCUSSION OF FOODS AND OF LOCATION OF DOMICILE AS ETIOLOGICAL FACTORS IN PELLAGRA*

The preceding pages have presented the data concerning the use of particular foods and concerning the location of domicile in relation to pellagra, obtained by an intensive study of the inhabitants of six mill villages. It remains to discuss these facts presented and their bearing on the problem of the causation of pellagra.

In the first place the data do not support the theory that pellagra is an intoxication, the recurrent manifestations of which are due to the continued use of maize. The simple fact is that the portion of the population rarely or never using shipped corn contained a relative excess of pellagrins as compared with those using this food daily. Of those persons using shipped corn daily, 3.02 per cent. were pellagrins; of those using it habitually, 3.92 per cent., of those using it rarely or never, 5.49 per cent. The relation to local corn-meal was somewhat



similar. Of those persons using it daily, 2.99 per cent. were pellagrins; of those using it habitually, 3.90 per cent.; of those using it rarely or never, 3.83 per cent. The study of corn-meal, both kinds considered together, gave an even more emphatic result. Of those persons using it daily, 3.13 per cent. were pellagrins; of those using it habitually, 4.30, and of those using it rarely or never, 6.02 per cent. were pellagrins. It would seem justifiable to dismiss at once the idea that continued use of maize was the important factor in producing the symptoms of pellagra in the population of these villages.

A precisely similar conclusion may be drawn concerning the supposed toxic influence of canned foods as a primary factor in the causation of the symptoms of pellagra. Of the 89 persons using canned foods daily, none were pellagrins; of those using these foods habitually, 3.25 per cent. were pellagrins; of those using them rarely or never, 4.12 per cent. were pellagrins.

So far as we are aware, no one has yet ascribed the causation of pellagra to the use of fresh meat, milk or eggs, and we do not perceive any reason for giving them any consideration as direct causes of this disease.

In the second place it is necessary to examine the food data from the point of view of those who regard deficiency in total amount or in the quantity of particular elements of the food as the real cause of the symptoms and lesions of pellagra. The data presented in the preceding pages have little bearing on the theory that pellagra is the direct result of a general deficiency in diet. Our observation of pellagra in apparently well-nourished growing children, however, as well as in apparently well-nourished adults, have made this conception appear unworthy of consideration. The theory that a deficiency in some special dietary constituent may cause pellagra seems worthy of much more attention, especially because of the brilliant success attained in the prophylaxis of beriberi by measures based on a similar theory of causation in that disease. In general the dietary in these villages showed considerable variety. Most of the families possessed small gardens, and fresh vegetables were everywhere used in season. The data concerning the use of fresh meat, milk and eggs would appear to have a particular bearing on this question, because these foods might be supposed to contain the particular substance or substances, a lack of which would be assumed to cause the signs and symptoms of pellagra. Of the 82 persons in families using fresh meat daily, four were pellagrins, 4.88 per cent.; of the 2,591 persons in families using this food habitually, 3.74 per cent.; of the 2,460 persons in families using this food rarely or never, 3.98 per cent. were pellagrins. Most significant of all, perhaps, was the fact that of the 263 persons never



using fresh meat, only 4, or 1.52 per cent., were pellagrins, a figure considerably below the average morbidity for the whole population considered, namely, 3.88 per cent. Evidently the fresh meat used in these villages cannot be regarded as the essential pellagra-preventing food.

The data concerning the use of milk do show evidence of a relation of this food to pellagra. Of the 3,171 persons in families using milk daily, 89, or 2.81 per cent., were pellagrins, while of the 619 persons avoiding the use of milk, 43, or 6.95 per cent. were pellagrins. An analogous apparent effect of milk in preventing the development of new cases of pellagra was also evident in the study of the incident cases. We do not regard deficiency of milk in the diet as the cause of pellagra, however, because pellagra existed in many families in which milk was used daily and we have records of many cases of pellagra in persons who habitually drank sweet milk or buttermilk, and of several who drank buttermilk daily. Furthermore, it is well known that milk and milk products, although valuable dietary elements for adult man, are not absolutely essential for his nutrition. A further reason for refusing to accept deficiency in milk as the essential cause of pellagra is its complete failure to account for the focal distribution of the incident cases so clearly brought out in the domiciliary study. Nevertheless, as far as these data are concerned, milk, including buttermilk, stands out prominently as the one dietary element which seems to have had any influence at all on the prevention of pellagra, and the number of persons included in each of the groups using this food daily, habitually, rarely and never is sufficiently large to give some weight to the evidence.

The use of eggs exerted no apparent influence on the existence of pellagra and only an uncertain influence on the origin of new cases. The pellagra morbidity in the 170 persons avoiding the use of eggs was only 2.94 per cent., while the average for the total population considered in this relation was 3.67. Of the population considered in relation to the incidence of pellagra, 175 persons never used eggs. Of these, 6, or 3.43 per cent., contracted the disease, an incidence somewhat above the average, 2.10 per cent., for the total population considered. The small number of persons in this group (175), and the great irregularity of the figures in the different villages, render the average figure, 3.43 per cent., very unreliable as an indication of the value of eggs in preventing pellagra. We are inclined to ascribe no importance whatever to this article of diet.

The omission or restriction of the use of corn-meal does show a slight associated increase in pellagra. For example, the 123 persons who avoided the use of corn-meal altogether included 6 pellagrins,



a morbidity of 4.88 per cent., as against an average of 3.81 per cent. in the total population considered. Similarly, of the population considered in relation to incident cases, 123 persons avoided the use of corn-meal and four of these contracted pellagra, an incidence of 3.25 per cent., as against an incidence of 2.14 per cent. for the whole 5,056 persons considered. We do not believe that omission of maize from the diet has contributed essentially to the increase of pellagra. The real explanation seems to be that some of those persons who already had the disease have restricted their use of maize and in some cases other members of their families have done the same. As has been shown in the domiciliary study, those persons closely associated with preexisting cases of pellagra contracted the disease most frequently. The slightly higher incidence among those taking little or no corn-meal is probably to be explained, therefore, by a relatively closer association of these persons with previous cases of the disease; an association which tended to produce two results, namely, restriction in the use of corn-meal and also a higher incidence of pellagra.

In the third place we wish to consider the bearing of the facts presented on the theory that pellagra is an infectious disease. The relationships discovered in the domiciliary study seem to us to be conclusive evidence of the correctness of this view. It is evident that, so far as was observed in the population of these mill villages in 1912 and 1913, the location of one's domicile in the same house with, or next door to a pellagrin, or farther away, had a greater and more definite relation to the subsequent development of pellagra than did the use or avoidance of any of the foods to which attention has been given. The observations indicate very clearly that pellagra actually spread in these villages from a preexisting case as a center, and that it spread readily only within a very small area surrounding such a preexisting case.

In order to present in a graphic manner the apparent relation of these dietary elements and of location of domicile to the origin of new cases of pellagra we have constructed a series of charts to illustrate the data in regard to incident cases, showing by actual area of each column the number of persons in families using each of the foods daily, habitually and rarely (including never) in each of the mill villages. These charts (Figs. 3 to 26, inclusive) show at a glance the relative number of the population in each of the frequency groups in respect to each of the seven foods studied and, in a precisely similar way, the population in each of the three domiciliary zones in the same village. In each of the large columns a smaller black column at the lower left corner indicates the actual number of that group which contracted pellagra during 1912 and 1913. The variation in the size



of the different dietary and domiciliary groups in the different villages is shown very clearly.

Figure 28 shows the incidence of new cases per ten thousand in the total population in the six villages using each of the foods daily, habitually and rarely (including never). The *higher* incidence of pellagra in those who rarely or never used corn-meal, the *higher* incidence in those who did use fresh meat daily, the *absence* of incident cases among those using canned foods daily, and the *lower* incidence among

**USE OF VARIOUS FOODS  
INCIDENT CASES <sup>per</sup> 10,000  
IN VILLAGES I, W, P, SA, A & SP**

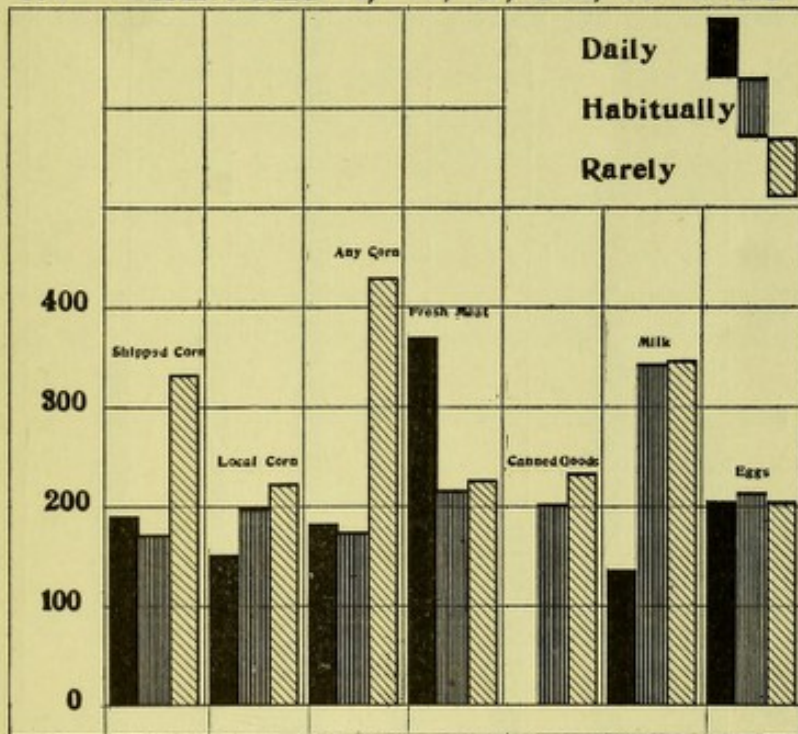


Fig. 28.—The incidence of new cases of pellagra in the total population of the six villages in each of the three groups summarized according to frequency of use of the various foods.

those using milk daily can be appreciated at a glance. It is, of course, necessary to refer to the preceding charts or to the tabulated data to ascertain the size of each group, in order to know the significance of the ratios shown here.

Figure 29 shows in a similar way the incidence rate per ten thousand in each of the three domiciliary zones for each of the six mill villages and, at the right under "Av.," for the total population considered together. This distribution of incident cases can be accounted for, in our opinion, only by the conception that pellagra is an infectious disease spreading from a preexisting case as a center. Further-



# LOCATION OF DOMICILE INCIDENT CASES per 10.000

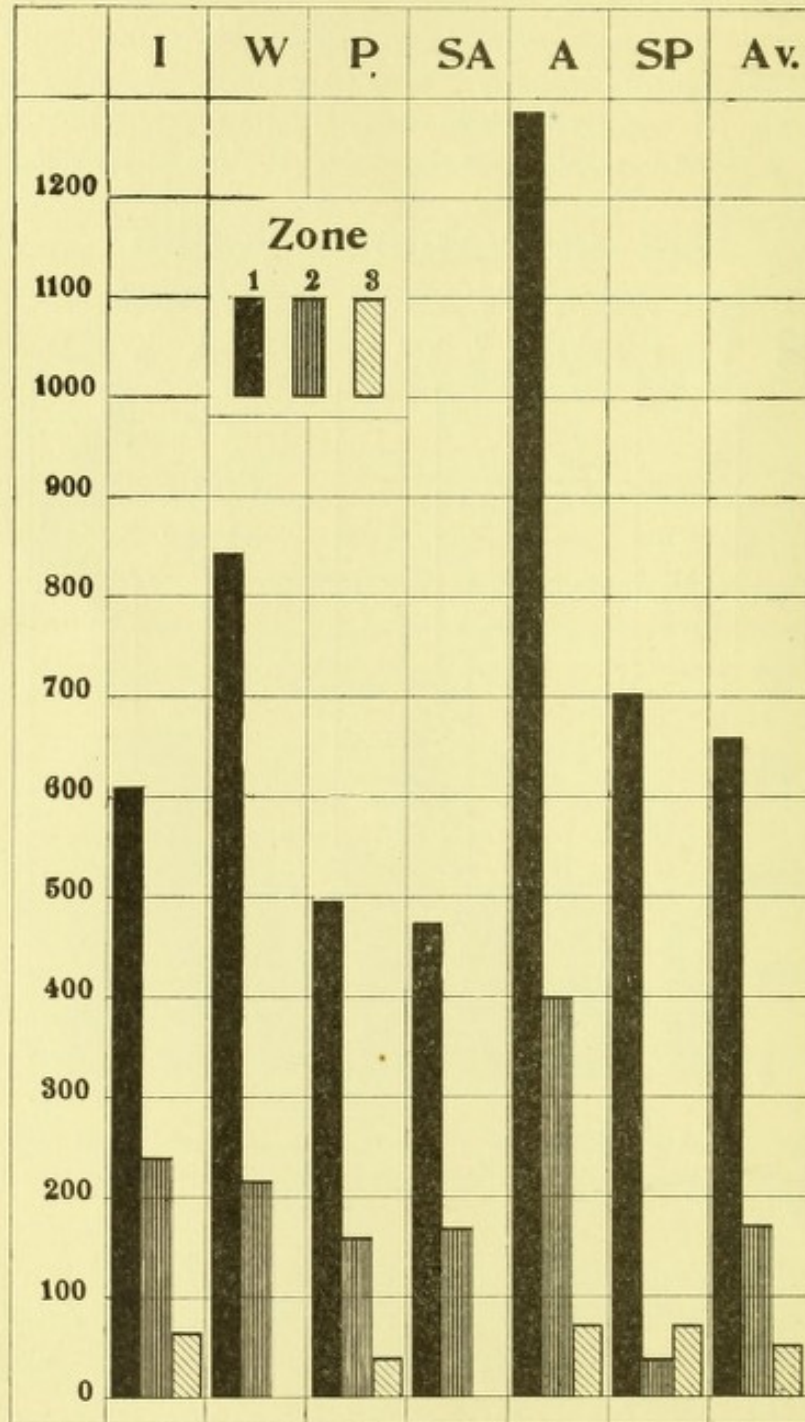


Fig. 29.—The black columns indicate the incidence of new cases of pellagra among persons living in the same house with a preexisting case. The columns striped vertically indicate the incidence in the population living next door. The columns striped obliquely indicate the incidence in the population living within the respective village, but farther away than next door from a preexisting case of pellagra.



more, it seems in general not to be very readily transmitted even to those in the same house, and its spread to those at a greater distance is very much less common. It should be remembered that nearly two years elapsed while the new cases on which this chart is based were originating.

*Summary*

1. Pellagra spread from a preexisting case as a center in the six villages here studied.

2. It was transmitted to new victims only through very short distances and chiefly to those immediately associated in the home with a preexisting case of the disease.

3. Frequent use of corn-meal as an article of diet was not a factor in the causation of pellagra in these villages.

4. There was discovered no evidence that canned goods have anything to do with the causation of pellagra.

5. Frequent use, even daily use, of fresh meats and of eggs afforded no relative protection from pellagra in these villages.

6. The daily use of milk seemed to diminish to some extent the danger of contracting pellagra in these mill villages in 1912 and 1913, although its use did not fully insure against the development of the disease.





















