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FLUORIDE DOMESTIC WATERS AND SYSTEMIC EFFECTS [1]

II. Fluorine Content of Urine in Relation to Fluorine in Drinking Water

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A preceding article (*1*), by one of us (F. J. McC.), reports an epidemiological study of the bone-fracture experience, height, and body weight of high school boys and young men in relation to their exposure to fluorine in drinking water. The fluorine content of urine specimens obtained from a large number of these same men and boys is reported in this article. The urine analyses also are studied in relation to the fluorine content of the local water supply.

Concentrations of fluorine permissible in domestic water and in food are now established at 1.00 p. p. m. in drinking water according to Public Health Service Drinking Water Standards (*2*) and 7.0 p. p. m. in marketable sprayed apples and pears as established by Federal Government restriction. When the concentration of fluorine in a domestic water exceeds approximately 1.5 p. p. m. (associated with an index of dental fluorosis of about 0.6) endemic dental fluorosis as stated by Dean (*3*) "begins to constitute a public health problem warranting increasing consideration." Fluoride ingested in food alone has been found "insufficient to produce even the faintest signs of dental fluorosis in as little as one percent" of a group of over 2,000 white public school children (*4*). Fruits and vegetables carrying fluorine spray residues, while not studied specifically in these regards, have given no evidence of producing dental fluorosis (mottled enamel).

An important effect of fluorine in drinking water is a marked reduction of dental caries attack in children aged 12 to 14 (*4*, *5*). It is quite possible that this effect also applies to older age groups (*6*). These effects are associated with as little as 1.00 p. p. m. fluorine in a domestic water. Absence of endemic dental fluorosis (mottled enamel)

[1] From the Dental Research Section, Division of Physiology, National Institute of Health.

in connection with the domestic use of waters of this fluoride concentration, i. e., 1.00 p. p. m. fluorine (*4*), has made it possible to consider seriously the direct fluorination of communal water supplies in this concentration, for the partial control of dental caries (*7*). Other suggested health hazards which may surround this concentration, and also higher concentrations of fluorine in drinking water, are being investigated in studies such as those reported in this article and in the preceding article (*1*).

The public health hazard possibly connected with the domestic use of fluoride-bearing waters and which seems to deserve most serious study at this time relates to cumulative toxic bone fluorosis (*8*). This form of fluorine toxicity is attributed to the abnormal accumulation of fluorine in skeletal tissues (*8*). In connection with excessive exposures to fluorine from food or drinking water, it appears that the successful adjustment of the body to this fluorine may be largely dependent on the elimination of fluorine via the urinary excretion. For this reason the fluorine content of urine studied in relation to the fluorine exposure may be of special value as a measure of a suspected health hazard related to cumulative bone fluorosis. Urinary fluorine data may also serve as an index of the approximate fluorine exposure from food and drinking water.

Fluorine content of urine of human subjects has been studied most extensively thus far by Machle (*9*), Machle, Scott, and Treon (*10*), Machle, Scott, and Largent (*11*), and Machle and Largent (*12*). Brun, Buchwald, and Roholm (*13*) studied the excretion of fluorine in urine of cryolite factory workers. (Cryolite is the mineral Na_3AlF_6.) Shortt, McRoberts, Barnard, and Nayar (*14*) found fluorine in appreciable quantities in urine of certain natives of India exposed to fluorine in their water supplies.

The results of studies by Machle and his coworkers may be summarized as follows: According to Machle (*9*) fluorine content of urine ranges from 0.5 to 2.89 p. p. m. and averages about 1.00 p. p. m. The specimens analyzed were provided by 10 women and 19 children who were hospital patients, and by 101 subjects chosen at random. Based on a rather limited number of specimens, Machle, Scott, and Treon (*10*) report an appreciable elevation of fluorine in urine where there is an exposure to fluorine in the drinking water. In an experimental study (*11*), a normal man was found to remain in a normal or noncumulative fluorine balance when ingesting 0.4 mg. to 0.6 mg. of fluorine daily. "Measurable storage of fluorine did not occur. Over 80 percent of the fluorine was absorbed and excreted in the urine" (*11*). An equilibrium between fluorine ingestion and output was further demonstrated by these workers "under normal levels of fluoride intake," i. e., at about 0.5 mg. fluorine ingested daily (*11*). Increasing the daily fluorine intake by addition of 6.0 mg. of fluorine to the ingesta

caused an increase in the urinary excretion of fluorine. However, this increased urinary excretion did not bring about the elimination of all the absorbed fluorine (ingesta fluorine minus feces fluorine). A body storage of fluorine occurred, therefore, estimated as follows in milligrams of fluorine retained daily: From sodium fluoride in drinking water, 3.87 mg.; from bone meal 1.74 mg.; and from cryolite 2.43 mg. As noted above, in these comparative tests an equal quantity (6.0 mg. daily) of fluorine was provided by each fluorine compound. The observed differences in daily retention were due mainly to differences in quantities absorbed rather than to a variability in the percent of absorbed fluorine excreted in the urine.

Fluorine content of urine, according to Brun, Buchwald, and Roholm (*13*), will normally average 0.80 p. p. m., varying from 0.3 to 1.6 p. p. m. Average daily excretion equals 0.92 mg., varying from 0.18 to 1.85 mg. daily. These results are based on 24-hour urine collections from 30 hospital patients aged 2 months to 78 years Twenty-four workers exposed to cryolite-factory dust had an average of 16 p. p. m. of fluorine in urine specimens excreted between 8 a. m. and 2:30 p. m. at the factory. These analyses varied from 2.4 to 43.4 p. p. m. fluorine and seemed proportional to exposure to cryolite dust. In this connection it is interesting to note that men who had remained away from these factories as long as 5 to 7 years, after working in the factories 24 to 28 years, continued to show as much as 3.7 to 3.9 p. p. m. fluorine in urine specimens. In these men fluorine was undoubtedly being mobilized from skeletal fluorine acquired during previous fluorine exposure from cryolite dust.

PLAN OF STUDY

With the assistance of induction center personnel, urine specimens were obtained from young adult men reporting for physical examination at Army induction centers, located at Fort Myer, Va. (Washington, D. C., area), Manchester, N. H., Indianapolis, Ind., Chicago, Ill., Oklahoma City, Okla., and Lubbock, Tex. Specimens were obtained from high school boys aged 15 to 17, residing in Washington, D. C., Little Rock, Ark., Oklahoma City, Okla., Lubbock, Tex., Amarillo, Tex., and in the following Illinois cities: Waukegan, Quincy, Elgin, Aurora, Monmouth, and Galesburg. As a rule, specimens were obtained between 9 a. m. and noon. Equal volumes, usually 20 cc., of each specimen were pooled (15 to 20 or less specimens per pooled sample), according to age or duration of fluorine exposure. These samples were preserved with toluene and shipped to the National Institute of Health, U. S. Public Health Service, Bethesda, Md., for fluorine analysis.

The fluorine exposure via drinking water of the majority of these men and boys has been discussed somewhat in detail in the previous

report on the bone-fracture experience, height, and body weight of these men and boys (*1*). This report should be consulted for details of fluorine exposures. In connection with the study of high school boys, a sample of the local water supply was obtained at the time of the survey. The fluorine content of these waters appears in table 2. Current water samples from a number of communities in which the inductees resided also were analyzed for fluorine, and these results appear in table 1 along with the analytical figures for fluorine in urines.

DETERMINATION OF FLUORINE

The volume of urine for fluorine determination was 100 ml., with the exception that 50 or 25 ml. were taken if the fluorine content was expected to be considerably above normal. The rule followed was to have preferably 50 to 100 micrograms of total fluorine in the analytical sample. Although 100-ml. quantities of urines from nonfluoride areas

TABLE 1.—*Fluorine content of urine. Pooled specimens from men taking physical examination at armed forces induction centers located in fluoride and nonfluoride areas*

Location	Date (1943)	Fluorine in water (p. p. m.)	Fluorine in urine (p. p. m.)	Number of specimens pooled	Comment
NONFLUORIDE AREAS					
Washington, D. C.	May 21	0.0	0.3	22	Men aged 17 to 28 reporting at the Ft. Myer, Va., induction center. Lifetime residence in Washington, D. C., or suburbs.
	May 22	0	.4	22	
	May 24	0	.3	28	
	May 25	0	.5	27	
	May 26	0	.4	27	
	May 27	0	.4	27	
	May 28	0	.6	21	
	May 29	0	.4	28	
Indianapolis, Ind.	June 12	.2	.5	24	Men aged 17 to 27 reporting at Indianapolis, Ind., induction center. Lifetime residence in Indianapolis.
	June 12	.2	.4	18	
	June 14	.2	.5	19	
	June 16	.2	.3	22	
	June 16	.2	.3	20	
	June 19	.2	.3	18	
Hendricks County, Ind.	June 15	[1] 0.6–1.8	1.0	18	Men aged 18 to 25 reporting at Indianapolis induction center. Lifetime residence in respective county or town.
Jay County, Ind.	June 15	[2] 0.7–1.1	.8	21	
Anderson, Ind.	June 16	.3	.3	26	
Lebanon, Ind.	June 17	.7	.9	18	
Whiting, Ind.	June 18	.1	.4	26	
Chicago, Ill.	Nov. 13	0	.3	19	Men aged 18 to 31 reporting at Chicago induction center. Lifetime residence in Chicago.
	Nov. 13	0	.3	17	
	Nov. 16	0	.2	24	
Lebanon, N. H.	Sept. 1	0	.3	25	Men aged 17 to 30 reporting to New Hampshire induction center. Lifetime residence in respective communities.
Keene, N. H.	Sept. 1	0	.2	25	
Nashua, N. H.	Sept. 2	0	.2	24	
Lancaster, N. H.	Sept. 2	----------	.4	25	
Manchester, N. H.	Sept. 3	0	.4	25	
Laconia, N. H.	Sept. 3	0	.2	25	
Newport, N. H.	Sept. 3	0	.2	25	

[1] Fluorine analyses of waters of Hendricks County towns are reported by Jeup (*28*) as follows: Brownsburg 0.7 p. p. m., North Salem 1.0 p. p. m., Pittsboro 0.6 p. p. m. Danville water contains (November 1943) 1.8 p. p. m. fluorine (F. J. Mc.).

[2] Jay County towns.—Fluorine analyses are reported by Jeup (*28*) as follows: Portland 1.0 p. p. m., Dunkirk 0.9 p. p. m., Pennville 1.1 p. p. m. Portland water contains (November 1943) 0.7 p. p. m. fluorine (F. J. Mc.).

TABLE 1.—*Fluorine content of urine. Pooled specimens from men taking physical examination at armed forces induction centers located in fluoride and nonfluoride areas*—Continued

Location	Date (1943)	Fluorine in water (p. p. m.)	Fluorine in urine (p. p. m.)	Number of specimens pooled	Comment
FLUORIDE AREAS					
Amarillo, Tex.	July 6	[3] 4.3–5.1	3.9	27	Men aged 18 to 34. 1 year in Amarillo.
	July 17	4.3–5.1	4.0	15	Men aged 18 to 35. 1 year in Amarillo.
Lubbock, Tex.	July 7	3.8	4.2	21	Men aged 16 to 21. 1 month to 1 year in Lubbock (Texas Technical College students); man aged 19, lifetime in Lubbock.
	July 8	3.8	4.2	1	
Lubbock Army Air Field	July 15	5.1	4.8	12	Men aged 17 to 34. 12 to 19 months at Air Field.
	July 15	5.1	3.8	7	Men aged 21 to 46. 8 to 11 months at Air Field.
	July 15	5.1	3.7	6	Men aged 22 to 37. 2 to 3 months at Air Field.
	July 15	5.1	3.6	25	Men aged 17 to 46. 2 to 12 months at Air Field.
Lamesa, Tex.	July 12	[4] 3.9	4.5	11	Men aged 18 to 35 years reporting at Lubbock, Tex., induction center. 1-year residence in respective county or town.
Levelland, Tex.	July 17	[4] 3.5	4.8	6	
Gaines County, Tex.	July 9	----------	3.7	7	
Dallam County, Tex.	July 13	----------	4.0	12	
Hutchinson County, Tex.	July 8	----------	4.0	12	
Pampa, Tex.	July 9	[4] .8	3.7	15	
Clarendon, Tex.	July 7	[4] .2	3.3	19	
Wheeler, Tex.	July 8	[4] .3	2.3	18	
Wellington, Tex.	July 16	[4] .4	3.0	8	
Lubbock Glider Field	July 17	2.0	2.0	8	Men aged 20 to 35. 1 to 4 months at Glider Field.
	July 17	2.0	1.9	8	Men aged 22 to 36. 1 to 4 months at Glider Field.
Joliet, Ill.	Nov. 13	1.3	1.0	21	Men aged 22 to 37 (entire life in Joliet).[5]

[3] Amarillo city water (August and September 1943) analyses by J. C. Wyatt, City Chemist, Amarillo, Tex.

[4] It should be noted particularly that these men, although exposed to these waters at home, as a general rule arrived in Lubbock, Tex., the afternoon or evening prior to the morning on which the urine specimens were obtained. During their stay in Lubbock they were exposed to Lubbock drinking water, which contained 3.8 p. p. m. fluorine. The rapid response of urinary fluorine to fluorine ingested in drinking water is shown by the data in table 3.

[5] These men were taking the physical examination at the Chicago, Ill., induction center, and were in Chicago several hours at least prior to obtaining these urine specimens. Chicago drinking water is fluoride-free.

contained only 25 to 50 micrograms, these quantities were determined with the desired accuracy. The urine sample was made slightly alkaline with sodium hydroxide, 2.5 ml. of 5-percent magnesium acetate added, the sample evaporated to dryness in a platinum dish, and then ashed at 500° C. Moistening the ash with water, drying, and ashing again facilitates the ashing process. This ashed sample was transferred to a 50-ml. Claissen flask containing a glass bead and a pinch of silica, using water and 5 or 6 ml. of 60-percent perchloric acid. Total volume of washing water and perchloric acid amounted to about 15 ml. The sample was thoroughly disintegrated and a solution of silver perchlorate (1.0 gm. per ml.) added slowly to precipitate chlorides. This addition of silver perchlorate was roughly quantita-

TABLE 2.—*Fluorine content of urine. Pooled specimens from high school boys exposed to drinking waters containing different quantities of fluorine*

Location	Date	Fluorine in water (p. p. m.)[1]	Fluorine in urine (p. p.m.)	Number of specimens pooled	Comment
	1943				
Amarillo, Tex.	July 17	4.3-5.1	4.6	26	Boys aged 16 to 18. 3 to 17 years in Amarillo.
Lubbock, Tex.	July 14	3.8	3.5	15	Boys aged 16 to 18. 11 years in Lubbock.
	July 14	3.8	4.2	11	Boys aged 16 to 18. 1 to 5 years in Lubbock.
	July 14	3.8	3.8	26	Boys aged 16 to 18. 6 to 18 years in Lubbock.
Galesburg, Ill.	Oct. 20	1.9	2.0	17	Boys aged 15 to 17 who had lived practically their entire lives in Galesburg.
	Oct. 20	1.9	1.5	9	
	Oct. 20	1.9	1.7	17	
	Oct. 20	1.9	2.0	15	
	Oct. 21	1.9	2.1	16	
	Oct. 21	1.9	2.0	18	
	Oct. 21	1.9	1.6	15	
	Oct. 28	1.9	1.8	25	Boys aged 13 to 16. Entire life spent in Galesburg.
	Oct. 28	1.9	1.2	21	
	Oct. 28	1.9	2.2	20	
Monmouth, Ill.	Nov. 1	1.7	1.4	14	Boys aged 15 to 17. Entire life in Monmouth.
	Nov. 2	1.7	1.5	18	
	Oct. 29	1.7	1.7	20	Boys aged 14 to 17. Entire life spent in Monmouth.
	Oct. 29	1.7	1.4	15	
	Nov. 1	1.7	1.3	20	Boys aged 15 to 17. Lifetime in Monmouth or Monmouth area.[2]
	Nov. 1	1.7	1.1	23	
	Nov. 2	1.7	1.2	21	
	Nov. 2	1.7	1.1	25	
Aurora, Ill.	Nov. 4	1.0	.8	25	Boys aged 15 to 17. Practically entire life spent in Aurora.
	Nov. 4	1.0	.9	25	
	Nov. 4	1.0	.9	25	
	Nov. 5	1.0	1.1	28	
	Nov. 5	1.0	.9	25	
	Nov. 5	1.0	.7	25	
	Nov. 5	1.0	1.0	20	
Elgin, Ill.	Nov. 8	.7	.6	21	Boys aged 15 to 17. Practically entire life spent in Elgin.
	Nov. 8	.7	.4	23	
	Nov. 9	.7	.7	20	
	Nov. 9	.7	.6	24	
	Nov. 9	.7	.7	22	
	Nov. 10	.7	.9	24	
	Nov. 10	.7	.8	24	
Oklahoma City, Okla.	July 22	.5	.6	26	Boys aged 16 to 17. 12 years in Oklahoma City.
Quincy, Ill.	Oct. 25	.1	.6	16	Boys aged 15 to 17. Lifetime residence in Quincy.
	Oct. 25	.1	.4	11	
	Oct. 25	.1	.2	20	
	Oct. 26	.1	.2	14	
	Oct. 26	.1	.2	24	
Waukegan, Ill.	Nov. 12	0	.4	20	Boys aged 15 to 17. Lifetime residence in Waukegan.
	Nov. 12	0	.6	22	
	Nov. 15	0	.5	20	
	Nov. 15	0	.4	25	
	Nov. 15	0	.4	17	
	Nov. 16	0	.3	17	
	Nov. 16	0	.3	21	
Little Rock, Ark.	July 27	0	.3	26	Boys aged 16 to 18. 12 years in Little Rock.
	1944				
Washington, D. C.	Jan. 4	0	.3	22	Boys aged 15.[3]
	Jan. 5	0	.2	22	Boys aged 16.[3]
	Jan. 6	0	.2	23	Boys aged 17.[3]

[1] These figures are for samples of water taken from the high school tap at the time the urine specimens were obtained.

[2] Several of the boys in these groups lived outside the city limits and their drinking water exposures were not ascertained.

[3] These boys had spent their entire lives in Washington, D. C.

tive, i. e., until all the chloride in the sample appeared to be precipitated. A slight excess of silver perchlorate, however, has not been found to interfere with the determination (*15*). The fluorine was steam distilled from this mixture, 150 ml. being distilled, the distillate kept alkaline to phenophthalein with 5 ml. of 0.10 normal sodium hydroxide. This volume was distilled over in about one-half hour. Some bumping may occur during the early stages of this distillation but can be kept under control so as not to interfere with the determination. The 150 ml. of distillate was evaporated in a platinum dish almost to dryness, made slightly acid, and transferred to a 10-ml. volumetric flask. A one-fifth or one-tenth aliquot of this solution was then titrated with standard thorium nitrate. This is essentially the method of Willard and Winter (*16*) modified by Armstrong (*17*). A study of this method by McClure (*15*) has been reported. The accuracy of this procedure with respect to urine samples is approximately ±0.2 p. p. m. The recovery of known quantities of fluorine added to 100-ml. volumes of urine was as follows:

Fluorine present		Fluorine added		Fluorine found		Recovered
Micrograms	p. p. m.	Micrograms	p. p. m.	Micrograms	p. p. m.	Percent
40.0	0.4	20	0.2	70	0.7	117
30.0	.3	20	.2	45	.5	90
40.0	.4	50	.5	70	.7	78
30.0	.3	50	.5	87	.9	108
40.0	.4	80	.8	120	1.2	100
40.0	.4	100	1.0	150	1.5	107
30.0	.3	100	1.0	117	1.2	92
40.0	.4	150	1.5	180	1.8	95
40.0	.4	200	2.0	220	2.2	92
30.0	.3	200	2.0	241	2.4	104

Fluorine was determined in water supplies by this method, using 100 ml. as the analytical sample.

DISCUSSION

Urinary fluorine in specimens from over 1,900 men and boys representing a variety of conditions ranging from flouride-free to high flouride domestic-water areas, has been studied. A remarkable relationship was observed between urinary fluorine and fluorine content of domestic water. Beginning with exposures approximating 0.5 p. p. m. fluorine in the local domestic water, urine specimens show a detectable increase in fluorine. Fluorine in urine continues proportional to water fluorine up to about 5.0 p. p. m. fluorine in the local water supply (fig. 1).

The sensitivity of urinary fluorine excretion to fluorine in the drinking water is shown by data in table 3. The consumption of fluoride waters by one of us (F. J. Mc.) produced an immediate proportional increase in urinary fluorine. During these field studies

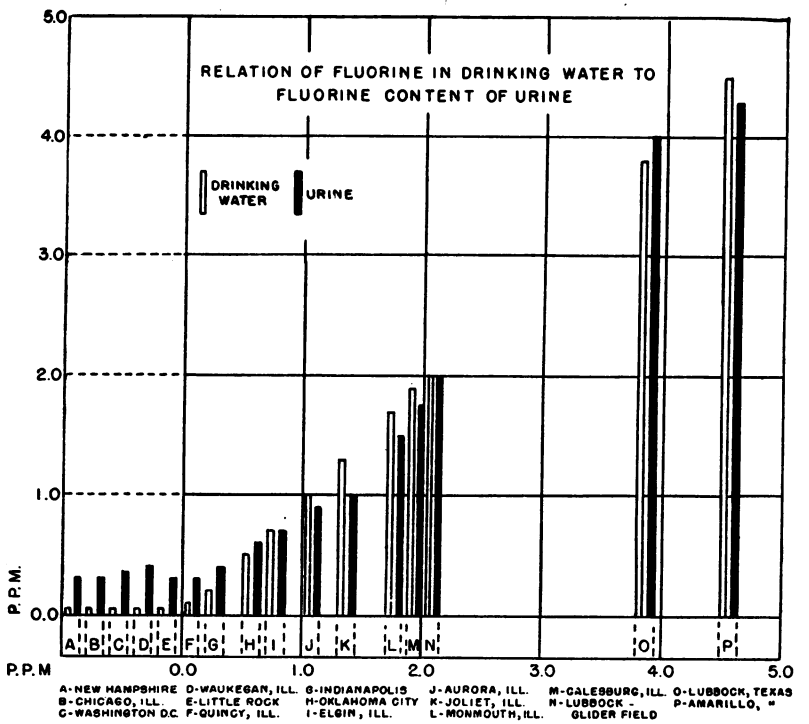

FIGURE 1.

TABLE 3.—*Fluorine content of urine of one individual (F. J. Mc.). Residence in Washington, D. C., versus residence in Lubbock, Tex., and Galesburg, Monmouth, Aurora, Elgin, and Quincy, Ill.*

Location	Date (1943)	Fluorine in drinking water (p. p. m.)	Fluorine in urine (p. p. m.)	Comment
Washington, D. C.	Jan. 12	0.0	0.4	24-hour collection.
	Jan. 13	0	.2	
	Jan. 14	0	.3	
	June 29	0	.4	
	June 30	0	.3	
	July 1	0	.4	
Lubbock, Tex.	July 6	3.8	3.9	First 18 hours in Lubbock.
	July 7	3.8	3.9	Second 24 hours in Lubbock.
	July 8	3.8	4.0	Third 24 hours in Lubbock.
	July 9	3.8	3.5	Fourth 24 hours in Lubbock.
	July 11	3.8	3.8	Sixth day in Lubbock, night urine.
	July 13	3.8	3.5	Eighth day in Lubbock, night urine.
	July 15	3.8	3.6	Tenth day in Lubbock, night urine.
	July 17	3.8	3.5	Twelfth day in Lubbock, night urine.
Galesburg, Ill.	Oct. 21	1.9	1.8	First day in Galesburg, night urine.
	Oct. 22	1.9	1.8	Second day in Galesburg, night urine.
	Oct. 23	1.9	1.3	Third day in Galesburg, night urine.
	Oct. 24	1.9	2.4	Fourth day in Galesburg, night urine.
Quincy, Ill.	Oct. 25	.1	.5	First day in Quincy, night urine.
	Oct. 26	.1	.4	Second day in Quincy, night urine.
	Oct. 27	.1	.5	Third day in Quincy, night urine.
Galesburg, Ill.	Oct. 28	1.9	1.7	First day in Galesburg, night urine.
	Oct. 31	1.9	1.1	Fourth day in Galesburg, night urine.
Monmouth, Ill.	Nov. 2	1.7	1.0	Second day in Monmouth, night urine.
	Nov. 3	1.7	2.1	Third day in Monmouth, night urine.
Aurora, Ill.	Nov. 6	1.0	1.1	Third day in Aurora, night urine.
Elgin, Ill.	Nov. 10	.7	.7	Fourth day in Elgin, night urine.

TABLE 4.—*Fluorine content of urine. Relation to fluorine in drinking water. Summary of data appearing in tables 1 and 2*

Location	Fluorine in water (p. p. m.)	Fluorine in urine (p. p. m.)	Number of specimens represented	Comment
Amarillo, Tex.	4.7	4.6	26	High-school boys, aged 16 to 18.
	4.7	4.0	42	Selectees, Lubbock induction center.
Air Field, Lubbock, Tex.	5.1	4.0	50	Servicemen stationed at Air Field.
Lubbock, Tex.	3.8	3.8	62	High-school boys, aged 16 to 18.
	5.8	4.2	21	Texas Technical College men, aged 17 to 21.
	5.8	3.7	108	Selectees, Lubbock induction center.
Glider Field, Lubbock, Tex.	2.0	2.0	16	Servicemen stationed at Glider Field.
Galesburg, Ill.	1.9	1.8	173	High-school boys, aged 15 to 17.
Monmouth, Ill.	1.7	1.5	87	High-school boys, aged 15 to 17.
Joliet, Ill.	1.3	1.0	21	Selectees, Chicago induction center.
Aurora, Ill.	1.0	.9	173	High-school boys, aged 15 to 17.
Elgin, Ill.	.7	.7	158	High-school boys, aged 15 to 17.
Rural central Indiana	[1].5	.7	109	Selectees, Indianapolis, Ind., induction center.
Oklahoma City, Okla.	.5	.6	26	High-school boys, aged 16 to 18.
Indianapolis, Ind.	.2	.4	121	Selectees, Indianapolis induction center.
Chicago, Ill.	0	.3	60	Selectees, Chicago induction center.
Quincy, Ill.	.1	.3	85	High-school boys, aged 15 to 17.
Washington, D. C.	0	.4	202	Selectees, Fort Myer, Va., induction center.
	0	.3	67	High-school boys, aged 15 to 17.
Little Rock, Ark.	0	.3	26	High-school boys, aged 15 to 18.
Waukegan, Ill.	0	.4	142	High-school boys, aged 15 to 17.
New Hampshire	0	.3	174	Selectees, Manchester induction center.

[1] Estimated average for fluorine in waters in this area.

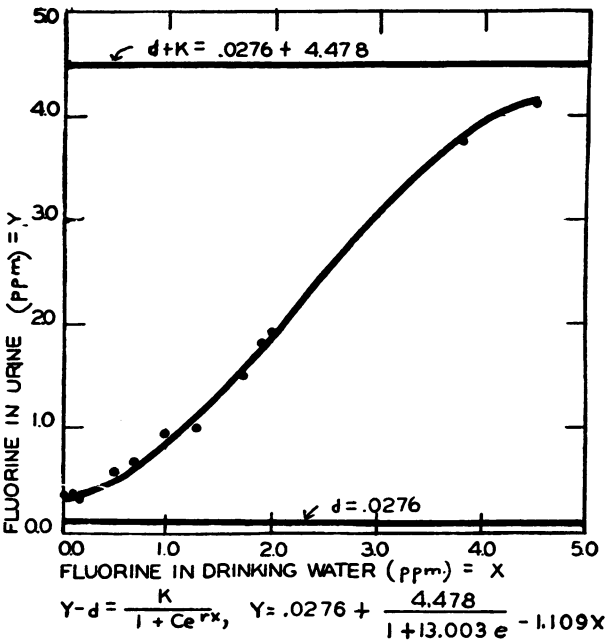

FIGURE 2.—The relationship between fluorine in drinking water and fluorine in urine fitted with a symmetric logistic curve for the interval x=0.0 to x=4.5.

wherever specimens were collected the fluorine concentration of urine specimens of this individual followed closely the fluorine contained in the local drinking water.

As shown in tables 1 and 2, individual urine specimens were pooled to provide an analytical sample for fluorine determination. A total of 114 comparisons between fluoride domestic water and urinary fluorine, covering 13 levels of water-fluorine concentration, is available for study. Inspection of these data suggested that a logistic curve (*20*) would be most suited to describe graphically the water fluorine-urinary fluorine relation. Accordingly, using the equation $Y-d=\frac{K}{1+Ce^{rx}}(20)$, the symmetric logistic curve shown in figure 2, was obtained.[2] The data as used and the observed and predicted values for urinary fluorine are as follows:

Number of pooled urine analyses averaged	Fluorine in drinking water (p. p. m.)	Fluorine in urine (found) (p. p. m.)	Fluorine in urine (calculated) (p. p. m.)
35	0.0	0.340	0.348
8	.1	.375	.382
6	.2	.383	.420
1	.5	.600	.557
7	.7	.671	.669
8	1.0	.925	.875
1	1.3	1.000	1.127
6	1.7	1.516	1.534
14	1.9	1.814	1.763
2	2.0	1.900	1.883
22	3.8	3.759	3.785
3	4.5	4.166	4.143

Within the range of water-borne fluorine (0.0 to 4.5 p. p. m. F) the logistic curve appears particularly descriptive of these data. Absence of fluorine in water (X equals 0.0) gives values equalling 0.340 p. p. m. (observed) and 0.348 p. p. m. (calculated) for fluorine in urine, and the other observed and calculated values are in very close agreement. Within the range 1.0 p. p. m. to 4.0 p. p. m. fluorine in water the curve rises rapidly and begins to level off at slightly above 4.0 p. p. m. water-fluorine concentration. At higher levels of water fluorine, however, it is unquestioned that the urinary flourine would continue to increase and, with additional data for waters above 4.5 p. p. m. fluorine the calculation of a logistic curve would be expected to give a higher value to the asymptote (*20*).

The association shown between water and urinary fluorine is strikingly similar to the relation between water fluorine and mottled enamel as observed by Dean (*3*). The logistic curve appears to describe adequately both mottled enamel and urine fluorine as related to fluorine in drinking water. It is to be noted, however, that the

[2] One urinary value representing but one pooled urine sample, i. e., for 5.1 p. p. m. fluorine in water, was rejected in the calculation of this logistic curve.

logistic curve which would appear to describe Dean's data showing the relation between fluorine in drinking water and index of dental fluorosis (fig. 2 in Dean's article (*3*)) applies to values of X (water fluorine) ranging from 0.0 to 14 p. p. m. There is every indication in Dean's data also that the maximum mottled enamel effect (index of dental fluorosis) is reached at about 6 p. p. m. water fluorine. The logistic curve for urinary fluorine concentration (fig. 2), on the other hand, applies only to a range of 0.0 to 4.5 p. p. m. fluorine in drinking water and is not intended to describe urinary-fluorine concentrations beyond 4.5 p. p. m. of water fluorine.

Without quantitative ingestion and excretion data it is obviously impossible to assess exactly the relations between total fluorine ingested from drinking water and food and the accompanying total fluorine elimination in urine, feces, and perhaps sweat. At the same time, in view of the large number of urine specimens represented and the wide variety of conditions surrounding the eating and drinking habits of these individuals, important deductions regarding the ingestion and metabolism of fluorine from food and drinking water seem justified.

First, it may be pointed out that the pronounced increases of fluorine in urine which accompany these exposures to fluorine in drinking water provide additional evidence that fluoride domestic waters are to be regarded as the most important as well as the most universal source of fluorine in human diets. The close correlation between urinary fluorine and domestic-water fluorine lends strong support to this conclusion. It is of interest to note also the uniformity in the urinary-fluorine figures for areas as widely separated as New Hampshire, Washington, D. C., Waukegan and Chicago, Ill., Quincy, Ill., Indianapolis, Ind., and Little Rock, Ark. (tables 1 and 2). A very uniform quantity of fluorine appears to be absorbed daily from foods as ingested by individuals residing in these several nonfluoride localities. These data suggest that the content of fluorine in the average human diet, exclusive of drinking water is remarkably uniform regardless of the locality. It may be suggested that this is indicative also that fluorine in food produce is quite uniform, regardless of the conditions under which the food is grown or produced.

The urinary fluorine data also seem to be in accord with previous estimates of total fluorine in the average diet exclusive of drinking water. Although analytical fluorine data on foods still lack the accuracy desirable for final conclusions, 0.2 to 0.5 p. p. m. or less fluorine seems to be a reasonably good estimate to apply to most fresh foods (*18*). Teas and seafoods in general contain unusual quantities of fluorine (teas 40 to 60 p. p. m., seafoods 2 to 12 p. p. m.), but it does not appear that these foods contribute significantly to the average daily fluorine ingested from food alone. The average daily

diet has been estimated to contain 0.3 to 0.5 mg. fluorine (*18*). Numerous analyses of the daily diet of an adult man showed on the average 0.45 mg. fluorine present daily, exclusive of water drinking per se (*11*). This individual was residing in Cincinnati, Ohio, a nonfluoride area. As of November 1939, the Cincinnati water supply contained less than 0.2 p. p. m. fluorine (*19*). Another estimate, based on analyses of meals served to the staff of the Minnesota General Hospital, Minneapolis, Minn., indicates a daily intake of 0.27 to 0.32 mg. fluorine "from sources other than water" (*21*).

Urinary fluorine in concentrations equalling 0.3 to 0.5 p. p. m. (tables 1, 2, and 3) will account for approximately 0.3 to 0.5 mg. fluorine eliminated daily in the urine alone, assuming 1,000 ml. as an average daily volume of urine. In support of this estimate it may be noted that the Brun, Buchwald, and Roholm (*13*) found 0.92 mg. to be the average quantity of fluorine in 24-hour urine specimens of 30 hospital patients aged 2 months to 70 years. The analytical figures for these daily specimens averaged 0.80 p. p. m. fluorine.[2] It may be suggested, therefore, that 0.3 to 0.5 mg. fluorine appears to be a reasonably good estimate of total daily fluorine eliminated in the average 24-hour urinary excretion, as applied to individuals 15 to 17 years old or older residing in nonfluoride areas.

Fluorine balance studies reported by Machle, Scott, and Largent (*11*) are of interest in these regards as showing that fluorine in food equalling about 0.3 to 0.6 mg. fluorine ingested daily, is largely eliminated from the body. Approximately 88 percent of the total fluorine ingested appeared in the urine, about 8 percent being excreted in the feces. These data (*11*) also are cited by these workers as emphasizing the significance of the urinary fluorine figure as an approximate index of the level of ingestion and elimination of fluorine as applied to the average adult.

The importance of water-borne fluorine as a source of fluorine in average diets has been strongly implied in previous epidemiological studies relative to water-borne endemic dental fluorosis (*3*), as well as in epidemiological studies showing the striking relation of fluorine in drinking water to dental caries (*4, 5*). As noted above, Dean (*4*) has failed to find the "fluoride intake from sources other than domestic water" sufficient "to produce even the faintest signs of dental fluorosis in as little as one percent" of a group of 2,042 white public school children using fluoride-free Lake Michigan water (*4*). The epidemiological surveys relative to water fluoride-dental caries relations, demonstrate a remarkable relation between fluorine in

[2] During the preparation of this manuscript, E. J. Largent and I. F. Ferneau (J. Indust. Hyg. and Toxicol., 26: 113 (April 1944)) presented evidence that spot urine specimens will give analytical fluorine figures almost identical with the fluorine analysis for the corresponding total 24-hour urine excretion.

domestic water and dental caries experience in 12- to 14-year age groups exposed to these waters throughout life. This relation is maintained regardless of possible differences in local food conditions and thus appears to be an effect of water-borne fluorine alone, over and above food fluorine. In all these epidemiological dental studies the evidence has been indicative (and now seems supported by urinary-fluorine data) that the predominant source of additional fluorine associated with dental effects of fluorine is the domestic water supply. There is little or no acceptable evidence that food produced in fluoride areas contains increased quantities of fluorine. It seems worth emphasizing that fluorine provided by sources other than drinking water in the average diet is a quite uniform quantity approximating 0.3 to 0.5 mg. daily. This much fluorine in the daily diet seems secondary in importance, both as to quantity and physiological effects, in comparison with the fluorine provided by fluoride domestic water supplies indigenous to the United States and other parts of the world. Insofar as the most significant source is the drinking water, fluorine appears to be a unique dietary constituent.

A second important implication surrounding the urinary fluorine figures relates to the daily accumulation of fluorine in skeletal tissue which might accompany exposure to fluorine in drinking water. It is strongly implied by these urinary fluorine data that fluorine present in drinking water in concentrations up to at least 4.0 to 5.0 p. p. m., when ingested by men and boys of these age groups, is largely eliminated in the urine. There is no reason to anticipate a sex difference in these regards, so it may be presumed that an efficient elimination of fluorine is characteristic of individuals in this age group, regardless of sex, exposed to these concentrations of fluorine in drinking water. It is not to be inferred, however, that these data indicate that storage of fluorine does not occur to any extent from these low concentrations of water-borne fluorine. This conclusion, as noted above, can be justified only by controlled balance experiments.

The hazard of cumulative fluorosis from water-borne fluorine in these concentrations may be minimized also by the following observations: (a) Fluorine is not an essential element but in small quantities appears to be a harmless constituent of all skeletal tissue. Trace quantities of fluorine in foods are a source of this fluorine. (b) According to experimental evidence fluorine may accumulate in skeletal tissue to an appreciable extent without injury. A tenfold increase in fluorine content of bones of experimental animals above an assumed normal of about 200 p. p. m. has been suggested by Peirce (*22*) as commensurate with absence of manifest morphological change in skeletal tissue. This is a highly tentative figure and may be too high. The tolerance of human skeletal tissue in terms of

fluorine storage cannot be exactly stated at this time. (c) Results reported by Lawrenz, Mitchell, and Ruth (*23*) indicate that "growing rats adapt themselves to the continuous ingestion of low levels of fluorine by excreting greater and greater proportions of the ingested fluorine in feces and urine. This adaptation involves the excretory capacity of both kidney and intestine, that of the latter to a somewhat greater extent" (*23*). Fluorine in diets fed these rats ranged from 4 to 12.5 p. p. m. There is other evidence indicating that when increasing quantities of fluorine were ingested by a dog (*24*) and growing rats (*25*) a much larger percent of the quantity ingested was eliminated from the body. Other experiments by Lawrenz, Mitchell, and Ruth (*26*) also suggest an increased efficiency in fluorine elimination in rats, as associated with lengthening periods of fluorine feeding. (d) Mobilization of fluorine from skeletal tissue (*13*) seems to be a normal and perhaps a very important phase of fluorine metabolism. This defense mechanism has an analogy in the mobilization of lead from skeletal tissue. It may be a highly significant action connected with the defense of the organism against skeletal storage of toxic quantities of fluorine.

Excessive fluorine ingestion, however, under any circumstance, increases the fluorine stores of the body, and the tolerance level of fluorine per se in the skeletal tissue may be exceeded. Toxic bone fluorosis and accompanying morphologic effects will probably appear. However, systemic evidence of fluorine toxicosis related to skeletal storage of fluorine has not been reported as associated with the domestic use of fluoride waters most common in the United States. This subject has had very little study in fluoride areas of this country. It would appear, however, in the light of the urinary fluorine data available, that cumulative storage of fluorine as related to these low concentrations of fluorine in domestic waters is not sufficient to cause serious concern. As related to these low fluoride domestic waters, this form of fluorine toxicosis seems unlikely to become an endemic health problem.

Finally, it may be noted that fluorine in urines where 0.0 to 0.2 p. p. m. fluorine occurred in the drinking water averages 0.3 to 0.5 p. p. m. fluorine according to our data. This is considerably less fluorine than Machle's reported mean of 1.07 ± 0.02 p. p. m. fluorine in urines of 101 subjects selected at random (*9*). Although the residences of these individuals as reported by Machle (*9*), do not indicate an exposure to fluorine from local water supplies, there is no assurance of this fact. For comparison with our data it may be recalled also that Brun, Buchwald, and Roholm (*13*) found an average of 0.80 p. p. m. fluorine in 24-hour urine specimens of 30 hospital patients. The fluorine exposures of these patients also are not stated.

SUMMARY

The fluorine content of urine specimens of a large number of men and boys has been studied in relation to fluorine in their domestic water supplies. Where domestic waters are free of fluorine, the fluorine present in urine averages 0.3 to 0.5 p. p. m. An increase of fluorine in urine was associated with the use of domestic waters containing as little as 0.5 p. p. m. fluorine. Fluorine in urine specimens continues strikingly proportional to the fluorine content of the drinking water through the range of 0.5 to 5.1 p. p. m. fluorine in the domestic water. The results appear to furnish additional evidence of the importance of water-borne fluorine as a source of fluorine in human diets. The data agree with previous epidemiological studies which have demonstrated a striking relation between fluorine in communal water supplies and dental health, including reduced incidence of dental caries in 12- to 14-year-old children.

The close correlation between fluorine in drinking water and fluorine content of urine suggests that the presumed hazard of cumulative toxic bone-fluorosis surrounding certain water-borne sources of fluorine in the United States is greatly reduced by this relationship. An efficient urinary elimination of fluorine appears to be characteristic of individuals residing in certain fluoride areas of the United States, where the drinking water contains 0.5 to 5.0 p. p. m. fluorine. The metabolism of fluorine under these conditions seems to be a normal function of the human body and seems characterized by a condition approaching metabolic equilibrium, at least in the adult organism.

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PERMISSION FOR PUBLICATION

Permission for publication of the data obtained at armed forces induction centers and from the Lubbock Air and Glider Fields has

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INCIDENCE OF HOSPITALIZATION, OCTOBER 1944

Through the cooperation of the Hospital Service Plan Commission of the American Hospital Association, data on hospital admissions among members of Blue Cross Hospital Service Plans are presented monthly. These plans provide prepaid hospital service. The data cover hospital service plans scattered throughout the country mostly in large cities.

Item	October	
	1943	1944
1. Number of plans supplying data	65	76
2. Number of persons eligible for hospital care	10,473,984	15,384,804
3. Number of persons admitted for hospital care	89,070	132,891
4. Incidence per 1,000 persons, annual rate, during current month (daily rate×365)	100.1	102.0
5. Incidence per 1,000 persons, annual rate for the 12 months ending October 31	105.0	103.8

DEATHS DURING WEEK ENDED NOVEMBER 11, 1944

[From the Weekly Mortality Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Nov. 11, 1944	Corresponding week, 1943
Data for 93 large cities of the United States:		
Total deaths	8,607	8,621
Average for 3 prior years	8,568	
Total deaths, first 45 weeks of year	403,799	411,025
Deaths under 1 year of age	582	627
Average for 3 prior years	604	
Deaths under 1 year of age, first 45 weeks of year	27,922	29,715
Data from industrial insurance companies:		
Policies in force	66,882,764	66,035,045
Number of death claims	11,875	12,330
Death claims per 1,000 policies in force, annual rate	9.3	9.7
Death claims per 1,000 policies, first 45 weeks of year, annual rate	10.0	9.7

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED NOVEMBER 18, 1944

Summary

A total of 288 cases of poliomyelitis was reported, as compared with 314 last week, 221 for the corresponding week last year, and a 5-year (1939–43) median of 174. Of the current total, 181 cases occurred in the 7 States reporting 10 or more cases each, as follows (last week's figures in parentheses): *Increases*—Massachusetts 13 (9), Ohio 24 (19), North Carolina 10 (4), California 14 (4); *decreases*—New York 93 (106), Pennsylvania 15 (27); *no change*—Illinois 12 (12). The cumulative total to date is 18,490, as compared with a 5-year median of 8,535 and 11,843 for the corresponding period last year. The latter figure is 95 percent of the total for that year.

The incidence of meningococcus meningitis for the current week, 204 cases, is 33 percent higher than last week's total of 153. The corresponding 5-year median is 30. Increases occurred in the New England, Middle Atlantic, West Central, and Pacific areas. States reporting the largest numbers are New York (27), California (19), Pennsylvania (18), Ohio (14), Michigan (13), and New Jersey and Texas (12 each).

Current figures above the corresponding 5-year medians were reported for diphtheria, influenza, and scarlet fever.

A total of 3,243 cases of scarlet fever was reported, as compared with 2,845 last week, 3,053 for the corresponding week last year, and a 5-year median of 2,651. The cumulative figure since the lowest weekly incidence of the year, 647 cases for the week ended August 26, is 20,839, as compared with 23,500 for the corresponding period last year and a 5-year median of 20,800.

A total of 9,143 deaths was recorded for the week in 93 large cities of the United States, as compared with 8,607 last week and a 3-year (1941–43) average of 8,930. The cumulative figure to date is 412,943, as compared with 420,065 for the corresponding period last year.

Telegraphic morbidity reports from State health officers for the week ended November 18, 1944, and comparison with corresponding week of 1943 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none was reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended—		Median 1939–43	Week ended—		Median 1939–43	Week ended—		Median 1939–43	Week ended—		Median 1939–43
	Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943	
NEW ENGLAND												
Maine	1	0	1	-	-	-	0	112	92	0	3	1
New Hampshire	0	0	0	-	-	-	20	0	4	2	0	0
Vermont	0	0	0	-	-	-	2	2	9	0	0	0
Massachusetts	2	14	5	-	-	-	83	224	224	7	16	4
Rhode Island	2	1	1	14	-	-	2	62	6	0	2	0
Connecticut	0	3	0	-	3	1	13	3	32	7	4	0
MIDDLE ATLANTIC												
New York	13	13	13	[1] 1	[1] 5	[1] 11	44	281	207	27	33	3
New Jersey	4	0	7	5	16	10	13	282	20	12	6	1
Pennsylvania	10	8	14	1	3	-	33	222	222	18	23	4
EAST NORTH CENTRAL												
Ohio	14	16	16	8	3	10	11	259	27	14	13	1
Indiana	10	20	20	3	9	9	3	111	22	1	5	0
Illinois	3	8	26	4	4	8	24	64	34	10	9	4
Michigan [2]	17	6	6	-	2	2	8	281	160	13	21	3
Wisconsin	4	4	2	12	18	28	9	329	116	2	4	0
WEST NORTH CENTRAL												
Minnesota	11	9	3	-	1	-	6	725	28	2	7	0
Iowa	9	2	4	-	-	1	3	96	28	0	2	0
Missouri	12	1	12	1	3	1	0	4	8	9	8	1
North Dakota	7	1	1	-	-	2	0	226	4	1	1	0
South Dakota	1	4	1	-	1	1	10	4	4	1	0	0
Nebraska	1	5	2	18	3	-	14	5	2	2	0	0
Kansas	4	10	6	-	9	4	7	9	22	3	0	0
SOUTH ATLANTIC												
Delaware	0	0	0	-	-	-	1	6	0	1	3	0
Maryland [2]	8	6	7	4	2	4	3	21	21	3	7	0
District of Columbia	0	1	1	3	-	-	2	9	1	1	5	0
Virginia	12	12	29	205	168	157	8	62	55	3	10	2
West Virginia	1	5	9	17	-	13	11	50	24	1	2	0
North Carolina	34	27	49	2	1	5	7	68	68	1	9	1
South Carolina	5	8	24	302	295	306	1	6	5	1	1	0
Georgia	27	14	29	18	34	35	1	24	9	3	4	0
Florida	20	20	11	-	7	3	9	24	5	2	5	0
EAST SOUTH CENTRAL												
Kentucky	7	8	11	1	1	7	3	11	11	4	9	1
Tennessee	8	15	15	5	25	28	14	15	15	7	7	0
Alabama	34	25	25	29	60	60	0	67	8	3	3	2
Mississippi [2]	27	11	18	-	-	-	-	-	-	0	2	1
WEST SOUTH CENTRAL												
Arkansas	18	8	12	28	45	53	6	28	8	3	0	0
Louisiana	13	13	10	3	15	10	2	20	1	1	3	1
Oklahoma	22	2	17	43	39	39	1	13	5	1	0	0
Texas	80	43	46	993	716	553	16	63	41	12	2	0
MOUNTAIN												
Montana	1	5	3	12	5	1	3	85	9	0	0	0
Idaho	0	2	1	3	-	-	0	1	1	0	0	0
Wyoming	0	0	1	1	1	1	1	3	3	0	0	0
Colorado	4	11	11	11	30	30	6	46	46	1	0	0
New Mexico	3	0	1	-	19	1	1	0	8	0	1	0
Arizona	5	7	6	55	163	84	1	3	8	0	0	0
Utah [2]	0	0	0	22	6	6	4	3	23	1	4	0
Nevada	0	0	0	-	-	-	1	0	0	0	0	0
PACIFIC												
Washington	19	8	1	-	-	-	30	49	49	2	3	1
Oregon	9	2	2	11	3	12	16	23	23	3	4	0
California	30	30	22	28	19	46	157	64	64	19	24	3
Total	512	408	502	1,863	1,734	1,734	610	4,065	2,483	204	265	30
46 weeks	11,706	11,921	13,575	352,351	95,943	160,713	597,762	561,941	480,638	14,985	16,061	1,798

[1] New York City only.
[2] Period ended earlier than Saturday.

Telegraphic morbidity reports from State health officers for the week ended November 18, 1944, and comparison with corresponding week of 1943 and 5-year median—Continued

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever [3]		
	Week ended—		Median 1939–43	Week ended—		Median 1939–43	Week ended—		Median 1939–43	Week ended—		Median 1939–43
	Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943		Nov. 18, 1944	Nov. 20, 1943	
NEW ENGLAND												
Maine	1	0	0	56	18	9	0	0	0	0	0	0
New Hampshire	0	2	0	25	10	9	0	0	0	2	0	0
Vermont	0	0	0	6	1	2	0	0	0	0	0	0
Massachusetts	13	4	1	175	187	156	0	0	0	1	5	1
Rhode Island	0	1	0	9	6	6	0	0	0	2	0	0
Connecticut	7	6	0	31	39	35	0	0	0	1	1	1
MIDDLE ATLANTIC												
New York	93	12	12	237	290	236	0	0	0	6	7	7
New Jersey	7	0	3	50	98	88	0	0	0	1	4	3
Pennsylvania	15	3	8	203	179	179	0	0	0	3	6	9
EAST NORTH CENTRAL												
Ohio	24	4	7	324	280	210	0	0	0	2	2	8
Indiana	4	0	1	77	90	86	2	7	1	3	0	1
Illinois	12	24	12	180	115	168	1	0	0	6	0	2
Michigan [2]	9	4	5	147	129	156	0	0	0	1	3	2
Wisconsin	5	3	4	94	143	117	2	1	1	1	0	0
WEST NORTH CENTRAL												
Minnesota	7	1	3	63	56	56	0	0	1	0	0	0
Iowa	1	3	3	41	78	52	0	0	1	2	4	2
Missouri	6	1	1	65	49	62	2	0	0	0	0	1
North Dakota	1	0	0	11	9	11	0	0	0	0	0	0
South Dakota	0	0	0	6	12	13	0	0	0	0	0	0
Nebraska	4	0	2	44	17	17	1	1	0	0	1	1
Kansas	1	11	2	84	74	83	1	0	0	0	0	2
SOUTH ATLANTIC												
Delaware	5	0	0	3	7	9	0	0	0	0	1	0
Maryland [2]	4	2	2	99	32	32	0	0	0	3	1	3
District of Columbia	1	0	0	17	11	11	0	0	0	0	0	0
Virginia	7	0	0	104	44	79	0	0	0	1	2	8
West Virginia	6	0	1	116	79	67	0	0	0	2	0	3
North Carolina	10	0	2	83	123	89	0	0	0	2	2	2
South Carolina	2	1	1	10	12	21	1	0	0	1	1	2
Georgia	3	1	1	40	29	43	0	0	0	2	0	8
Florida	0	0	1	7	10	9	0	0	0	2	4	3
EAST SOUTH CENTRAL												
Kentucky	4	1	3	62	43	54	0	1	0	6	1	5
Tennessee	0	1	2	88	47	71	0	0	0	5	2	4
Alabama	1	2	2	35	15	42	0	0	0	0	1	2
Mississippi [2]	0	0	2	20	14	15	0	0	0	0	2	3
WEST SOUTH CENTRAL												
Arkansas	1	0	0	30	12	13	0	0	0	8	4	4
Louisiana	0	3	1	16	10	10	0	0	0	2	8	8
Oklahoma	1	5	1	24	73	23	0	0	0	1	6	3
Texas	8	12	6	97	55	55	0	3	0	15	14	9
MOUNTAIN												
Montana	1	0	0	18	19	19	0	0	0	1	1	1
Idaho	0	0	1	19	30	7	0	0	0	0	1	1
Wyoming	0	3	1	11	5	5	0	0	0	0	0	0
Colorado	2	0	0	57	37	36	0	0	0	1	1	2
New Mexico	0	4	0	14	8	8	0	0	0	0	2	2
Arizona	0	0	0	11	26	6	0	0	0	2	1	1
Utah [2]	0	6	2	15	36	19	0	0	0	0	3	1
Nevada	0	0	0	1	2	0	0	0	0	0	1	0
PACIFIC												
Washington	4	30	3	51	91	30	0	0	0	4	1	1
Oregon	4	17	4	34	53	16	0	0	0	2	0	0
California	14	54	23	233	242	146	0	0	0	1	2	4
Total	288	221	174	3,243	3,053	2,651	10	13	13	92	95	136
46 weeks	18,490	11,843	8,535	169,078	121,996	121,996	354	676	1,265 [4]	5,047	5,085	7,830

[2] Period ended earlier than Saturday.

[3] Including paratyphoid fever reported separately as follows: New Hampshire 2; New York 1; Illinois 1; Maryland 1; Georgia 1; Texas 5.

[4] Cumulative total changed by corrected reports.

Telegraphic morbidity reports from State health officers for the week ended November 18, 1944, and comparison with corresponding week of 1943 and 5-year median—Continued

Division and State	Whooping cough			Week ended Nov. 18, 1944								
	Week ended—		Median 1939–43	Anthrax	Dysentery			Encephalitis, infectious	Leprosy	Rocky Mt. spotted fever	Tularemia	Typhus fever
	Nov. 18, 1944	Nov. 20, 1943			Amebic	Bacillary	Unspecified					
NEW ENGLAND												
Maine	55	17	36	0	0	0	0	0	0	0	0	0
New Hampshire	23	0	1	0	0	2	0	0	0	0	0	0
Vermont	53	7	9	0	0	0	0	0	0	0	0	0
Massachusetts	122	113	158	0	0	2	0	1	0	0	0	0
Rhode Island	23	29	12	0	0	0	0	0	0	0	0	0
Connecticut	91	31	72	0	0	2	0	0	0	0	0	0
MIDDLE ATLANTIC												
New York	310	294	465	0	2	74	0	1	0	0	0	0
New Jersey	103	135	186	0	5	1	0	0	0	0	0	1
Pennsylvania	137	164	305	0	0	1	0	0	0	0	0	0
EAST NORTH CENTRAL												
Ohio	79	142	180	0	1	0	0	0	0	0	1	0
Indiana	16	55	39	0	0	0	1	0	0	0	1	0
Illinois	58	150	198	0	1	10	0	2	0	0	3	0
Michigan [2]	59	157	263	0	0	5	0	0	0	0	0	0
Wisconsin	59	153	188	0	5	0	0	0	0	0	0	0
WEST NORTH CENTRAL												
Minnesota	39	38	52	0	5	0	0	0	0	0	0	0
Iowa	4	61	17	0	0	0	0	0	0	0	0	0
Missouri	40	26	26	0	0	0	0	0	0	0	0	0
North Dakota	10	5	13	0	0	0	0	0	0	0	0	0
South Dakota	3	10	5	0	0	0	0	0	0	0	0	0
Nebraska	1	15	7	0	0	0	0	0	0	0	0	0
Kansas	38	31	49	0	0	1	0	0	0	0	0	0
SOUTH ATLANTIC												
Delaware	0	1	9	0	0	0	0	0	0	0	0	0
Maryland [2]	101	74	74	0	0	0	0	0	0	0	0	0
District of Columbia	7	7	11	0	0	0	0	0	0	0	0	0
Virginia	16	59	59	0	0	0	221	0	0	0	2	0
West Virginia	24	22	22	0	0	0	0	0	0	0	0	0
North Carolina	69	193	107	0	0	0	0	0	0	0	0	9
South Carolina	67	53	32	0	1	7	0	0	0	0	0	6
Georgia	3	10	14	0	0	0	0	0	0	0	0	43
Florida	7	7	7	0	0	1	0	1	1	0	0	12
EAST SOUTH CENTRAL												
Kentucky	5	88	68	0	0	0	0	0	0	0	2	0
Tennessee	12	23	43	0	4	0	3	1	0	0	2	3
Alabama	28	26	13	0	20	0	0	0	0	1	0	12
Mississippi [2]	----	----	----	0	0	0	0	0	0	0	0	6
WEST SOUTH CENTRAL												
Arkansas	30	49	11	0	0	13	0	0	0	0	0	0
Louisiana	0	2	2	0	3	0	0	0	1	0	0	1
Oklahoma	8	0	10	0	0	4	0	0	0	0	0	0
Texas	167	93	89	0	7	504	59	2	0	0	0	44
MOUNTAIN												
Montana	26	9	9	0	0	0	0	0	0	0	0	0
Idaho	0	4	5	0	0	0	0	0	0	0	0	0
Wyoming	17	3	2	0	0	0	0	0	0	0	0	0
Colorado	24	53	38	0	0	0	0	0	0	0	0	0
New Mexico	0	2	20	0	0	1	3	1	0	0	0	0
Arizona	39	36	5	0	0	0	11	2	0	0	0	0
Utah [2]	12	21	25	0	0	0	0	0	0	0	0	0
Nevada	0	13	0	0	0	0	0	0	0	0	0	0
PACIFIC												
Washington	23	73	57	0	0	0	0	0	0	0	0	0
Oregon	2	17	22	0	0	0	0	0	0	0	0	0
California	122	104	164	0	2	14	0	1	0	0	0	4
Total	2,132	2,675	3,296	0	56	642	298	12	2	1	11	141
Same week, 1943	2,675	----	----	1	41	648	81	13	2	2	6	110
Same week, 1942	3,600	----	----	1	25	168	37	10	1	0	12	91
46 weeks, 1944	84,921	----	----	38	1,668	21,685	8,167	589	29	451	500	4,669
46 weeks, 1943	164,249	----	----	61	1,897	15,276	6,991	623	27	430	714	3,930
46 weeks, 1942	159,129	----	[3] 159,129	72	1,090	11,365	6,138	522	43	[3] 450	770	[3] 2,603

[2] Period ended earlier than Saturday.

[3] 5-year median, 1939–43.

WEEKLY REPORTS FROM CITIES

City reports for week ended November 11, 1944

This table lists the reports from 90 cities of more than 10,000 population distributed throughout the United States, and represents a cross section of the current urban incidence of the diseases included in the table.

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
NEW ENGLAND												
Maine:												
Portland	0	0	------	0	0	0	1	1	8	0	0	1
New Hampshire:												
Concord	0	0	------	0	0	0	0	0	0	0	0	0
Vermont:												
Barre	0	0	------	0	0	0	0	0	0	0	0	4
Massachusetts:												
Boston	0	0	------	1	93	1	14	8	51	0	0	13
Fall River	0	0	------	0	0	0	2	0	4	0	0	7
Springfield	0	0	------	0	2	1	1	0	4	0	0	4
Worcester	0	0	------	0	2	0	10	0	5	0	0	13
Rhode Island:												
Providence	0	0	------	0	0	1	2	0	9	0	0	0
Connecticut:												
Bridgeport	0	1	------	0	0	0	1	0	2	0	0	0
Hartford	0	0	------	0	3	1	1	0	0	0	0	5
New Haven	0	0	------	0	1	1	0	0	6	0	0	9
MIDDLE ATLANTIC												
New York:												
Buffalo	0	0	------	1	0	0	4	3	5	0	0	0
New York	8	1	2	0	5	18	64	45	97	0	3	96
Rochester	0	0	------	0	12	2	5	4	4	0	0	8
Syracuse	0	0	------	0	0	0	2	0	5	0	0	8
New Jersey:												
Camden	0	0	------	0	0	1	0	0	0	0	0	1
Newark	0	0	2	0	1	0	2	1	1	0	0	2
Trenton	1	0	------	0	0	1	0	1	0	0	0	0
Pennsylvania:												
Philadelphia	0	0	1	0	0	3	15	3	41	0	1	29
Pittsburgh	1	0	3	2	0	5	7	0	10	0	2	4
Reading	0	0	------	0	0	0	0	0	1	0	0	0
EAST NORTH CENTRAL												
Ohio:												
Cincinnati	4	0	------	1	0	4	6	7	13	0	0	2
Cleveland	1	0	2	2	3	2	11	4	24	0	1	24
Columbus	0	0	2	2	1	0	1	0	7	0	0	1
Indiana:												
Fort Wayne	0	0	------	0	0	0	2	0	1	0	0	0
Indianapolis	0	0	------	1	2	1	6	0	7	0	0	8
South Bend	1	0	------	0	1	0	0	0	1	0	0	0
Terre Haute	0	0	------	0	0	1	0	0	0	0	0	1
Illinois:												
Chicago	1	0	4	2	10	6	23	7	56	0	0	36
Springfield	0	0	------	0	0	0	2	0	1	0	0	1
Michigan:												
Detroit	6	0	------	0	1	10	9	4	44	0	0	3
Flint	0	0	------	0	0	0	3	0	2	0	0	2
Grand Rapids	0	0	------	0	0	0	0	0	5	0	0	1
Wisconsin:												
Kenosha	0	0	------	0	0	0	0	0	2	0	0	13
Milwaukee	0	0	1	1	0	1	2	0	6	0	0	5
Racine	0	0	------	0	1	0	0	0	1	0	0	6
Superior	0	0	------	0	0	0	0	0	0	0	0	0
WEST NORTH CENTRAL												
Minnesota:												
Duluth	1	0	------	0	0	1	1	1	3	0	0	4
Minneapolis	6	0	------	0	0	1	3	5	8	0	0	2
St. Paul	0	0	------	1	1	0	3	1	9	0	0	16
Missouri:												
Kansas City	1	0	------	0	0	0	6	0	14	0	0	8
St. Joseph	0	0	------	0	0	0	0	0	1	0	0	0
St. Louis	0	0	1	0	0	1	12	3	6	0	1	8
North Dakota:												
Fargo	0	0	0	0	0	0	0	0	3	0	0	0

City reports for week ended November 11, 1944—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
WEST NORTH CENTRAL—continued												
Nebraska:												
Omaha	0	0	------	0	6	0	5	0	10	0	0	0
Kansas:												
Topeka	0	0	------	0	2	0	0	0	7	0	0	3
Wichita	0	0	------	0	0	0	4	0	7	0	0	2
SOUTH ATLANTIC												
Delaware:												
Wilmington	0	0	------	0	1	1	2	0	1	0	0	0
Maryland:												
Baltimore	6	0	3	2	2	3	9	2	45	0	0	40
Cumberland	0	0	------	0	0	0	1	0	2	0	0	0
Frederick	0	0	------	0	0	0	2	0	0	0	0	0
District of Columbia:												
Washington	0	0	1	2	1	2	9	0	14	0	0	1
Virginia:												
Lynchburg	0	0	------	0	0	0	1	1	2	0	0	0
Richmond	2	0	------	0	0	0	3	1	14	0	1	2
Roanoke	0	0	------	0	0	0	0	1	2	0	0	0
West Virginia:												
Charleston	0	0	------	0	0	0	0	0	1	0	0	0
Wheeling	0	0	------	0	2	0	0	0	8	0	0	0
North Carolina:												
Raleigh	0	0	------	0	0	0	0	0	0	0	0	5
Wilmington	1	0	------	0	1	0	0	0	3	0	0	0
Winston-Salem	0	0	------	0	0	0	2	1	2	0	0	1
South Carolina:												
Charleston	0	0	1	0	0	0	2	0	2	0	0	0
Georgia:												
Atlanta	3	0	8	0	0	0	3	0	2	0	0	0
Brunswick	0	0	------	0	0	0	0	0	0	0	0	0
Savannah	0	0	------	0	0	0	1	0	1	0	0	0
Florida:												
Tampa	0	0	------	0	0	1	3	0	1	0	0	0
EAST SOUTH CENTRAL												
Tennessee:												
Memphis	2	0	1	0	1	0	11	0	6	0	0	18
Nashville	0	0	------	1	0	0	4	0	4	0	0	0
Alabama:												
Birmingham	3	0	0	0	0	0	3	0	4	0	0	0
Mobile	2	0	------	1	0	1	4	1	2	0	0	0
WEST SOUTH CENTRAL												
Arkansas:												
Little Rock	0	0	------	0	0	0	0	0	2	0	0	4
Louisiana:												
New Orleans	5	0	7	2	0	0	12	0	11	0	0	0
Shreveport	3	0	------	0	0	0	5	0	1	0	0	0
Texas:												
Dallas	3	0	------	0	0	0	2	0	2	0	0	2
Galveston	0	0	------	0	0	1	3	0	2	0	0	0
Houston	5	0	------	0	1	1	6	1	1	0	0	0
San Antonio	1	0	------	0	0	0	8	0	1	0	0	2
MOUNTAIN												
Montana:												
Billings	0	0	------	0	0	0	1	0	0	0	0	0
Great Falls	0	0	------	0	0	0	1	0	1	0	0	0
Helena	0	0	------	0	0	0	1	0	0	0	0	0
Missoula	0	0	------	0	1	0	2	1	0	0	0	2
Idaho:												
Boise	0	0	------	0	0	0	0	0	5	0	0	0
Colorado:												
Denver	2	0	5	0	0	0	8	0	14	0	0	6
Pueblo	0	0	------	0	0	0	0	0	3	0	0	0
Utah:												
Salt Lake City	0	0	------	0	2	0	1	0	1	0	0	5

City reports for week ended November 11, 1944—Continued

	Diphtheria cases	Encephalitis, infectious, cases	Influenza		Measles cases	Meningitis, meningococcus, cases	Pneumonia deaths	Poliomyelitis cases	Scarlet fever cases	Smallpox cases	Typhoid and paratyphoid fever cases	Whooping cough cases
			Cases	Deaths								
PACIFIC												
Washington:												
Seattle	3	0	-----	2	5	0	2	0	6	0	0	1
Spokane	0	0	-----	0	2	0	1	0	3	0	0	0
Tacoma	0	0	0	0	3	0	0	0	1	0	0	1
California:												
Los Angeles	8	0	5	1	0	2	9	0	27	0	0	7
Sacramento	0	0	-----	0	0	1	6	0	6	0	0	3
San Francisco	1	0	3	1	7	2	6	0	33	0	0	9
Total	81	2	52	26	176	78	364	107	727	0	9	459
Corresponding week, 1943	95	-----	68	26	879	-----	325	-----	734	1	10	727
Average, 1939–43	97	-----	86	[1] 25	[2] 571	-----	[1] 351	-----	679	1	23	967

[1] 3-year average, 1941–43. [2] 5-year median, 1939–43.

Dysentery, amebic.—Cases: New York 2; Chicago 4; Detroit 1.
Dysentery, bacillary.—Cases: Worcester 1; New Haven 1; Buffalo 1; New York 56; Rochester 4; Syracuse 4; Cleveland 1; Chicago 1; Detroit 3; St. Louis 1; Wichita 1; Charleston, S. C. 10; Los Angeles 8.
Dysentery, unspecified.—Cases: Richmond 1.
Leprosy.—Cases: Los Angeles 1.
Tularemia.—Cases: Cincinnati 1; Missoula 1.
Typhus fever.—Cases: New York 1; Wilmington, N. C. 1; Charleston, S. C. 1; Atlanta 9; Savannah 2; Tampa 3; Birmingham 4; Mobile 1; New Orleans 4; Dallas 3; Galveston 2; Houston 9; San Antonio 3; Los Angeles 1.

Rates (annual basis), per 100,000 population, by geographic groups, for the 90 cities in the preceding table (estimated population, 1943, 34,394,800)

	Diphtheria case rates	Encephalitis, infectious, case rates	Influenza		Measles case rates	Meningitis, meningococcus, case rates	Pneumonia death rates	Poliomyelitis case rates	Scarlet fever case rates	Smallpox case rates	Typhoid and paratyphoid fever case rates	Whooping cough case rates
			Case rates	Death rates								
New England	0.0	2.6	-----	2.6	264	13.1	83.6	23.5	233	0.0	0.0	146
Middle Atlantic	4.6	0.5	3.7	1.4	8	13.9	45.8	26.4	76	0.0	2.8	69
East North Central	7.9	0.0	5.5	5.5	12	15.2	39.5	13.4	103	0.0	0.6	63
West North Central	15.9	0.0	2.0	2.0	18	6.0	67.6	19.9	135	0.0	2.0	86
South Atlantic	19.6	0.0	21.2	6.5	11	11.4	62.1	9.8	163	0.0	1.6	80
East South Central	41.3	0.0	5.9	11.8	6	5.9	129.8	5.9	94	0.0	0.0	106
West South Central	48.8	0.0	20.1	5.7	3	5.7	103.3	2.9	57	0.0	0.0	23
Mountain	15.9	0.0	39.7	0.0	24	0.0	111.2	7.9	191	0.0	0.0	103
Pacific	19.0	0.0	12.7	6.3	27	7.9	38.0	0.0	120	0.0	0.0	33
Total	12.3	0.3	7.9	4.0	27	11.9	55.3	16.3	111	0.0	1.4	70

PLAGUE INFECTION IN TACOMA, WASH.

Plague infection has been reported proved in 2 specimens collected at the waterfront, Tacoma, Wash.; one a pool of 2 fleas from 2 rats, *R. rattus*, taken Nov. 1, and the other a pool of 119 fleas from 65 rats, *R. norvegicus*, taken November 4.

TERRITORIES AND POSSESSIONS

Puerto Rico

Notifiable diseases—4 weeks ended November 4, 1944.—During the 4 weeks ended November 4, 1944, cases of certain notifiable diseases were reported in Puerto Rico as follows:

Disease	Cases	Disease	Cases
Bilharziasis	12	Poliomyelitis	2
Chickenpox	11	Syphilis	439
Diphtheria	45	Tetanus	12
Dysentery, unspecified	1	Tetanus, infantile	1
Filariasis	2	Tracoma	3
Gonorrhea	441	Tuberculosis (all forms)	534
Influenza	171	Typhoid fever	27
Malaria	957	Typhus fever (endemic)	7
Measles	480	Whooping cough	202
Mumps	3		

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended October 28, 1944.—During the week ended October 28, 1944, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		33		116	260	19	23	37	64	552
Diphtheria	1	4	1	60	5	5	4	3		83
Dysentery, bacillary				4		1			7	12
German measles				7	8	3	2	3	6	29
Influenza		7	1		8				2	18
Measles		1	3	211	68	13	12	2	47	357
Meningitis, meningococcus				2	3	1		1	1	8
Mumps			1	103	72	1	1	15	27	220
Poliomyelitis				2	[1] 20	1		3		[1] 26
Scarlet fever		12	7	111	138	15	1	41	27	352
Tuberculosis (all forms)			12	107	55	22	24	6	30	256
Typhoid and paratyphoid fever				18	4					22
Undulant fever				3				1	1	5
Venereal diseases:										
Gonorrhea	1	31	16	81	120	42	20	30	73	414
Syphilis	5	10	28	145	101	10	4	17	31	351
Other forms				1						1
Whooping cough		33		133	36	5	10	25	35	277

[1] Includes 8 cases, delayed reports.

CUBA

Habana—Communicable diseases—4 weeks ended October 14, 1944.—During the 4 weeks ended October 14, 1944, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Cerebrospinal meningitis		1	Measles	2	
Diphtheria	20		Scarlet fever	1	
Dysentery, unspecified	7	1	Tuberculosis	5	1
Malaria	4		Typhoid fever	21	2

Provinces—Notifiable diseases—4 weeks ended November 4, 1944.—During the 4 weeks ended November 4, 1944, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana[1]	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer		1	4	6	1	12	24
Chickenpox		1					1
Diphtheria		25	4	2			31
Hookworm disease			13				13
Leprosy			1				1
Malaria	2	14	3	4	5	230	258
Measles		1				2	3
Poliomyelitis		1					1
Tuberculosis	7	19	18	24	16	47	131
Typhoid fever	15	52	13	33	5	35	153

[1] Includes the city of Habana.

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—Except in cases of unusual incidence, only those places are included which had not previously reported any of the above-mentioned diseases, except yellow fever, during the current year. All reports of yellow fever are published currently.

A table showing the accumulated figures for these diseases for the year to date is published in the PUBLIC HEALTH REPORTS for the last Friday in each month.

(Few reports are available from the invaded countries of Europe and other nations in war zones.)

Plague

Bechuanaland.—From the beginning of the outbreak in October 1944, up to November 14, 1944, a total of 171 cases of plague with 90 deaths were reported in Bechuanaland. These figures include 30 deaths from plague reported in the region of Ngami Lake. All measures are being taken to prevent the spread of the disease.

Belgian Congo.—Plague has been reported in Belgian Congo as follows: Week ended October 7, 1944, 5 cases, 3 deaths; week ended October 14, 1944, 1 case, 1 death.

French West Africa—Dakar.—For the week ended October 28, 1944, 15 cases of plague with 14 deaths were reported in Dakar, French West Africa.

Madagascar.—Plague has been reported in Madagascar as follows: October 1–10, 1944, 3 cases; October 11–20, 1944, 4 cases.

Morocco (French)—Casablanca region.—For the period October 11–20, 1944, 18 cases of plague were reported in Casablanca region, French Morocco.

Sudan (French)—Bamaku.—For the week ended October 28, 1944 1 death from plague was reported in Bamaku, French Sudan.

Smallpox

Belgian Congo.—Smallpox has been reported in Belgian Congo as follows: Week ended October 7, 1944, 210 cases; week ended October 14, 1944, 318 cases, 3 deaths.

Union of South Africa.—For the month of August 1944, 346 cases of smallpox with 38 deaths were reported in the whole Union of South Africa.

Typhus Fever

Egypt.—For the week ended October 14, 1944, 36 cases of typhus fever with 2 deaths were reported in Egypt.

Gibraltar.—For the week ended October 21, 1944, 1 case of typhus fever was reported in Gibraltar.

Morocco (French).—For the period October 11–20, 1944, 28 cases of typhus fever were reported in French Morocco.

Turkey.—Typhus fever has been reported in Turkey as follows: Week ended November 4, 1944, 15 cases; week ended November 11, 1944, 35 cases.

Yugoslavia.—For the period September 1–7, 1944, 377 cases of typhus fever were reported in Yugoslavia, including 198 cases reported in Croatia and 179 cases reported in Bihac.

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