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CARBON MONOXIDE: ITS TOXICITY AND POTENTIAL DANGERS

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Carbon monoxide is a toxic gas. Its toxic effects are similar to those of anoxemia because it combines with the red pigment of the blood (hemoglobin) and thus prevents the absorption and supply of oxygen to the tissues of the organism.

Physical-Chemical Properties of Carbon Monoxide.

Carbon monoxide, CO, has a molecular weight of 28.01, a specific gravity of 0.9671 (air =1), and its density is 1.2504 grams per liter (at 0° C. and 760 mm. Hg). It is a colorless and odorless gas, except in high concentrations (75 or 100 percent) when it has an appreciable garliclike odor. It melts at −207° C. and boils at −192° C. and its solubility in water decreases from 3.5 volumes percent at 0° C. to 1.5 volumes percent at 60° C. It may be adsorbed by dusts, as for instance by coal dust, and may be again liberated under certain conditions. At 650° C. it burns with a blue flame which is extinguished in air containing less than 13.4 percent oxygen, but it does not support combustion. Its explosive limits are between 12.5 and 74.2 volumes percent carbon monoxide in air.

Maximal Permissible Concentration of Carbon Monoxide.

The maximal permissible concentration of carbon monoxide in air is accepted as 100 parts per million or 0.01 percent by volume [1] (0.11 mg. per liter at 25° C. and 760 mm. Hg) with atmospheric oxygen not below 19 volumes percent (at 25° C. and 760 mm. Hg) for exposures not exceeding a total of 8 hours per day, and as 400 parts per million or 0.04 percent by volume (0.46 mg. per liter at 25° C. and 760 mm. Hg) for exposures not exceeding a total of 1 hour daily. It should be emphasized that, with concentrations greater than 100 parts per million, increased physical activity, increased humidity,

[1] These figures for the maximal permissible concentration of carbon monoxide have been accepted and published by the American Standards Association in its American Standard Allowable Concentrations of Carbon Monoxide–Z37.1–1941. Copies of the standard may be obtained from the American Standards Association, 29 West Thirty-ninth Street, New York, N. Y.

increased carbon dioxide concentration in the atmospheric air, or decreased concentration of oxygen increase the toxicity of carbon monoxide so that toxic effects may result more readily from exposure to such concentrations.

Sources of Exposure to Carbon Monoxide.

In accordance with the wide distribution and frequent occurrence of carbon monoxide as the product of incomplete combustion of coal or organic (carbon-containing) materials, such as wood, gasoline, illuminating gas, and many others, the hazards of carbon monoxide exposure exist in many industrial operations and also in our daily lives.

In the *chemical industry* this holds true especially for the manufacturing of illuminating gas, where coke-oven workers and tar distillers appear to be especially exposed; the manufacturing of ammonia gas according to the procedure of Haber and Bosch; the synthetic production of methane and methyl alcohol; and the manufacturing of soda by the LeBlanc process. Charcoal burners and carbide makers may also be exposed to carbon monoxide.

In the *metal industry* the blast-furnace workers, Bessemer-furnace men, and welders may be exposed to carbon monoxide. Carbon monoxide hazards exist also in smelting copper, lead, silver, and zinc, and in brass foundries (chargers, cleaners, coremakers, and cupola men). Blacksmiths, plumbers, and solderers may also be exposed to carbon monoxide.

In the *garment industry* felt blockers and flangers, calico printers, cloth singers, ironers, and pressers may have exposure to carbon monoxide.

In the *ceramic industry* kiln workers and brick burners may be especially exposed but some exposure appears to exist also for teazers, temperers, and moldmakers, enamel makers, and enamelers.

In the *mining industry* the main hazards appear to result from firedamp explosions but the gases of explosives also contain more or less high concentrations of carbon monoxide, so that blasters may have a heavy exposure.

In the *electric industry* carbon monoxide hazards may exist in certain occupations such as cable splicing.

In other trades there is some exposure to carbon monoxide, for example among *lino- and monotypists* from melting pots. *Chimney masons* and *chimney sweepers* may have exposure while repairing and cleaning chimneys if these have not been ventilated.

Carbon monoxide hazards exist also in those *industries which use ovens and stoves* of different types. Here the personnel attending the furnaces, firemen, and boiler cleaners, are especially exposed, but cooks and bakers may also contract carbon monoxide poisoning if their ovens are not properly kept or constructed. Carbon monoxide poisoning has been reported repeatedly in homes from gas heaters and

gas stoves. In this connection it should be pointed out that not only escaping gas but also incomplete combustion may cause carbon monoxide poisoning, as would result for instance from contact of the flame with a cooling surface.

TABLE 1.—*Exposure of workers to carbon monoxide in various industries*

[Number of men exposed out of the total of 136,422 surveyed in Maryland and of 25,122 surveyed in Utah]

Industry	Maryland	Utah
Chemical:		
Fertilizer	52	------
Paint and varnish	34	------
Petroleum	411	16
Soap	7	------
Chemicals, dyes, and insecticides	56	8
Artificial silk	129	------
Gas works	74	------
All other	71	6
Compressed gases	--------	4
Total	834	34
Clay, glass, and stone:		
Brick and tile	210	4
Glass	125	------
Lime, cement, and artificial stone	89	14
Marble and stone	5	6
Asphalt	12	------
Others	53	5
Total	494	29
Clothing:		
Hats	89	------
Shirts, neckwear, etc	524	------
Men's suits, coats, etc	748	8
Women's and children's dresses	199	------
Hosiery	4	------
Others	104	------
Total	1,668	8
Food and allied industries:		
Bakeries	631	69
Dairy products	72	7
Candy	24	33
Fish curing and packing	264	------
Flour and grain mills	3	4
Fruit and vegetable canneries	160	13
Ice manufacturing	24	------
Slaughter and packing houses	90	4
Liquor and beverage	73	------
Sugar factories and refineries	--------	17
Others	115	1
Total	1,456	148
Iron and steel:		
Automobile factories	67	------
Automobile repair shops	8	------
Blast furnaces and foundries	7,547	456
Car and railroad shops	189	------
Ship and boat building	180	------
Other iron and steel factories	779	------
Others	114	------
Total	8,884	456
Metals, other than iron and steel:		
Brass and copper mills	531	253
Gold and silver jewelry factories	15	8
Lead and zinc	37	426
Tin, enamelware, etc	1,035	9
Other metal factories	23	------
Total	1,641	696
Leather:		
Shoe factories	6	------
Tanneries	9	------
Total	15	------
Lumber and furniture:		
Furniture factories	8	2
Lumber saw mills and planing	12	------
Other woodwork factories	55	------
Total	75	2
Paper and printing:		
Blank books, envelopes, paper bags, etc	25	------
Paper and pulp mills	65	------
Paper-box factories	71	4
Job and newspaper printing	564	7
Total	725	11
Textile:		
Cotton mills	3	------
Sail, awning, and tent	34	------
Silk mills	4	------
Textile dyeing, finishing, and printing mills	8	------
Other and not specified textile mills	14	1
Total	63	1
Miscellaneous industries:		
Aircraft	361	------
Broom and brush factories	4	------
Button factories (buckles)	1	------
Dental laboratories	--------	13
Electric light and power plants	660	------
Electric machinery and supplies	181	4
Rubber factories	49	1
Mattresses, bedding, etc	5	1
Others	28	2
Total	1,289	21
Transportation industries:		
Steam railroads	1,458	449
Garages, greasing stations, and automobile laundries	113	137
Total	1,571	586
Other trades	15	------
Total	15	------
Domestic and personal service:		
Laundries	73	(
Cleaning, dyeing, and pressing	22	------
Total	95	6
Extraction of minerals:		
Bituminous coal mines	--------	30
Nonferrous metal mines	--------	953
Nonmetallic mines and quarries	--------	20
Other mineral industries	--------	14
Total	--------	1,017

One source of carbon monoxide exposure which is often not recognized is the use of pressure air lines in safety appliances where the carbon monoxide may originate from the compressor or may be formed by oxidation in dirty air filters.

Cases of carbon monoxide poisoning resulting from *inhalation of exhaust gases* of internal combustion motors represent a very high percentage of all accidents from this gas. Garage workers as well as drivers may have such exposure and suffer from more or less severe carbon monoxide poisoning.

The incidence of potential exposure to carbon monoxide in different industries is illustrated in table 1 which is based on the survey made in different industries in Maryland (*1*) and Utah (*2*), which covered a total of 136,422 and 25,122 workers, respectively, of whom 18,825 and 3,015 had potential exposure to carbon monoxide.

Determination of Carbon Monoxide in Air.

For the determination of carbon monoxide in air, the following general outline is recommended. Samples should be taken wherever there is a known or suspected source of carbon monoxide. Samples should be taken at the breathing level of the workers exposed, special emphasis being given to the locations nearest the source and those in the path of air currents carrying the gas. Such samples should be taken at sufficient intervals of time so that variations of the concentration will be evident. When automatic devices are used, these should be operated continuously during the entire working period; in case single determinations are made, half-hour samples during the working period should be taken. Such samples should be taken in sufficient number to avoid any reasonable doubt of the results found. If only one sampling point is deemed necessary, the samples should be taken in triplicate; in case numerous locations are to be sampled, representative points may be selected among these. The total volume of samples submitted for a single determination should be 125 to 1,000 cc., depending on the concentration of CO. The samples may be collected in vacuum flasks or in transfer flasks by liquid displacement, and they should be transferred to the analytical apparatus by means of water. All methods used for the determination of carbon monoxide should be standardized by the iodine pentoxide technique [2] (*3*). The different analytical methods are discussed in a detailed review by Berger and Schrenk (*20*).

1. *Iodine pentoxide method.*—Carbon monoxide may be determined by means of the iodine pentoxide indicator (Hoolamite), as described by Katz and Bloomfield (*4*). Carbon monoxide produces, with iodine pentoxide in an acid medium, a green color by the formation of an

[2] For further details refer to the Report of the Subcommittee on Chemical Methods of Air Analysis, American Public Health Association Year Book, 1940-41.

unstable substance which may be matched against a set of artificial standards. Unsaturated hydrocarbons, gasoline vapors, hydrogen sulfide, arsine, hydrocyanic acid, and various complex organic compounds will give a similar reaction with this "Hoolamite" reagent unless filtered off by charcoal.

2. *Pyrotannic acid method.*—Other investigators made use of the reaction of carbon monoxide with the hemoglobin of the blood by measuring the amount of carbon monoxide hemoglobin formed, as for instance by the pyrotannic acid method, as described by Sayers, Yant, and Jones (*5*).

3. *Palladous chloride method.*—A semiquantitative method for the detection of carbon monoxide is based on the reduction of palladous chloride with the formation of metallic palladium, as described by Berger and Yant (*6*).

4. *Carbon monoxide recorder.*—Carbon monoxide may also be determined by means of the carbon monoxide recorder and alarm, as described by Katz, Reynolds, Frevert, and Bloomfield (*7*). This is based on the fact that the catalyst "Hopcalite" oxides carbon monoxide with the liberation of heat which can be measured by means of thermocouples and recording potentiometers.

Concentrations of Carbon Monoxide Determined Under Different Conditions.

The following determinations of the amount of carbon monoxide in gases from various sources (*8*) give some information with respect to the concentration of carbon monoxide formed under different conditions.

TABLE 2.—*Concentrations of carbon monoxide found in air under different conditions*

(Sayers and Yant (*8*))

Type and source:	*Carbon monoxide, volume percent*
Mine explosion, immediately after dust explosion (experimental) as found in mine air	8.0
Mine explosion, 1 day after explosion in coal mine	1.0
Mine fire (as found in mine air)	1.0
Blasting with 40 percent gelatin dynamite, 7 minutes after shooting 100 sticks (as found in mine air)	1.2
Blasting—products of combustion from black powder	10.8
Products of combustion of 40 percent nitroglycerin dynamite (gas diluted with air)	28.0
Products of combustion of 40 percent ammonia dynamite	5.0
TNT (gases produced, undiluted with air)	60.0
Blast furnace stack gas (undiluted with air)	28.0
Bessemer furnace gas (undiluted with air)	25.0
Crucible furnace; gas fuel, melting Al–Cu–Sn alloy (undiluted with air)	5.5
Arc furnace melting aluminum (undiluted with air)	32.2
Cupola gas (undiluted with air)	17.0
Coke oven gas (undiluted with air)	6.0

TABLE 2.—*Concentrations of carbon monoxide found in air under different conditions*—Continued

(Sayers and Yant (8))

Type and source—Continued.	Carbon monoxide volume percent
Coal gas (undiluted with air)	16.0
Carburetted water gas (undiluted with air)	30.0
Blue gas, water gas (undiluted with air)	40.0
Producer's gas from coke (undiluted with air)	25.0
Producer's gas from oil (undiluted with air)	5.0
Distillation of coal-oil mixture (undiluted with air)	7.4
Gas range burning natural gas, improperly constructed and operated appliance (diluted with air)	.1
Room heater, natural gas, improperly constructed and operated appliance (diluted with air)	.5
Automobile exhaust gas from exhaust pipe approximately 2 to 12 average	7.0
City fire (black smoke from burning building)	.1
Insulation burning in electric arc	.5
Furnace gas from solid fuel fired small house hot water heating system	1.0
Railroad locomotive stack gas	2.0

Carbon monoxide determinations which were made in city streets at peak hours of traffic showed an average concentration of 0.8 parts of carbon monoxide per 10,000 parts of air (*9*) (corresponding to 0.008 percent by volume). Carbon monoxide determinations made in the blood of traffic policemen (*10*), and also other findings (*11*), seem to indicate that with continued exposure there may exist some risk from exposure to carbon monoxide in streets with heavy traffic.

Regarding the concentration of carbon monoxide in the air of garages, an average concentration of 2.1 parts per 10,000 (corresponding to 0.021 percent by volume) was found (*9*). It appears, therefore, that in garages and repair shops dangerous conditions may exist which require special exhaust ventilation and restrictions regarding the time motors are allowed to run in such buildings.

Absorption and Elimination of Carbon Monoxide.

Carbon monoxide is *absorbed* exclusively through the lungs.

The *elimination* of carbon monoxide takes place solely through the lungs by reversal of the process responsible for its absorption; it is not oxidized in the organism (*12*). The rate of elimination of carbon monoxide from the blood depends upon the percentage of oxygen in the air breathed and also upon the type of the respiration. With a carbon monoxide hemoglobin saturation of 40 percent in the blood, the inhalation of pure oxygen causes elimination of carbon monoxide about four times faster, and breathing a mixture of pure oxygen and carbon dioxide (8 to 10 percent) about five to six times faster than when normal air is breathed.

The Determination of Carbon Monoxide in Blood.

The determination of carbon monoxide in blood is very important for proof of existing exposure to carbon monoxide and for the appraisal of the seriousness of the exposure.

The *qualitative* tests for the detection of carbon monoxide hemoglobin are based on its greater stability as compared with that of oxyhemoglobin. Carbon monoxide hemoglobin may be detected by the pyrotannic acid test (*5*, *13*). It may also be detected spectroscopically by its absorption spectrum which shows two absorption bands between the D and E lines which, in opposition to those produced by oxyhemoglobin, persist upon the addition of ammonium sulfide.

There are several methods for the quantitative determination of carbon monoxide in the blood. The pyrotannic acid method (*5*, *13*) is based on the fact that, in the absence of carbon monoxide, pyrotannic acid gives a dirty brown color with blood but in the presence of carbon monoxide hemoglobin, various degrees of pink to red color are developed which may be matched against suitable standards.

Carbon monoxide hemoglobin may be determined by *spectrophotometric* measurements (*14*) and it may be determined *volumetrically* after liberation of the carbon monoxide from its compounds with hemoglobin (*15*, *16*).

Other methods of determining carbon monoxide in blood are based on the reaction of carbon monoxide with iodine pentoxide.

The Relation Between Concentrations of Carbon Monoxide in Air and Toxic Symptoms.

Numerous attempts have been made to determine the minimal toxic or the maximal allowable concentration of carbon monoxide in air. It is generally assumed that concentrations of 0.01 volume percent or 100 parts per million are not harmful. Higher concentrations become rapidly injurious, especially with prolonged exposure, as illustrated in table 3 (*17*).

TABLE 3.—*Physiological response to various concentrations of carbon monoxide*

(Henderson, Haggard, Teague, Prince, Wunderlich (*17*))

	Carbon monoxide, parts per million of air	Volume percent
Concentration allowable for an exposure of several hours	100	0.01.
Concentration which can be inhaled for 1 hour without appreciable effect.	400 to 500	0.04 to 0.05.
Concentration causing just appreciable effects after 1 hour exposure.	600 to 700	0.06 to 0.07.
Concentration causing unpleasant but not dangerous symptoms after 1 hour of exposure.	1,000 to 1,200	0.1 to 0.12.
Dangerous concentration for exposure of 1 hour	1,500 to 2,000	0.15 to 0.2.
Concentrations which are fatal in exposures of less than 1 hour	4,000 and above	0.4 and above.

It was shown that the quantity of carbon monoxide absorbed varies with the amount of physical exercise (*18*). In addition, a reduction of the concentration of oxygen in the air or an increase of the content of carbon dioxide in the air will favor the formation of carbon monoxide hemoglobin and the same physiological effect will be produced by raising the temperature and the humidity of the air.

When an individual is at rest, or with moderate physical exercise, the amount of carbon monoxide hemoglobin formed by exposure to certain concentrations for a definite period of time increases first rapidly and later slowly until an equilibrium between the carbon monoxide in the air and the carbon monoxide hemoglobin is established, as illustrated in table 4 for different concentrations of carbon monoxide in air (*12*).

TABLE 4.—*Equilibria of carbon monoxide with various concentrations of carbon monoxide in the air*

(Sayers and Yant (*12*))

Concentration of carbon monoxide in air (inclusive), volume percent	Percent blood saturation (80 percent approximate equilibrium value)	Time in hours	Concentration of carbon monoxide in air (inclusive), volume percent	Percent blood saturation (80 percent approximate equilibrium value)	Time in hours
0.02–0.03	23–30	5–6	0.16–0.20	61–64	1–1½
0.04–0.06	36–44	4–5	0.20–0.30	64–68	½–¾
0.07–0.10	47–53	3–4	0.30–0.50	68–73	[1] 20–30
0.11–0.15	55–60	1½–3	0.50–1.00	73–76	[1] 2–15

[1] Minutes.

Symptoms of Acute Carbon Monoxide Poisoning.

It has been shown that the primary site of the toxic action of carbon monoxide is the circulatory system but the symptoms and signs from the central and peripheral nervous system are the most conspicuous and show great variation.

1. *From the central nervous system.*—Feeling of fear, headache, vertigo, vomiting, abdominal pain, cough and, later, asphyxial convulsions. Frequently there is a rise of the body temperature which may last for several days. The most characteristic sign in acute carbon monoxide poisoning is the loss of consciousness which may occur quite suddenly and which is usually very deep and persistent so that it takes a comparably long time to recover even under treatment. *Signs of motor irritation* are: Spasms, especially of the upper extremities, trismus, choreatic movements, and, occasionally, convulsions. *Signs of motor depression* have been observed in the form of weakness, especially of the legs. This may sometimes persist after the patient has recovered otherwise and, occasionally, may result in paralysis or paresis. *Sensory disturbances* may consist in headache, pain in the

extremities and in the cardiac region, anesthesias of parts of the body, and neuritides. The response to stimulation of the *reflexes* is very variable and appears to be independent of the severity of the exposure. In deep coma the pupils are sometimes dilated, sometimes constricted, and their reaction to light and accommodation is very inconsistent. *Psychic symptoms* following acute carbon monoxide poisoning may vary in type and intensity. Frequently there is a more or less complete amnesia regarding the time of the exposure. Psychic changes, such as restlessness, irritability, sometimes followed by depression, delusions, disorientation, and, occasionally, dementia, may persist for some time after other symptoms have subsided.

Excretion of sugar and of urobilinogen with the urine indicates a *toxic effect on the metabolism.*

2. *From the circulatory apparatus.*—Lowering of the blood pressure due to vasodilatation and weakening of the heart muscle, or increase of the blood pressure, stasis in the circulatory system, quickening or slowing of the pulse rate and cardiac distress may be observed.

3. *The color of the skin* and especially of the mucous membranes is frequently, but not always, bright red and there may be small hemorrhages, localized edema, vesicles with serous content, and a tendency for decubitus and gangrene.

4. *From the gastrointestinal and urinary tract.*—Nausea, vomiting, diarrhea or constipation, incontinence of urine, and bladder spasms have been reported.

5. Other toxic signs and symptoms observed were: Irregularities of menstruation and *disturbances of the respiratory apparatus.* These may be characterized by an abnormal rate and abnormal sounds, bronchitis appears to be not infrequent, and pulmonary edema and pneumonia may develop on the basis of the disturbed circulation or due to aspiration of vomitus.

The *blood picture* shows, occasionally, in the beginning, a more or less high white blood cell count with a relative increase of the polynuclears, and, in subacute poisoning, an increase of the red blood cells and hemoglobin.

Chronic Carbon Monoxide Poisoning.

There is, at present, considerable controversy as to whether or not there is chronic carbon monoxide poisoning, largely depending on the interpretation of the word "chronic." It appears that continued exposure to moderately toxic concentrations will result in disturbances of the circulation and nervous system.

The Relation Between Exposure to Carbon Monoxide and Toxic Symptoms.

Table 5 shows the relation between the amount of carbon monoxide hemoglobin formed and the toxic symptoms produced (*8*).

TABLE 5.—*Symptoms caused by gradual increase of percentages of carbon monoxide hemoglobin in the blood while individual is at rest or doing moderate exercise*

(Sayers and Yant (8))

Blood saturation in percent of CO hemoglobin:	*Symptoms*
10–20	Tightness across forehead, possibly slight headache, dilatation of cutaneous blood vessels.
20–30	Headache, throbbing in temples.
30–40	Severe headache, weakness, dizziness, dimness of vision, nausea, vomiting, collapse.
40–50	Same as previous item with more possibility of collapse and syncope, increased respiration and pulse.
50–60	Syncope, increased respiration and pulse, coma with intermittent convulsions, Cheyne-Stokes respiration.
60–70	Coma with intermittent convulsions, depressed heart action and respiration, possibly death.
70–80	Weak pulse and slow respiration, respiratory failure, and death.

Mechanism of Carbon Monoxide Poisoning.

Most investigators agree that the toxic effects of carbon monoxide are due to its great affinity for hemoglobin and that it acts mainly by interfering with and finally inhibiting completely the oxygen metabolism.

Effect of Carbon Monoxide on Tolerance.

It appears that some men, frequently exposed to low concentrations of carbon monoxide, may not experience moderate signs of poisoning, such as headache and vertigo.

Measures for the Prevention of Carbon Monoxide Poisoning.

It is obvious that the best prevention of carbon monoxide poisoning would be the prevention of any pollution of the air with carbon monoxide. This can be accomplished to a very high degree by proper engineering methods and adequate ventilation. For continued exposure the concentrations should be kept at or below 100 parts per million by volume (0.01 volume percent). It appears absolutely necessary that the public, and especially those persons who may have occupational exposure to carbon monoxide, be instructed regarding its toxicity and potential dangers. Before entering any space not frequently used and suspected of containing carbon monoxide, air samples should be taken to determine the amount of carbon monoxide present.

Special attention should be paid to safety regulations. It should be kept in mind that carbon monoxide may accumulate in the upper levels of enclosures. Whenever a person must enter a room in which the

presence of carbon monoxide is suspected, he should wear a safety line and an air-supplied respirator or an oxygen respirator while so engaged; he should be watched by a crew of men familiar with the dangers, signs, and symptoms of carbon monoxide poisoning.

It has been stated that the maximal allowable concentration for several hours' exposure is 100 parts of carbon monoxide per million parts of air, or 0.01 percent by volume, and it has been shown that 400 to 500 parts per million, or 0.04 to 0.05 percent, can be inhaled for 1 hour without appreciable effects. It should be emphasized, however, that, with concentrations greater than 100 parts per million, increased humidity, increased carbon dioxide concentration in the air, and decreased concentration of oxygen tend to increase the toxicity of carbon monoxide, so that toxic effects may result more readily from exposure to concentrations above the maximal allowable limit. Under certain conditions the appraisal of the carbon monoxide hazard may, therefore, also require the determination of the carbon dioxide and oxygen content and the humidity of the air.

In view of the toxic effects of carbon monoxide on the circulatory and nervous systems a proper choice of personnel is also of considerable importance. Any person suffering from serious diseases of the vascular system, nervous disorders, or extensive affections of the lungs should be excluded from operations in which the danger of exposure to carbon monoxide may exist.

Serious sequelae of carbon monoxide poisoning may be prevented by adequate medical supervision. If there is the slightest indication of exposure to carbon monoxide, the blood should be tested for carbon monoxide hemoglobin so that the prodromal stage of the poisoning may be detected and treated properly. The enforcement of such regulations prevents claims attributing pathologic conditions from other causes to carbon monoxide exposure.

The Treatment of Carbon Monoxide Poisoning.

This should always be carried out by a qualified physician, although first aid (Nos. 1, 2, and 3) must be given pending his arrival. In summarizing experience with the treatment of carbon monoxide poisoning, the procedure outlined by R. R. Sayers (*19*) is recommended. It is as follows:

1. The victim should be removed to fresh air as soon as possible.
2. If breathing has stopped, is weak and intermittent, or present in but occasional gasps, artificial respiration by the Shaefer method should be given persistently until normal breathing is resumed or until after the heart has stopped.
3. Pure oxygen or a mixture of 5 percent carbon dioxide and 95 percent oxygen should be administered using an inhaler, beginning as soon as possible and continuing for at least 20 minutes in mild cases and as long as 3 hours if necessary in severe cases if the patient does not regain consciousness. The administration of oxygen or of the mixture of carbon dioxide and oxygen when given immediately

will greatly lessen the number and severity of the symptoms from carbon monoxide poisoning and will decrease the possibility of serious aftereffects.

4. Circulation should be aided by rubbing the extremities of the patient and keeping the body warm with blankets, hot-water bottles, hot bricks, or other devices, care being taken that these objects have been wrapped or do not come into contact with the body and cause burns.

5. The patient should be kept at rest, lying down to avoid any strain on the heart. Later he should be treated as a convalescent and should be given plenty of time to rest and recuperate. Exercise was at one time recommended; however, the procedure is hazardous, as the patient quite often loses consciousness, and in some cases death occurs.

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(Publications marked with an asterisk (*) may be obtained from the U. S. Public Health Service, Washington, D. C.; those preceded by two asterisks (**) may be obtained from the U. S. Bureau of Mines, Washington, D. C.; those marked with a dagger (†) may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C.; and the sign ‡ indicates that the publication is out of print. It is believed that most of the other publications may be consulted at local medical or technical libraries, or access to them may be secured through State health departments.)

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FINANCIAL SUPPORT OF HOSPITALS CONTROLLED BY STATE AND LOCAL GOVERNMENTS [1]

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This article, one in the series reporting the findings of the Federal Business Census of Hospitals,[2] is limited to an analysis of the financial plans of only those hospitals which are controlled by State and local governments. An early article [3] has already covered in some detail the financial support of nongovernmental or voluntary hospitals. The study of voluntary institutions treats such topics as the completeness of the coverage of the Census, total hospital income and income per bed, expenditure per unit of income, and proportions of revenue derived from particular sources. Since the earlier article was more or less preliminary in nature and since in many instances the financial structure of nongovernmental and of governmental hospitals is

[1] From the Division of Public Health Methods, National Institute of Health. Study conducted in connection with the National Health Inventory, assistance in the preparation of these materials having been furnished by the personnel of Work Projects Administration Official Project Number 712159-658/9999.

[2] Previous articles based on the 1935 Business Census of Hospitals conducted by the United States Public Health Service are:

Pennell, Elliott H., and Mountin, Joseph W.: The financial support of non-government hospitals as revealed by the recent Federal Business Census of Hospitals. Hospitals, Vol. 11, No. 12, December 1937.

Mountin, Joseph W., Pennell, Elliott H., and Hankla, Emily: A study of the variations in reports on hospital facilities and their use. Public Health Reports, Vol. 53, No. 1, January 7, 1938.

Pennell, Elliott H., Mountin, Joseph W., and Hankla, Emily: Summary figures on income, expenditures, and personnel of hospitals. Hospitals, Vol. 12, No. 4, April 1938.

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Pennell, Elliott H., Mountin, Joseph W., and Pearson, Kay: Business Census of Hospitals, 1935. General report. Supplement No. 154 to the Public Health Reports, United States Government Printing Office, 1939.

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Mountin, Joseph W., Pennell, Elliott H., and Pearson, Kay: The distribution of hospitals and their financial support in southern States. Southern Medical Journal, Vol. 33, No. 4, April 1940.

Pennell, Elliott H., Mountin, Joseph W., and Pearson, Kay: Existence and use of hospital facilities among the several States in relation to wealth as expressed by per capita income. Public Health Reports, Vol. 55, No. 19, May 10, 1940.

[3] Pennell, Elliott H., and Mountin, Joseph W.: The financial support of non-government hospitals as revealed by the recent Federal Business Census of Hospitals. Hospitals, Vol. 11, No. 12, December 1937.

fundamentally different, little attempt has been made here to parallel the analysis followed in the other report.

Certain points of difference between the two articles should, however, be made clear. The present study treats only governmental hospitals, exclusive of the Federal, which are registered by the American Medical Association;[4] the other study embraces both registered and nonregistered voluntary hospitals which supplied information during the Census. Totals presented here are estimates obtained by projecting figures submitted by registered hospitals to such level that they represent aggregate registered hospitals; the sums presented in the earlier analysis are reported figures. This study is confined to general and allied special[5] hospitals; the preceding one includes mental and tuberculosis hospitals as well. Numerically, the general and special hospitals under the control of State and local governments are in most instances better adapted to statistical treatment; and, in particular, they appear more responsive to environmental forces. This responsiveness may be attributed in part to the fact that they receive more of their support directly from patients than do the governmental hospitals devoted solely to the care of mental and tuberculosis cases, and thus are more closely allied with the economic status of inhabitants of the area.

As this is in principle a survey of governmental hospital facilities available to the general population, the Federal hospitals do not provide a sufficient volume of community service to warrant inclusion here. Also it should be made clear that these data as well as those published in other reports of the Census do not include figures for infirmary units of institutions such as prisons, homes for the aged, and colleges, many of which are maintained by governments. Because of the subsidiary nature of such hospital departments, they do not readily lend themselves to comparison with hospitals that exist independently. Then, too, financial reports do not as a rule separate the accounts of the infirmary units from those of the foster institutions.

Hospitals selected for analysis are divided on the basis of control into two groups—those subject to State governments and those subject to local governments. For each of the groups, subdivided by geographic location of the hospital, are presented income per bed and percentage of income from patients, taxes, and miscellaneous sources.[6]

[4] Journal of the American Medical Association, Vol. 106, No. 10, March 7, 1936.

[5] "Special" hospitals, as used here, are hospitals furnishing types of care which are closely identified with general medical and surgical service. These hospitals include maternity, industrial, isolation, eye-ear-nose-throat, orthopedic, children's, and others offering similar specialized types of care. Mental and tuberculosis hospitals are not included.

[6] Only hospital income used for current operation is considered. Under the heading "patients" are included all receipts from persons who are given either bed or ambulatory care. Usual allotments as well as emergency appropriations from public revenue represent "taxes." Such sums as earnings from investments and donations from charitable orders are comprised in the classification "other."

Data covering the same items are likewise furnished for each control group subdivided according to the bed capacity of the institution.

The two summary investigations just described, namely, an inquiry regarding sources of income for each control group classified first by geographic locality and second by bed capacity, are followed by a more detailed investigation which is the nucleus of the study. It is devoted only to those general and special hospitals that are operated by county and city governments, singly or in association. Amount of income and its derivation remain the foci of the investigation. Inasmuch as there is no apparent demarcation between county and city hospitals in regard to their location and mode of operation, they are treated in the aggregate.

As has already been stated, financial figures presented herein are estimates covering all registered hospitals of specified type in the United States. The first step in preparing the estimates was to determine how many of the total beds in registered hospitals were covered by the schedules submitted during the Census. Returns from hospitals operated by State and local governments proved to be especially satisfactory in compass, representing 90 percent of the aggregate beds in such institutions. Use of this base made possible the computation of totals that describe rather accurately, it is believed, the financial support of all registered governmental hospitals.

In only limited measure have governmental agencies of the continental United States participated in the provision of general and allied special hospitals. Not more than one-eighth of the entire number classified as general and special are owned by State and local governments. However, the supply of beds in the hospitals so owned amounts to practically one-fourth of the total capacity, an indication of the exceptional size of governmental hospitals. Large capacity is especially typical of State operated hospitals, which average twice as many beds as do those provided by local governments. Among local agencies, city governments surpass those of counties both in number of institutions and in number of beds which they supply for general and allied special services.

Diversity in geographic and economic features of various sections of the country invites question as to how peculiarities of each area are reflected in the distribution of hospitals and in their means for support. Throughout the series of reports on the Business Census of Hospitals, the forty-eight States and the District of Columbia have, for comparative purposes, been divided into four areas designated as Northeastern, Southern, Central, and Western.[7] The Northeastern is,

[7] The estimated population of each area as of July 1, 1935, and the States included in each are as follows:
Northeastern (38,261,000): Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia.
Southern (37,576,000): Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.

of course, densely settled, industrial, and relatively wealthy. The Southern, with agriculture as the main pursuit, stands almost in direct contrast. Central States, next to those of the South in point of per capita income, combine the industry of the Northeast and the agriculture of the South, leaning in general toward the latter. Western States, rather dissimilar among themselves, rank close to the Northeastern area in per capita income.

In figure 1 is shown, by geographic area, the income pattern for hospitals provided by State and by local governments. Before income is examined as to source, brief consideration may be given the

CONTROL AND LOCATION OF HOSPITAL	NUMBER OF HOSPITALS	NUMBER OF HOSPITAL BEDS	INCOME PER BED
STATE GOVERNMENTS			
NORTHEASTERN	22	7,756	$1,081
SOUTHERN	15	4,337	613
CENTRAL	15	5,739	1,284
WESTERN	6	747	1,780
LOCAL GOVERNMENTS			
NORTHEASTERN	107	33,644	872
SOUTHERN	120	11,200	721
CENTRAL	196	23,224	770
WESTERN	88	16,622	866

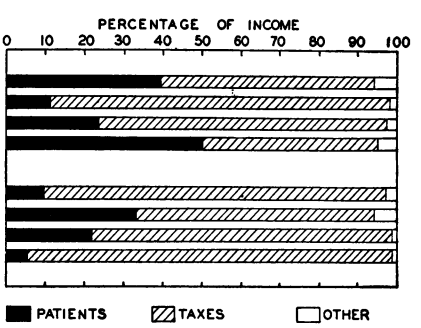

FIGURE 1.—Estimated income per bed and percentage from specified source for registered general and special hospitals under State and local governmental control, by location of hospital.

proportionate income of the several classes of hospitals. Income per bed, which serves as an adequate measure for comparison, may also be considered as cost per bed, in view of the fact that hospital income is taken here to be identical in amount to operating expense. Some explanation should be given, however, regarding the limitations of the measure adopted. Between total income for hospitals accepting fees from patients and number of beds occupied, there is of course direct relationship, poor occupancy naturally resulting in low average income. Governments with small budgets may demand that their hospitals limit both the expensiveness and the variety of the services afforded, thus keeping low the allotments necessary. Governments in wealthy areas may encourage expansion in specialized and expensive treatment, thereby increasing average costs per bed. Always present is inequality in price levels from area to area, a factor that enters into the costs of supplies and of personnel service which the hospital must procure, hence into the scale of fees charged patients and into the size of the appropriation required from the sponsoring agency. Such conditions as these, which are in some measure conducive to variation,

Central (39,300,000): Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

Western (12,384,000): Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, and California.

should be taken into account at any time that comparisons of total revenue are made.

State controlled hospitals are, according to the statistics shown in figure 1, operated much less expensively in the South than in any other area. This is the only section in which such hospitals are maintained at a cost of less than $1,000 per bed. In fact, the income per bed, $613, is only three-fifths as large as that for the next lowest area, the Northeast. The position of the Northeast is somewhat unusual, as heretofore investigations[8] have shown rather consistently that operating costs as reflected by expenditures are higher in the Northeastern area than in any other. State hospitals in the Central region rank second highest in average income per bed. Most expensive in operation, the few relatively small institutions owned by States in the Western section receive per bed an amount almost three times that provided in Southern States.

Hospitals under the supervision of city or county governments do not receive as liberal incomes in relation to bed capacity as do those under State management. Figures not supplied in the chart show that the difference in the averages for the two control groups exceeds $200 per bed. Within each separate area except the South receipts per bed for State hospitals decidedly overtop those for hospitals under local sponsorship. In the South, upkeep of city and county hospitals consumes more than $100 per bed beyond the sum devoted to State institutions. If the four geographic areas are ranked according to income per bed received by local governmental hospitals, the Northeastern stands highest, the Southern lowest, the Western in upper intermediate position, and the Central in lower intermediate position. The uniformity of the figures showing income per bed for local governmental hospitals in the several areas is in striking contrast with the wide deviation revealed by State hospitals of different location.

The proportion of income which State-controlled general and special hospitals derive from fees paid directly by patients is of singular interest. The sums so derived run as high as 50 percent of the total income for hospitals of the West and 40 percent for those of the Northeast. In Central States the percentage drops to about 25, and in Southern States to 10. It happens that a fairly high proportion of the general hospitals owned by States are teaching hospitals affiliated with State universities. Having a stated fee schedule,[9] these hospitals obtain considerable revenue from patients who are perhaps attracted by the availability of special techniques in the teaching hospitals. In some instances, State hospitals not affiliated with medical schools also

[8] Pennell, Elliott H., Mountin, Joseph W., and Pearson, Kay: Business Census of Hospitals, 1935. General report. Supplement No. 154 to the Public Health Reports. United States Government Printing Office, 1939.

[9] Fifield: American and Canadian Hospitals, 1937. Midwest Publishers' Company, Minneapolis.

levy nominal fees on those who can pay, often adjusting the rates according to the individual's financial ability. It may be that occasionally remittances by county or city governments to State hospitals for service to indigents of the local jurisdictions are recorded by the hospital as received from the patient rather than from tax funds. These facts taken together undoubtedly account in large part for the high degree of patient support existing in some areas.

Only in Southern and Central regions is income for State hospitals obtained almost entirely from tax funds, the respective percentages being 87 and 74. The other two geographic divisions range around 50 percent in proportion of hospital income which is obtained from public sources. The relative amounts received by governmental hospitals

CONTROL AND BED CAPACITY OF HOSPITAL	NUMBER OF HOSPITALS	NUMBER OF HOSPITAL BEDS	INCOME PER BED
STATE GOVERNMENTS			
LESS THAN 50	4	158	$3,616 [1]
50 TO 149	25	2,324	966
150 AND OVER	29	16,097	1,051
LOCAL GOVERNMENTS			
LESS THAN 50	247	6,856	790
50 TO 149	140	10,730	758
150 AND OVER	124	67,104	836

[1] INCLUDING INCOME REPORTED BY A HOSPITAL FOR SPECIAL STUDY

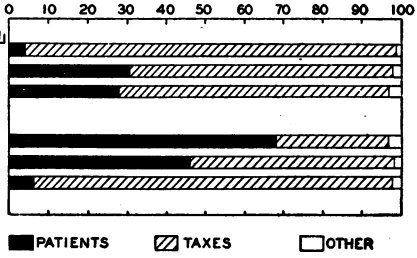

FIGURE 2.—Estimated income per bed and percentage from specified source for registered general and special hospitals under State and local governmental control, by bed capacity of hospital.

from "other" sources are, as a rule, so trivial a fraction of the total that in this analysis they are seldom given particular mention.

Hospitals provided by county and city governments, like those controlled by State governments, are not fully tax-supported. In Southern States as much as one-third and in Central States more than one-fifth of the revenue originates from patients. These, it will be recalled, are the two areas in which the smallest proportions of the income for State hospitals are reported as derived directly from patients. Oddly, between State and local governmental hospitals in each of the geographic areas there happens to be complete inversion in the rank of the percentages of income secured from patients, and, concomitantly, in the order of those showing income from taxes.

To what extent is the size of a hospital associated with particular financial patterns? Data bearing on this question are furnished in figure 2, which presents on the basis of bed capacity the same data that were submitted on the basis of geographic area in figure 1. For convenience of discussion, general and special hospitals are divided into three size categories: small (less than 50 beds), medium (50 to 149 beds), and large (150 beds and over).

It is doubtful that changes in bed capacity classification show any consistent relation to fluctuations in average income per bed. If the

small hospitals of State ownership, which appear to be atypical as a result of the presence among them of a hospital devoted to research, are excluded, the remaining groups do not show notable deviation. Income per bed, it may be pointed out, is greater for State hospitals of each bed capacity interval than for city and county hospitals of corresponding size.

As to source of income, some differences occur among State hospitals of diverse capacities; pronounced variation is apparent among the several size categories of hospitals subject to city or county governments. Again, the direction of the changes is apparently diametric

LOCATION AND BED CAPACITY OF HOSPITAL	NUMBER OF HOSPITALS	NUMBER OF HOSPITAL BEDS	INCOME PER BED
NORTHEASTERN			
LESS THAN 50	33	981	$ 935
50 TO 149	27	2,141	947
150 AND OVER	47	30,522	864
SOUTHERN			
LESS THAN 50	53	1,412	606
50 TO 149	43	3,253	652
150 AND OVER	24	6,535	781
CENTRAL			
LESS THAN 50	131	3,684	845
50 TO 149	38	2,779	895
150 AND OVER	27	16,761	732
WESTERN			
LESS THAN 50	30	779	683
50 TO 149	32	2,557	584
150 AND OVER	26	13,286	931

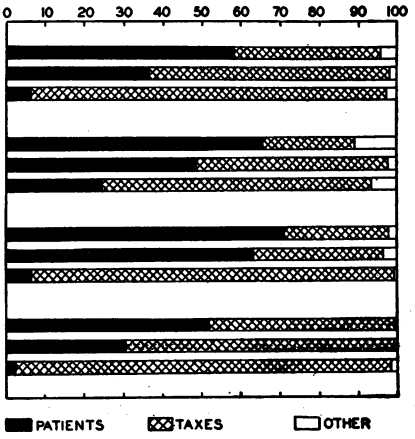

FIGURE 3.—Estimated income per bed and percentage from specified source for registered general and special hospitals under local governmental control, by location and bed capacity of hospital.

for the two control groups. Both medium and large State hospitals receive more income from patients and miscellaneous sources and correspondingly less from taxes than do small institutions. In fact, the few State-owned hospitals of small capacity are almost wholly tax-supported. Among local hospitals of official control, the proportion of income from patients sinks from 68 percent for small hospitals to 7 percent for large ones; at the same time the percentage from public funds rises sharply from 29 for small hospitals to 91 for the large. In other words, small city and county hospitals are supported chiefly by fees from patients and large ones almost wholly by tax funds.

The remainder of the analysis is restricted to general and special hospitals which are controlled by local governments. In figure 3 may be seen again the lack of association between size and amount of income per bed. Neither within a given geographic area nor among the corresponding size categories of hospitals in the several areas is there any indication of correlation between size and per bed income received by hospitals under the supervision of local governments.

As explained earlier, so many factors may alter amount of income that no one of them can well be identified as ascendant.

Striking parallelism in pattern of income by source characterizes each area, as is shown in figure 3. When bed capacity increases, percentage of income from patients decreases; and this decline is, in turn, offset by a corresponding rise in percentage of income from taxes. Briefly, the relation between size of hospital and proportion of income from patients is inverse; between size and proportion from taxes, direct. The percentage of income from patients and percentage from taxes are essentially complementary; the remainder of the revenue, that from miscellaneous sources, is too small to exert appreciable effect.

To all appearances, small governmental hospitals locally controlled are supported in much the same manner as are voluntary hospitals. In some instances the same thing may be said for those of medium size. For example, small hospitals in Central States obtain practically three-fourths of their receipts from patients and medium sized ones get almost two-thirds through the same channel. In sharp contrast, large hospitals so located secure but 6 percent of their revenue directly from patients. For each area the course is repeated on a slightly different plane. Small and medium sized hospitals in Southern States derive from fees of patients two-thirds and one-half of their income, respectively. Large hospitals of this area constitute an exception, in that one-fourth of their support originates from patients—a fraction that is markedly higher than it is for large hospitals in any other region. Systems of support for hospitals of the Northeast and those of the West are of much the same mold. In each section hospitals with less than 50 beds rely on patients for something more than one-half of their upkeep and those with 50 to 149 beds rely on such source for approximately one-third. The large ones are practically independent of charges to patients, the Western group in particular as only 3 percent of their support is thus derived. For emphasis of the resemblance between voluntary hospitals and small governmental hospitals under local agencies, attention may be called to the fact that governmental institutions of low bed capacity in both Southern and Central States are but one-fourth tax-supported.

In each geographic area, with its particular economic characteristics, bed capacity of hospitals has been proved to be highly correlated with scheme of financial support. Within these areas is it possible that the population of the county may also be instrumental in shaping the financial pattern of hospitals? There are reasons for expecting an affirmative answer, the chief reason being that between size of hospital and population of county there is some degree of interrelationship. In general, small hospitals are indigenous to localities of limited population; large ones to more populous areas. For a graphic pres-

entation of the influence of various ranges of population, figure 4 has been prepared. Counties have been assembled into three population classes, small, medium, and large, with 40,000 and 100,000 as the points of division.

Again the matter of income per bed may be dismissed with the statement that apparently county population is not associated with income per bed received by hospitals. As to source of income, a rather definite trend is evident among the population brackets established for the analysis. Broadly speaking, hospitals in counties with less than 100,000 population receive the greater part of their support from patients, and those in large counties secure practically all of their revenue from taxes. Figures descriptive of Northeastern,

LOCATION OF HOSPITAL AND POPULATION OF COUNTY	NUMBER OF HOSPITALS	NUMBER OF HOSPITAL BEDS	INCOME PER BED
NORTHEASTERN			
LESS THAN 40,000	13	507	$1,016
40,000 TO 99,999	11	444	584
100,000 AND OVER	83	32,693	873
SOUTHERN			
LESS THAN 40,000	50	1,737	568
40,000 TO 99,999	39	3,358	677
100,000 AND OVER	31	6,105	789
CENTRAL			
LESS THAN 40,000	105	3,260	793
40,000 TO 99,999	34	1,906	870
100,000 AND OVER	57	18,058	755
WESTERN			
LESS THAN 40,000	49	2,614	636
40,000 TO 99,999	17	2,680	650
100,000 AND OVER	22	11,328	970

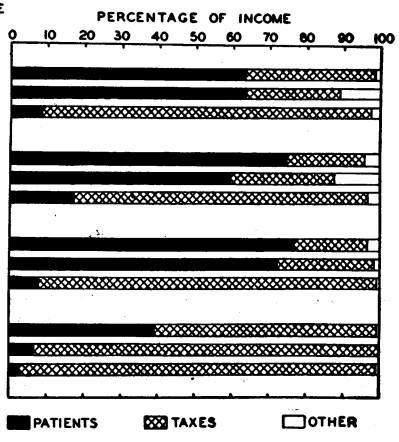

FIGURE 4.—Estimated income per bed and percentage from specified source for registered general and special hospitals under local governmental control, by location of hospital and population of county wherein it is situated.

Southern, and Central States substantiate this statement. The Northeastern area may be cited as typical. There, close to two-thirds of the income for hospitals in counties of small and intermediate population classes is acquired through the medium of patients, while nine-tenths of the income for hospitals in counties of the large class comes through government appropriation. Hospitals in the Western section fail to conform entirely with the financial patterns of those in other areas. Although reduction in the percentage of income from patients accompanies an increase in population, it is only hospitals in small counties of the West that collect a considerable fraction of their income from patients. Hospitals in counties of the two upper population classes obtain well over 90 percent of their revenue from taxes. Of interest is the fact that in both the Northeast and the South hospitals located in counties of intermediate population range secure slightly more than one-tenth of their receipts from miscellaneous sources.

From the foregoing analysis, it is obvious that a far larger fraction of the services of governmental hospitals in counties of large population is available for low income patients than in those of small population, if the proportion of income from taxes is used as an index of the amount of free treatment afforded. Between metropolitan and nonmetropolitan counties in each area, there is likewise a decided difference in the sums contributed from taxes. Figure 5 demonstrates the inequality. In this figure, counties containing hospitals are divided into two groups, those that are metropolitan and first tier and those that are second tier and beyond. According to the classification used here, the metropolitan character of a county is determined by its location in relation to a metropolitan district as defined by the Bureau of the Census.[10] Any county in which more

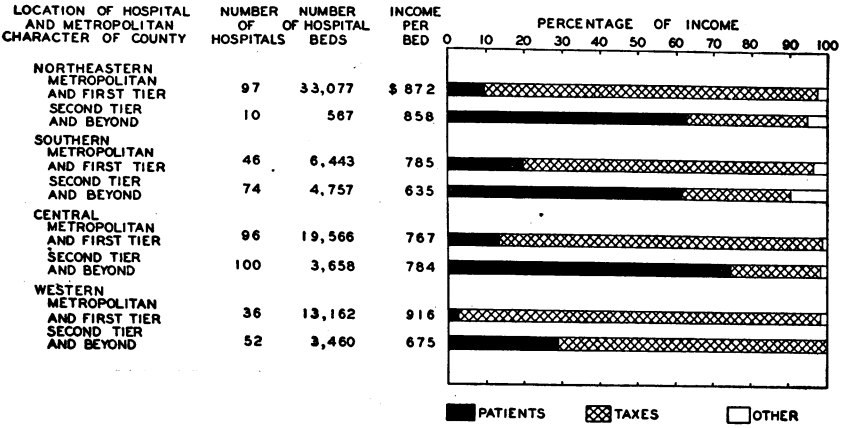

FIGURE 5.—Estimated income per bed and percentage from specified source for registered general and special hospitals under local governmental control, by location of hospital and metropolitan character of county wherein it is situated.

than half of the population resides within the limits of these established metropolitan districts is considered metropolitan. Counties adjoining those which are of metropolitan classification are designated as first tier; all others are described as second tier and beyond.

It is recognized that the two factors, metropolitan character and population of county, are to some extent interwoven. Populous counties are likely to be metropolitan in character, while those with few inhabitants are likely to be remote from population centers. In each area except the Central, the income per bed is higher for hospitals located in metropolitan and first tier counties than for those in other counties. The two figures for institutions in Central States are rather close. Clear-cut distinctions describe sources of income for hospitals located in counties of different metropolitan character. In no in-

[10] Metropolitan Districts—Population and Area. Fifteenth Census of the United States, 1930, Bureau of the Census, United States Department of Commerce.

stance among hospitals in metropolitan and first tier counties does the portion of income from patients exceed 20 percent. At the same time, in no area, exclusive of the Western, does the percentage so derived fall below 60 for hospitals in counties two or more tiers from metropolitan centers. Equally striking, of course, are the variations in the percentage of income from governments. Hospitals in metropolitan and first tier counties are almost wholly tax-supported, percentages ranging from 76 for the South to 96 for the West. Not more than one-third of the income for hospitals in nonmetropolitan or rural counties results from taxation except in the West where nearly all income is tax-derived, regardless of the characteristics of the hospital locality.

As a concluding investigation of the means of support for general and special hospitals, bed capacity of the hospital in conjunction with

POPULATION OF COUNTY AND BED CAPACITY OF HOSPITAL	NUMBER OF HOSPITALS	NUMBER OF HOSPITAL BEDS	INCOME PER BED
LESS THAN 40,000 POPULATION			
LESS THAN 50 BEDS	166	4,385	$ 746
50 TO 149 BEDS	49	3,339	690
150 BEDS AND OVER	2	394	452
40,000 TO 99,999 POPULATION			
LESS THAN 50 BEDS	47	1,421	843
50 TO 149 BEDS	39	3,158	671
150 BEDS AND OVER	15	3,809	687
100,000 TO 249,999 POPULATION			
LESS THAN 50 BEDS	17	527	586
50 TO 149 BEDS	31	2,484	756
150 BEDS AND OVER	29	8,660	711
250,000 POPULATION AND OVER			
LESS THAN 50 BEDS	17	523	1,231
50 TO 149 BEDS	21	1,749	1,047
150 BEDS AND OVER	78	54,241	870

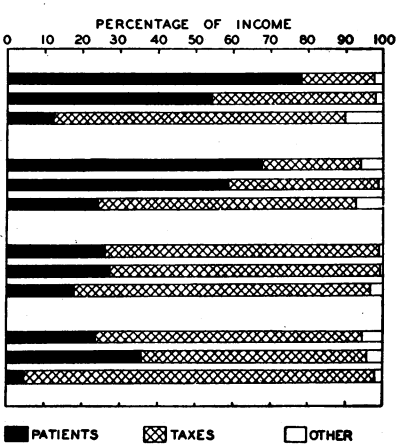

FIGURE 6.—Estimated income per bed and percentage from specified source for registered general and special hospitals under local governmental control, by population of county wherein the hospital is situated and bed capacity of hospital.

population of the county is examined. In order that the weight of county population in altering amount of income from a particular source may be more fully appreciated, the group of counties earlier designated as large is divided into two classes which will hereafter be described as large (100,000 to 249,999) and very large (250,000 and over). Average income per bed for hospitals in counties of each of the population classes under 250,000 is not widely different; for the class of 250,000 and over it is considerably higher. Inspection of figure 6 shows that among the bed capacity groups of each population bracket, changes in amounts per bed are not so ordered that positive trends may be discovered.

Sources of income again prove to be closely allied with county population. Averages not supplied in figure 6 emphasize the modifi-

cation of financial structure that is concurrent with change in population. For aggregate hospitals in counties of low population the percentage of income from patients is 66; it falls to 45 for hospitals in counties of medium-sized population range, to 20 for the large, and to 6 for the very large. Percentage of income from public funds ascends with about the same acceleration that percentage from patients descends, beginning with 32 and ending with 92. In the first two population categories, the proportion of income which hospitals draw from patients steadily falls as the size of the hospital grows. In general, a similar shift occurs in regard to the income for hospitals located in counties of the two upper population brackets; however, the highest proportion from patients is obtained not by small but by medium-sized hospitals. Extremes in the proportions of income furnished by patients are interesting—78 percent for small hospitals in counties with less than 40,000 population and 5 percent for large hospitals in counties with 250,000 or more inhabitants. All in all, when size of hospital in conjunction with size of county forms the basis for analysis, findings regarding schemes of support are in close accord with those resulting from the preceding investigations.

SUMMARY

Knowledge of existing possibilities for hospitalization is needed if plans for extension of hospital service are to be successful. Since the matter of availability goes much deeper than the mere presence of facilities, it has been the purpose of this report and of others in the series to analyze the means of support for various groups of hospitals and thus to reflect in some measure the opportunity which persons with little or no income have of securing hospitalization, unless given aid. Fiscal data for the several studies were afforded by the Business Census of Hospitals conducted during 1935 by the United States Public Health Service.

This report has covered governmental hospitals, exclusive of the Federal, which offer general or closely allied medical or surgical service. As it is concerned primarily with community facilities and their means of operation, State hospitals, which are not definitely a part of the community containing them, have been given brief treatment. Composed to a considerable extent of teaching hospitals associated with universities and of other hospitals which customarily collect fees directly from persons receiving care, they report a sizable fraction of their income from patients, especially if the hospitals are located in Northeastern and Western States. Only in Southern and Central States is the amount of support obtained from taxes sufficient to enable State hospitals to devote most of their service to persons in the low-income brackets.

Operating expense, which may in the case of governmental hospitals be measured by receipts per bed, proves to be lower by an average of some $200 for hospitals controlled by local governments than for those controlled by State governments. The proportion of their income which city and county hospitals receive from patients amounts to but one-seventh of the aggregate revenue; however, among locally controlled institutions of different size and of different location, sources of income are widely divergent.

Throughout each geographic area, county and city hospitals with a bed capacity of less than 50 derive considerably more than half of their income from direct payments by patients. Also, throughout all sections except the Western, hospitals located in counties of less than 100,000 population receive from three-fifths to three-fourths of their income from individual fees. Likewise all hospitals in nonmetropolitan counties secure similar fractions of their revenue from individual fees. Probably the most striking finding of the study is that local governmental hospitals with less than 50 beds, located in counties of less than 40,000 population, obtain from patients 78 percent of their entire receipts.

Evidently, then, many of the publicly controlled hospitals are operated from a financial viewpoint in much the same manner as are privately owned ones. Small hospitals, those situated in counties with few inhabitants, and those in counties distant from population centers draw from patients practically the same proportion of their income as do nonprofit hospitals. Disclosure of this interrelationship between characteristics of the community and means of financial support for governmental hospitals serves to highlight existing inequalities in opportunity for hospitalization.

QUALIFICATIONS OF PROFESSIONAL PUBLIC HEALTH PERSONNEL [1]

V. LABORATORY WORKERS

By MAYHEW DERRYBERRY, *Senior Health Education Analyst*, and GEORGE CASWELL, *United States Public Health Service*

Laboratory service is the one essential public health function that has, in general, remained centralized and under the control of State health departments. Although laboratories may be found operating

[1] From the Division of Public Health Methods, National Institute of Health. This is the fifth in the series: Qualifications of Professional Public Health Personnel. The preceding papers are: I. Plan and Scope of the Survey, II. Health Officers and Other Medical Personnel, III. Nurses, and IV. Sanitation Personnel. The coverage, limitations, and methods of the survey have been fully discussed in the earlier papers, especially the first.

This survey was made possible through the cooperation of State and local health officers and members of their staffs throughout the country. Acknowledgment is also made of the extensive clerical assistance provided by the Works Progress Administration, Project No. 765-23-3-2. Data collected in 1938.

in conjunction with local departments, they are frequently branches of the State organization. Only a few cities and other jurisdictions operate laboratories independently, since the facilities in a given department can and do serve relatively extensive geographic areas. For these reasons, the workers concerned are not only mainly under State control but also numerically the smallest of the major professional groups in public health.

Out of 16,670 schedules submitted in the general survey of the qualifications of public health personnel, only 1,291 (fewer than 8 percent) came from professional laboratory workers of all classes. Because of the centralized character of laboratory service, no attempt has been made to maintain jurisdictional distinctions in the present analysis, but rather the 1,291 workers have been classified only by function. There are 124 laboratory directors, 703 expert technicians (bacteriologists, chemists, and toxicologists), and 464 assistants (including laboratory technicians). No schedules were requested from semiskilled and unskilled personnel such as laboratory helpers and laborers. In contrast to the other professional groups in public health, laboratory workers are about equally divided between the sexes, with a ratio of 12 men to 13 women. In table 1 it will be seen that the great majority of directors and over half the expert technicians are men, but two out of three assistants are women. All but 3 percent of the group as a whole are white.

TABLE 1.—*Laboratory workers by professional classification, sex, and color*

Professional classification	All laboratory workers	Sex and color			
		Male		Female	
		White	All other	White	All other
	Number				
All classes	1,291	592	28	655	16
Directors of laboratories	124	89	3	31	1
Expert technicians	703	353	16	325	9
Laboratory assistants	464	150	9	299	6
	Percentage				
All classes	100.0	45.9	2.2	50.7	1.2
Directors of laboratories	100.0	71.8	2.4	25.0	.8
Expert technicians	100.0	50.2	2.3	46.2	1.3
Laboratory assistants	100.0	32.3	1.9	64.5	1.3

Age.—Laboratory workers are, on the average, the youngest of the major professional groups in public health. With an average age of 36.5 years, they are 2.5 years younger than the public health nurses,

whom they resemble in age distribution. Laboratory directors average 44 years of age, 6.5 years older than the expert technicians and 11 years older than assistants (see table 2). It might be pointed out that almost half of the assistants are under 30; but 3 out of 4 expert technicians and 24 out of 25 directors are 30 or over. These differences are to be expected in view of the extensive experience commonly required for the more responsible positions.

TABLE 2.—*Age of laboratory workers*

Age (years)	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All ages	1,291	100.0	124	100.0	703	100.0	464	100.0
Under 25	137	10.6			46	6.5	91	19.6
25–29	274	21.2	5	4.0	135	19.2	134	28.9
30–34	265	20.5	17	13.7	166	23.6	82	17.7
35–39	185	14.3	23	18.5	101	14.4	61	13.1
40–44	153	11.9	26	21.0	91	13.0	36	7.8
45–49	113	8.8	19	15.3	67	9.5	27	5.8
50–54	78	6.1	20	16.1	43	6.1	15	3.2
55–59	40	3.1	7	5.7	21	3.0	12	2.6
60 and over	34	2.6	7	5.7	22	3.1	5	1.1
Unknown	12	.9			11	1.6	1	.2
Average	36.5		44.1		37.4		33.1	

EDUCATIONAL QUALIFICATIONS

Basic training.—Laboratory personnel as a whole appear basically well trained for their positions. Previous studies have pointed to the fact that, in contrast to other classes of public health personnel, qualified laboratory workers have consistently been available.[2] Fewer than 15 percent of the present employees (mostly laboratory assistants) do not report college training. Only 5 directors and 58 expert technicians do not report some college training. In table 3, showing levels of training for the several groups, it will be noted that two-thirds of all the workers have college degrees and nearly one-quarter have had some graduate work. Academic and professional degrees held are shown at the foot of the table. In tabulating the degrees, no attempt has been made to determine the number of workers having two academic degrees, or both an academic and a professional degree, as opposed to those having only a single degree. Hence, the total number of degrees reported is considerably greater than the number of individuals with college and graduate work.

[2] The White House Conference in 1930 reported that the securing of qualified laboratory workers presented no serious administrative difficulty. (Public Health Organization, vol. IIA, Reports of the White House Conference on Child Health and Protection. The Century Company, New York, 1932, p. 265.)

TABLE 3.—*Level of academic and professional training reported by laboratory workers*

Level of training reported	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
Less than high school	35	2.7	2	1.6	10	1.4	23	5.0
High school, no college [1]	145	11.3	3	2.4	48	6.8	94	20.2
College, no degree	244	18.9	12	9.7	100	14.2	132	28.4
College degree	567	43.9	61	49.2	347	49.4	159	34.3
Graduate work	300	23.2	46	37.1	198	28.2	56	12.1
Number with academic degrees	791	61.3	89	71.8	495	70.4	207	44.6
Number with professional degrees	139	10.8	38	30.6	87	12.4	14	3.0
Number with graduate degrees	181	14.0	35	28.2	120	17.1	26	5.6

[1] Includes those who made no report on training beyond high school.

A distribution of the specific degrees held by the various types of workers appears in table 4. There are more doctors of philosophy and science among this small group of laboratory workers than among any of the other larger groups of professional public health personnel. In addition, there are 51 doctors of medicine, two-fifths of whom are in charge of laboratories. Among the three functional classes, the directors report relatively the largest number of degrees of all types, although almost as great a proportion of expert technicians as of directors report undergraduate degrees. In comparison with the other two laboratory groups, the assistants have relatively few graduate academic degrees, but even so, they have relatively more such degrees than do either nurses or sanitation workers.

TABLE 4.—*Degrees held by laboratory workers, by type of degree and class of worker*

Degrees held	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total persons	1,291	100.0	124	100.0	703	100.0	464	100.0
Total with degrees	867	67.1	107	86.3	545	77.5	215	46.3
Undergraduate academic	796	61.6	89	71.8	500	71.1	207	44.6
Bachelor of arts	340	26.3	40	32.3	213	30.3	87	18.8
Bachelor of science	411	31.8	45	36.3	256	36.4	110	23.7
All other	45	3.5	4	3.2	31	4.4	10	2.1
Graduate academic	229	17.7	46	37.1	156	22.2	27	5.8
Master's (arts or science)	183	14.2	35	28.2	122	17.4	26	5.6
Doctor of philosophy [1]	42	3.2	9	7.3	32	4.5	1	.2
Doctor of science [1]	4	.3	2	1.6	2	.3	-------	-------
Professional	139	10.8	38	30.6	87	12.3	14	3.0
Doctor of medicine	51	4.0	22	17.7	29	4.1	-------	-------
Doctor of veterinary medicine	11	.9	1	.8	10	1.4	-------	-------
Pharmacy	30	2.3	4	3.2	17	2.4	9	1.9
All other	47	3.6	11	8.9	31	4.4	5	1.1

[1] The master's degree is assumed, whether or not reported.

The schedule on which training was reported requested each individual to state the amount of both his academic college work and his professional training and to record degrees earned. Although much of the laboratory workers' education should be professional training, fewer than one-fourth of them reported any of their college work in that category. In view of this fact, academic work and professional training have been combined in table 5 to show the length of training beyond high school for the three classes of workers. The training of a substantial number of individuals (10 percent) is labeled "unspecified" in the table. These workers submitted schedules with some evidence of training beyond high school but the information was reported in such a way that the amount could not be exactly determined in terms of years.

TABLE 5.—*Aggregate years of training beyond high school* [1] *reported by laboratory workers*

Aggregate years of training beyond high school	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
Less than 1 [2]	57	4.4	-------	-------	22	3.1	35	7.6
1	64	5.0	-------	-------	22	3.1	42	9.1
2	85	6.6	5	4.0	31	4.4	49	10.6
3	62	4.8	5	4.0	25	3.6	32	6.9
4	525	40.7	50	40.3	331	47.1	144	31.0
5	136	10.5	14	11.3	81	11.5	41	8.8
6	96	7.4	14	11.3	61	8.7	21	4.5
7	53	4.1	11	8.9	35	5.0	7	1.5
8	46	3.6	6	4.8	33	4.7	7	1.5
9 or more	34	2.6	12	9.7	20	2.8	2	.4
Unspecified [3]	133	10.3	7	5.7	42	6.0	84	18.1

[1] Including academic and graduate college work and professional school training.
[2] Includes those who reported definitely that they had no training beyond high school.
[3] Includes those who did not report on college work.

The modal number of years of education beyond high school for each of the groups is four, although the proportion with less than that amount is much greater among assistants than among directors or expert technicians. Only 28 percent of the total have had more than the modal 4 years of training but 46 percent of the directors and 33 percent of the technicians have had 5 or more years of education beyond high school. In comparison with other professional groups in public health, laboratory personnel have, as a class, a more extensive basic training than sanitation workers but less training than physicians.[3]

Public health training.—Training in the special techniques of public health has not been emphasized for laboratory workers as it has for

[3] No comparison is made between the laboratory workers' training and the total years of training reported by nurses since it could not always be determined in individual cases how much time nurses spent in their professional (nursing) education. (*Cf.* No. III in this series of papers, Nurses.)

physicians, nurses, and sanitarians. Neither of the professional training committees [4] has set up standards of public health training for laboratory workers, nor has there been any particular concern expressed regarding their lack of it. At various times there has been discussion of the necessity for study in clinical pathology, serology, biochemistry, and fundamental sciences by this group,[5] but no mention has been made of specialized training in a graduate school of public health. In fact, it is doubtful that the work of a health department laboratory is sufficiently different from other laboratory work in medicine to require specialized *public health* training for all its personnel. It is rather surprising, therefore, to find that over 20 percent of the laboratory workers have had some public health training and over 5 percent have had a year or more (see table 6). Fifteen percent have had some type of special courses in public health and another very small proportion have had less than a year of graduate public health training. The differences between the three groups of personnel are similar to those shown in relation to academic training, i. e., the proportion with public health training is greatest among directors (who need it) and least among assistants. There is almost as high a percentage of directors (19.4) as of medical health officers (21.8) with a year or more of training.[6]

TABLE 6.—*Public health training reported by laboratory workers*

Public health training	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
None	997	77.2	76	61.3	548	78.0	373	80.4
Special courses only	197	15.3	19	15.3	104	14.8	74	15.9
Less than 1 year	25	1.9	5	4.0	15	2.1	5	1.1
Year or more	72	5.6	24	19.4	36	5.1	12	2.6
Certificate or degree	48	3.7	23	18.5	21	3.0	4	0.9

Judging from the reported length and character of their training, laboratory workers on the whole would seem to be better prepared for the tasks they are required to perform than any of the three groups previously studied.

[4] The Committee on Professional Education of the American Public Health Association and the Committee on Professional Education and Qualifications of Public Health Personnel, representing the Conference of State and Territorial Health Officers.

[5] For example, see Part I, Proceedings, Assembly of Laboratory Directors and Serologists, October 1938 (Supplement No. 9 to Venereal Disease Information), pp. 102–131.

[6] *Cf.* No. II in this series, Health Officers and Other Medical Personnel.

EMPLOYMENT EXPERIENCE

Laboratory workers reported their employment more completely than any other major professional group.[7] Only 15 percent failed to report sufficient employment to account for the period of availability. The following tabulations may, therefore, be taken to represent almost all of the prior experience of the laboratory personnel.

Types of experience reported.—The experience of almost 40 percent of the workers has been confined to the field of public health. Twenty percent have had no other jobs than the ones in which they are now working. For the remaining three-fifths who have worked in other fields, the types of previous experience are shown in table 7. It is apparent that earlier employment reported by 26.7 percent of the workers was wholly unrelated to laboratory work. Approximately 32 percent have worked as chemists or bacteriologists and 9 percent have had other types of laboratory or scientific experience. Among the three groups, the employment reported by directors is most closely related to laboratory service and that by assistants least so. In fact, almost one-half of the assistants report only jobs having no relation to laboratory work.

TABLE 7.—*Types of prior experience reported by laboratory workers*

Type of experience reported	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
Public health only	485	37.6	38	30.6	269	38.3	178	38.4
Other than public health [1]	806	62.4	86	69.4	434	61.7	286	61.6
Chemist	168	13.0	22	17.7	120	17.1	26	5.6
Bacteriologist	240	18.6	58	46.8	151	21.5	31	6.7
Entomologist	6	.5			4	.6	2	.4
Microscopist	6	.5	2	1.6	2	.3	2	.4
Analyst (laboratory)	13	1.0	3	2.4	6	.9	4	.9
Instructor in science	43	3.3	11	8.9	28	4.0	4	.9
Laboratory research, not otherwise specified	51	4.0	4	3.2	36	5.1	11	2.4
Unrelated employment	345	26.7	7	5.6	124	17.6	214	46.1

[1] Combinations are not shown, but number and percentage reporting each type are shown.

Public health experience.—A broad experience in many public health organizations is perhaps less essential to laboratory workers, particularly those engaged in the diagnostic and routine analytical work, than to the medical, nursing, and sanitation personnel. Aside from differences in research work that various laboratories may be carrying on, the problems confronting a worker in one position are in many

[7] See especially No. II in this series, Health Officers and Other Medical Personnel, for the method of determining adequacy of employment reporting, as determined by the relationship of present age and probable date of first employment to the number of years reported.

respects identical with those in another. For that reason, the somewhat limited nature of the public health experience of the workers, as revealed by the number of positions they have held (see table 8), does not necessarily detract from the quality of laboratory service rendered, as it might in some of the other branches of the department. This is particularly true in reference to technicians and assistants, both of which groups report a relatively small number of positions. The directors, on the other hand, have had many more affiliations; three-fourths of them report more than one position.

TABLE 8.—*Number of positions in public health reported by laboratory workers*

Number of public health positions reported	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
1 [1]	758	58.7	34	27.4	391	55.6	333	71.8
2	285	22.1	30	24.2	180	25.6	75	16.2
3	133	10.3	24	19.4	79	11.2	30	6.5
4	65	5.0	25	20.2	26	3.7	14	3.0
5	31	2.4	8	6.4	18	2.6	5	1.1
6	8	.6	-------	-------	6	.9	2	.4
7	5	.4	1	.8	1	.1	3	.6
8 or more	6	.5	2	1.6	2	.3	2	.4
Average	1.8	-------	2.7	-------	1.8	-------	1.5	-------

[1] Includes those reporting only the present position.

The relatively large number reporting only one job in public health would indicate that laboratory work in health departments is a stable occupation. Even the workers who change positions have tended to remain in public health. Only 8 percent of the expert technicians and 6 percent of the assistants have had any employment in other fields after entering public health. Twenty-seven percent of laboratory directors have, however, worked in other fields after entering public health employment. But since directors represent less than 10 percent of the total, the number whose public health experience has been interrupted by outside employment is still extremely small.

Since relatively few individuals have had more than one position in public health or any interruption to their continuity of service, the length of public health experience becomes another indication of the stability of laboratory work in health departments. The distributions of the three groups of workers, by length of public health experience, is summarized in table 9. This professional class, as a whole, has an average of 9.1 years of public health experience, including the present position.[8] Laboratory directors, with an average of more than 14 years, have had the longest experience in the field,

[8] This average represents only the length of service to the time of reporting. It does not represent completed experience.

although expert technicians average 10 years and laboratory assistants 6.3 years. Fewer than 10 percent of laboratory assistants, who are much younger than the other two groups, have been in public health as long as 15 years, but 4 out of 9 laboratory directors, the oldest group, have been in the field 15 years or more.

TABLE 9.—*Length of experience in public health*[1] *reported by laboratory workers*

Years of experience in public health reported	All laboratory workers		Directors of laboratories		Expert technicians		Laboratory assistants	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Total	1,291	100.0	124	100.0	703	100.0	464	100.0
Under 5	563	43.6	18	14.5	262	37.3	283	61.0
5–9	243	18.8	20	16.1	143	20.3	80	17.2
10–14	204	15.8	28	22.6	122	17.4	54	11.6
15–19	140	10.9	31	25.0	79	11.2	30	6.5
20–24	75	5.8	14	11.3	48	6.8	13	2.8
25 or more	66	5.1	13	10.5	49	7.0	4	.9

[1] Including the present position.

In general, employment on the staff of a health department laboratory may be characterized, in terms of the experience of existing personnel, as highly stable, of relatively long duration, but with little variety or change from one department to another.

SUMMARY AND DISCUSSION

1. Laboratory workers, aggregating somewhat less than 8 percent of professional public health personnel, are in general under the supervision of State health departments. This is the only major professional group in public health in which, as a whole, there is an approximately equal division between the sexes. Two out of three laboratory assistants are women.

2. The average age of all laboratory workers is 36.5 years, although laboratory directors, averaging 44 years of age, are considerably older than either the expert technicians or laboratory assistants. Laboratory workers, though somewhat younger, resemble in age distribution the public health nursing group.

3. With the exception of physicians, the laboratory personnel have the most extensive academic and professional training in the public health field. More than two-thirds of all laboratory workers have college degrees and almost one-fourth of them have done some graduate work. One-seventh of all laboratory workers have graduate degrees.

4. Since specific training in public health is not commonly considered an essential for all laboratory workers, it is rather surprising to find that, as a whole, they have more of such training than sanitation

personnel. Relatively almost as many laboratory directors as medical health officers have a year or more of graduate public health training.

5. The prior employment of laboratory workers, which was somewhat better reported than that of the other professional groups, does not appear to have particular bearing on their present employment. Aside from public health experience, and except among laboratory directors, almost half of whom have had prior experience as bacteriologists, no one kind of related experience is reported in more than 22 percent of the cases.

6. With an average experience of 9 years (but only 1.8 positions) in public health, laboratory personnel are a stable occupational group. Among the fewer than 10 percent of all employees who have had interrupted service in public health, the average number of periods of employment in other fields is only 1.7.

7. Perhaps because of the nature of their training and the kind of work done by laboratory personnel, there seems very little tendency for them to move from place to place or change positions.

CONTRIBUTIONS TO OUTSIDE JOURNALS OF THE PERSONNEL OF THE UNITED STATES PUBLIC HEALTH SERVICE

January–December 1940

The following list includes the contributions of United States Public Health Service personnel published during the calendar year 1940 in journals other than the Public Health Reports, Hospital News, and other periodicals of the Service. It also includes books, monographs, and reports issued by private publishers or other agencies. The references do not include contributions of the staffs of St. Elizabeths Hospital and Freedmen's Hospital, both of which institutions were transferred to the Public Health Service July 1, 1940. Contributions published in the Public Health Reports will be found in the semiannual indices of that publication.

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[1] Not employed by the U. S. Public Health Service.

MOTOR VEHICLE ACCIDENT FATALITIES IN THE UNITED STATES, 1939

There were 32,386 deaths from motor vehicle accidents in the United States in 1939,[1] giving a death rate of 24.7 per 100,000 population. This is the lowest rate reported in the United States since 1933.

No distinction is made between traffic and nontraffic accidents in this classification. Automobile accidents (other than collisions with trains or street cars) accounted for 30,466, or 94 percent, of the total deaths due to motor vehicle accidents.

The death rates from these accidents are higher for the Mountain and Pacific States than for any other geographic region. The rates in 1939 were particularly high for Nevada, Wyoming, Arizona, California, and New Mexico. In some of these States, however, a large proportion of the high rate is due to the involvement of the residents of other States in the fatal accidents.

The number of motor vehicle accident fatalities was lowest for the first 6 months of the year, shows a small peak in July, a drop in August, and the highest rates for the last 4 months of the year. As heretofore, the largest numbers of such accidents by days of the week occurred on Saturday and Sunday, reflecting the increased week-end travel. The average daily number of these fatalities in 1939 was approximately 89.

Among white persons the ratio of these deaths in males and females was about 3.2 to 1, and in colored about 3.8 to 1.

Automobile accident fatalities are an important public health problem, since they are responsible for approximately twice as many victims each year as typhoid fever, cerebrospinal meningitis, scarlet fever, whooping cough, diphtheria, dysentery, malaria, measles, poliomyelitis, pellagra, and smallpox combined, more than half as many as pulmonary tuberculosis, and nearly half the mortality caused by pneumonia.

While mechanical faults are responsible for many of these deaths, the personal factor doubtlessly plays the most important part—drunkenness, exhaustion, willingness to take a chance (or the gambling instinct), disregard for traffic regulations and for the rights of others, and the psychological complex which seems to afflict certain drivers. Disease and age also play their role.

Dr. Daniel Blain,[2] of New York, has pointed out that of 4,500,000 traffic accidents of all kinds, one-third are due to accident-prone drivers, who are probably mentally or physically ill, while 3,000,000 accidents, 600,000 injuries, and 20,000 fatalities each year are presumably due to the acts of normal persons whose individual accident rate is lower than that of subnormal drivers, but whose total contribution

[1] Vital Statistics—Special Reports, Vol. 11, No. 51, Bureau of the Census, U. S. Department of Commerce.
[2] J. Am. Med. Assoc., Sept. 14, 1940, p. 906.

to these injuries and deaths is greater because this group of drivers is the most numerous.

Accident prevention programs have achieved some degree of success, but the preventable loss of life and injury due to motor vehicle accidents surely demands a more careful analysis of the causes of these accidents and a more effective and concentrated program of prevention. The accident-prone drivers should be eliminated by appropriate physical and mental examinations given before the issuance of permits and by the revocation of permits of drivers showing a high frequency accident rate. A more effective educational program directed to both drivers and pedestrians, as well as the encouragement of greater respect for traffic regulations by imposing severer penalties for minor infractions, as some cities are doing, would no doubt contribute to a significant reduction in motor vehicle accident fatalities.

COURT DECISION ON PUBLIC HEALTH

Provisions of city ordinance regulating hours of operation of barber shops held invalid.—(Kentucky Court of Appeals; *City of Louisville* v. *Kuhn*, 145 S.W.2d 851; decided December 6, 1940.) One section of an ordinance of the city of Louisville pertaining to barbering made it unlawful to keep open any barber shop or to conduct any barber business therein on specified holidays or on any other day before 8 a. m. or after 6 p. m., except on Saturday and a day preceding a holiday when the closing hour was 8 p. m. In a suit brought by a barber against the city the plaintiff took the position that the said section of the ordinance was invalid as an improper exercise of the police power in that it invaded fundamental rights guaranteed to him and others similarly situated by both the Federal and State Constitutions. The trial court held the challenged section void and its action was sustained by the court of appeals. The view expressed was that the involved restrictions on the lawful and necessary business of barbering were unreasonable.

DEATHS DURING WEEK ENDED FEBRUARY 22, 1941

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

	Week ended Feb. 22, 1941	Corresponding week, 1940
Data from 88 large cities of the United States:		
Total deaths	9,043	9,409
Average for 3 prior years	9,395	
Total deaths, first 8 weeks of year	78,362	77,350
Deaths under 1 year of age	524	490
Average for 3 prior years	552	
Deaths under 1 year of age, first 8 weeks of year	4,353	4,369
Data from industrial insurance companies:		
Policies in force	64,708,572	66,131,396
Number of death claims	15,265	12,624
Death claims per 1,000 policies in force, annual rate	12.3	10.0
Death claims per 1,000 policies, first 8 weeks of year, annual rate	10.8	10.4

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 MARCH 1, 1941

Summary

Health conditions with respect to the 9 communicable diseases reported weekly by the State health officers, and included in the following table, remained favorable during the current week, with the single exception of measles. Decreases were recorded for influenza (from 13,688 for the preceding week to 11,767 for the current period), meningococcus meningitis, poliomyelitis, and smallpox, while slight increases were reported for diphtheria, scarlet fever, typhoid fever, and whooping cough.

The number of reported cases of measles increased from 24,079 for the preceding week to 31,490. The current incidence is more than three times the 5-year (1936–40) median, while the total number of cases reported this year to date is about 2½ times the 5-year cumulative median for the corresponding period (first 9 weeks of the year). As the peak for measles does not usually come before the latter part of March or middle of April, the indications are that 1941 will fall into the cyclic (3-year) period of a "measles" year.

The highest current incidence is reported for the Middle Atlantic, East North Central, and South Atlantic States. These areas also show the largest increases for the current week.

Of 35 cases of smallpox, 31 cases were reported in the North Central group of States (9 in Minnesota, 8 in Wisconsin, and 6 in Illinois), and of 23 cases of endemic typhus fever, 10 cases occurred in Georgia. No State reported more than 2 cases of poliomyelitis.

The death rate for the current week for 92 major cities of the United States, as reported by the Bureau of the Census, was 13.0 per 1,000 population, as compared with 12.6 for the preceding week and with a 3-year (1938–40) average of 13.1 (for 88 cities).

Telegraphic morbidity reports from State health officers for the week ended March 1, 1941, and comparison with corresponding week of 1940 and 5-year median

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

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40
	Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940	
NEW ENG.												
Maine	0	1	1	28	3	5	88	336	165	0	0	0
New Hampshire	0	0	0	10	----	----	37	23	13	0	0	0
Vermont	0	0	0	----	----	----	47	11	23	0	0	0
Massachusetts	1	3	5	----	----	----	682	329	916	1	4	4
Rhode Island	0	0	0	2	----	----	4	183	43	1	0	0
Connecticut	1	4	4	62	7	17	52	150	150	1	0	1
MID. ATL.												
New York	18	18	31	[1] 68	[1] 68	[1] 68	5,545	468	1,224	0	1	10
New Jersey	11	7	13	183	29	29	2,023	73	159	1	1	3
Pennsylvania	16	28	38	----	----	----	4,434	254	388	7	12	6
E. NO. CEN.												
Ohio	5	12	24	104	253	103	3,149	28	34	1	3	3
Indiana	11	12	17	97	52	52	478	23	23	1	1	1
Illinois	34	18	39	49	52	52	2,861	30	30	0	2	5
Michigan [2]	4	1	12	112	20	10	3,496	213	213	0	1	1
Wisconsin	0	5	5	240	173	120	668	233	233	0	0	2
W. NO. CEN.												
Minnesota	1	8	3	19	3	3	4	253	253	1	0	1
Iowa	3	3	4	194	65	27	160	309	54	0	0	0
Missouri	12	19	19	18	32	382	141	54	20	0	1	2
North Dakota	3	2	1	85	44	31	8	11	8	0	0	0
South Dakota	1	1	1	2	1	2	21	0	0	0	0	1
Nebraska	0	0	4	----	----	----	4	49	29	0	0	1
Kansas	5	5	11	91	41	41	429	639	12	0	0	1
SO. ATL.												
Delaware	1	0	0	----	----	----	312	1	26	0	0	0
Maryland [2]	3	4	9	113	55	72	115	2	146	3	1	4
Dist. of Col	2	7	7	15	4	3	67	2	19	1	0	2
Virginia	10	12	16	1,600	1,696	----	1,864	30	218	0	0	5
West Virginia [2]	6	8	8	321	1,500	271	189	9	21	3	1	2
North Carolina	14	13	16	154	52	97	490	183	183	4	2	5
South Carolina	2	5	6	1,056	945	1,181	268	6	27	5	0	1
Georgia [2]	2	13	6	547	590	590	200	94	94	0	3	2
Florida [2]	9	10	8	229	9	9	395	68	68	1	0	0
E. SO. CEN.												
Kentucky	3	8	13	107	107	107	723	32	73	6	1	6
Tennessee	3	4	8	548	231	231	185	78	78	1	2	2
Alabama [2]	2	6	11	490	528	599	305	224	224	1	1	1
Mississippi [2]	3	8	4	----	----	----	----	----	----	0	0	0
W. SO. CEN.												
Arkansas	3	2	3	711	838	303	146	17	17	0	0	0
Louisiana [2]	5	3	10	133	194	78	59	12	12	1	3	2
Oklahoma	6	6	9	209	443	334	11	3	34	0	0	0
Texas [2]	39	23	40	3,100	2,547	965	577	465	465	0	1	4
MOUNTAIN												
Montana	0	0	0	29	4	29	9	22	49	0	0	0
Idaho	1	0	0	11	1	3	19	96	28	0	0	0
Wyoming	0	0	0	29	----	----	80	57	17	1	1	0
Colorado	13	7	7	64	25	----	167	25	25	1	0	0
New Mexico	2	0	3	24	2	8	199	4	38	0	0	0
Arizona	4	3	5	181	280	177	111	25	31	0	0	0
Utah [2]	1	3	1	20	17	----	26	341	130	0	0	0
Nevada	0	----	----	----	----	----	0	----	----	0	----	----
PACIFIC												
Washington	4	0	4	14	4	4	121	776	261	0	1	1
Oregon	0	8	1	30	38	97	391	446	60	0	0	0
California [3]	12	21	27	[4] 668	580	580	130	462	462	2	1	5
Total	276	321	472	11,767	11,533	11,533	31,490	7,149	10,396	44	44	103
9 weeks	2,658	3,716	5,056	541,893	124,174	51,047	144,881	44,809	58,065	398	351	858

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended March 1, 1941, and comparison with corresponding week of 1940 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40
	Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940		Mar. 1, 1941	Mar. 2, 1940	
NEW ENG.												
Maine	0	0	0	7	3	14	0	0	0	0	0	1
New Hampshire	0	0	0	2	3	4	0	0	0	0	0	0
Vermont	0	0	0	4	2	11	0	0	0	1	0	0
Massachusetts	0	0	0	166	135	229	0	0	0	1	1	1
Rhode Island	0	0	0	8	15	18	0	0	0	0	0	0
Connecticut	0	0	0	35	82	90	0	0	0	2	1	0
MID. ATL.												
New York	1	2	1	467	835	905	0	0	0	10	1	3
New Jersey	1	0	0	365	425	206	0	0	0	1	0	2
Pennsylvania	0	0	1	331	389	512	0	0	0	3	9	3
E. NO. CEN.												
Ohio	2	1	0	251	436	436	0	1	3	3	3	2
Indiana	0	0	1	170	168	204	0	1	4	0	1	2
Illinois	1	1	1	475	703	703	6	4	12	2	3	2
Michigan [2]	0	0	0	280	414	469	0	4	4	3	1	1
Wisconsin	0	3	0	127	136	293	8	13	9	0	0	0
W. NO. CEN.												
Minnesota	0	0	0	42	118	125	9	5	8	1	0	0
Iowa	0	0	0	58	65	126	1	4	20	0	1	0
Missouri	0	0	0	97	101	219	4	4	17	0	7	4
North Dakota	0	0	0	9	17	29	0	0	8	0	0	0
South Dakota	0	0	0	16	14	24	3	0	11	0	0	0
Nebraska	0	0	0	16	19	66	0	0	9	0	0	0
Kansas	0	0	0	73	83	217	0	2	28	0	0	0
SO. ATL.												
Delaware	0	0	0	15	7	9	0	0	0	0	0	0
Maryland [2]	1	0	0	61	43	47	0	0	0	0	2	2
Dist. of Col	1	0	0	11	26	25	0	0	0	0	0	0
Virginia	0	0	1	35	32	40	0	0	0	2	1	2
West Virginia [2]	1	0	0	35	53	45	0	1	1	0	0	1
North Carolina	1	0	0	55	45	44	0	1	0	0	0	0
South Carolina	0	1	0	13	1	5	0	1	0	3	1	1
Georgia [2]	1	0	0	15	25	13	0	0	1	0	1	1
Florida [2]	2	0	0	1	13	8	0	0	0	5	1	2
E. SO. CEN.												
Kentucky	0	0	0	144	88	76	0	0	0	2	2	2
Tennessee	0	0	0	122	77	37	0	4	4	5	4	1
Alabama [2]	1	0	1	18	18	18	2	0	0	3	1	1
Mississippi [2]	2	1	0	5	8	8	0	0	0	2	0	1
W. SO. CEN.												
Arkansas	1	0	0	17	6	9	0	2	2	4	0	1
Louisiana [2]	1	0	0	11	11	11	0	0	0	4	1	6
Oklahoma	0	0	0	32	13	31	1	1	8	0	1	2
Texas [2]	0	2	1	58	67	89	0	5	5	2	5	7
MOUNTAIN												
Montana	0	0	0	22	33	33	0	0	8	0	0	0
Idaho	0	0	1	6	20	20	0	0	4	1	0	0
Wyoming	0	0	0	3	6	37	0	0	0	1	1	1
Colorado	0	0	0	28	66	66	0	11	8	2	1	1
New Mexico	0	0	0	3	17	27	0	1	0	1	0	4
Arizona	0	0	0	5	14	12	0	1	1	1	1	0
Utah [2]	0	0	0	12	24	42	0	0	0	0	0	0
Nevada	0	----	----	0	----	----	0	----	----	0	----	----
PACIFIC												
Washington	0	0	0	27	64	63	1	0	8	4	2	2
Oregon	0	0	0	13	32	34	0	1	9	1	0	0
California [2]	1	4	3	118	175	250	0	0	12	2	0	3
Total	18	15	17	3,884	5,147	6,224	35	67	293	72	53	88
9 weeks	289	275	192	30,370	40,913	54,300	413	640	2,657	631	670	985

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended March 1, 1941, and comparison with corresponding week of 1940 and 5-year median—Con.

Division and State	Whooping cough	
	Week ended	
	Mar. 1, 1941	Mar. 2, 1940
NEW ENG.		
Maine	28	46
New Hampshire	24	0
Vermont	28	70
Massachusetts	262	119
Rhode Island	12	19
Connecticut	45	63
MID. ATL.		
New York	341	492
New Jersey	107	84
Pennsylvania	421	341
E. NO. CEN.		
Ohio	373	156
Indiana	27	33
Illinois	85	110
Michigan [3]	375	153
Wisconsin	104	130
W. NO. CEN.		
Minnesota	65	28
Iowa	28	7
Missouri	55	11
North Dakota	14	13
South Dakota	7	1
Nebraska	25	4
Kansas	132	36
SO. ATL.		
Delaware	21	8
Maryland [3]	84	207
Dist. of Col	11	6
Virginia	159	45
West Virginia [3]	27	42
North Carolina	280	138
South Carolina	83	22
Georgia [3]	56	11
Florida [3]	21	4
E. SO. CEN.		
Kentucky	67	52
Tennessee	71	31
Alabama [3]	28	12
Mississippi [3]	----	----
W. SO. CEN.		
Arkansas	53	1
Louisiana [3]	18	28
Oklahoma	27	5
Texas [3]	348	154
MOUNTAIN		
Montana	32	10
Idaho	14	8
Wyoming	1	12
Colorado	58	11
New Mexico	17	71
Arizona	2	28
Utah [3]	76	117
Nevada	0	----
PACIFIC		
Washington	107	24
Oregon	10	44
California [3]	341	167
Total	4,570	3,174
9 weeks	37,778	25,267

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Typhus fever, week ended Mar. 1, 1941, 23 cases, as follows: Georgia, 10; Florida, 1; Alabama, 3; Louisiana, 3; Texas, 4; California, 2.
[4] Delayed reports of approximately 330 cases included.

MONTHLY REPORTS FROM STATES

Case reports consolidated for the year 1940

Division and State	Diphtheria	German measles	Influenza	Malaria	Measles	Meningitis, meningococcus	Ophthalmia neonatorum	Pellagra	Poliomyelitis	Puerperal septicemia	Rocky Mountain spotted fever	Scarlet fever	Small pox	Typhoid and paratyphoid fever	Typhus fever	Undulant fever	Whooping cough
NEW ENG.																	
Maine	53	221	217	1	10,046	11	4	1	11	----	0	432	0	41	----	27	1,664
New Hampshire	1	----	4	----	1,041	0	----	----	6	----	0	109	0	7	----	2	332
Vermont	4	102	21	----	492	4	----	----	4	----	0	354	0	23	----	45	1,135
Massachusetts	158	558	----	7	21,704	47	[1] 447	13	46	----	0	5,279	0	196	----	52	7,959
Rhode Island	17	42	2	1	5,287	11	1	----	15	----	0	491	0	29	1	12	427
Connecticut	42	133	152	5	2,773	15	2	----	17	----	0	2,544	0	113	----	91	2,704
MID. ATL.																	
New York	535	1,869	----	134	25,802	148	[2] 97	----	230	----	1	23,039	0	457	42	257	18,199
New Jersey	336	646	465	14	16,878	20	130	----	58	----	10	10,093	0	122	3	73	5,434
Pennsylvania	836	680	----	16	18,237	231	43	6	170	----	9	12,946	0	543	1	124	20,000
E. NO. CEN.																	
Ohio	614	276	1,937	49	1,619	50	----	3	641	15	3	10,960	21	343	2	109	11,928
Indiana	440	----	13,217	27	656	42	----	----	682	----	10	5,324	99	160	1	57	1,330
Illinois	942	383	1,124	199	8,609	50	37	8	583	----	17	20,817	167	335	----	157	6,410
Michigan	264	505	379	60	20,209	47	----	----	1,216	----	0	10,337	76	135	----	109	11,726
Wisconsin	69	236	3,191	5	20,386	27	2	----	504	----	0	5,311	186	41	1	132	5,717
W. NO. CEN.																	
Minnesota	121	----	143	10	5,219	15	1	2	248	----	0	3,355	389	59	----	129	2,445
Iowa	190	56	643	60	6,018	27	----	2	931	----	19	2,560	412	91	----	250	1,152
Missouri	367	----	439	100	686	33	1	2	313	----	9	2,421	100	320	2	25	1,607
North Dakota	136	7	940	----	189	9	1	----	34	----	0	590	88	37	----	7	657
South Dakota	63	----	70	----	176	6	----	----	81	----	1	678	95	16	----	4	171
Nebraska	69	----	38	----	1,042	15	----	----	182	----	0	732	33	27	----	12	478
Kansas	250	108	5,232	23	11,565	33	----	4	537	----	0	2,906	16	128	2	163	2,621

[1] Also reported were 408 cases including suppurative conjunctivitis.
[2] Exclusive of New York City.

Case reports consolidated for the year 1940—Continued

Division and State	Diphtheria	German measles	Influenza	Malaria	Measles	Meningitis, meningococcus	Ophthalmia neonatorum	Pellagra	Poliomyelitis	Puerperal septicemia	Rocky Mountain spotted fever	Scarlet fever	Smallpox	Typhoid and paratyphoid fever	Typhus fever	Undulant fever	Whooping cough
SO. ATL.																	
Delaware	16	3			121	1	3		2		6	376	0	23		5	659
Maryland	152	77	1,250	14	249	24	5	5	16		52	1,630	0	123	4	27	6,196
Dist. of Col	180		143		102	9		1	8		9	792	0	31		5	472
Virginia	712		22,975	110	4,171	77		84	242		43	1,781	5	278	8	22	2,910
West Virginia	338		7,544	9	694	72		10	662		2	1,889	6	213	1	5	2,233
North Carolina	1,121	125	2,113	653	3,685	34		97	74		19	2,442	6	241	65	11	5,500
South Carolina	1,150	111	28,937	9,435	619		33	1,494	19		0	459	8	276	132	33	1,064
Georgia	496		12,106	2,258	3,210	22		253	28	5	7	985	11	483	574	121	925
Florida	227	98	631	148	2,323	7		97	34		0	262	9	120	114	47	376
E. SO. CEN.																	
Kentucky	380	776	2,548	48	3,425	59		11	224		5	2,818	7	404		24	3,658
Tennessee	322	211	4,780	903	3,095	51	26	123	49	21	10	2,979	49	332	30	39	2,117
Alabama	549	349	11,495	9,442	3,205	83	11	294	54		0	939	51	278	291	70	1,004
Mississippi	366		85,149	40,965	5,604	28	95	4,089	39	353	0	466	18	208	49	30	9,458
W. SO. CEN																	
Arkansas	397	16	20,371	3,511	1,181	12	7	444	29	12	0	456	81	524		21	844
Louisiana	366		16,221	519	289	34	4	54	129		0	469	5	560	118	72	1,302
Oklahoma	481		8,466	1,871	433	33	3	122	138		10	893	157	341	6	112	764
Texas	1,450		57,289	6,606	17,612	73	47	1,367	187		0	1,802	121	1,000	410	414	10,414
MOUNTAIN																	
Montana	117	28	1,565	1	1,310	15	1		108		31	1,044	8	32	1	7	197
Idaho	28	94	1,255	6	1,611	7			66		17	480	6	79		5	478
Wyoming	40	63	1,693	7	704	8			41	2	61	266	7	25		19	251
Colorado	364		1,718	3	1,558	10			39		10	1,502	302	83		50	948
New Mexico	73	38	352	90	1,338	8		23	26	16	1	421	14	157		28	1,585
Arizona	167	90	10,898	35	2,217	16		27	13		0	304	21	66	2	29	1,148
Utah	26	129	20,058	5	10,231	3			59		15	611	15	32		13	5,037
Nevada	5		2,486	1	61	5			3	2	10	72	2	10		2	51

PACIFIC																	
Washington	101	569	9,524	2	17,254	23			444	1	5	1,696	14	92		27	2,576
Oregon	231		8,100	32	9,432	11			63		22	711	55	77		5	1,197
California	890	1,083	55,191	168	12,363	65	37	52	476		3	5,884	104	347	19	278	15,813
Total	16,252	9,682	423,072	77,553	286,791	1,631	1,038	8,688	9,781	427	417	155,707	2,764	9,658	1,879	3,358	183,273
Alaska	18	4	497		1,098	2				1		14	1	9		2	21
Hawaii	77	191	16,550	7	578	7	4		57			4	1	67	70	2	680
Puerto Rico [3]	449		79,694	16,475	701	5	35	27	7	81		1		307			1,069

[3] Reports for January to September, inclusive.

Case reports consolidated for the year 1940—Continued

Division and State	Actinomycosis	Chickenpox	Dysentery, amoebic	Dysentery, bacillary	Dysentery, undefined	Encephalitis, epidemic or lethargic	Encephalitis, equine	Hookworm disease	Mumps	Rabies in animals	Rabies in man	Septic sore throat	Tetanus	Trachoma	Trichinosis	Tularemia	Vincent's infection
NEW ENG.																	
Maine	1	2,401							337	3		25	2		3		43
New Hampshire		377							327			6					
Vermont		1,746		4					824			5					151
Massachusetts	4	12,857	5	326		13			6,257	72		213	17	14	46		
Rhode Island		978	1	1		3			752	31	1	172			1	1	
Connecticut		5,899	1	86		7			2,893			271	8	4	29	1	
MID. ATL.																	
New York		30,355	63	572		109				[2] 130	2	1,364	47		277	2	[2] 447
New Jersey		16,016	29	10		20			12,822	402	3	141	10	4	30	2	
Pennsylvania		35,483	23	20		20			11,899		1			2	14	49	
E. NO. CEN.																	
Ohio		15,443	4	288		17			5,068		4	145	24	45	29	62	
Indiana		2,840		16		7			4,324	259	1	34	5	14		119	
Illinois	11	18,053	67	138		32		1	6,408	241	1	67	42	323	13	273	300
Michigan	4	17,878	15	26		10		1		19		1,166	14	3	15	12	204
Wisconsin		22,305	2			6			10,949			166		1		23	
W. NO. CEN.																	
Minnesota	9	7,423	29	120		11				37		146	9	10	2	14	
Iowa		2,306	5	7	5	38			3,098	30		57				77	
Missouri		1,457	1	19	47	5			721	2	1	77	4	375	1	106	
North Dakota	2	1,234			2	21			1,206			16		14			27
South Dakota		826							268			40		75			
Nebraska		1,061				7			1,236			6					
Kansas	1	4,281	4	12	5	43			1,644	1		195	5	4	1	37	165
SO. ATL.																	
Delaware		628		1		1			64	1		1					
Maryland		4,292	9	107	30	3			602	2		259	8	4	13	22	144
Dist. of Col.		1,073	3			4										2	
Virginia		2,647	12	1,880		5			687			1,500	11	7		47	
West Virginia		1,394		99		3			371		2	77				7	
North Carolina		4,360		9							1	88		8		11	134
South Carolina		1,100	6			8		1,567	503	189	3	40	8			15	
Georgia		1,383	85	331	84			17,383	1,076			893	12	9		102	
Florida		2,008	37	8		7		8,623	279	15		44	10	1		16	53

E. SO. CEN.																	
Kentucky		2,975	10	232		13			3,331		1	555		124		132	54
Tennessee	1	1,801	18	321		7		73	1,010	1	1	337	14	144		76	200
Alabama		1,148	6			23			845	202	1		36	3		8	
Mississippi		4,099	1,784	9,787				7,241	3,873	73				107		7	
W. SO. CEN.																	
Arkansas		780	128	358		2		47	909	189	5	839	12	1,045	2	68	
Louisiana		415	37	17		4		586	92	87		59	41	120		34	
Oklahoma		984	22	603		7		2	409	142		594	7	763		62	118
Texas		5,939	331	2,989		23			2,057	30				83		40	
MOUNTAIN																	
Montana		1,967		34	1	61			897			75	2	75		19	5
Idaho		941	3	1		3			567			42		1		6	11
Wyoming		630		1	11	7			862			33			1	80	12
Colorado		2,437	11	94		53			6,150			127				14	
New Mexico	3	1,038	17	86	66	2			520	104	1	35		23		5	
Arizona		1,009			1,077	9			1,598			1		595		6	
Utah		3,494	5		156	2			1,190	2		90		222		54	
Nevada		356	1			2	1		33			30		1		8	1
PACIFIC																	
Washington	1	5,540	8	35		22	86		2,911	49		39	3	24		1	18
Oregon		2,308	26	3		2			1,542	52		39		7		5	80
California		21,194	183	511		182		12	14,282	396	2	89	61	235	44	16	
Total	37	279,159	2,991	19,152	1,484	824	87	35,536	117,693	2,761	31	10,198	412	4,489	521	1,641	2,167
Alaska		206							2			56					6
Hawaii	1	602	41					154	259			2	25	18	1		
Puerto Rico [3]		305			440				24				[4] 142				2

[3] Exclusive of New York City.
[3] Reports for January to September, inclusive.
[4] 20 cases infantile tetanus included.

Anthrax: Massachusetts, 8; New York, 16; New Jersey, 12; Pennsylvania, 24; Ohio, 1; Delaware, 1; Arkansas, 2; Louisiana, 2; Texas, 1; Montana, 1; Colorado, 1; Arizona, 1; Utah, 1; California, 4.
Beriberi: California, 2.
Botulism: New York, 1; Washington, 4; California, 13.
Colorado tick fever: Idaho, 2; Wyoming, 13; Utah, 2.
Dengue: South Carolina, 32; Florida, 5; Mississippi, 9; Louisiana, 6; Texas, 6.
Diarrhea: Ohio, 1,182 (under 2 years; enteritis included); Michigan, 31;(infant diarrhea); Maryland, 143; South Carolina, 9,529; New Mexico, 197; Nevada, 2 (infant diarrhea).
Enteritis: Kansas, 1; Washington, 139 (61, under 2 years; 78, over 2 years).
Filariasis: Puerto Rico [3], 12.
Food poisoning: Kansas, 5; New Mexico, 4, Washington, 169; California, 848.
Granuloma, coccidioidal: California, 53.
Leprosy: Hawaii Territory, 37; Puerto Rico,[3] 12; Massachusetts, 1; Pennsylvania, 1; Indiana, 1; Illinois, 3; Missouri, 1; Maryland, 1; Florida, 4; Louisiana, 20; Texas, 16; California, 5.
Plague, bubonic: Idaho, 1.
Psittacosis: Connecticut, 1; New York, 1; Pennsylvania, 1; Ohio, 1; Minnesota, 2; California, 2.
Rat bite fever: Missouri, 1; Tennessee, 2.
Relapsing fever: Kansas, 1; Oklahoma, 9; Texas, 11; California, 19.
Weil's disease: Hawaii Territory, 5; Michigan, 17.

WEEKLY REPORTS FROM CITIES

City reports for week ended February 15, 1941

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	146	1,179	142	4,289	935	1,889	32	387	18	1,078	----
Current week [1]	74	1,580	121	8,635	681	1,139	4	347	10	1,144	----
Maine:											
Portland	0	----	----	1	----	0	0	----	0	7	----
New Hampshire:											
Concord	0	----	1	0	3	1	0	0	0	0	17
Manchester	0	----	1	0	1	8	0	0	0	0	11
Nashua	0	----	0	0	0	0	0	0	0	2	2
Vermont:											
Barre	----	----	----	----	----	----	----	----	----	----	----
Burlington	0	----	0	0	0	0	0	0	0	0	10
Rutland	0	----	0	0	1	0	0	0	0	0	12
Massachusetts:											
Boston	1	----	4	184	17	26	0	8	1	107	241
Fall River	0	----	0	0	4	7	0	4	0	10	34
Springfield	0	----	0	0	2	7	0	0	0	2	33
Worcester	0	----	0	72	8	4	0	1	0	0	54
Rhode Island:											
Pawtucket	0	----	0	0	4	0	0	0	0	0	24
Providence	1	1	0	0	3	2	0	2	0	7	73
Connecticut:											
Bridgeport	0	12	0	5	3	2	0	0	0	0	56
Hartford	0	3	1	0	3	2	0	2	0	1	49
New Haven	0	2	1	0	5	18	0	0	0	3	57
New York:											
Buffalo	0	----	4	44	12	9	0	5	0	21	145
New York	15	182	7	2,628	127	192	0	60	2	99	1,747
Rochester	0	----	0	6	9	1	0	0	1	14	87
Syracuse	0	----	0	0	3	0	0	3	0	5	72
New Jersey:											
Camden	2	----	0	70	4	6	0	2	0	4	44
Newark	1	32	6	126	7	29	0	2	0	13	97
Trenton	0	5	1	2	4	67	0	2	0	0	54
Pennsylvania:											
Philadelphia	3	10	9	1,097	53	97	0	27	0	58	556
Pittsburgh	1	12	6	18	13	10	0	7	0	74	190
Reading	1	1	0	213	5	0	0	2	0	6	30
Scranton	0	----	----	1	----	2	0	----	0	0	----
Ohio:											
Cincinnati	3	3	1	75	8	19	0	4	0	2	121
Cleveland	0	157	6	1,113	18	28	0	5	0	58	215
Columbus	1	5	5	24	7	6	0	6	0	23	95
Toledo	0	5	2	3	1	5	0	1	0	7	66
Indiana:											
Anderson	0	----	0	0	2	3	0	1	0	0	10
Fort Wayne	1	----	2	31	4	0	0	0	0	1	35
Indianapolis	2	----	2	11	17	18	0	4	0	10	131
Muncie	0	----	0	0	3	8	0	0	0	0	16
South Bend	0	----	0	4	4	0	0	0	0	0	14
Terre Haute	0	2	1	0	5	0	0	0	0	0	21
Illinois:											
Alton	0	1	1	0	0	1	0	0	0	0	11
Chicago	7	20	3	1,383	50	195	0	47	1	57	829
Elgin	0	----	0	14	1	0	0	0	0	0	10
Moline	0	----	0	2	0	0	0	0	0	0	16
Springfield	0	1	2	0	3	9	0	0	0	0	32
Michigan:											
Detroit	0	39	4	752	22	103	0	12	1	122	306
Flint	0	----	1	40	4	1	0	0	0	15	28
Grand Rapids	0	----	1	37	3	4	0	0	0	14	61
Wisconsin:											
Kenosha	0	----	0	75	2	1	0	0	0	0	15
Madison	0	----	0	0	0	1	0	0	0	0	19
Milwaukee	0	----	0	60	4	25	0	1	0	40	125
Racine	0	----	0	1	0	3	0	0	0	4	15
Superior	0	----	0	0	0	15	0	0	0	0	8

[1] Figures for Barre and Tampa estimated; reports not received.

City reports for week ended February 15, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Minnesota:											
Duluth	0	8	0	1	0	1	0	1	0	6	30
Minneapolis	1	211	1	1	10	14	3	0	0	15	127
St. Paul	0	2	2	4	7	3	0	2	0	10	68
Iowa:											
Cedar Rapids	0	---	---	0	---	3	0	---	0	0	---
Davenport	0	---	---	0	---	1	0	---	0	0	---
Des Moines	0	---	---	0	---	7	0	---	0	2	30
Sioux City	1	---	---	0	---	0	0	---	0	4	---
Waterloo	1	---	---	2	---	1	0	---	0	2	---
Missouri:											
Kansas City	0	6	3	3	6	7	1	5	0	9	115
St. Joseph	0	---	1	0	3	1	0	1	0	0	24
St. Louis	5	41	3	10	24	57	0	10	0	18	216
North Dakota:											
Fargo	0	---	0	0	2	0	0	0	0	7	12
Grand Forks	0	---	---	0	---	0	0	---	0	1	---
Minot	1	---	---	0	---	0	0	---	0	2	6
South Dakota:											
Aberdeen	0	---	---	0	---	1	0	---	0	2	---
Sioux Falls	0	---	---	0	---	4	0	---	0	0	9
Nebraska:											
Lincoln	1	---	---	1	---	4	0	---	0	1	---
Omaha	0	---	0	0	8	5	0	0	0	1	71
Kansas:											
Lawrence	0	3	0	2	0	0	0	0	1	0	4
Topeka	0	1	1	36	2	4	0	0	0	2	13
Wichita	0	2	0	1	4	5	0	0	0	30	38
Delaware:											
Wilmington	0	---	0	49	5	5	0	2	0	3	37
Maryland:											
Baltimore	0	24	2	13	20	23	0	9	0	77	255
Cumberland	0	5	0	0	1	0	0	0	0	0	9
Frederick	0	---	0	0	0	0	0	0	0	0	2
Dist. of Col.:											
Washington	0	37	0	31	21	7	0	12	0	10	195
Virginia:											
Lynchburg	0	---	0	0	2	0	0	0	0	2	9
Norfolk	1	91	0	17	3	1	0	0	0	0	36
Richmond	1	---	4	11	4	3	0	2	0	1	56
Roanoke	0	---	0	225	1	2	0	0	0	9	19
West Virginia:											
Charleston	0	2	0	10	8	0	0	0	0	0	28
Wheeling	0	---	0	0	1	0	0	0	0	4	22
North Carolina:											
Gastonia	0	3	---	3	---	0	0	---	0	13	---
Raleigh	0	---	1	37	3	0	0	0	0	12	17
Wilmington	1	---	0	3	1	0	0	0	0	0	13
Winston-Salem	0	3	0	0	3	1	0	1	0	6	17
South Carolina:											
Charleston	0	110	2	11	5	2	0	2	0	2	32
Florence	0	76	0	28	3	0	0	1	0	1	18
Greenville	0	---	1	13	1	0	0	0	0	8	6
Georgia:											
Atlanta	0	15	4	12	7	3	0	8	1	0	99
Brunswick	0	---	0	0	2	0	0	0	0	0	5
Savannah	0	52	3	1	1	0	0	1	0	0	28
Florida:											
Miami	0	24	0	4	1	2	0	0	0	0	37
Tampa	---	---	---	---	---	---	---	---	---	---	---
Kentucky:											
Ashland	0	---	0	0	3	0	0	1	0	0	9
Covington	0	17	0	2	3	0	0	2	0	1	17
Lexington	0	---	0	15	3	0	0	2	0	4	21
Tennessee:											
Knoxville	0	---	1	6	2	16	0	2	1	2	22
Memphis	0	10	3	20	7	6	0	5	1	2	92
Nashville	0	---	2	6	5	5	0	2	0	7	53
Alabama:											
Birmingham	0	117	3	40	8	1	0	2	0	7	78
Mobile	0	2	1	0	1	0	0	1	0	0	27
Montgomery	0	3	---	3	---	2	0	---	0	12	---

City reports for week ended February 15, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Arkansas:											
Fort Smith	0	------	--------	0	-------	0	0	-------	0	0	--------
Little Rock	0	69	1	0	8	1	0	1	0	1	43
Louisiana:											
Lake Charles	0	------	0	0	1	0	0	0	0	0	6
New Orleans	3	7	2	6	16	4	0	15	1	2	167
Shreveport	0	------	0	0	0	0	0	1	0	3	43
Oklahoma:											
Oklahoma City	0	16	1	0	4	3	0	1	0	0	58
Tulsa	4	------	1	0	2	5	0	2	0	12	31
Texas:											
Dallas	0	1	1	4	2	4	0	3	0	1	88
Fort Worth	0	------	2	149	2	2	0	1	0	1	35
Galveston	1	------	0	0	1	0	0	1	0	0	11
Houston	2	3	2	0	8	1	0	5	0	0	85
San Antonio	1	3	5	1	10	0	0	8	0	1	77
Montana:											
Billings	0	------	0	0	1	2	0	0	0	0	12
Great Falls	0	------	0	0	1	1	0	0	0	0	4
Helena	0	------	0	0	0	0	0	0	0	1	9
Missoula	0	------	0	0	0	0	0	0	0	0	8
Idaho:											
Boise	0	------	0	1	0	0	0	0	0	0	5
Colorado:											
Colorado Springs	0	------	0	4	1	1	0	1	0	1	9
Denver	9	25	0	7	3	7	0	3	0	21	66
Pueblo	0	------	0	1	0	2	0	0	0	13	5
New Mexico:											
Albuquerque	0	------	0	7	2	2	0	1	0	0	12
Utah:											
Salt Lake City	1	------	0	3	2	2	0	2	0	14	30
Washington:											
Seattle	2	2	1	3	4	4	0	5	0	5	105
Spokane	0	------	0	6	3	1	0	0	0	0	29
Tacoma	0	------	0	0	2	0	0	0	0	2	38
Oregon:											
Portland	0	4	0	15	5	4	0	1	0	4	77
Salem	0	------	--------	0	-------	0	0	-------	0	0	--------
California:											
Los Angeles	2	64	2	4	5	27	0	20	1	16	337
Sacramento	3	------	1	0	3	8	0	0	0	4	30
San Francisco	2	270	0	2	3	13	0	9	0	43	165

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Vermont:				South Carolina:			
Burlington	1	1	0	Charleston	2	0	0
New York:				Georgia:			
Buffalo	1	1	0	Savannah	0	0	1
New York	2	0	2	Tennessee:			
Pennsylvania:				Knoxville	3	0	0
Pittsburgh	1	0	0	Memphis	1	0	0
Indiana:				Alabama:			
Indianapolis	1	0	0	Mobile	1	1	0
Muncie	1	0	0	Louisiana:			
Illinois:				Shreveport	0	2	0
Chicago	0	0	1	Texas:			
Minnesota:				Dallas	1	0	0
St. Paul	0	0	1	California:			
Missouri:				Los Angeles	0	0	2
St. Louis	1	0	0				
Maryland:							
Baltimore	2	0	1				

Encephalitis, epidemic or lethargic.—Cases: Denver, 1.
Pellagra.—Cases: Philadelphia, 1; Winston-Salem, 2; Atlanta, 2; Dallas, 1; San Francisco, 1.
Typhus fever.—Cases: Savannah, 1; New Orleans, 2; Houston, 1.

TERRITORIES AND POSSESSIONS

HAWAII TERRITORY

Plague (rodent).—A rat found on January 23, 1941, near Paauhau landing, in Paauhau area, Hamakua District, Island of Hawaii, has been proved positive for plague.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended January 25, 1941.—During the week ended January 25, 1941, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis	1	9	1	7	13	2	3	3	8	47
Chickenpox		15	16	209	343	32	28	38	107	788
Diphtheria		24		8	2	1	4	1		40
Dysentery				2						2
Influenza		118			157	52	3		228	558
Measles		477	57	93	709	233	484	447	527	3,027
Mumps				79	157	18	1	24	17	296
Pneumonia		5			19	5	2		20	51
Scarlet fever		24	8	115	192	10	10	21	12	392
Tuberculosis		4	8	106	43	6				167
Typhoid and paratyphoid fever				34				2	2	38
Whooping cough				379	210	18	7	19	5	638

CUBA

Habana—Communicable diseases—4 weeks ended February 8, 1941.—During the 4 weeks ended February 8, 1941, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	25	2	Tuberculosis		1
Malaria	1		Typhoid fever	38	1
Scarlet fever	2				

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

NOTE.—A cumulative table giving current information regarding the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS of February 28, 1941, pages 416-420. A similar table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Plague

Morocco.—During the week ended February 8, 1941, 88 cases of plague were reported among the tribes of the Agadir Territory and the Marrakesh region, Morocco.

Yellow Fever

Ivory Coast—Sproa Plantation.—On February 21, 1941, 1 death from suspected yellow fever and on February 22 a case of yellow fever were reported at Sproa Plantation, east of Bingerville, Ivory Coast.

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