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## Epidemiological Studies of Tuberculosis\*

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MASS production now appears in order in the field of epidemiological studies. Henceforth, great discoveries such as were made in this field during the 18th and 19th centuries are not to be expected to derive from narrowly limited individual observation and study of one or a few basic facts or conditions. Broad gauge open-minded observation, thorough study of all facts or conditions reasonably considered likely to prove salient, definite—but duly elastic—long-pull program planning, and organized effort now are needed to give promise of satisfactory accomplishment in this as in many other lines of scientific endeavor. Old tilled fields must be resurveyed, new unbroken fields explored, and every trail followed until found false, promising, or true.

The epidemiological studies of tuberculosis inaugurated by the U. S. Public Health Service and conducted intensively since July 1, 1936, with the cooperation of the State Health Departments of Alabama and Tennessee, the

local health departments directly concerned, and the Tennessee Valley Authority, were planned and organized and have been and are being carried out in accord with prescribed epidemiological principles.<sup>1</sup> This paper is intended as a progress or, rather, a summary report of procedures and findings to date. A detailed report will be prepared for publication by the U. S. Public Health Service in due time.

### OBJECTIVES

The main objectives of the studies are: (1) the development of needed additional practical knowledge regarding the causation and means for prevention of tuberculosis in general, and (2) the determination in particular of the factors which in kind or degree operate to cause the notable differences established by statistical studies<sup>2</sup> in the geographical, age, sex, and race distributions of tuberculosis mortality among persons.

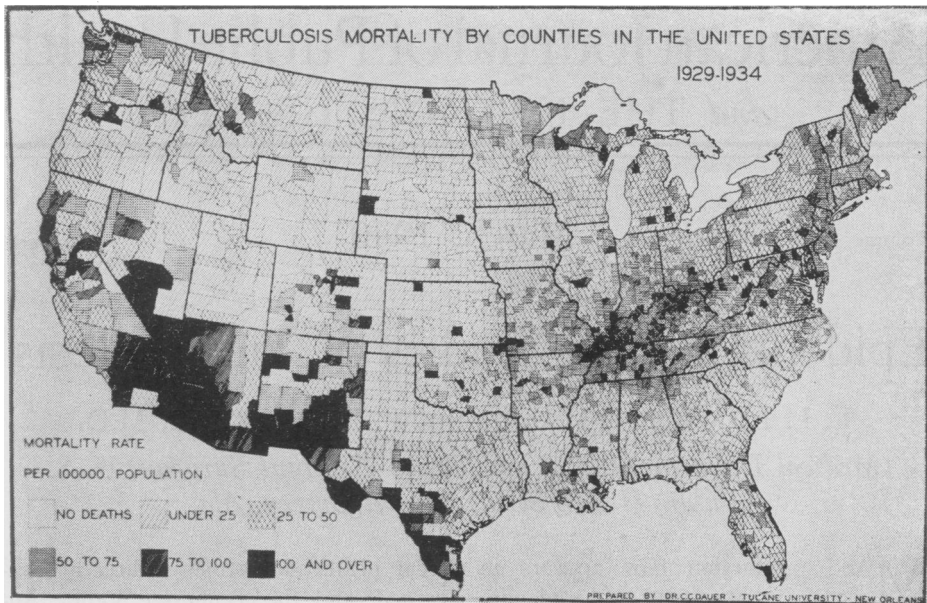
### PROCEDURES AND FINDINGS

The program of detailed procedures was developed on a basis of statistical evidence, especially the recorded tuberculosis mortality rates in different areas of our southeastern states. Among all

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the states, Tennessee and Kentucky have had during the last decade the highest rates of mortality attributable to tuberculosis of local origin. In these two states, the comparatively high rate regions are in Middle Tennessee and in the Kentucky Blue Grass, which regions interestingly appear, according to the usual methods of evaluation, among the most prosperous and progressive in our southeastern states. In the areas extending in any direction from the high rate center in Tennessee and Kentucky—north, east, south, or west—the tuberculosis mortality rates are markedly less (see Map I).<sup>\*</sup> Among white persons in Alabama, the rate in the southern third of the state is less than one-half that in the northern third, while in Indiana the rate is very considerably higher in the southern than in the central and northern thirds of the state.

In the southeastern coastal plain, generally, the rate is remarkably low. In the region to the north of it, comprising northern parts of Arkansas, Mississippi, Alabama, and Georgia,

western parts of South Carolina and North Carolina, and most of Tennessee, Kentucky, Virginia, Maryland, and Delaware, the rate is high as compared with that for the United States as a whole. A line drawn to separate these two regions, herein defined as the high and low tuberculosis mortality rate regions, coincides remarkably with a line separating the Southern Pine Forest region from the Central Hardwood Forest region and also with one indicating the southern limit of exposure of the paleozoic rocks.

This geographical distribution of tuberculosis mortality presented a challenging problem. We undertook to study it on a broad scale. Coffee County in Southeastern Alabama and Giles County in South-central Tennessee, representative respectively of the low and the high tuberculosis regions, were selected for intensive detailed studies. Both are very largely rural, agricultural counties. The distribution of their populations by land area, town, village, and open country districts, and by race and nationality is much the same. Topography, geology, soil forma-

<sup>\*</sup> Prepared by C. C. Dauer and published originally in *Public Health Reports*, 52:70 (Jan. 15), 1937.

tions, and meteorological conditions present, on the other hand, readily obvious dissimilarities in the two counties. From general indications, Giles County appears considerably more prosperous than Coffee County. The mortality statistics, however, show that, for the 10 year period 1929 to 1938, the average annual death rate per 100,000 from tuberculosis among white persons was 113.9 in Giles and 13.2 in Coffee County, and among Negroes, 210.2 in Giles and 66.7 in Coffee County. A difference of about 9 to 1 for whites of generally similar European antecedents, and of about 4 to 1 for Negroes of largely or wholly identical African antecedents, obviously means a definite and substantial difference in salient factors operating either for predisposition to or for protection against tuberculosis mortality.

*House-to-House Survey and Family Canvass*—To check on the statistical records and surface indications, and to determine as nearly as practicable the economic status and living conditions (social, sanitary, and dietary), family origins and traits, and the morbidity and mortality, a survey and canvass was made of all the homes in the two counties—6,319 in Coffee County and 5,937 in Giles County. This survey and canvass was made by a force of trained, experienced, carefully selected public health nurses, whose work was alternated between the two counties so as to apply the same personal equations in each. A comprehensive questionnaire calling for every datum regarded as likely to prove of value was filled out for every home. The duration of the visit to a home averaged about 1½ hours. With notably few exceptions, the families were thoroughly cordial and coöperative.

The large mass of detailed data collected by the canvass is yet in process of tabulation and can be presented only in small part in this paper. Among the

determinations of special interest were that the actual morbidity and mortality rates from tuberculosis during the 6 or 7 year period immediately preceding the canvass had been slightly higher, and that the difference between the rates for the two counties was even somewhat greater than had been indicated by the official mortality statistics. There was found to be no significant difference between the two counties as to ancestral origins and general character of the population. Economic status, comforts above the necessity level, food consumption, and housing—especially with respect to crowding—were found to average better among the families of Giles County than among those of Coffee County. Detailed data on household populations and per capita consumption of different classes of foods are presented in Table 1. The per capita consumption of milk was found surprisingly high in both counties, but to average very considerably higher in Giles County. Giles led in the consumption of lean meats, eggs, tomatoes, and citrus fruits and was slightly behind in the consumption of green, yellow, and leafy vegetables. Coffee County led in consumption of starchy foods, syrup, and fat meat—staples of the poor. The sanitary ratings with respect to excreta disposal and domestic water supplies for the two counties were not far apart.

The family records of illness indicate a much higher incidence of respiratory diseases besides tuberculosis in Giles and a much higher incidence of hookworm disease and pellagra in Coffee County. General nutrition of school children appears to average very considerably better in Giles County.

*Tuberculin Testing and X-ray Examinations*—With a view to determining whether the difference between the two counties in tuberculosis mortality is due to a difference in extent and degree and kind of distribution of the specific in-

TABLE 1  
*Comparison of Food Consumption  
 Giles County, Tenn., and Coffee County, Ala.  
 Per Capita per Week by Color, Tenure, and Residence*

Tenure and Residence		Total		Ave. No. Persons per HH	Flour and Corn lbs.	Sweet and Irish Potato lbs.	Tomato and Citrus lbs.	Gr., Yel. and Leafy Veg. lbs.	Sugar lbs.	Syrup lbs.	Milk* qts.	Eggs No.	Lean Meat lbs.	Fat Meat lbs.
		Households	Population											
<b>OWNERS</b>														
<i>White</i>														
Country	Giles	1,953	7,842	4.02	5.20	2.17	1.28	2.07	1.23	0.69	6.99	5.55	1.48	1.29
	Coffee	1,316	5,855	4.45	5.54	2.07	0.97	2.10	1.04	0.78	6.69	5.31	1.34	1.27
Town	Giles	260	868	3.34	4.26	2.11	3.12	2.45	1.28	0.43	4.30	8.32	2.03	1.22
	Coffee	424	1,674	3.95	4.63	1.59	2.00	2.70	1.13	0.51	4.66	8.69	1.59	1.08
<b>TENANTS</b>														
Country	Giles	1,412	6,582	4.66	5.35	1.75	0.91	1.56	0.98	0.59	6.57	3.54	0.93	1.05
	Coffee	1,641	8,041	4.90	5.74	1.80	0.60	1.69	0.85	0.82	4.97	3.43	0.89	1.13
<b>RENTERS</b>														
Country	Giles	524	2,310	4.41	4.98	1.95	1.25	1.59	1.09	0.57	5.85	4.77	1.14	1.08
	Coffee	1,120	5,611	5.01	5.44	1.92	0.77	1.76	0.89	0.81	5.29	3.99	0.91	1.16
Town	Giles	418	1,714	4.10	4.36	1.89	1.65	1.63	1.02	0.45	2.80	5.95	1.27	1.10
	Coffee	561	2,300	4.10	4.65	1.68	1.50	1.97	1.00	0.66	3.27	6.33	1.46	1.08
<b>OWNERS</b>														
<i>Colored</i>														
Country	Giles	331	1,480	4.47	5.20	1.48	0.43	1.75	0.93	0.55	3.91	2.12	0.86	1.06
	Coffee	106	532	5.02	6.06	1.38	0.31	1.78	0.73	0.92	3.98	2.02	0.89	1.10
Town	Giles	131	444	3.39	4.31	1.53	0.68	1.57	0.96	0.34	1.60	3.10	1.08	1.14
	Coffee	134	598	4.46	4.43	1.32	0.48	1.84	0.77	0.74	1.79	3.10	0.87	1.05
<b>TENANTS</b>														
Country	Giles	590	3,040	5.15	4.99	1.21	0.34	1.53	0.85	0.48	3.79	2.03	0.77	1.01
	Coffee	679	3,451	5.08	5.29	1.08	0.37	1.38	0.80	1.50	2.55	1.48	0.80	1.15
<b>RENTERS</b>														
Country	Giles	84	391	4.65	4.51	1.04	0.47	1.39	0.80	0.42	2.76	1.72	0.81	0.91
	Coffee	104	504	4.85	5.26	1.21	0.35	1.44	0.82	0.93	2.79	1.88	0.75	1.15
Town	Giles	234	884	3.78	4.03	1.34	0.55	1.23	0.80	0.29	1.06	2.30	0.83	0.99
	Coffee	234	959	4.10	4.14	1.24	0.46	1.44	0.68	0.82	1.18	2.27	0.80	1.02

\* Includes whole, skim, sour, and condensed milk.

fectious agent, an extensive program of tuberculin testing and x-ray examination of chests was carried out. This work among children attending schools in the two counties was discussed in detail in a paper presented at the annual meeting of this Association last year.<sup>3</sup> In addition to the examination of children in schools, clinics were held in suitable locations scattered over the two counties for the purpose of examining a cross-section of the adult and pre-school populations. Identical methods of advertising the clinics and soliciting attendance were employed in both counties.

The results of the tuberculin testing of a total of 10,355 persons in the two counties—5,674 in Giles and 4,681 in

Coffee County—are shown in Table 2. The testing of the school age children was done mostly with a preparation of tuberculin PPD made by one company ("A"), whereas the testing of the pre-school children and adults was done with a preparation of tuberculin PPD made by another company ("C"). The latter preparation had been found by duplicate tests on a group of school children to give a much larger percentage of positive reactions than the former.<sup>3a</sup>

Among white persons tested with one or the other of these preparations, the percentage of positive reactors among those under 20 years of age was slightly higher in Coffee County, but among those over that age, the percentage of

positive reactors was higher in Giles County. Among the colored, the percentage of positive reactors was higher in Giles County for every age group except that under 5 years. For all ages, the percentage of positives was 25.2 among whites and 43.9 among colored in Giles County, as against 20.4 among whites and 32.5 among colored in Coffee County. It is interesting that, if the incidence of reactions two plus or larger only is compared, the differences between Giles and Coffee Counties are magnified for every age group.

X-ray pictures of the chests were made on all of the persons tuberculin tested, regardless of tuberculin reaction. All films were read by the same roentgenologist without knowledge of the tuberculin reaction or clinical history. It was recognized that this procedure is not definitive for diagnosis, but the objectivity of the method tends to produce greater uniformity of interpretation.

The findings from the x-ray examination of 5,646 persons in Giles County and of 4,650 persons in Coffee County are shown in Table 3. The survey showed a much higher incidence of lesions certainly or probably tuberculous in Giles than in Coffee County, but the difference between the two counties in incidence of cardiac and nonspecific pulmonary lesions was not so great.

Most striking was the finding of an incidence of focal pulmonary calcification 40 times as high among white persons and 30 times as high among colored persons in Giles County as in Coffee County. With a view to defining the geographical area of high incidence of this condition, our survey was extended to 16 additional counties—3 in Alabama, 3 in Tennessee, 6 in Kentucky, 2 in Ohio, and 2 in Indiana, covering all together 7,472 white school children. Approximately 500 children, usually the entire attendance of one or

TABLE 2  
Comparison of Reactions to 0.0005 mg. of Tuberculin PPD  
Giles County, Tenn., and Coffee County, Ala., by Race and Age

Age in Years	Total Tested		Tuberculin Positive							
			Total				2 Plus or More			
	Giles	Coffee	No.		Per cent		No.		Per cent	
			Giles	Coffee	Giles	Coffee	Giles	Coffee	Giles	Coffee
<i>White</i>										
0-4	141	165	11	12	7.8	7.3	3	0	2.1	0.0
5-9	940	649	60	85	6.4	13.1	30	8	3.2	1.2
10-14	1,247	914	167	158	13.4	17.3	101	26	8.1	2.8
15-19	745	615	141	113	18.9	18.4	85	11	11.4	1.8
20-29	460	467	179	118	38.9	25.3	120	26	26.1	5.6
30-39	333	396	193	109	58.0	27.5	133	34	39.9	8.6
40-49	252	247	159	84	63.1	34.0	105	32	41.7	13.0
50-59	161	147	111	57	68.9	38.8	63	10	39.1	6.8
60 Plus	111	89	87	42	78.4	47.2	49	16	44.1	18.0
Total	4,390	3,689	1,108	778	25.2	20.4*	689	163	15.7	4.0*
<i>Colored</i>										
0-4	85	32	14	6	16.5	18.8	4	0	4.7	0.0
5-9	286	218	52	32	18.2	14.7	32	10	11.2	4.6
10-14	340	293	95	67	27.9	22.9	68	16	20.0	5.5
15-19	186	148	83	56	44.6	37.8	57	25	30.6	16.9
20-29	130	87	88	40	67.7	46.0	59	21	45.4	24.1
30-39	76	77	61	40	80.3	51.9	44	24	57.9	31.2
40-49	68	67	60	38	88.2	56.7	48	30	70.6	44.8
50-59	55	43	53	26	96.4	60.5	38	21	69.1	48.8
60 Plus	58	27	50	17	86.2	63.0	38	11	65.5	40.7
Total	1,284	992	556	322	43.9*	32.5*	388	158	30.8*	15.7*

\* Total per cent positive adjusted to age distribution of Giles County white population tuberculin tested

TABLE 3

*Comparison of Incidence of Intrathoracic Lesions Demonstrated by X-ray Examination in Residents of Giles County, Tenn., and Coffee County, Ala., by Color*

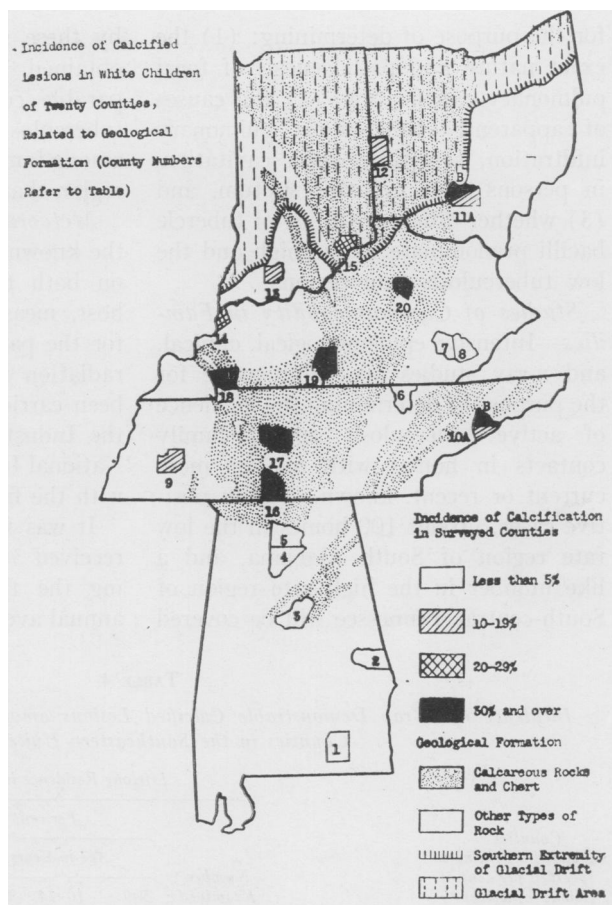
	White				Colored			
	Number		Per cent		Number		Per cent	
	Giles	Coffee	Giles	Coffee	Giles	Coffee	Giles	Coffee
Total Number Examined	4,377	3,667			1,269	983		
I. Presumptive Tuberculosis								
1. First Infection Type (Focal Parenchymal Infiltration or Enlarged Hilum Glands)	6	2	0.1	0.05	5	0	0.4	0.0
2. Reinfection Type								
a. Minimal	34	12	0.8	0.3	7	3	0.6	0.3
b. Moderately Advanced	17	5	0.4	0.1	4	1	0.3	0.1
c. Far Advanced	6	0	0.1	0.0	3	0	0.2	0.0
Total	57	17	1.3	0.5	14	4	1.1	0.4
II. Lesions of Doubtful Significance								
1. Focal Parenchymal Lesions, Not Calcified	4	4	0.1	0.1	2	2	0.2	0.2
2. Focal Parenchymal or Glandular Calcification	1,473	31	33.7	0.8	271	7	21.4	0.7
3. Miliary								
a. Infiltration	2	0	0.05	0.0	0	0	0.0	0.0
b. Calcification	10	0	0.2	0.0	1	0	0.1	0.0
4. Irregular Thickening of Apical Pleura	20	4	0.5	0.1	3	0	0.2	0.0
III. Nonspecific Lesions								
1. Parenchymal	42	27	1.0	0.7	21	2	1.7	0.2
2. Pleural	32	17	0.7	0.5	18	4	1.4	0.4
IV. Cardiac and Aortic Lesions	58	40	1.3	1.1	51	26	4.0	2.6

two 12 grade schools, were examined in each of these counties. Our findings in these counties and in Giles and Coffee Counties, along with those of other workers in Williamson County, Tenn.,<sup>4</sup> and Lee County, Ala.,<sup>5</sup> are shown in Table 4 and Map 2. The findings in Lee and Williamson Counties are somewhat high in comparison with our findings in their respective regions presumably because in those two counties repeat examinations in oblique positions were made on doubtful cases which would have been recorded negative from single film examination.

The areas of high incidence of this condition correlate closely with the areas in which limestone and chert formations underlie the top soil and out-crop in many places. They also correlate generally with the areas of highest tuberculosis mortality. They are quite sharply defined geographically. In Giles

County, Tenn., the incidence was found to be over 20 times as high as that in Cullman County, Ala., only 50 miles to the south. The incidence in Fayette County, Ky., was found to be over 50 times as great as in Leslie County, Ky., 60 miles to the southeast. Two counties, Ross in Ohio and Cocke in Tennessee, each with areas of different geological formations, showed a remarkably higher incidence among children in the schools located in the areas of limestone and chert. The only counties entirely in the limestone and chert area with an incidence below 30 per cent are Darke, Ohio (14.2 per cent), and Jefferson, Ind. (24.1 per cent), both of which are covered with glacial drift. The only counties outside the limestone and chert area with an incidence over 5 per cent are Madison, Tenn. (12.7 per cent), Union, Ky. (25.8 per cent), and Dubois, Ind. (10.4 per cent). Madison and

MAP 2  
EAST CENTRAL  
UNITED STATES



Union Counties are subject to mixed influences from the coastal plain and river deposits on which they lie, whereas Dubois County is adjacent to limestone on the east.

The correlation between the environment and pulmonary calcification is further emphasized by comparing the findings in natives and non-natives. Of 11 counties or schools with less than 20 per cent of natives showing calcification, all but one showed a *higher* incidence in non-natives whereas of 5 counties or schools with 30 per cent or more natives showing calcification, all but one showed *lower* incidence in non-natives.

The pathological significance of these calcifications is not known. We have called attention in a previous paper<sup>8b</sup> to the lack of correlation between this

condition and tuberculin sensitivity. The correlations between this condition and geological formations and tuberculosis furnish an epidemiological lead, which will be thoroughly explored by extensive experimentation on laboratory animals and otherwise. Recent findings of other workers<sup>6</sup> indicating the protective influence of aluminum dust against silicosis suggest one line of experimentation.

*Pathological and Bacteriological Studies*—The Divisions of Pathology and of Infectious Diseases of the National Institute of Health, and the Department of Pathology of Vanderbilt University Medical School, are coöperating with the field study force in conducting special studies in pathology, chemistry, bacteriology, and mycology

for the purpose of determining: (1) the exact nature and pathogenesis of focal pulmonary calcification, (2) the causes of apparently tuberculous pulmonary infiltration, sometimes with cavitation, in persons with negative sputum, and (3) whether different strains of tubercle bacilli predominate in the high and the low tuberculosis rate regions.

*Studies of Communicability in Families*—Intensive epidemiological, clinical, and x-ray studies are being made for the purpose of determining the incidence of active tuberculosis among family contacts in homes with one or more current or recent, known, sputum positive cases. About 100 homes in the low rate region of South Alabama, and a like number in the high rate region of South-central Tennessee will be covered

by these studies. The evidence so far obtained suggests that, under comparable conditions of exposure, active tuberculosis is much more frequent among familial contacts in the Tennessee region than it is in the Alabama region.

*Meteorological Studies*—Because of the known biological effects of radiation on both the tubercle bacillus and its host, measurements of visible daylight for the past 3 years and of ultra-violet radiation for the past 18 months have been carried out in the two counties by the Industrial Hygiene Division of the National Institute of Health, cooperating with the field force.

It was found that Coffee County has received 36 per cent more daylight during the three winter periods and an annual average of 20 per cent more than

TABLE 4  
Incidence of X-ray Demonstrable Calcified Lesions among White Children of Twenty Counties in the Southeastern United States

Counties (grouped according to specified per cent of lesions in natives *)	Lifelong Residence in County *				Some Previous Residence Outside County		No. on Map
	Number Examined	Per cent Lesions			No.	Per cent Lesions	
		Age in Years					
		5-9	10-14	15-19	Total †		
<b>Less than 5 Per cent</b>							
Coffee, Alabama	2,343	0.4	0.5	0.2	0.4	*	1
Lee, ‡ Alabama	948	3.1	5.6	2.8	4.1	*	2
Shelby, Alabama	289	1.1	1.5	0.0	1.0	218	1.8
Cullman, Alabama	344	2.2	2.3	0.8	1.8	151	3.3
Morgan, Alabama	410	3.6	3.5	7.0	4.6	109	10.1
Scott, Tennessee	398	2.7	2.4	2.5	2.5	86	4.7
Clay, Kentucky	219	2.7	2.7	5.6	3.5	90	13.3
Leslie, Kentucky	132	0.0	1.4	0.0	0.6	32	9.4
<b>10 to 19 Per cent</b>							
Madison, Tennessee	388	8.8	12.6	16.7	12.7	97	16.5
Cocke, Tennessee (Cosby School)	165	6.1	13.2	23.4	14.2	65	10.8
Ross, Ohio (Harrison School)	154	11.9	21.9	15.4	17.3	42	26.2
Darke, Ohio	364	6.1	14.4	21.6	14.2	148	24.3
Dubois, Indiana	401	9.3	8.1	14.7	10.4	132	22.0
<b>20 to 29 Per cent</b>							
Union, Kentucky	347	17.3	28.6	29.5	25.8	112	25.9
Jefferson, Indiana	509	12.9	27.1	30.0	24.1	10	40.0
<b>30 Per cent and Over</b>							
Giles, Tennessee	2,231	29.4	42.0	42.0	38.6	732	35.8
Williamson, ‡ Tennessee	1,051	?	?	?	49.5 †	*	17
Cocke, Tennessee (Parrottsville School)	281	20.0	30.8	45.7	32.3	14	35.7
Trigg, Kentucky	352	19.3	35.1	41.4	32.6	148	31.1
Barren, Kentucky	466	27.6	30.4	36.8	31.5	—None—	19
Fayette, Kentucky	305	35.2	42.1	44.8	41.0	193	31.6
Ross, Ohio (Clarksburg School)	251	29.3	33.0	37.9	33.4	50	18.0

\* Except in Coffee, Lee, and Williamson Counties, where non-natives are not recorded separately

† Total per cent adjusted to age distribution of Giles County white school population examined (except Williamson County total)

‡ Survey by other agency



Giles County. For two of the 3 years, the winter difference averaged about 50 per cent and in some months averaged as high as 100 per cent. The ultraviolet radiation during the single winter of observation showed an even greater difference in favor of Coffee County than did the daylight.

Continuous hygrothermographic records of temperature and humidity are also being made in the two counties. During the year of observation, there have been 7 times more diurnal temperature swings of at least 30° F. in Giles County than in Coffee County. During the past year, the monthly average relative humidity was found not to differ greatly in the two counties, but the records are being studied further for comparison of maximum and minimum humidities, dew points, and total vapor content of the atmosphere. Anemometric studies in the two areas are contemplated.

*Geological Studies*—The U. S. Geological Survey coöperated in making a thorough survey of the two counties, on the basis of which detailed studies were made of rock formations, soil, and water. Coffee County is in what is ordinarily known as a "sandy region," while Giles County is in a "limestone region" with limestone outcropping in many places. Interbedded with the limestone and outcropping with it is a considerable proportion of "chert," a sub-crystalline, flinty rock composed of nearly pure silicon dioxide.

One hundred and four samples of soil and 408 samples of domestic water supplies were collected from the different representative areas of the two counties and analyzed by the Geological Survey. The soil of Giles County was found to contain much more calcium and phosphorus than Coffee County soil, and about 5 times as much free silica of small particle size (under 5 microns).

The water samples from Giles County were found much harder, due mainly to

calcium bicarbonate content, whereas those from Coffee County were found to be more acid.

*Food Chemistry Studies*—Concurrently with the geological studies of soil and water, a study of the foods of the two counties was undertaken through coöperation from the Division of Chemistry of the National Institute of Health. Quantitative analyses for silica, iron, manganese, magnesium, calcium, phosphorus, potassium, and sulphur have been made of 140 different samples of 7 staple, locally produced foods from the two counties, and other foods are now being analyzed. Vitamin C determinations on 100 samples of fresh vegetable foods from the two counties have been carried out.

The foods from Giles County were found in general to contain larger amounts of calcium and phosphorus, and those from Coffee County to contain more vitamin C and to have a higher magnesium/calcium ratio.

#### DISCUSSION

Nothing in these findings furnishes cause for discouragement to any of us concerned with practical measures for the prevention of tuberculosis. The ingenuity of public health administration can be expected to apply advantageously any additional knowledge which may be acquired by such research. The delineation of the high and the low tuberculosis rate regions provides a basis for strategic attack. Even in the highest rate regions, there has been for years and is continuing a gratifying decrease in tuberculosis mortality. Not all of the factors operating in the causation of this decrease are understood. Additional knowledge should augment the progress. If ingredients of dust, grime, water or foods, or meteorological conditions were proved to be damaging in one region or protective in another, advantageous adjustments should become feasible.

In the course of our research in the two areas, over 50 cases of previously unrecognized reinfection type tuberculosis have been found and brought under the supervision of local health departments. We now are developing a portable modification of the radiophotography (photography on a small film of the chest image on a fluoroscopic screen) technic which is reported satisfactory in screening surveys abroad<sup>7</sup> and to a small extent in this country. Promising results have been obtained with this method, which is expected to provide x-ray photographs of the chest at a cost of less than one cent each. This technic may help to lead us out of the present maze of tuberculin testing by serving as a most advantageous and economical "screen" in case finding for tuberculosis and other diseases, and thereby relegating tuberculin testing to its proper place as a procedure in differential diagnosis.

#### CONCLUSION

The findings to date from these continuing studies strongly suggest that some factor or set of factors of a general environmental nature such as may derive directly from the soil or the

sunlight, operates importantly in the causation of the regional distribution of tuberculosis mortality in the southeastern section of the United States.

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