Public Health Reports

Vol. 55 • DECEMBER 6, 1940 • *No. 49*

STUDIES ON FOODSTUFFS FUMIGATED WITH METHYL BROMIDE [1]

By H. C. DUDLEY, *Associate Chemist*, J. W. MILLER, *Pathologist*, P. A. NEAL, *Passed Assistant Surgeon*, and R. R. SAYERS, *Senior Surgeon, United States Public Health Service*

The use of methyl bromide as a fumigant for the control of insect pests has increased markedly within the past 3 years. Control of the spread of the Japanese beetle has occasioned initiation of the use of methyl bromide in fumigation of railroad cars containing fresh vegetables going out of the Japanese beetle quarantine area. During the fumigation seasons of 1938 and 1939, several thousand carloads of fresh vegetables were treated by methods developed and approved by the United States Department of Agriculture (*1*). This type of fumigation applied to dried fruits has increased to such an extent that large quantities of such produce originating in the western fruit-growing States have been so treated.

The effectiveness of methyl bromide at moderate concentrations in causing death of many insects in nearly all stages of development, and the ease of handling and operation, makes the increased use of this fumigant probable (*2*). The annual production of methyl bromide in the United States during the past 5 years has increased more than sevenfold, owing primarily to the rapid increase in fumigation procedures developed and placed in commercial use during this time.

Two public health problems are encountered in the use of this fumigant: First, the dangers arising from the exposure of fumigators and others to the fumigant; and second, the effect on the consumer of the residue on fumigated foods. In order to study certain phases of these problems the United States Public Health Service has been carrying on studies with methyl bromide for the past 2 years, in cooperation with Dr. Lon A. Hawkins, Chief of the Division of Control Investigations, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.

This study deals primarily with possible injury to consumers of foodstuffs fumigated with methyl bromide; as an addendum to this

[1] From the Division of Industrial Hygiene, National Institute of Health.

paper, there is given a discussion of the precautions which should be considered when using methyl bromide as a fumigant, together with recommendations which have been found effective for its safe use.

The problem of the consumer hazard of methyl bromide has been approached from two angles: First, investigation of foodstuffs, with determination of the rate of release of methyl bromide and the amount of residual bromide following fumigation; and second, the physiological and pathological changes induced by consumption of methyl bromide-treated foodstuffs as shown in experimental animals.

Methyl bromide is a colorless organic liquid, having the formula CH_3Br, with a boiling point of 4.6° C., so that at ordinary room temperature it is a gas. The specific gravity of the gas is 3.27 (air=1). The inflammable limits are within a very narrow range, 13.5–14.5 percent by volume. In the fumigation procedures described later in this paper, and in commercial practice, the concentration of methyl bromide is 1 percent, or less, by volume so that the fire or explosion hazards are negligible. The use of methyl bromide as a fire extinguisher fluid, especially in portable or automobile fire extinguishers, is rather widespread in Europe. Recently methyl bromide fire extinguishers have been placed on the market in the United States.

The methyl bromide now supplied in commercial quantities is of high purity, being more than 99 percent methyl bromide. Methyl bromide has a slight aromatic odor in high concentrations. At low concentrations, which may still be toxic, the gas has no odor.

ANALYSIS OF FOODSTUFFS FOR BROMIDE RESIDUES

In order to study the absorption and adsorption of methyl bromide by foodstuffs, a method of analysis for total bromide in food products has been developed. Results of analyses by this method are shown in tables 1 and 2. This analytical procedure involves the hydrolysis of the CH_3Br by means of alcoholic potassium hydroxide, drying, and ashing at 500° C. The carbonized material was extracted with water, and the residue again ashed at 500° C. The ash was extracted again, at which time the combined water extracts were taken to dryness. The dried extracts were taken up with H_2SO_4, treated with chromic acid solution, and the resultant bromide aerated into KI solution. The liberated iodine was titrated with standard thiosulfate. The details of this method of analysis, together with the results of standard samples, have been given by Dudley in an earlier publication (*3*).

Results.—Table 1 shows the bromide content of various foodstuffs before fumigation, immediately after fumigation, and 24 and 48 hours later. All data are for materials fumigated under laboratory conditions. Examination of table 1 indicates that, in general, fresh vegetables and fruits, dried fruits, and whole grains retain but minor amounts of the fumigant. Milled grains and fatty or oily foods (i. e., nuts, nutmeats, cheese) absorb a greater amount of the methyl bromide and generally retain considerable quantities of bromides even after aeration for 48 hours.

TABLE 1.—*Bromide content of fruits and vegetables after laboratory fumigation with CH_3Br* [1]

Sample	Mg. Br/100 gm. sample				Dosage CH_3Br at atmospheric pressure 20–25° C.
	Before fumigation (control)	Immediately after fumigation	24 hours after fumigation	48 hours after fumigation	
White potatoes:					
Peel	2.58	4.22	3.66	3.02	2 pounds CH_3Br/1,000 cubic feet for 2 hours.
Pulp	0.79	1.28	1.29	1.00	
Sweet potatoes:					
Peel	1.66	3.16	3.20	3.16	Do.
Pulp	.55	.99	.98	.90	
Green beans	.54	7.22	4.20	4.08	Do.
Tomatoes	Trace	1.26	1.11	.91	Do.
Eggplant	.10	2.39	2.11	1.72	Do.
Onions	Trace	.80	.62	.61	Do.
Carrots	do	2.59	1.23	1.20	Do.
Beets	.83	3.65	3.83	3.16	Do.
Turnips	None	2.43	2.09	1.58	Do.
Apples (fresh)	do	.30	.31	.27	Do.
Pears (fresh)	do	.28	Trace	None	Do.
Corn (whole grain)	do	.70	do	Trace	2 pounds CH_3Br/1,000 cubic feet for 24 hours.
Corn meal (white)	do	5.82	3.26	2.90	Do.
Wheat (whole grain)	do	0.95	Trace	Trace	Do.
Flour (white)	do	11.10	4.54	4.26	Do.
Flour (whole wheat)	do	7.44	6.35	5.18	Do.
Oats (whole grain)	Trace	4.00	2.96	2.60	Do.
Rolled oats	do	17.24	14.68	13.02	Do.
Barley (whole grain)	do	.52	Trace	Trace	Do.
Rice (brown) (whole grain)	None	1.58	1.38	1.22	Do.
Raisins (seedless)	do	.36	.28	.26	Do.
Peaches (dried)	1.44	2.31	1.86	1.60	Do.
Apricots (dried)	.90	1.89		1.18	Do.
Prunes (processed)	None	.27	Trace	Trace	Do.
Pecans (whole nut)	do	7.00	7.00	6.90	Do.
Peanuts (whole nut unroasted)	do	5.04	5.00	5.00	Do.
Pecan nut meats	do	21.50	13.14	12.66	Do.
English walnut meats	do	11.50	8.70	7.44	Do.
Cashew nut meats (unroasted)	do	22.92	15.20	14.88	Do.
Peanuts (shelled unroasted)	do	7.88	5.46	4.74	Do.
Cheese (yellow American)	.85	8.01	8.10	7.65	Do.

[1] Values are not corrected for moisture content of sample. Results are average of 3 or more determinations on samples from same lot of material.

In this connection, it was found that the surface area exposed to the gas is an important factor in determining methyl bromide adsorption. Adsorption is greater during fumigation in the more finely divided foods. It was also found that wheat flour, when fumigated in a cloth bag or paper package, adsorbed less fumigant than unpackaged flour.

Table 2 presents analytical results on samples of foodstuffs fumigated under commercial conditions.

TABLE 2.—*Bromide content of some foodstuffs following fumigation with CH_3Br under commercial conditions* [1]

Sample	Mg. Br/100 gm.		Dosage CH_3Br	Remarks
	Before fumigation	After fumigation		
Raisins, seedless	0.56	0.86	3 pounds CH_3Br/3,100 cubic feet—15½ hours.	Shipped to laboratory in sealed cans. Time of sampling after fumigation not given.
Prunes, dried	0.39	0.48	4 pounds CH_3Br/1,988 cubic feet for 15 hours.[2]	Do.
Peaches, dried	0.40	1.97	do. [2]	Do.
Flour, white:				
Mill No. 1:				
First floor	0.35	5.03	1 pound CH_3Br/1,000 cubic feet for 24 hours.	Samples taken 48 hours after completion of fumigation. Shipped to laboratory in sealed cans.
Second floor	0.56	7.76	do	
Mill No. 2: First floor		7.70	1 pound CH_3Br/1,000 cubic feet for 19½ hours.	Do.
Cheese (yellow)		3.42	Commercial sample.	History unknown.

[1] Values are not corrected for moisture content of sample. Results are average of 3 or more determinations on samples from same lot of material.
[2] Box-car fumigation.

Table 3 shows the calculated methyl bromide content of foodstuffs 24 hours after completion of methyl bromide fumigation of our samples.

These values are based on the difference between the bromide content of the unfumigated samples and that of the samples taken 24 hours after completion of fumigation. They are calculated on the assumption that all excess bromide is present as methyl bromide. Table 3 also gives for comparison the calculated methyl bromide contents of foodstuffs analyzed and reported by Mackie (*2*), McLaine and Munro (*4*), and Stenger et al. (*5*, *6*). Although these authors do not give the time interval between the end of fumigation and the sampling, a fair agreement between their results and those presented here may be noted. The finding of Stenger, Shrader, and Beshgetoor (*6*) that milled grains and foodstuffs containing relatively high percentages of fat absorbed methyl bromide to a marked degree was confirmed.

Neufeld (*7*) and Damiens and Blaignan (*8*) have made an extensive study of the normal bromide content of fruits, vegetables, and animal matter. Table 4 presents selected values from Neufeld's and Damiens' results. These figures indicate that the bromide content of vegetable products is low in comparison with the values given herein for fumigated products.

TABLE 3.—*Calculated* CH_3Br *content of fumigated foodstuffs compared with results obtained by other investigators*

Sample	CH_3Br content of foodstuffs 24 hours following fumigation (present study) CH_3Br p. p. m.[1]	Mackie (2), McLaine and Munro (4) CH_3Br p. p. m.[2]	Stenger et al. (5, 6) CH_3Br p. p. m.[2]
White potatoes (whole)		14	28
Peel	13		
Pulp	6		
Sweet potatoes:			
Peel	18		
Pulp	5		
Green beans	44		
Tomatoes	13	6	
Eggplant	24		
Onions	7	2	
Beets	36		
Carrots	15		
Cabbage		17	
Turnips	25		
Peas		15	
Cauliflower		16	
Apples (fresh)	4	1	
Pears (fresh)	Trace		
Prunes, dried	Trace		3
Figs, dried			7
Peaches, dried	5		23
Apricots, dried	8		
Raisins	3		4
Wheat, whole grain	Trace		
Corn, whole grain	Trace		
Oats, whole grain	36		
Rice, whole grain	17		8
Flour:			
White	55		
Whole wheat	76		109
Corn meal	39		
Oats, rolled	176		
Farina			54
Hominy			18
Peanuts	66		
Cashew nut meats	182		97
Pecan nut meats	158		234
Cheese (yellow American)	87		90

[1] Parts CH_3Br per million (mg. CH_3Br/kilo of sample) are computed as follows from values shown in table 1.

$$12\times\left[\left(\begin{matrix}\text{Br content 24 hrs. after fumigation}\\ \text{(mg./100 gm.)}\end{matrix}\right)-\left(\begin{matrix}\text{Br content before}\\ \text{fumigation (mg./100 gm.)}\end{matrix}\right)\right]=CH_3Br\text{, p. p. m.}$$

[2] The results of analyses reported by Mackie (2), McLaine and Munro (4), and by Stenger et al. (5, 6) are expressed either in percent bromine or p. p. m. Br. Since their publications do not show the time of sampling after fumigation, we have computed the apparent CH_3Br content of their samples, as well as the CH_3Br content of our samples, which were analyzed 24 hours after completion of fumigation. (See table 1 for original values.)

No published work is available on the chemical nature of the bromide residues remaining on the fumigated products. Methyl bromide may be hydrolyzed to methanol and hydrogen bromide, and it is probable that during the fumigation of many foodstuffs this reaction occurs. The formation of complex organic bromides by the action of methyl bromide or of hydrogen bromide is also a probability.

The excess bromide, as determined in the procedure outlined above, is expressed in terms of methyl bromide in table 3 in order to give a basis of comparison for the amount of bromide retained by the fumigated animal feeds.

TABLE 4.—*Bromide content of some common foodstuffs*

Material	Mg. Br/100 gm. of sample (dry weight)		Material	Mg. Br/100 gm. of sample (dry weight)	
	From Neufeld [1]	From Damiens and Blaignan [2]		From Neufeld [1]	From Damiens and Blaignan [2]
Rye	0.5	0.19	Lettuce	1.9	
Corn	0.6	0.15–0.19	Cucumber	4.0	
Wheat	0.1–1.10	0.21	Onions, garlic, etc.		0.10–0.52
Rhubarb	0.9	0.75	Beets	None	0.37–0.55
Turnip	2.40	0.31–0.89	Apple	0.3	Trace
Cabbage	0.2–2.50	0.45	Pear	0.6	
Carrots	T–3.60	0.39	Peach	None	T–0.47
Potatoes	None	0.27–1.43	Grapes	T–1.10	0.195
Tomatoes	0.3–1.4	0.95–5.34			

[1] Neufeld (7) used essentially the same analytical procedure as that used in this study, except a microchemical modification. Results are expressed in the original paper as percent Br.

[2] Damiens and Blaignan (8) express their results as mg. Br/100 gm. sample (dry weight). The analytical method was based on colorimetric procedures.

Note that the values given in this table are for dry weight of samples, whereas the values shown in tables 1 and 2 are for samples in the usual state.

It is not substantiated by certain of our findings that cooking markedly reduces the quantity of bromide residue. In the case of fumigated flour, we mixed 100-gram portions with water into a stiff dough and baked at 175° to 200° C. for 1 hour. The resulting loss of bromide during this procedure approximated 10 percent of the total amount present. Cooking of dried fruits and of certain fresh vegetables produced little change in the total bromides if the water and juices remained in the sample.

For ease in comparing the results on various samples of foodstuffs, the excess bromide content of the samples following fumigation may be expressed as parts of methyl bromide per million (mg. CH_3Br/kilo of sample), although this volatile compound is probably present only in small amounts 48 hours after fumigation. These values (p. p. m.) may be calculated as follows:

$$12\times\left[\frac{\text{(Final bromide content)}}{\text{mg. per 100 gm.}}-\frac{\text{(Original bromide content)}}{\text{mg. per 100 gm.}}\right]=\text{Parts } CH_3Br \text{ per million}$$

Figure 1 shows the drum type fumigator used in the experimental fumigation work in this laboratory. This fumigator was constructed from a 55 gallon alcohol drum with a special galvanized sheet steel cover. A fumigator drum of this type was developed by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, for use in certain of their experimental work. Its design suited the purpose of our work so a similar drum was used in these experiments.

The method of fumigation was to place in the drum those materials which were to be fumigated, start the électric fan, and pour into the top vent the required quantity of cooled liquid methyl bromide. The

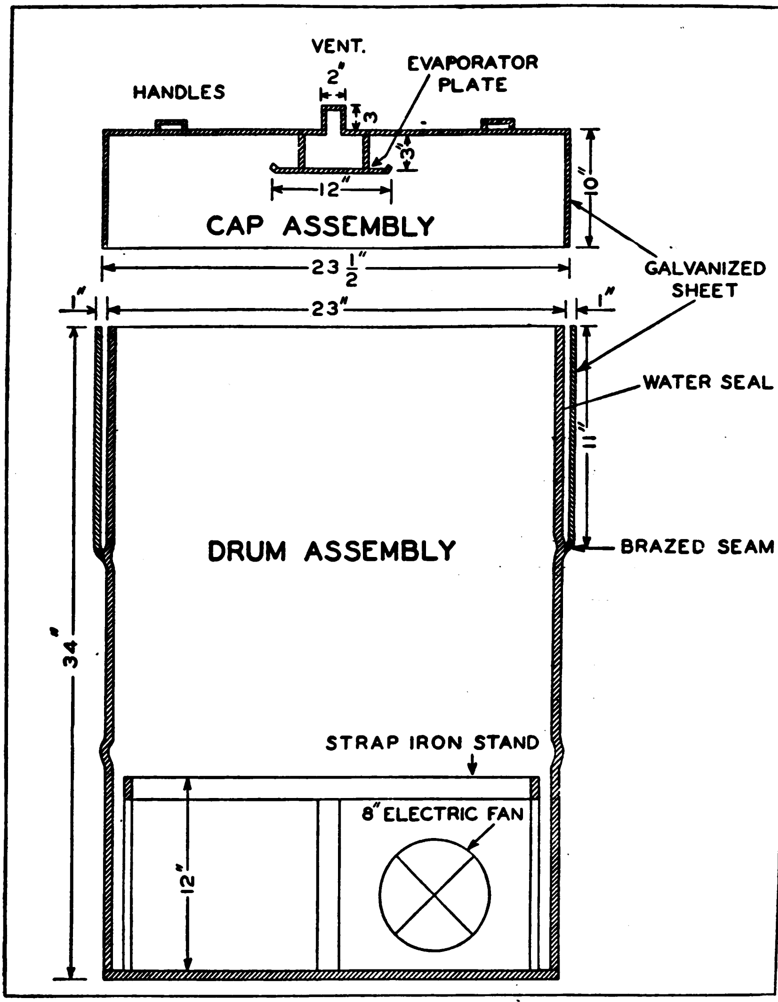


FIGURE 1.—Fumigator drum used for experimental fumigation of foodstuffs.

vent was closed with a rubber stopper. The methyl bromide cylinder was cooled in a refrigerator to about 5° to 6° C. A cooled graduate was then used to measure the amount of liquid methyl bromide necessary to establish the desired concentration. By working with a cold cylinder and graduate, accurate measurements could be made conveniently.

FEEDING EXPERIMENTS

Feeding experiments utilizing diets containing moderate and excessive amounts of methyl bromide were carried out with young white rats and rabbits.

The rat feeding experiments were made in three groups: The first was a preliminary 8-week feeding test; the second continued 16 weeks; and the third group of rats was fed various fumigated diets for 20 weeks. The rabbit feeding experiments were carried on for 52 weeks. Studies were also made on the acute effects on rabbits of single doses of methyl bromide fed in olive oil solution.

The rat and rabbit feeding experiments are later described under appropriate headings. Results of the 20-week rat and 52-week rabbit feedings are given in detail together with weight curves and other pertinent data.

TABLE 5.—*Bromide content of materials fumigated and fed to experimental animals*

Foodstuffs	Mg. Br/100 gm.[1] Before fumigation (control)	Immediately after fumigation	24 hours after fumigation	48 hours after fumigation	Dosage CH_3Br atmospheric pressure 20-25° C.
	Rat feedings—20 weeks				
Rat pellets[2]	5.20	620.0	529.0		Undiluted CH_3Br gas for 24 hours.
Do.[2]	5.20	28.9	26.3	24.7	3 pounds CH_3Br/1,000 cubic feet for 24 hours.
Cheese	0.73	24.0	18.2		Do.
Peanuts	Trace	7.09	7.00		Do.
Whole sweetpotatoes	Trace	5.80	5.61		Do.
Whole white potatoes	1.11	4.04	4.08		Do.
Green beans	0.68	6.02	5.62		Do.
Dried peaches	0.68	1.55	1.33		Do.
	Rabbit feedings—52 weeks				
Rabbit pellets-oats mixture[3]	1.00	311.0	256.0		Undiluted CH_3Br gas for 24 hours.
Alfalfa hay	Trace	362.3	360.8		Do.
Rabbit pellets-oats mixture[3]	1.00	9.36	9.12	7.84	3 pounds CH_3Br/1,000 cubic feet for 24 hours.
Alfalfa hay	Trace	7.15	6.75	5.55	Do.

[1] Results shown are average of 3 or more determinations by method of Dudley (3). No correction for moisture content.
[2] A commercial, mixed, balanced dog and rat food. In pellets about ½"×½"×1". Fat content rather high.
[3] A mixture consisting of one-half oats and one-half rabbit pellets. Rabbit pellets were a commercial, prepared rabbit food.

NOTE: To calculate the apparent CH_3Br content of the animal foods, the following formula may be used:

$$12\times\left[\begin{pmatrix}\text{Final Br content}\\ \text{per 100 gm.}\end{pmatrix}-\begin{pmatrix}\text{Original Br content}\\ \text{per 100 gm.}\end{pmatrix}\right]=\text{Parts } CH_3Br \text{ per million or mg. } CH_3Br \text{ per kilo.}$$

The CH_3Br content of the animal foods has been calculated by this method and appears in the tables describing the animal tests as CH_3Br, p. p. m.

In table 5 are shown the results of analyses of the several food mixtures and dietary components of the rat- and rabbit-feeding experiments. A footnote to table 5 gives the method of calculating the amount of methyl bromide retained by the various foodstuffs. These calculated values appear in the tables describing the animal feeding as the amount of methyl bromide (p. p. m. or mg. CH_3Br per kilo of food) retained by the food and consumed by the test animals.

The majority of animal diets were treated with 3 pounds of methyl bromide per 1,000 cubic feet in the drum fumigator (fig. 1). The diets which were fumigated in the drum fumigator were treated as were the foods used for analysis (table 1), except that the diets were all fumigated at a concentration of 3 pounds of CH_3Br/1,000 cubic feet for 24 hours. The diets to be fumigated in an atmosphere of methyl bromide gas were placed in a vacuum desiccator, which was evacuated to a pressure of about 10 mm. Hg; the gaseous methyl bromide was then led into the desiccator, so as to bring the pressure to atmospheric, and the food was allowed to remain in this atmosphere of methyl bromide for 24 hours.

The greater absorption of methyl bromide by the rat pellets, when compared with rabbit pellets fumigated under the same conditions, is due to the much greater fat content of the rat food.

RAT FEEDING EXPERIMENTS

A. A preliminary series of tests was made to determine the approximate upper level at which methyl bromide produced toxic effects. These consisted of feeding rats a commercial rat food fumigated for 24 hours in an atmosphere of methyl bromide gas. The animals were fed immediately after fumigation. (Concentration of methyl bromide on the food averaged 6,830 p. p. m.) Deleterious effects were observed in a feeding period of 8 weeks. These animals developed diarrhea during the first 3 weeks, after which the condition subsided. Weight gains of these animals were slight, their general condition was poor, and reproduction ceased.

B. Sixteen-week feeding experiments: Following the preliminary 8-week feeding experiments a series of rats was fed for 16 weeks on various diets fumigated with methyl bromide. There occurred an epizootic of pneumonia throughout this colony during these feeding tests, unrelated to the methyl bromide exposure, so that results failed to bring out clearly the effects of methyl bromide treated foods on this group of rats. However, it was learned that concentrations of methyl bromide in the range of 1,550 p. p. m. caused sleepiness, reduced activity, increased death rates, decreased weight gains, and caused cessation of reproduction. The more important findings resulted when rats that had been fed on this 1,550 p. p. m. diet were placed on a normal diet. Within 4 weeks the weight of the survivors had increased markedly, general condition was excellent, and reproduction was normal. The females were able to raise their litters.

These results indicated that the effects of this diet were largely transitory. In later work (20-week rat feeding tests), additional study was made of the effects of such feeding on reproduction.

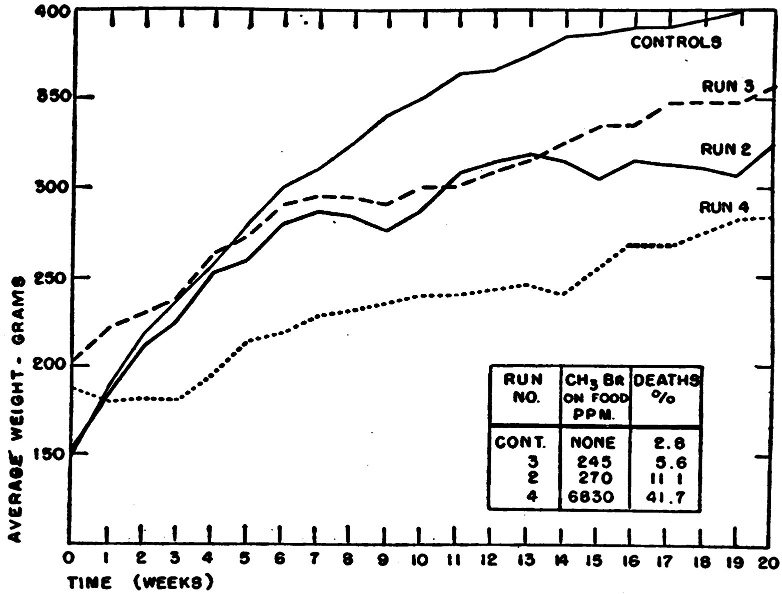
C. Twenty-week feeding experiments: To study further the effects of various foods fumigated with methyl bromide, four series of tests were run over a period of 20 weeks with young white rats. The details and results of these tests are given in table 6. Figures 2 and 3 show the average weight curves of the animals.

TABLE 6.—*Rat feeding tests, 20 weeks*

Number	Number of rats on test	CH_3Br content of food (p. p. m.) [1]	Treatment of food and feeding program [2]	Results
1 (control)	36	None (unfumigated)	Rat pellets (*ad lib.*), unfumigated.	Excellent weight gains (1 death). General condition good.[4]
		(*Time fed after fumigation*)		
2	36	Rat pellets At once, 284. In 24 hours, 253. Average, 270.	Rat pellets (*ad lib.*), fumigated for 24 hours at 3 pounds CH_3Br/1,000 cubic feet. Fed immediately after fumigation.	Good weight gains (4 deaths). General condition good. Reproduction normal. Average weight gains, 10 percent below controls. No significant pathology.[4]
3	36	Rat pellets In 24 hours, 253. In 48 hours, 234. Average, 245.	Same diet as for run 2 except food aerated for 24 hours before feeding.	Good weight gains (2 deaths). General condition good. Reproduction normal. Average weight gains, 11 percent below controls. No significant pathology.[4]
4	36	Rat pellets At once, 7,375. In 24 hours, 6,285. Average, 6,830.	Rat pellets (*ad lib.*), fumigated for 24 hours with undiluted CH_3Br gas. Fed immediately after fumigation.	Condition poor (15 deaths). Weight gains slight, 30 percent below controls. No reproduction. Activity reduced. Little significant histopathology.[4]
5 (control)	36	None (unfumigated)	½ diet rat pellets, remainder made up of 3 of following articles: sweet potatoes, potatoes, green beans, dried peaches, cheese, peanuts. Pellets and others all unfumigated.	Condition excellent (4 deaths). Weight gains good.[5] Reproduction normal.
		At once / *In 24 hours*		
6	36	Rat pellets: 284 / 253 Potatoes: 35 / 35 Sweet potatoes: 70 / 67 Green beans: 64 / 59 Dried peaches: 10 / 8 Cheese: 279 / 210 Peanuts[3]: 85 / 84	Same diet as for run 5 except pellets and all other foods fumigated for 24 hours with 3 pounds CH_3Br/1,000 cubic feet and fed immediately after fumigation.	Condition excellent (3 deaths). Weight gains good.[5] Reproduction normal. Weight gains equal to controls in run 5. No significant pathology.

[1] CH_3Br content based on values shown in table 5. See footnote to table 5 for method of calculation.
[2] As rats ate varying quantities of food no estimate can be given of total daily CH_3Br intake.
[3] As foodstuffs other than rat pellets were varied from week to week, no estimate can be given of CH_3Br level. At all times either cheese or peanuts were given. This diet simulates a normal human diet, in which are included those materials which absorb the greatest amounts of CH_3Br.
[4] See figure 2 for weight curves.
[5] See figure 3 for weight curves.

Examination of the results of these tests shows that the 36 rats receiving a diet containing an average methyl bromide content of 6,830 p. p. m. were adversely affected. All developed partial paralysis of the hind quarters for the first 3 or 4 weeks of the test, and during this time 12 of the animals died. Most of those that survived this



RUN NO.	CH_3Br ON FOOD PPM.	DEATHS %
CONT.	NONE	2.8
3	245	5.6
2	270	11.1
4	6830	41.7

FIGURE 2.—Weight curves of rats fed on fumigated pellets. (See table 6 for details of feeding and results.)

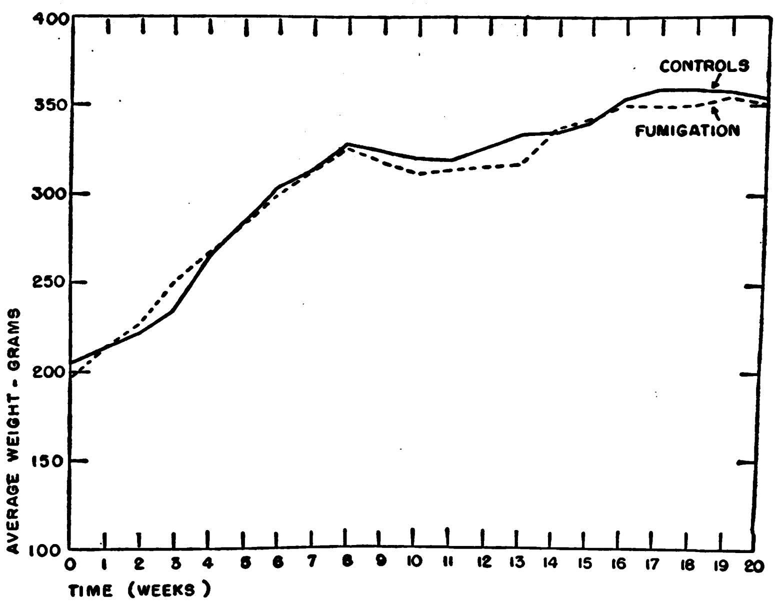


FIGURE 3.—Weight curves of rats fed on mixed diet containing fruits, vegetables, cheese, and peanuts (See table 6, runs 5 and 6, for details of feeding and results.)

period began to gain weight slowly but were in generally poor condition. The partial paralysis cleared completely after the fifth week of feeding. During the tenth through the fifteenth week of the test, the animals developed scaly tails, eye lesions similar to xerophthalmia, and loss of hair. These conditions improved somewhat so that at the end of the twentieth week the 21 survivors were in fair condition, with hair and eyes normal, but with scaly tails. During the entire test the animals showed marked inactivity, reduced food intake, and loss of reproduction.

At the end of the 20-week feeding period, 12 of the survivors were killed for pathological study, while 9 were placed on the same but unfumigated diet, whereupon they showed moderate weight gains, and a slowly improved condition. Females gave birth to litters 12 weeks after being placed on the normal diet, but the young were not raised. In general the rats showed residual symptoms (no deaths) after 20 weeks on the normal diet, indicating that the effects of the diet containing 6,830 p. p. m. of methyl bromide were more or less permanent in character. This finding is significant in the light of the results obtained with rats which had been fed for 16 weeks on a diet containing 1,550 p. p. m. of methyl bromide; they were able to regain their normal condition and successfully raise their litters after but 4 weeks on an unfumigated diet.

No deleterious effects were noted in two series of rats receiving for 20 weeks rat pellets fumigated at a concentration of 3 pounds of CH_3Br per 1,000 cubic feet for 24 hours. Concentration in the feed ranged between 245 and 270 parts of CH_3Br per million. There was a slight reduction in average weight gains. (See table 6 and figure 2.)

Rats fed for 20 weeks on a mixed diet containing fresh vegetables, peanuts, cheese, dried fruits, and rat pellets fumigated with 3 pounds of CH_3Br per 1,000 cubic feet were entirely normal in every respect. In weight gains, reproduction, and general condition they equalled the control rats fed on the same unfumigated diet. (See table 6 and figure 3.)

Detailed research on the mechanism of the various manifestations noted in the rats, particularly with regard to nutritional effects of vitamin supplements, is desirable. However, owing to the urgent demand for information covering the potential toxicity of foodstuffs fumigated with methyl bromide, time did not permit us to go into this phase of the study.

RABBIT EXPERIMENTS

Minimum lethal dose: In order to determine the minimum lethal dose of methyl bromide for rabbits by ingestion, an olive oil solution of methyl bromide containing 34.4 mg. of methyl bromide per cc. was introduced into the esophagus through the mouth of each animal by means of a long, blunt, hollow needle attached to a 5 cc. tuberculin syringe. Dosage varied from 1 to 5 cc. of the olive oil-methyl bromide mixture. To prevent volatilization of the methyl bromide from the oil solution, both solution and syringe were cooled to about 5° C. Results of these tests were shown in table 7. According to these data the minimum lethal dose of methyl bromide for rabbits by ingestion is 60–65 mg. per kilo of body weight.

TABLE 7.—*Determination of minimum lethal dose of methyl bromide for rabbits by ingestion of methyl bromide in olive oil*

Animal's weight (gm.)	Oil mixture administered (cc.)[1]	Total CH_3Br (mg.)	Mg. CH_3Br per kilo of bodyweight	Results
2,360	1.0	34.4	14.7	No effect.
2,370	1.7	58.8	24.9	Do.
5,450	5.0	173.0	31.7	Slight to no effect.
2,405	3.0	103.8	43.2	Do.
3,320	5.0	173.0	52.1	Sleepy for 10 hours.
2,540	4.0	138.4	54.5	Sleepy and reduced activity.
2,465	4.0	138.4	56.1	Do.
2,460	4.0	138.4	56.3	Dead in 8 hours.
2,300	4.0	138.4	60.2	Slight sleepiness and reduced activity.
2,200	4.0	138.4	62.9	Do.
2,720	5.0	173.0	63.6	Dead in 6 hours.
2,675	5.0	173.0	64.7	Dead in 5 hours.
2,100	4.0	138.4	65.9	Partial paralysis 18 hours. Dead in 70 hours.
2,620	5.0	173.0	66.0	Dead in 4 hours.
2,435	5.0	173.0	71.0	Dead in 5 hours.
2,425	5.0	173.0	71.3	Dead in 6 hours.
Controls				
2,230	5.0 (olive oil only).			No effect.
2,235	do			Do.

[1] 1 cc. olive oil solution contained 34.4 mg. methyl bromide.

RABBIT FEEDING EXPERIMENTS

Three series of rabbits (12 in each group) were fed for 52 weeks on foodstuffs fumigated with methyl bromide for 24 hours. In table 8 are given the feeding schedule and results of these several feeding tests.

The rabbits fed on the foodstuffs fumigated with undiluted methyl bromide gas showed a drop in food intake to about one-half normal as soon as feeding of the fumigated products was begun. A drop in weight also resulted. A progressive paralysis, beginning in the hind quarters of the animals and moving forward, developed 2 to 3 days before death; all died within 2 weeks after feeding was begun. At 3 to 5 hours before death a nearly complete paralysis was observed that affected the fore and hind quarters but not the neck and head. Respiration became retarded and death occurred without convulsions. Animals were apparently conscious until a few minutes before death. Gross autopsy findings were essentially negative. However, in 10 of 12 cases a stomach filled with food to near capacity was noted. In 9 of 12 cases the bladder was found markedly distended with urine, indicating a possible paralysis of the bladder.

Rabbits fed for 52 weeks on foodstuffs fumigated with 3 pounds of methyl bromide per 1,000 cubic feet for 24 hours were in good health throughout the entire time of the test. A few that became ill with an ear infection were killed to prevent spreading the infection. The only difference noted between the animals fed the fumigated diet and the control animals was a 10 to 12 percent reduction in the average weight gains of the former group. Some of these test animals showed a markedly increased water intake and urine excretion.

The effects of methyl bromide on reproduction in rabbits were not determined as the animals were kept in individual cages with no opportunity for breeding.

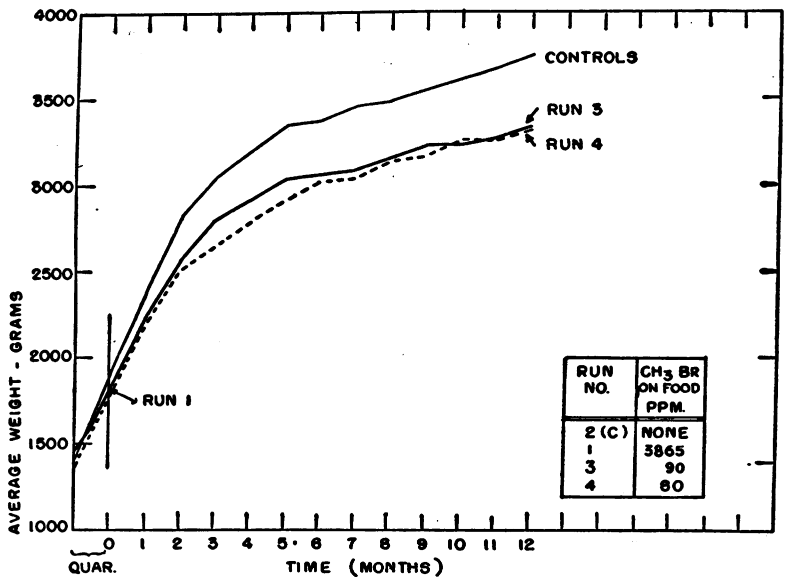


FIGURE 4.—Weight curves of rabbits fed foodstuffs fumigated with methyl bromide. (See table 8 for details of feeding and results. All of run 1 dead in 2 weeks.)

Complete data on the rabbit feeding tests are given in table 8. Figure 4 shows the average weight curves.

It will be noted that 21 of the 36 rats on a diet containing 6,830 p. p. m. methyl bromide survived 20 weeks, while all 12 rabbits receiving a diet containing 3,865 p. p. m. methyl bromide died in 2 weeks. The rats on a diet of from 245 to 270 p. p. m. of methyl bromide showed but slight decrease in weight gains, while rabbits on a diet of 80 to 90 p. p. m. of methyl bromide also showed a slight decrease in average weight gains. Thus it would seem that there is a definite species susceptibility of rabbits since these animals are more affected by similar or lower concentration of methyl bromide in their diet.

TABLE 8.—*Fifty-two-week rabbit feedings of methyl bromide fumigated materials*

Number	Number of rabbits on test	CH_3Br content of food (p. p. m.) [1]	Treatment of food and feeding program [2]	Results
2	12	None, unfumigated	100 grams pellet-oats mixture per animal per day. 100 grams alfalfa hay per animal 3 times per week. Unfumigated.	3 deaths. General condition excellent. Normal weight increases. All deaths due to ear infection.
		(Time fed after fumigation)		
1	12	Pellets-oats: At once, 3,720. In 24 hours, 3,060. Alfalfa hay: At once, 4,350. In 24 hours, 4,330. Average, 3,865.	100 grams pellet-oats mixture per day. 100 grams alfalfa hay 3 times per week. All food fumigated with undiluted CH_3Br gas, at atmospheric pressure, for 24 hours. Fed immediately after fumigation.	All dead in 2 weeks. Death preceded by marked decrease in food intake and marked drop in weight. In 3 to 5 days before death, progressive paralysis was noted in all animals, beginning in hind quarters and progressing forward. Death occurred without convulsions. Pathologic examination showed cerebral changes; secondary pulmonary damage in all.
3	12	Pellets-oats: At once, 100. In 24 hours, 97. Alfalfa hay: At once, 86. In 24 hours, 81. Average, 90.	100 grams pellet-oats mixture per day. 100 grams alfalfa hay 3 times per week. All food fumigated 24 hours at concentration of 3 lbs. CH_3Br/1,000 cu. ft. Food fed immediately after fumigation.	No deaths. General condition excellent. Average weight increases good but 10 percent less than controls. Marked increase in water intake and urine excretion. Estimated average intake of CH_3Br per animal per day=13.5 mg. CH_3Br. No significant histopathology.[3]
4	12	Pellets-oats: In 24 hours, 97. In 48 hours, 82. Alfalfa hay: In 24 hours, 81. In 48 hours, 67. Average, 80.	Same feeding schedule as in Run 3 but food and hay aerated 24 hours after fumigation, and then fed	3 deaths. General condition excellent. Average weight increases good but 11 percent less than controls. Marked increase in water intake and urine excretion. Estimated average intake of CH_3Br per animal per day=12.0 mg. CH_3Br. No significant histopathology.[3] 2 deaths due to ear infection. 1 death due to intestinal obstruction.

[1] The CH_3Br content (p. p. m. or mg. CH_3Br/kilo of sample) is calculated from the excess Br content of the samples by the method shown in footnote to table 5.

[2] Pellets were a balanced commercially-prepared rabbit food. Pellets and whole grain oats were mixed half and half, and 100 grams of the mixture fed to each animal per day. This amount was regularly completely consumed except in the case of the animals dying in 2 weeks. Dried alfalfa hay was fed 3 times per week, 100 grams per animal per day.

[3] The estimated daily apparent intake of CH_3Br per animal is calculated from the excess Br on the food by striking a general average. This is based on the assumption that all excess Br is present as CH_3Br. The values provide a basis of comparison for the possible intake of man when eating such foods as are shown in tables 1, 2, and 3.

PATHOLOGY

Tissues from 105 rats and 44 rabbits were examined to determine what histopathological changes were produced by the ingestion of food fumigated with methyl bromide. Rather large representative groups of animals from each experiment were killed and examined. A total of 3,400 histological sections was studied.

Paraffin sections were made from the heart, lungs, liver, spleen, pancreas, adrenals, kidneys, stomach, duodenum, jejunum, ileum, large intestine, and, in some animals, the brain and mesenteric lymph nodes. The sections were stained routinely by Lillie's (*9*) modification of the eosin-polychrome methylene blue method. Spleen sections and some liver sections were stained by ferrocyanide to demonstrate the presence or absence of iron-bearing pigment. Lillie's (*10*) current modification of Gallego's elastic and connective tissue stain was also used when indicated.

Table 9 presents the salient features regarding diet, duration of feeding, concentration of methyl bromide, and number and kind of animals.

TABLE 9.—*Treatment of animals for pathological study*

Diet	Duration of feeding (weeks)	Concentration CH_3Br in food (p. p. m.)	When fed with relation to fumigation	Number of animals studied pathologically
Rabbits				
Olive oil	All dead in 8 hours.	56–71 mg./kg. body weight.		6
Mixed	All dead in 14 days.	3,865	At once	12
Do	52	90	do	12
Do	52	80	24 hours later	9
Do	52	0	Controls	5
Rats				
Stock	16	1,550	At once	32
Pellets	20	6,830	do	12
Do	20	270	do	15
Do	20	245	24 hours later	12
Do	20	0	Controls	10
Vegetables and pellets	20	Various	At once	12
Do	20	0	Controls	12

The pathological changes found in the animals fed methyl bromide fumigated food were not striking except in the series in which rabbits received methyl bromide in oil by intubation and the series in which rabbits received food containing a high concentration of the fumigant.

RABBITS

Minimum lethal dose (CH_3Br in olive oil).—A series of 6 rabbits was given a single dose of from 56 to 71 mg. of methyl bromide in olive oil per kilo of body weight. A rabbit receiving 56 mg. per kilo died in 8 hours. The others receiving from 65 to 71 mg. died between 4 and 5½ hours after intubation.

The most prominent changes occurred in the gastrointestinal tract. Grossly, the fundus of the stomach showed a marked congestion with scattered, punched-out areas of the mucosa, and superficial hemorrhages. Areas of destruction of the surface epithelial cells were noted microscopically. The mucosa was covered by a thick layer of fibrinous exudate containing, at intervals, desquamated epithelial cells. Areas of hemorrhage in the mucosa, underlying denuded regions, were present and regions of marked hyperemia were noted.

Marked desquamation of the mucosa of the duodenum was noted in 5 of the animals and was least prominent in the rabbit which died in 8 hours after receiving 56 mg. per kilo. A layer of fibrinous exudate in which were scattered clumps of cells, isolated swollen cells with small, dense nuclei, and nuclear debris, covered the mucosa. Slight to moderately marked congestion of the mucosa was present in all of the animals and the degree of congestion showed no relation to the size of the dose. Superficial hemorrhages in the villi, at or near the tips, were found in a few sections.

Desquamation of the mucosa of the jejunum was noted in only 2 of the rabbits and 3 showed a slight to moderate congestion of the capillaries of the mucosa. The damage to the jejunum was much less prominent and frequent than damage to the duodenum.

No changes of note were seen in the ileum or large intestine. In general, the findings resemble the effects of an acute irritation.

Changes in the other organs were neither conspicuous nor important. The spleen showed a slight to marked amount of iron-bearing pigment in all of the animals, but this also was noted in the controls. Moderate to marked congestion of the cavernous veins, occasionally with small interstitial hemorrhages, was present. The Malpighian corpuscles were generally large and well defined. In the lungs slight to moderate congestion of the interalveolar capillaries was the only finding and this could probably be of agonal origin. Moderate to marked congestion of the interstitial capillaries of the kidney with occasional slight injection of the glomeruli was noted. The heart, liver, pancreas, and adrenals were essentially negative.

Food fumigated with concentrated CH_3Br (death in 2 weeks).— A group of 12 rabbits was fed a mixed diet consisting of hay, pellets, and oats which had been fumigated in an atmosphere of concentrated methyl bromide gas for 24 hours. They were fed immediately after the fumigation was completed and the average methyl bromide content of the food was 3,865 parts per million. The first animal died 3 days after feeding was begun and the last in 13 days.

The gastrointestinal tract was essentially normal. A few scattered areas of desquamation of surface epithelium were found in the duodenum and jejunum of only 2 of the animals. The stomach, ileum, and large intestine showed nothing of note.

Subacute interstitial nephritis, usually very slight, was present in 5 rabbits and moderate congestion of the interstitial capillaries of the cortex and medulla was noted in 3 animals, accompanying the nephritis in 2. Bronchopneumonia occurred in 8 of the animals, acute diffuse pneumonitis in 2, and purulent bronchitis in 2. All showed acute respiratory damage. This may be coincidental or the result of inhalation of residual methyl bromide in the food.

A very slight to moderate amount of brown pigment occurred in the liver cells of 7 animals. This did not give the iron reaction with potassium ferrocyanide. Hemosiderin was demonstrated in the spleen of 2 animals and appeared to be of no importance. Slight to marked congestion of the cavernous veins was noted in all but 1 rabbit.

Sections from the brain showed slight to moderate congestion of the capillaries of the cerebral cortex and medulla in 3 animals, and an occasional small, focal, perivascular area of lymphocytic infiltration in 3 others. No changes of the cerebellar cortex were noted. Studies of sections of the upper and lower segments of the cervical, thoracic, and lumbar portions of the spinal cord and a section of the sacral cord and large nerve trunks leading to the affected parts of 5 monkeys and 2 rabbits exposed to methyl bromide by inhalation failed to show evidence of myelin degeneration. This material was supplied by Dr. D. D. Irish, whose report of the investigation of the effects of methyl bromide by inhalation is now in press.

The heart, pancreas, and adrenals showed no changes of note.

Fifty-two-week feeding tests.—Two groups of 12 and 9 rabbits, respectively, and one of 5 rabbits for control were fed a mixed diet of hay, oats, and pellets for 52 weeks. The food was fumigated for 24 hours with a concentration of 3 pounds of methyl bromide per 1,000 cubic feet. One series of animals was fed immediately after the food was removed from the fumigator. This diet had an average concentration of 90 parts of methyl bromide per million. The other lot of animals was fed after the food had been allowed to stand for 24 hours following fumigation. The methyl bromide content of this diet averaged 80 parts per million. The controls received the same diet but without fumigation. The animals were killed and examined at the end of 52 weeks. Inasmuch as the tissues showed essentially the same findings in each group of exposed animals, these experiments will be discussed together.

No changes were noted in the gastrointestinal tract in either group or in the controls. In the lungs, scattered single alveoli and areas of alveoli filled with red blood cells and varying in numbers were noted. Since these animals were killed by a blow on the head, this finding could not be attributed to the methyl bromide. No pneumonia was present in any of the animals. A small area of interstitial fibrosis with lymphocytic infiltration, accompanied by local dilation of tubules, was noted in the kidney of only one animal—this from the group fed immediately after the fumigation of the food.

Relatively large amounts of iron-bearing pigment were found in the spleens but a somewhat lesser amount also occurred in the spleens of the control animals. The liver, heart, pancreas, and adrenals were essentially normal.

RATS

Food containing 1,550 p. p. m. (1–16-week feeding).—A series of 32 rats was fed a specially prepared stock diet fumigated for 24 hours with undiluted methyl bromide gas. They were fed immediately after fumigation and the concentration of the methyl bromide averaged 1,550 parts per million in the food. Groups of these animals were killed at 1- or 2-week intervals over a period of 16 weeks especially for pathological study.

Very few changes were observed in these animals. Bronchopneumonia occurred in 5 rats, and purulent bronchitis in 6 others. In the spleen the presence of pigment, free and in the cells of the splenic pulp, was conspicuous but this was also noted in the controls and in other series of rats studied. The cavernous veins were filled with blood and a slight to marked perifollicular zone of anemia was usually present, which varied in size inversely with the amount of blood in the pulp. Slight to moderate phagocytosis of nuclear fragments in the follicles was also seen. Infiltration of the muscular trabeculae was less frequently noted.

The gastrointestinal tract was normal throughout. The liver, heart, pancreas, kidneys, adrenals, and mesenteric lymph nodes showed nothing of note.

Food containing 6,830 p. p. m. (20-week feeding).—A group of 12 rats was fed for 20 weeks with pellets fumigated for 24 hours with pure methyl bromide. Animals were fed immediately after fumigation and the concentration of methyl bromide in food averaged 6,830 parts per million. All of the animals studied were killed and examined at the end of 20 weeks.

In this series pneumonia occurred in only one animal. The spleen showed findings similar to those encountered in the previous groups; however, the perifollicular anemia and phagocytosis were more marked. The gastrointestinal tract, liver, kidneys, adrenals, heart, pancreas, and mesenteric lymph nodes showed no histopathological changes.

Food containing 245–270 p. p. m. (20-week feeding).—Two groups of 12 and 15 rats were fed pellets fumigated with 3 pounds of methyl bromide per 1,000 cubic feet for 24 hours. One group was fed immediately after fumigation, the food having an average methyl bromide content of 270 parts per million. The other group was fed 24 hours after the food was fumigated, the food containing an average of 245 parts per million. A group of 10 rats receiving unfumigated pellets served as controls. All were killed and examined 20 weeks after feeding was begun.

In this entire lot of animals only one showed pneumonia. The gastrointestinal tract showed no histopathological changes. The spleen presented findings similar to those in the controls for the previous series of rats. The liver, heart, kidneys, adrenals, pancreas, and mesenteric lymph nodes showed nothing of note.

A group of 12 animals was fed a mixed and vegetable diet fumigated with 3 pounds of methyl bromide per 1,000 cubic feet for 24 hours. Feeding took place immediately after fumigation. A similar number of rats, used as controls, was fed the same diet but without fumigation. All were killed and examined at the end of 20 weeks.

Here again the pathological findings were essentially the same as those encountered in the previous exposures in which rats were used. Pneumonia (acute diffuse pneumonitis) was encountered in 2 of the exposed animals but subacute bronchopneumonia was also found in one of the controls. The findings in the spleen were similar to those described above. The gastrointestinal tract, liver, heart, kidneys, adrenals, pancreas, and mesenteric lymph nodes were essentially negative.

DISCUSSION

Under normal conditions of fumigation, that is, those approved by the United States Department of Agriculture and now recommended by the principal manufacturers of methyl bromide, fresh fruits and vegetables are fumigated at atmospheric pressure for 2 hours or less with concentrations approximating 2 to 2½ pounds of methyl bromide per 1,000 cubic feet of fumigated space. Dried fruits are fumigated at concentrations of 2 pounds or less of methyl bromide per 1,000 cubic feet for periods of 15 to 24 hours, while milled grains usually receive a dosage of 1 pound of methyl bromide per 1,000 cubic feet for about 24 hours.

In the experiments reported here, the foodstuffs fumigated for analysis were carried through procedures approximating the usual commercial fumigation practices. Dried fruits, flour, nuts, and cheese were fumigated at 2 pounds of methyl bromide per 1,000 cubic feet for 24 hours. Fresh fruits and vegetables were fumigated at the same concentrations for 2 hours. As these concentrations of fumigant and time of fumigation approximate commercial practice, it is reasonable to assume that the amount of bromides retained by the foodstuffs after laboratory fumigation is of the same order of magnitude as would be retained by foods fumigated in larger quantities.

The fumigation of materials used in the animal feeding experiments was, in all cases, at a concentration (3 pounds of methyl bromide per 1,000 cubic feet) above those usually used in actual practice. Likewise, the period of fumigation in all cases was 24 hours. These facts explain why the bromide content of the rat feed was higher than that of corresponding foodstuffs fumigated by the usual procedure (usually 2 pounds of methyl bromide per 1,000 cubic feet).

In actual practice the use of excessive concentrations of methyl bromide or of lengthy fumigation periods is discouraged because fresh fruits and vegetables are harmed by such procedures. In the case of other foodstuffs, the tendency is to use the lowest effective concentration because of the cost of the fumigant. Excessive and rapid deterioration of the fresh produce is caused by high dosage, prolonged fumigation, or high temperatures. These conditions also tend to cause excessive absorption of the fumigant.

Materials containing relatively large amounts of fats and oils will absorb larger amounts of methyl bromide during fumigation because of its solubility in fats. However, from the reports of some experimental fumigators it seems that fresh produce containing relatively high concentration of oils is readily damaged by methyl bromide fumigation. When the common foodstuffs were fumigated in this laboratory at a concentration of 2 pounds of methyl bromide per 1,000 cubic feet, no change in color, odor, taste, or texture was noted. This statement holds true for fruits eaten raw and for vegetables following cooking.

Because of the greater absorption capacity of milled grains, and the solubility of methyl bromide in oily or fatty foods (i. e., cheese, nutmeats, nuts, etc.) it is suggested that the use of methyl bromide as a fumigant for these materials be limited for the present to experimental trials. Until a more complete picture is to be had of the commercial methods of fumigation of these products, together with the results of a considerable number of experimental procedures now being studied in industrial and governmental laboratories, the use of methyl bromide as a routine fumigant for those materials that absorb considerable amounts of the gas is inadvisable.

When the more absorptive foods (rat and rabbit pellets, hay) were fumigated with 3 pounds of methyl bromide per 1,000 cubic feet and fed to rabbits and rats, the animals remained in good condition and made good weight gains. The gain in weight of these test animals was, however, 10 to 12 percent below the gains made by control animals fed the same diets, unfumigated. No other changes were noted during the test periods or after autopsy and histopathological examination.

Hanzlik, Talbot, and Gibson (*11*), after feeding rats sodium bromide (0.5 to 0.6 mg. NaBr per day) for a period of 7 months, observed no significant changes except a diminished weight. These test animals lost 11 percent in weight with but a 2.2 percent decrease in food intake. Lethargy or narcosis was not observed at any time. It is probable that the diminished weight gains noted in the animals fed on foodstuffs containing moderate concentrations of residual bromides are due to the effects of inorganic bromides resulting from hydrolysis of methyl bromide.

In those animals fed on foodstuffs fumigated with undiluted methyl bromide gas and the rabbits treated with methyl bromide in oil, the effects seem to be in large part due to the direct action of methyl bromide.

Previously in this paper, when discussing the amount of methyl bromide taken up by the various materials during fumigation, references were made to the absorptive and adsorptive capacity of the product. Inasmuch as no study has been made of the nature of the residues remaining in the fumigated material, nor the physico-chemical mechanisms by which the gas is held by the produce, it is not possible at this time to state the nature of the residue. Therefore, the question of the forms of bromides present, whether inorganic bromide, methyl bromide, or some other more complex organic bromide, is a problem yet to be studied. The analytical procedure used throughout this study determines the total bromides but does not differentiate between the various forms present.

SUMMARY AND CONCLUSIONS

A method of analyzing fruits and vegetables for total bromides following fumigation with methyl bromide has been developed. Results indicate that the amount of methyl bromide (determined as bromide) absorbed by the produce during fumigation is several times the normal bromide content. In most cases the fumigated material showed a drop in bromides after aeration. Dried fruits, fresh fruits, and vegetables absorbed minor quantities of the fumigant. The foodstuffs which absorb greater amounts of the fumigant include milled grains, cheese, nuts, and nutmeats. The adsorptive capacity of milled grains is due primarily to their greater surface area, while the oily and fatty foods absorb large quantities of methyl bromide because of its solubility in fats.

Feeding experiments with rats show that when excessive (620 to 529 mg. Br/100 gm.) amounts of methyl bromide are present in the food, an increased death rate is produced, gain in weight and activity are reduced, and general health and reproductivity are adversely affected. When rat food containing moderate amounts of bromides (following fumigation at 3 pounds of methyl bromide per 1,000 cubic feet for 24 hours) or when fumigated fruits and vegetables are fed, little or no deleterious effects were noted. Activity, general condition, gain in weight, and reproductivity were normal.

The minimum lethal dose of methyl bromide for rabbits by ingestion is estimated at 60–65 mg. of methyl bromide per kilogram of body weight.

When rabbits were fed on a diet containing excessive amounts of methyl bromide (362 to 256 mg. Br/100 gm.), all animals died in 2 weeks, exhibiting symptoms of progressive paralysis. In prolonged rabbit feeding experiments (52 weeks' duration), the animals were fed on food fumigated at a concentration of 3 pounds of methyl bromide per 1,000 cubic feet (9.36 to 5.55 mg. Br/100 gm.). These rabbits showed little or no deleterious effects. Activity and general condition were normal, but weight increases were 10 to 12 percent below those shown by the controls.

Rabbits receiving 56 to 71 mg. of CH_3Br per kilo of body weight in olive oil by intubation showed destruction of superficial layers of stomach, duodenum, and, occasionally, the jejunum, with accompanying hemorrhage and hyperemia.

Rabbits fed a mixed diet containing a concentration of 3,865 p. p. m. of methyl bromide showed no changes in the gastrointestinal tract. All were paralyzed prior to death and all showed pulmonary damage. Congestion of cerebral capillaries or focal areas of perivascular lymphocytic infiltration in the cerebrum were found in some of the animals.

Rabbits fed a mixed diet immediately and 24 hours after fumigation with a concentration of 3 pounds of methyl bromide per 1,000 cubic feet showed no resulting pathological damage after 52 weeks' feeding.

Rats fed a stock diet containing 1,550 parts per million and examined at 1- or 2-week intervals for 16 weeks showed no histopathological damage that could be attributed to methyl bromide.

Rats fed pellets containing an average of 6,830 parts per million of methyl bromide for a period of 20 weeks showed nothing of note histopathologically.

Rats fed for 20 weeks with pellets used immediately and 24 hours after fumigation with a concentration of 3 pounds of methyl bromide per 1,000 cubic feet showed nothing of note. Rats fed vegetable diets similarly treated also presented negative pathological findings.

Definite pathological lesions produced in the stomach, duodenum, and jejunum of rabbits receiving high concentrations of methyl bromide in olive oil appear to be of the nature of an acute irritative reaction. The irritation may be caused by hydrolysis of the methyl bromide to hydrobromic acid and methanol, or by a delayed direct action of the methyl bromide because of its partial retention in the oil.

The pneumonia and bronchitis encountered in the rabbits receiving the mixed diet containing a very high concentration of methyl bromide might be attributed, at least to some extent, to inhalation of the methyl bromide retained in the feed, particularly the hay. It could also be considered as an indication of general physical debility, especially in view of the fact that gastrointestinal damage, even though slight, was found in some of these animals. That the rabbits of this group died following paralysis and that slight cerebral changes were found would also suggest that the pulmonary damage was of a secondary nature.

The absence of fat droplets in the cells of the adrenals and liver was conspicuous in the rats and rabbits examined in this study. While an appreciable quantity of fat in the liver of rats and rabbits is generally conceded to be abnormal, at least some is found in a series of animals of this number. Fat droplets in the cells of the adrenal cortex usually occur more frequently in a similar number of animals. No conclusions can be drawn from the data at hand as to the significance of this conspicuous negative finding.

It is also to be noted that the pathological changes, when present, were more marked in the rabbit than in the rat, pointing to the possibility of a species tolerance or resistance.

The lack of appreciable systemic pathological findings in the animals fed foodstuffs fumigated with 3 pounds of methyl bromide per 1,000 cubic feet is significant.

The diets fed to the animals in the tests herein described consisted entirely of fumigated foodstuffs, all of which contained more methyl bromide than is found in similar foodstuffs fumigated by methods approximating present commercial procedures. Thus it seems unlikely that the small amount of methyl bromide or bromide residues on commercially fumigated fresh vegetables and fruits, or dried fruits, is harmful to the consumer.

ACKNOWLEDGMENT

The authors wish to thank Dr. Lon A. Hawkins, Chief of the Division of Control Investigations, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, and other members of the Bureau of Entomology and Plant Quarantine for their cooperation during the course of this investigation; Dr. L. T. Fairhall, Principal Industrial Toxicologist, for his suggestions and aid during the entire study; Mr. Otto J. Dekom, Laboratory Assistant, for aid in the chemical analyses, animal feeding, and preparation of bibliography; Mrs. Barbara H. Caminita for editorial assistance and manuscript preparation; and Mr. E. C. Thompson and Mrs. Anne S. Gerber for preparation of histological material.

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DISCUSSION OF THE HAZARDS ASSOCIATED WITH THE USE OF METHYL BROMIDE AS A FUMIGANT

In order to provide safe methods of application of methyl bromide as a fumigant, the Division of Industrial Hygiene of the National Institute of Health prepared and issued (May 1938) preliminary recommendations to fumigators for the use of methyl bromide (see below). These recommendations were of a preliminary character, based not only on experimental findings of studies of methyl bromide but also on experience with other toxic gases and particularly other fumigants. These preliminary recommendations were occasioned by one fatality and several cases of illness of a serious nature arising from inhalation of methyl bromide during or after commercial fumigation. The application of these precautionary measures during the past 2 years has apparently been helpful in preventing serious illness, since no new cases have been reported. The cooperation of the United States Department of Agriculture and the principal manufacturers of methyl bromide in insisting that safe methods be employed in the use of methyl bromide has resulted in the proper application of this fumigant.

Preliminary recommendations for use of methyl bromide as a fumigant

1. Avoid breathing air containing methyl bromide.
2. On completion of fumigation provide thorough ventilation for cars, rooms, or buildings before entering.
3. When necessary to enter spaces containing methyl bromide, use a gas mask provided with a canister giving protection against organic vapors, or a positive pressure hose mask. (Masks and canisters to be approved under United States Bureau of Mines Schedule 14D or 19A. Canisters, black, type B.)
4. Avoid spilling of methyl bromide. Get to fresh air immediately in case of spillage. Remove any clothing in contact with skin which has become impregnated with the liquid.
5. Post warning signs notifying that methyl bromide is being used and that the gas is toxic.
6. Containers of methyl bromide should be stored in a cool, well-ventilated place, outside inhabited buildings. Avoid leakage by seeing that valves on cylinders are tightly closed.

The maximum concentration now used in commercial fumigation procedures is about 2½ pounds of methyl bromide per 1,000 cubic feet (40 mg./l. or 0.95 percent by volume), with concentrations ranging as low as 1 pound of methyl bromide per 1,000 cubic feet of space to be fumigated. Experimental studies with animals by Sayers et al. (1929) have indicated that a concentration of methyl bromide of 0.2 to 0.4 percent by volume is dangerous for a 30–60 minute exposure, while as little as 0.005 percent by volume has produced slight symptoms in animals after prolonged exposure. Recent work by Irish et al. (1940) has shown that repeated exposure of experimental animals to low concentrations of methyl bromide causes the development of paralysis, which may terminate in death. Their findings indicate that rabbits exposed 6 hours per day for 6 months to a concentration of 0.13 mg. of methyl bromide per liter (34 p. p. m.) develop paralysis. At higher concentrations both rabbits and monkeys develop paralysis and soon die if exposure is continued. If the exposures are discontinued immediately upon the development of paralysis the animals often return to normal, exhibiting little or no signs of residual effects.

The method now in common use to test for the presence of methyl bromide in workrooms is that of some type of halogen lamp or halide leak detector. Findings in this laboratory, under ideal conditions of light and in the absence of air currents, show that the lower limit of this type lamp is about 50 p. p. m. of methyl bromide. At 50 p. p. m. a moderately strong positive test is seen. However, at 35 p. p. m. an unreliable test is given. Lower concentrations give a negative test. Thus it will be seen that as a test for dangerous concentrations of methyl bromide, especially where exposure is prolonged and repeated, the halogen test lamp leads to a false sense of security and it is recommended that some more sensitive method be used, preferably some type of quantitative chemical procedure.

In man, symptoms caused by slight exposure to methyl bromide, as reported in the literature, include weakness, vertigo, and dyspnea. Often symptoms appear several hours after inhalation of the gas. In more severe exposures there may also appear psychic disturbances, attacks of mania, and transitory brachial paralysis. Double vision, amblyopia, and aphasia are likewise noted in certain nonfatal cases. Several fatal poisonings as the result of inhalation of methyl bromide while filling fire extinguishers in France are reported in detail. (See selected bibliography which follows.) In the United States two fatalities and several less severe cases resulting from exposures during fumigation have been reported.

The toxicity of methyl bromide when used as a fumigant has unfortunately been underestimated in some quarters, owing to ignorance of its toxicity as well as its lack of odor at the lower concentrations and the fact that it possesses no irritant properties. Although methyl bromide is less toxic to man than certain other fumigants in common use in the United States, careless handling and inadequate protective measures will unduly expose fumigators and other persons coming in contact with the fumigant. It is recommended that the precautionary measures that have been issued by the United States Public Health Service be adhered to closely. Copies of these recommendations will be furnished on request.

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General

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Schuler, M.: Vergiftung durch Brommethyl? Deutsch. Vierteljahrschr. f. offentl. Gesundheitspflege, 31: 696–704 (1899).

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Jaquet, A.: Über Brommethylvergiftung. Deutsch. Arch. f. klin. Med., 71: 370–386 (1901).

(Report of 2 nonfatal cases which exhibited the typical series of symptoms described by Floret (1915). Some residual neurasthenia was observed. Probable repeated exposures.)

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Floret: Klinischer Beitrag zur gewerblichen Brommethylvergiftung. Zentralblatt für Gewerbehyg., 3: 146–149 (1915).

(Reports 3 nonfatal cases. Recovery in 4 to 6 weeks. The illness shows three stages:

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2. Delirium, hallucinations, convulsions, coma.
3. Hypochondric-hystero-neurasthenia which may last for years.)

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NOTE: See work of Irish et al. (1940) which indicates that methyl bromide is more toxic than methyl alcohol.)

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(Experimental studies of the toxicity of several halogenated hydrocarbons using mice, rats, and guinea pigs. Methyl bromide produced more toxic effects than C_2H_5Br, $C_2H_4Br_2$, or $C_2H_2Br_4$.)

Sayers, R. R., et al.: Physiological response attending exposure to vapors of methyl bromide, methyl chloride, ethyl bromide, and ethyl chloride. Public Health Bull. No. 185. U. S. Government Printing Office (1929).

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(A review of medical and legal aspects. Gives industries endangered by methyl bromide.)

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(Methyl bromide much more toxic than CCl_4. Exposure of dogs produced lung edema, dyspnoea, and finally death.)

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(Reviews symptoms and pathology of methyl bromide intoxication from various sources.)

Flury, F., and Zernik, F.: Schädliche Gase, Dämpfe, Nebel, Rauch- und Staubarten. Pp. 309–310 and others. Verlag von Julius Springer, Berlin, 1931.

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Nuckols, A. H., et al.: Comparative life, fire, and explosion hazards of common refrigerants. Underwrit. Labs. Misc. Hazards, No. 2375 (1933).

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(Reports 2 nonfatal cases with long symptom-free interval. Brain irritation of long duration was noted in one case and psychic debility in the other.)

See also Friemann (1937).

Tietze, A.: Klinische Beobachtungen zur Methylbromid- und Tetrachlokohlenstoff-Vergiftung. Arch. f. Gewerbepath. u. Gewerbehyg., 4:733–739 (1933).

(Describes 2 nonfatal cases of apparent chronic exposure for 3 and 6 months. Both exhibited epilepsy, with central and peripheral nervous disturbances. Recovery took place in 2 to 3 months.)

Beyne, J., and Goett, M.: Toxicité de certains appareils extincteurs d'incendie et précautions qu'ils comportent dans leur emploi. Arch. de méd. et pharm. nav., **124**:409–427 (1934).

(Review of toxicology. Experiment with rabbits and dogs at concentration of 6 to 36 mg./l. for 25 to 35 minutes. Acute exposure caused lung edema and congestion.)

International Labour Office: Occupation and Health, Vol. 2, pp, 238–240. Geneva, 1934.

(An excellent review. Toxic dose for man is small. Nerve action is due to rapid fixation of bromide in lipoids, which facilitates diffusion in the nerve cells. Is a central nervous system poison. Predisposition is variable. Persons of lymphatic type and those of nervous disposition show little resistance.)

Kohn-Abrest, E.: Précis de toxicologie. P. 83. G. Doin et Cie., Paris, 1934.

(Estimates methyl bromide to be four times as toxic as carbon tetrachloride.)

Schwarz, F.: Brommethyl in der Schädlingsbekämpfung. Aerztliche Sachverständigen-Zeitung, 42:258–9 (1936).

(States methyl bromide fumigation has no effect on taste or smell of foods except certain oils and fats. Believes methyl bromide to be extraordinarily stable, with little reaction with foodstuffs. Gives general discussion of toxicology and insecticidal value. Warns of dangers connected with use.)

Duvoir, M. et al: L'intoxication par le bromure de méthyle. Bull. et mém. Soc. Méd. d. hôp. de Paris, (3 S.) 53:1540–1554 (1937).

(Reports 6 cases, 2 fatal. Nonfatal cases exhibited amblyopia, ataxia, aphasia, and transitory paralysis. In some epileptiform crises were evidenced. Those which came to autopsy showed diffused acute congestion of the meninges and brain, and marked lung edema.)

Friemann, W.: Berufliche tödliche Brommethyl-Vergiftung. Sammlung von Vergiftungsfällen, 8: Abt. A, 31–32 (1937).

(Reports repeated epileptiform seizures for 2 years, in case reported by K. Opperman (1933). Some nystagmus and feeling of discomfort 4 years following exposure. Reports 2 newer cases, 1 fatal. Assumes that the fatal case was due in part to repeated previous exposures, since both men were exposed at the same time.)

Oettingen, W. F. von: The halogenated hydrocarbons: Their toxicity and potential dangers. J. Ind. Hyg. and Toxicol., 19:349–448 (1937).

(A review: Believes that methyl bromide is not as harmless as anticipated by Von Gronow (1917).)

Gueffroy, W., and Ehrhardt, W.: Die Halogenkohlwasserstoffe der Fettreihe als Lösungsmittel in ihrer Bedeutung fur die ärztliche Praxis. Zentr. f. Gewerbehyg. u. Unfallverh., (N. F.) 15: 224–230 (1938).

(Gives properties and preparation of methyl bromide, with sources of intoxication and a general review of literature on toxicology. Classes CH_3Br and other halogenated hydrocarbons as active toxic agents for which no specific medical prophylaxis for chronic poisoning is known.)

Duvoir, M., et al.: L'intoxication par le bromure de méthyle. Bull. sci. pharmacol., 46: 15 (1939).

(Experimental studies show much bromine in lipid rich tissues. The pathological picture is of a vasomotor crisis. Adrenaline was without effect.)

Dérobert, L.: L'intoxication professionelle par le bromure de méthyle. Gaz. méd. de Strasbourg, 99: 179–184 (1939).

(A review giving sources of intoxication and literature on toxicology of methyl bromide.)

Howcroft, J. R.: Modern fire fighting: Chem. and Indust., p. 323 (1939).

(Points out that fumes of CH_3Br and its decomposition products are toxic. Warns of dangers to firemen from use of CH_3Br as an extinguisher fluid.)

Irish, D. D., et al.: The response attending exposure of laboratory animals to vapors of methyl bromide. J. Ind. Hyg. and Toxicol., 22: 218 (1940).

(Shows results of experimental studies of chronic toxicity of methyl bromide. Produced paralysis in monkeys and rabbits by repeated exposures. Paralysis may be transitory if exposure is terminated.)

HOME SANITATION *

Since the home is the center of all family life, every effort should be made to make it a healthful place to live, as well as attractive and comfortable.

A number of States have enacted housing laws designed to raise the sanitary standards of housing. Health departments are also realizing that home sanitation is important in the control of many diseases. Society has come to realize that it can no longer afford the consequences of poor housing and slum conditions.

*This material is available in leaflet form and a limited number of copies may be obtained by addressing the Surgeon General, U. S. Public Health Service, Washington, D. C.

SANITARY AND HYGIENIC REQUIREMENTS OF GOOD HOUSING

Water Supply.

A safe and adequate water supply is one of the primary requirements of healthful living. To be fully serviceable, it should be convenient for cleansing and bathing purposes, as well as safe for drinking. People living in large cities are usually amply protected. In rural areas, it is necessary to take extra precautions to safeguard the water supply since the danger of contamination from excreta and other sources is so much greater than in cities. The local health department should be consulted regarding the best methods of preventing pollution of the water supply.

The most serious of the water-borne diseases are diseases of the intestinal tract—typhoid fever, dysentery, and cholera. All are due to germs from the intestinal discharges of infected persons which obtain entrance into the drinking water. Digestive disturbances may also result from water which has been highly polluted with decaying organic matter.

Excreta Disposal.

Indoor toilets, in addition to being a convenience, are usually much more sanitary than outdoor toilets. They should be kept clean, and there should be adequate provision for light and fresh air in the room in which they are located. In areas where this convenience is not available, proper construction and proper screening are highly important to guard against the spread of diseases by contact and by flies and other insects.

Refuse Disposal.

The garbage pail should be made of metal. It should be watertight and should always be kept properly covered. Where garbage is allowed to accumulate or is strewn on the ground, flies and rats are attracted. The accumulation of rubbish also creates a fire hazard in addition to being unsightly.

Flies, Other Insects, and Rats.

Every effort should be made to keep flies out of the home by proper screening of all doors, windows, and other openings. It is much more effective to prevent their entrance into the house than to attempt to destroy them after they have gotten in.

The best method of combating flies is to eliminate their breeding places. Attention to manure piles and open privies and prompt removal of accumulations of cut grass, garbage, or other refuse are important. Stagnant water should not be permitted around a dwelling, particularly water that becomes stagnant in broken bottles or open cans.

Houses should be made ratproof. When rats gain entrance, steps to eliminate them should be taken immediately by trapping, poison bait, and other methods. All food should be stored in protected containers to prevent rats from gaining access to it.

The Cellar.

Dampness and low temperatures lower the normal resistance of individuals to colds and other respiratory infections. Cellars should be kept clean and frequently aired and sunned to prevent dampness. All leaky pipes should be located and immediately repaired. Objects stored should be neatly piled to prevent accidents.

Light and Fresh Air.

Sunshine and fresh air are highly destructive to germ life. Every room should have at least one window, and the window area in each room should be at least 15 percent of the floor area. In general, rooms should be 8 to 9 feet high. Not more than two persons should occupy a sleeping room at the same time. Bedroom overcrowding is particularly undesirable since it favors the spread of disease, does not permit restful sleep, and is not in accord with the requirements of decency.

Plumbing.

All drainage pipes should be kept open and free from obstruction. The toilet bowl should not be used for the disposal of garbage, since waste materials of this type readily clog the pipes. Insanitary conditions as well as a plumber's bill are the result.

It is important that all refuse be strained from wash waters before the sink is drained. Kitchen closets should be kept clean and not used as "catch-alls" to serve as a breeding place for vermin.

Accident Prevention.

The number of accidents that occur in the home and their seriousness are not ordinarily appreciated. Improvement in heating and cooking devices and adequate lighting are aiding greatly in reducing the number of accidents. The house should be kept clean and in good repair, to avoid the danger from falls.

ANYTHING WHICH TENDS TO FOSTER FAMILY LIFE, AND TO MAKE IT DELIGHTFUL, COMFORTABLE, AND HAPPY, MAKES FOR A STABLE, CONTENTED PEOPLE.

A PRELIMINARY SURVEY OF THE INDUSTRIAL HYGIENE PROBLEM IN THE UNITED STATES[1]

A REVIEW

Surveys were made in certain States during the period 1936–39, which covered such items as existing health services in industrial establishments, exposure to materials and conditions which might influence health, and an inventory of control measures in use.

The present study is an analysis of such surveys conducted in 15 States, covering 16,803 plants, employing 1,487,224 workers. It is felt that the sample is sufficiently adequate and representative of industrial conditions in this country to warrant considering the data applicable to all industrial establishments of the type studied in the United States.

With reference to safety provisions, it appears that only 25.6 percent of the workers had the services of a full-time safety director. Hospital facilities were found to be available to only 15 percent of the workers, and first-aid rooms were provided for 51 percent. Full-time services of a physician were available to 15.5 percent, while full-time nursing services were provided for 33.3 percent of the employees. The analysis revealed that although accident records were kept on nearly all workers, sickness statistics were available for only 45.4 percent of the employees. For practically all of the health services now considered desirable, the larger plants were found to have these more frequently than the smaller plants.

The analysis of exposures of workers to various materials and conditions of health significance showed that slightly more than 1,000,000 persons are exposed in this country to the inhalation of silica dust and one and one-half million persons to silicate dusts. Of the various exposures to metal dusts and fumes, the analysis indicates that approximately 800,000 persons are handling lead and its compounds, 34,000 are exposed to arsenic and its compounds, and nearly 33,000 were found to be handling mercury and its compounds. The highest exposure of all was in connection with the agents known to produce dermatitis.

An analysis of the control measures now available for the protection of workers against the exposures found in the survey shows that much still remains to be done in this country for the protection of workers against industrial health hazards. Examination of control measures for 1,503,204 exposures shows that 14.3 percent were provided with local exhaust ventilation, 3.2 percent with enclosed operations, 3.2 percent with respiratory protective devices, and, in the

[1] Public Health Bulletin No. 259, same title as above. By J. J. Bloomfield, V. M. Trasko, R. R. Sayers, R. T. Page, and M. F. Peyton. Government Printing Office, Washington, 1940. Available from the Superintendent of Documents, Washington, D. C., at 20 cents per copy.

case of certain dusty trades, wet methods were employed in connection with 3.4 percent of the exposures.

From the analysis of the survey in the 15 States, certain conclusions and recommendations were possible. These deal primarily with the establishment of industrial hygiene programs in industry and in official agencies. A discussion on industrial hygiene administration is also presented in this bulletin.

COURT DECISION ON PUBLIC HEALTH

Village held liable on ground that sewage disposal plant constituted a nuisance.—(Wisconsin Supreme Court; *Hasslinger et al.* v. *Village of Hartland*, 290 N.W. 647; decided March 12, 1940.) The sewage disposal plant of the defendant village was located approximately 350 feet from the plaintiffs' house, and, in an action brought because of the odors from the plant, the Supreme Court of Wisconsin held that the plant constituted a nuisance and affirmed a judgment granting damages to the plaintiffs. "* * * where, as here," said the court, "it appears that defendant placed its plant so close to plaintiffs' dwelling as to bring it within the area in which odors from the plant normally, frequently, and regardless of unusual weather conditions produce an extreme degree of contamination of the air, the plant constitutes a nuisance by reason of its close proximity to plaintiffs' premises." The trial court had found that there appeared to be no changes in plan or operation by which the odors could be eliminated.

The village's plans and specifications for sewage disposal had been approved by the State board of health, and one of the claims of the village was that a sewage disposal plant which followed approved specifications could not be held a nuisance. But the appellate court said that, where the landowner's claim was that the plant was a nuisance not by reason of improper operation or planning but because of its location, the owner was not concluded by the orders or approval of the State board of health. The court further stated that, while plans included the location of the sewage disposal plant and the latter may have been within the scope of the board's approval, it was not within the competency of the board to foreclose a judicial determination whether by reason of location the plant would be a nuisance per se.

In answer to another contention that the village was discharging a governmental function and, therefore, immune, the supreme court said that the operation of the plant concededly constituted the exercise of a governmental function and that the village sustained no liability for negligence in the operation of this function but that it was not thereby exempted from liability for the maintenance of a nuisance.

DEATHS DURING WEEK ENDED NOVEMBER 23, 1940

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

	Week ended Nov. 23, 1940	Corresponding week, 1939
Data from 88 large cities of the United States:		
Total deaths	8,070	8,002
Average for 3 prior years	7,913	
Total deaths, first 47 weeks of year	393,058	386,491
Deaths under 1 year of age	498	466
Average for 3 prior years	483	
Deaths under 1 year of age, first 47 weeks of year	23,589	23,315
Data from industrial insurance companies:		
Policies in force	64,819,724	66,543,128
Number of death claims	10,773	10,541
Death claims per 1,000 policies in force, annual rate	8.7	8.3
Death claims per 1,000 policies, first 47 weeks of year, annual rate	9.5	9.9

PREVALENCE OF DISEASE

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

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED NOVEMBER 30, 1940

Summary

For the current week, increased incidence over the preceding week was recorded for diphtheria, influenza, measles, scarlet fever, smallpox, and whooping cough, while four of the communicable diseases reported weekly by the State health officers—influenza, measles, poliomyelitis, and whooping cough—were above the 5-year (1935–39) median.

The number of cases of influenza increased from 1,332 last week to 3,014 for the current week, with the largest numbers of cases and the greatest increases being recorded for California (from 471 to 1,490), Arizona (from 117 to 350), Texas (from 104 to 252), Oklahoma (from 38 to 118), and South Carolina (from 157 to 290). An official report from California dated December 3 indicated an unusual prevalence of a mild acute upper respiratory infection in the State, which is reported in the press as influenza. The highest incidence of influenza for the current week is apparently in the South Atlantic, South Central, and Western States, with comparatively few cases reported for the North-eastern and North Central areas. Up to and including the current week (48 weeks), 182,210 cases of influenza have been reported in the United States this year—a larger number than reported in any of the 5 preceding years with the exception of 1937. In none of the preceding years, however, was the occurrence of influenza of major epidemic proportions.

For the current week the Bureau of the Census reports 8,341 deaths in 88 major cities of the United States, as compared with 8,074 for the preceding week and with a 3-year (1937–39) average of 8,716 for the corresponding week.

Telegraphic morbidity reports from State health officers for the week ended November 30, 1940, and comparison with corresponding week of 1939 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: Week ended— Nov. 30, 1940	Diphtheria: Week ended— Dec. 2, 1939	Diphtheria: Median, 1935–39	Influenza: Week ended— Nov. 30, 1940	Influenza: Week ended— Dec. 2, 1939	Influenza: Median, 1935–39	Measles: Week ended— Nov. 30, 1940	Measles: Week ended— Dec. 2, 1939	Measles: Median, 1935–39	Meningitis, meningococcus: Week ended— Nov. 30, 1940	Meningitis, meningococcus: Week ended— Dec. 2, 1939	Meningitis, meningococcus: Median, 1935–39
NEW ENG.												
Maine	0	2	2	3	3	3	125	38	38	0	0	0
New Hampshire	0	1	1	------	------	------	0	3	2	0	0	0
Vermont	0	0	0	------	------	------	19	44	35	0	0	0
Massachusetts	4	11	7	------	------	------	226	225	158	1	1	1
Rhode Island	1	0	0	------	------	------	0	79	14	0	0	0
Connecticut	0	2	3	2	2	6	1	33	33	1	0	0
MID. ATL.												
New York	10	22	28	[1]2	[1]4	[1]11	644	373	373	2	1	6
New Jersey	11	19	19	4	13	13	258	12	21	0	3	2
Pennsylvania	11	37	36	------	------	------	746	61	48	2	5	3
E. NO. CEN.												
Ohio	11	47	47	25	62	28	65	45	45	1	1	1
Indiana	21	25	26	4	13	32	19	7	12	1	1	1
Illinois	42	45	45	5	15	15	510	22	22	3	0	3
Michigan [2]	13	10	30	12	4	2	523	133	133	0	0	2
Wisconsin	0	2	3	35	11	34	291	45	57	0	1	1
W. NO. CEN.												
Minnesota	1	4	7	------	3	1	75	61	49	0	0	1
Iowa	6	4	6	------	1	1	20	37	8	0	1	1
Missouri	4	15	28	1	------	48	12	9	9	0	0	1
North Dakota	2	0	1	13	16	16	0	1	2	0	0	0
South Dakota	3	1	1	------	1	------	1	3	3	0	0	0
Nebraska	0	4	4	------	------	------	0	1	1	0	1	0
Kansas	3	14	11	5	9	9	21	77	9	0	0	0
SO. ATL.												
Delaware	0	0	1	------	------	------	5	3	3	0	0	0
Maryland [2]	6	11	13	3	3	4	2	5	15	0	0	3
Dist. of Col.	0	1	6	1	1	1	1	2	2	0	0	0
Virginia [3]	32	38	49	107	145	------	20	13	13	1	0	3
West Virginia [2]	3	15	29	7	3	20	3	2	6	1	1	2
North Carolina [3]	30	63	64	10	6	6	25	136	136	1	1	2
South Carolina [3]	9	33	20	290	1,180	293	26	1	7	0	3	3
Georgia [3]	9	24	22	24	182	19	7	10	------	1	0	1
Florida [3]	5	4	9	11	6	6	1	2	2	0	0	0
E. SO. CEN.												
Kentucky	14	16	16	18	12	16	145	6	31	0	2	2
Tennessee [3]	11	13	27	26	44	44	11	15	11	1	0	2
Alabama [3]	23	29	34	25	175	104	31	11	11	2	1	2
Mississippi [2]	6	11	12	------	------	------	------	------	------	0	1	0
W. SO. CEN.												
Arkansas	11	16	16	43	59	59	9	12	7	0	0	0
Louisiana [3]	19	17	17	3	3	11	0	1	3	0	0	0
Oklahoma	19	31	21	118	54	87	0	1	7	1	0	0
Texas [3]	28	62	62	252	359	268	24	17	17	0	1	2
MOUNTAIN												
Montana	2	1	1	19	88	4	4	9	10	0	0	1
Idaho	0	2	2	------	1	1	0	9	49	0	0	0
Wyoming	0	1	0	4	13	------	2	8	2	0	0	0
Colorado	6	10	10	5	53	------	60	41	10	0	0	1
New Mexico	0	2	3	3	2	2	21	0	3	0	1	0
Arizona	6	4	6	350	65	65	29	1	1	0	0	0
Utah [2]	0	0	0	9	104	------	2	127	8	0	0	0
Nevada	0	------	------	------	------	------	0	------	------	0	------	------
PACIFIC												
Washington	2	8	8	4	------	------	11	470	52	0	0	2
Oregon	3	7	1	81	24	24	19	28	11	0	1	1
California [3]	29	39	44	1,490	17	27	51	160	127	1	1	2
Total	416	718	852	3,014	2,756	1,510	4,065	2,399	2,399	20	28	75
48 weeks	14,346	21,731	25,748	182,210	165,468	149,838	252,893	363,819	363,819	1,493	1,821	5,073

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended November 30, 1940, and comparison with corresponding week of 1939 and 5-year median—Continued

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended—		Median, 1935–39	Week ended—		Median, 1935–39	Week ended—		Median, 1935–39	Week ended—		Median, 1935–39
	Nov. 30, 1940	Dec. 2, 1939		Nov. 30, 1940	Dec. 2, 1939		Nov. 30, 1940	Dec. 2, 1939		Nov. 30, 1940	Dec. 2, 1939	
NEW ENG.												
Maine	0	0	0	2	12	18	0	0	0	0	0	1
New Hampshire	0	0	0	5	4	14	0	0	0	0	0	0
Vermont	0	0	0	9	4	9	0	0	0	1	0	0
Massachusetts	0	2	1	124	76	144	0	0	0	1	0	1
Rhode Island	0	0	0	2	3	18	0	0	0	0	0	1
Connecticut	0	0	0	31	37	37	0	0	0	0	0	0
MID. ATL.												
New York	2	16	4	230	268	310	0	0	0	15	8	9
New Jersey	1	2	0	103	166	97	0	0	0	0	4	4
Pennsylvania	5	10	2	196	467	296	0	0	0	11	17	16
E. NO. CEN.												
Ohio	13	3	1	168	361	343	0	2	2	1	9	8
Indiana	9	1	0	93	153	160	0	4	5	2	1	1
Illinois	16	1	6	292	330	354	3	0	1	7	4	8
Michigan [2]	5	4	2	153	281	281	7	4	2	1	5	4
Wisconsin	17	3	0	154	151	162	3	0	5	0	0	0
W. NO. CEN.												
Minnesota	5	3	1	68	138	138	10	12	9	0	0	0
Iowa	6	10	1	65	86	86	0	6	6	1	1	1
Missouri	4	1	2	54	66	121	1	7	7	3	4	6
North Dakota	0	0	0	11	41	41	0	0	4	0	0	1
South Dakota	0	1	0	32	28	35	1	0	1	0	0	0
Nebraska	3	2	0	11	13	39	0	0	4	0	1	1
Kansas	6	0	0	68	100	139	0	0	1	1	1	2
SO. ATL.												
Delware	0	0	0	14	24	11	0	0	0	0	1	0
Maryland [2]	0	0	0	51	52	59	0	0	0	4	5	5
Dist. of Col.	1	0	0	19	16	14	0	0	0	0	1	0
Virginia [3]	4	1	1	66	54	47	0	0	0	4	8	7
West Virginia [2]	10	4	1	39	69	69	1	0	0	4	7	4
North Carolina [3]	0	0	1	84	101	62	0	0	0	1	1	8
South Carolina [3]	1	0	0	23	17	10	0	0	0	0	2	0
Georgia [3]	1	0	0	19	38	34	0	1	0	6	3	6
Florida [3]	2	0	0	7	5	7	0	0	0	1	5	0
E. SO. CEN.												
Kentucky	3	4	2	78	71	79	0	0	0	4	6	6
Tennessee [3]	2	1	1	58	64	61	0	0	0	4	2	4
Alabama [3]	0	2	2	30	39	27	0	0	0	5	1	2
Mississippi [2]	2	1	2	10	13	15	0	0	0	3	3	8
W. SO. CEN.												
Arkansas	0	1	1	20	17	17	5	0	0	4	7	4
Louisiana [3]	5	0	0	15	31	14	0	0	0	9	27	10
Oklahoma	0	0	0	38	24	42	0	0	2	4	4	8
Texas [3]	4	3	3	58	60	85	0	1	1	8	17	17
MOUNTAIN												
Montana	0	0	0	20	31	33	0	0	23	1	0	1
Idaho	0	7	1	19	12	23	0	0	1	0	1	3
Wyoming	0	1	0	9	9	8	0	0	0	0	1	0
Colorado	0	7	0	24	42	42	0	0	6	3	1	1
New Mexico	0	2	0	11	22	19	0	0	0	3	10	7
Arizona	0	0	0	2	4	6	1	0	0	0	0	1
Utah [2]	0	5	0	14	26	26	0	1	0	3	0	0
Nevada	0	------	------	1	------	------	0	------	------	0	------	------
PACIFIC												
Washington	1	0	2	35	50	50	0	1	5	2	6	4
Oregon	0	3	2	17	24	45	7	0	1	2	8	2
California [3]	2	15	9	140	180	217	1	0	5	2	11	11
Total	130	116	95	2,792	3,880	3,959	40	39	164	121	188	234
48 weeks	9,509	7,027	7,027	143,545	147,380	204,483	2,242	9,161	9,161	9,159	12,265	13,855

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended November 30, 1940, and comparison with corresponding week of 1939 and 5-year median—Continued

Division and State	Whooping cough, week ended— Nov. 30, 1940	Dec. 2, 1939	Division and State	Whooping cough, week ended— Nov. 30, 1940	Dec. 2, 1939
NEW ENG.			SO. ATL.—continued.		
Maine	24	49	North Carolina [3]	136	46
New Hampshire	0	26	South Carolina [3]	24	14
Vermont	19	71	Georgia [3]	22	9
Massachusetts	210	98	Florida [3]	1	4
Rhode Island	8	14			
Connecticut	91	68	E. SO. CEN.		
MID. ATL.			Kentucky	122	89
			Tennessee [3]	32	42
New York	562	416	Alabama [3]	11	12
New Jersey	187	157	Mississippi [2]	------	------
Pennsylvania	503	439			
			W. SO. CEN.		
E. NO. CEN.					
			Arkansas	15	9
Ohio	271	246	Louisiana [3]	6	39
Indiana	19	72	Oklahoma	17	5
Illinois	220	164	Texas [3]	76	48
Michigan [2]	308	161			
Wisconsin	117	141	MOUNTAIN		
W. NO. CEN.			Montana	5	1
			Idaho	3	0
Minnesota	130	49	Wyoming	1	13
Iowa	37	12	Colorado	17	14
Missouri	51	9	New Mexico	21	24
North Dakota	32	33	Arizona	9	3
South Dakota	0	7	Utah [2]	33	71
Nebraska	29	4	Nevada	0	------
Kansas	76	5			
			PACIFIC		
SO. ATL.					
			Washington	94	35
Delaware	32	15	Oregon	15	24
Maryland [2]	107	70	California [3]	462	155
Dist. of Col.	10	19			
Virginia [3]	133	35	Total	4,310	3,042
West Virginia [2]	12	5	48 weeks	155,280	162,828

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Typhus fever, week ended November 30, 1940, 41 cases, as follows: Virginia, 2; North Carolina, 4; South Carolina 3; Georgia, 14; Florida, 1; Tennessee, 1; Alabama, 6; Louisiana, 3; Texas, 5; California, 2.

MONTHLY REPORTS FROM STATES

Case reports consolidated for the quarter July–September 1940

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
NEW ENG.																	
Maine	9	11	3		530	3	1		8		0	30	0	23		6	367
New Hampshire					38	0			3		0	20	0	3		1	7
Vermont	3	14			74	2			2		0	27	0	5		10	170
Massachusetts	26	68		1	3,544	7		3	27		0	404	0	72		14	1,505
Rhode Island		7			260	2	1		10		0	33	0	14		1	40
Connecticut	2	34	12		128	2			13		0	132	0	34		30	525
MID. ATL.																	
New York	87	319		31	3,634	34	[1] 34		137		0	1,161	0	161	12	67	3,478
New Jersey	54	122	21	12	2,058	3	17		29		8	448	0	59		24	1,249
Pennsylvania	94	131		8	1,722	26	14	3	71		6	971	0	209		30	4,690
E. NO. CEN.																	
Ohio	67	38	105	39	232	6			355	1	3	784	1	144		34	3,718
Indiana	70		50	15	77	7			512		7	221	5	61		16	237
Illinois	147	48	47	89	920	13	10	1	293		9	1,164	19	165		51	1,760
Michigan	32	57	43	24	2,018	8			832		0	794	7	59		27	3,392
Wisconsin	12		220	3	2,548	12			229		0	612	13	5		41	1,323
W. NO. CEN.																	
Minnesota	18		23	8	146	3			98		0	271	30	32		43	497
Iowa	40	12	16	26	450	14			617		18	213	34	35		76	370
Missouri	41		6	69	58	8	1	2	197		6	166	4	158		8	447
North Dakota	54		22		13	3	1		15		0	47	24	10		4	161
South Dakota	18		3		26	0			57		1	62	37	6			55
Nebraska	9				75	7			97		0	45	2	16		1	75
Kansas	65	9	20	12	232	5		1	410		0	303	0	77	1	34	591
SO. ATL.																	
Delaware	2				13	0			1		3	21	0	14		1	99
Maryland	27	8	21	5	48	5		3	8		37	116	0	51	1	7	1,387
Dist. of Col.	37				18	2			1		8	60	0	18		2	95
Virginia	117		548	59	364	12		15	114		31	150	0	125	3	9	728

West Virginia	57		84	6	45	17		2	440		1	205	0	110		2	626
North Carolina	199	15	17	370	238	6		31	41		15	372	2	138	27	3	1,333
South Carolina	267	21	1,433	4,476	97	0	10	410	6		0	51	2	183	36	7	251
Georgia	95		138	1,358	102	2		61	11	2	7	135	0	282	201	44	199
Florida	35	1	20	55	53	1		26	14		0	21	0	41	65	22	47
E. SO. CEN.																	
Kentucky	79	15	30	30	341	11		4	140		2	219	2	190		3	677
Tennessee	53	8	117	451	195	10	10	37	25	6	8	253	7	186	5	7	565
Alabama	110	3	250	6,526	463	20	4	112	27		0	190	6	150	120	32	239
Mississippi	85		3,008	21,230	331	4	23	1,214	16	101	0	97	4	131	18	13	1,979
W. SO. CEN.																	
Arkansas	64	9	86	1,864	91	1		107	13		0	72	0	349		3	257
Louisiana	62		38	250	21	8	3	18	79	([2])	0	51	0	298	44	20	489
Oklahoma	60		644	895	52	9		36	104		9	116	15	211	2	36	173
Texas	231		1,276	2,892	786	17	9	422	91		0	186	6	644	152	112	2,398
MOUNTAIN																	
Montana	22	7	23		145	7			88		4	113	1	7	1	2	75
Idaho	2	1	1	6	35	0			29		0	48	0	29		1	83
Wyoming	11	6	1	7	45	2			19		[3] 10	27	4	12		5	69
Colorado	75		32	3	100	0			17		3	117	24	36		17	174
New Mexico	29	15	7	7	127	2		2	17	4	1	16	1	53		15	268
Arizona	15	17	288	12	226	1		5	4		0	22	2	25		7	132
Utah	5	10	8	2	303	0			21		1	55	1	13		5	744
Nevada			1	1	4	0			1		1	2	0	6		1	13
PACIFIC																	
Washington	19	16	9		164	6			201		0	170	2	29		5	536
Oregon	32		50	13	249	3			37		2	74	9	29		3	210
California	181	229	171	84	966	13	13	15	217		1	692	5	123	6	76	3,732
Total	2,819	1,251	8,892	40,939	24,405	324	151	2,530	5,794	115	202	11,559	269	4,831	694	978	42,235
Alaska	9		9		128							3	1	5			
Hawaii	15	20	401	2	29	2			9			2		19	26		131

[1] Exclusive of New York City.
[2] Septicemia (undefined), Louisiana, 36.
[3] Also 1 case of Colorado tick fever was reported.

Case reports consolidated for the quarter July–September 1940—Continued

Division and State	Actino-mycosis	Chick-enpox	Dysen-tery, amoebic	Dysen-tery, bacil-lary	Dysen-tery, unde-fined	En-cepha-litis, epi-demic or le-thargic	En-cepha-litis, equine	Hook-worm disease	Mumps	Rabies in ani-mals	Rabies in man	Septic sore throat	Teta-nus	Tra-choma	Trichi-nosis	Tula-remia	Vin-cents' infec-tion
NEW ENG.																	
Maine	1	194							43	3		2	1				12
New Hampshire		22							6								
Vermont		146							135								26
Massachusetts	1	570	1	129		3			641	4		20	7	2	8		
Rhode Island		38				3			25	5		15					
Connecticut		311		60		1			152			39	4		8		
MID. ATL.																	
New York		1,992	20	160		28				38		205	15		42		129
New Jersey		727	6	4		9			1,184	75		18	1	1	5		
Pennsylvania		1,495	2	12		2			931						2	2	
E. NO. CEN.																	
Ohio		653		166		5			372		1	5	12	7	2		
Indiana		209		10		2			75	49	1	2	1			4	
Illinois	2	815	16	35		11		1	697	46	1	9	17	93	5	15	76
Michigan	1	658	5	13		5				3		157	4	1	5	1	36
Wisconsin		1,069				2			1,095			11				3	
W. NO. CEN.																	
Minnesota		347	7	9		5				4		32	6	7		7	
Iowa		80	4	2	4	9			216			9				12	
Missouri		44			44	2			56			7	2	76		15	
North Dakota		46				7			28			9		4			9
South Dakota		27							65			7		29			
Nebraska		27				5			42			1					
Kansas		107		4		18			81	1		15				6	47
SO. ATL.																	
Delaware		9				1			22								
Maryland		104	3	43	17				76			22	2	4		1	33
Dist. of Col		52				4										1	
Virginia		119	5	1,137		1			40			227	5			9	
West Virginia		78		3					52		2	8					
North Carolina		74		5								14		4			18
South Carolina		89	1					291	67	49	1		2			1	
Georgia		40	27	209	69			2,164	94			140	5	4		16	
Florida		23	12	6		2		1,574	15	1		14	5	1		2	16

E. SO. CEN.																	
Kentucky		73		87		1			180			28		45		13	
Tennessee		51	9	242		4		7	186		1	39	3	10		14	21
Alabama		29	1			7			106	48			13				
Mississippi		317	589	4, 974				2, 348	479	14				19			
W. SO. CEN.																	
Arkansas		28	79	305				8	102	42	2	266	6	360	1	26	
Louisiana		12	11	4		1		402	1	18		8	10	11		3	
Oklahoma		221	6	456		1			34	43		99		309		13	26
Texas		235	140	1, 546		6			347	1				15		11	
MOUNTAIN																	
Montana		92		27		30			54			16	1	4		7	5
Idaho		35	3	1					73					1		3	
Wyoming		15		1	10	3			14			9				47	7
Colorado		137	5	85		44			256			14				7	
New Mexico		28	5	50	44	2			17	19		10		1		2	
Arizona		32			288	1			154			1		137		3	
Utah		231	1		155				80			11				21	
Nevada		7	1				1		1			29		1		8	
PACIFIC																	
Washington		325	1	14		10	81		259	17		8	1	11		1	3
Oregon		135	13	1					145	20		10		1		3	22
California		1, 273	51	118		135			1, 496	59	1	8	17	29	13	3	
Total	5	13, 441	1, 024	9, 918	631	370	82	6, 795	10, 194	559	10	1, 544	140	1, 187	91	280	486
Alaska		35										6					1
Hawaii		53	1					47	24				5	4			

[1] Exclusive of New York City.

Anthrax: Massachusetts, 4; New York, 1; New Jersey, 3; Pennsylvania, 6; Louisiana, 1; Texas, 1; Colorado, 1; Arizona, 1.
Botulism: Washington, 3; California, 4.
Colorado tick fever: Wyoming, 1.
Dengue: South Carolina, 9; Florida, 4; Mississippi, 3.
Diarrhea: Ohio, 731 (under 2 years; enteritis included); Michigan, 3 (infant diarrhea); Maryland, 51; South Carolina, 4,700; Nevada, 2 (infant diarrhea); New Mexico, 186 (enteritis included).
Food poisoning: Kansas, 3; New Mexico, 3; Washington, 7; California, 396.
Granuloma, coccidioidal: California, 12.
Leprosy: Hawaii Territory, 6; Illinois, 1; Louisiana, 7; Texas, 6; California, 2.
Plague, bubonic: Idaho, 1.
Psittacosis: New York, 1; California, 1.
Rat bite fever: Tennessee, 2.
Relapsing fever: Kansas, 1; Texas, 7; California, 18.
Weil's disease: Hawaii Territory, 2; Michigan, 2.

WEEKLY REPORTS FROM CITIES

City reports for week ended November 16, 1940

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	198	90	34	558	483	959	6	325	34	998	--------
Current week [1]	75	118	26	1,081	335	636	3	328	33	1,299	--------
Maine:											
Portland	0	------	0	0	3	2	0	0	0	4	36
New Hampshire:											
Concord	0	------	0	0	1	3	0	0	0	0	10
Manchester	0	------	0	0	0	0	0	0	0	0	15
Nashua	0	------	0	0	0	0	0	0	0	0	9
Vermont:											
Barre	------	------	------	------	------	------	------	------	------	------	------
Burlington	0	------	0	0	0	0	0	0	0	0	8
Rutland	0	------	0	0	0	0	0	0	0	0	2
Massachusetts:											
Boston	1	------	0	55	16	28	0	9	0	84	194
Fall River	1	------	0	0	0	2	0	1	0	14	34
Springfield	0	------	0	0	2	2	0	1	0	0	30
Worcester	1	------	0	72	2	1	0	1	0	0	37
Rhode Island:											
Pawtucket	0	------	0	0	0	0	0	0	0	0	19
Providence	0	------	0	2	2	2	0	0	1	2	61
Connecticut:											
Bridgeport	0	------	0	0	1	1	0	1	2	1	19
Hartford	0	------	0	0	2	3	0	0	0	3	45
New Haven	0	1	0	0	1	3	0	1	0	21	51
New York:											
Buffalo	0	------	0	3	7	4	0	5	0	29	134
New York	16	11	4	201	59	73	0	67	11	138	1,457
Rochester	0	1	0	2	0	3	0	1	0	19	49
Syracuse	0	------	0	0	2	1	0	0	0	14	47
New Jersey:											
Camden	0	------	0	14	0	3	0	1	0	2	34
Newark	0	2	0	7	3	15	0	5	0	19	111
Trenton	0	------	1	0	1	2	0	2	0	3	42
Pennsylvania:											
Philadelphia	2	1	0	221	18	41	0	21	2	140	478
Pittsburgh	1	1	0	5	15	15	0	4	5	37	158
Reading	1	------	0	4	3	1	0	0	0	32	25
Scranton	1	------	--------	1	-------	0	0	-------	0	2	--------
Ohio:											
Cincinnati	1	------	0	0	2	16	0	4	0	3	98
Cleveland	0	16	0	1	5	19	0	8	4	97	199
Columbus	0	------	0	0	3	14	0	2	1	21	86
Toledo	0	1	1	1	1	6	0	5	0	7	43
Indiana:											
Anderson	0	------	0	0	0	3	0	0	0	0	8
Fort Wayne	0	------	0	0	0	0	0	0	0	0	18
Indianapolis	4	------	0	1	3	11	0	3	0	8	113
Muncie	0	------	0	1	1	1	0	0	0	0	9
South Bend	0	------	0	0	1	1	0	0	0	0	19
Terre Haute	0	------	0	0	1	1	0	0	0	0	13
Illinois:											
Alton	0	------	0	0	3	0	0	0	0	1	16
Chicago	5	3	0	167	18	93	0	47	0	73	699
Elgin	0	------	0	0	0	0	0	0	0	0	8
Moline	0	------	0	0	0	0	0	0	0	0	11
Springfield	0	------	0	2	1	9	1	1	0	3	29
Michigan:											
Detroit	3	------	0	240	10	46	2	8	1	143	271
Flint	0	------	0	0	1	1	0	2	0	2	30
Grand Rapids	0	------	1	0	0	7	0	0	0	21	44
Wisconsin:											
Kenosha	0	------	0	0	0	1	0	0	0	0	7
Madison	0	------	0	0	0	2	0	0	0	4	16
Milwaukee	0	------	0	20	4	13	0	2	0	31	83
Racine	0	------	0	1	0	1	0	0	0	1	9
Superior	0	------	0	0	0	2	0	0	0	0	10

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

City reports for week ended November 16, 1940—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	------	0	0	1	2	0	0	0	4	12
Minneapolis	0	------	1	3	2	16	0	1	0	12	99
St. Paul	0	------	0	0	10	9	0	3	0	10	66
Iowa:											
Cedar Rapids	0	------	------	0	------	6	0	------	0	0	------
Davenport	0	------	------	1	------	4	0	------	0	0	------
Des Moines	0	------	0	0	0	7	0	0	0	4	27
Sioux City	0	------	------	0	------	8	0	------	0	0	------
Waterloo	0	------	------	0	------	3	0	------	0	1	------
Missouri:											
Kansas City	0	------	0	2	5	3	0	4	0	20	94
St. Joseph	0	------	0	0	3	3	0	1	0	1	20
St. Louis	0	3	1	2	11	21	0	6	1	28	189
North Dakota:											
Fargo	0	------	0	1	1	1	0	0	0	2	16
Grand Forks	0	------	------	1	------	0	0	------	0	0	------
Minot	0	------	0	1	0	0	0	0	0	0	3
South Dakota:											
Aberdeen	0	------	------	0	------	1	0	------	0	2	------
Sioux Falls	0	------	0	0	0	5	0	0	0	0	7
Nebraska:											
Omaha	0	------	0	1	3	4	0	2	0	0	48
Kansas:											
Lawrence	0	------	0	0	1	0	0	0	0	0	3
Topeka	0	------	0	0	4	6	0	0	0	1	19
Wichita	0	------	0	0	5	0	0	0	0	14	28
Delaware:											
Wilmington	0	------	0	0	1	2	0	0	0	12	23
Maryland:											
Baltimore	0	1	2	4	11	19	0	17	0	71	187
Cumberland	0	------	0	0	1	1	0	0	0	0	11
Frederick	0	------	0	0	0	0	0	0	0	0	1
Dist. of Col.:											
Washington	14	1	0	1	10	10	0	10	1	3	158
Virginia:											
Lynchburg	0	------	0	0	0	1	0	0	0	0	13
Norfolk	0	------	0	0	1	2	0	0	0	0	28
Richmond	0	------	1	0	1	4	0	1	0	0	41
Roanoke	1	------	0	7	1	1	0	0	0	2	18
West Virginia:											
Charleston	0	2	0	0	2	1	0	1	0	0	43
Huntington	1	------	------	0	------	0	0	------	0	0	------
Wheeling	0	------	0	0	3	0	0	1	0	1	18
North Carolina:											
Gastonia	2	------	------	0	------	0	0	------	0	2	------
Raleigh	1	------	0	0	1	2	0	0	0	3	13
Wilmington	1	------	0	0	0	2	0	0	0	1	9
Winston-Salem	2	------	0	1	2	1	0	2	0	25	18
South Carolina:											
Charleston	0	10	0	2	1	3	0	2	0	0	22
Florence	0	5	0	0	0	0	0	0	0	0	9
Greenville	0	------	0	2	2	2	0	0	0	9	12
Georgia:											
Atlanta	2	3	0	1	0	4	0	5	0	2	67
Brunswick	0	------	0	0	0	0	0	0	0	0	2
Savannah	0	14	1	0	1	0	0	2	0	0	35
Florida:											
Miami	0	------	0	0	1	0	0	1	0	0	33
Tampa	0	------	1	0	0	1	0	2	0	0	25
Kentucky:											
Ashland	0	------	0	0	1	1	0	1	0	0	7
Covington	1	------	0	2	4	1	0	2	0	2	14
Lexington	0	------	0	20	0	0	0	0	0	2	14
Louisville	0	------	0	0	5	12	0	0	0	1	49
Tennessee:											
Knoxville	1	------	0	0	2	1	0	1	------	2	------
Memphis	0	------	1	5	2	6	0	3	0	3	73
Nashville	0	------	2	0	2	3	0	1	1	5	49
Alabama:											
Birmingham	0	3	1	10	5	3	0	2	0	2	61
Mobile	0	2	3	0	1	2	0	0	0	0	29
Montgomery	0	------	------	0	------	0	0	------	0	0	------
Arkansas:											
Fort Smith	0	------	------	1	------	0	0	------	0	0	------
Little Rock	0	------	0	0	1	1	0	1	0	0	------

City reports for week ended November 16, 1940—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								
Louisiana:											
Lake Charles	1	------	0	0	0	1	0	0	0	0	5
New Orleans	3	3	1	1	16	1	0	10	0	4	160
Shreveport	0	------	0	0	0	0	0	1	0	0	42
Oklahoma:											
Oklahoma City	0	------	0	0	3	1	0	0	0	0	41
Tulsa	1	------	0	0	1	6	0	0	0	5	22
Texas:											
Dallas	2	------	0	0	4	5	0	1	1	2	63
Fort Worth	0	------	0	10	0	3	0	0	0	2	37
Galveston	0	------	0	0	3	0	0	0	0	0	15
Houston	4	------	1	0	4	6	0	2	1	0	78
San Antonio	0	2	1	0	5	0	0	8	0	5	57
Montana:											
Billings	0	------	0	0	1	1	0	0	0	0	7
Great Falls	0	------	0	2	3	1	0	1	0	0	14
Helena	0	------	0	0	0	1	0	0	0	0	3
Missoula	0	------	0	0	0	0	0	0	0	0	5
Idaho:											
Boise	------	------	------	------	------	------	------	------	------	------	------
Colorado:											
Colorado Springs	0	------	0	0	2	6	0	0	0	0	7
Denver	2	------	2	9	4	6	0	5	1	11	89
Pueblo	0	------	0	0	1	3	0	0	0	0	7
New Mexico:											
Albuquerque	0	------	0	0	1	0	0	1	0	0	9
Utah:											
Salt Lake City	0	------	0	1	4	6	0	0	0	16	36
Washington:											
Seattle	2	------	0	1	3	5	0	3	0	3	98
Spokane	0	------	0	0	0	1	0	1	0	0	28
Tacoma	0	------	0	2	1	5	0	1	0	6	39
Oregon:											
Portland	1	1	0	3	4	4	0	1	0	1	66
Salem	0	1	------	0	------	0	0	------	0	5	------
California:											
Los Angeles	2	38	1	5	4	13	0	22	0	36	302
Sacramento	3	------	0	2	0	7	0	4	0	0	45
San Francisco	0	------	0	0	4	2	0	5	0	29	166

State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths	
New York:			
Buffalo	1	1	0
New York	0	0	1
Pennsylvania:			
Philadelphia	0	0	2
Ohio:			
Cincinnati	0	0	2
Cleveland	0	0	2
Columbus	0	0	1
Toledo	0	0	1
Illinois:			
Chicago	0	0	8
Elgin	0	0	1
Michigan:			
Detroit	2	0	2
Wisconsin:			
Madison	0	0	1
Minnesota:			
Minneapolis	0	0	1
Missouri:			
St. Joseph	1	0	0
St. Louis	0	0	1
Kansas:			
Wichita	0	0	1

State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths	
Maryland:			
Baltimore	0	0	1
Virginia:			
Norfolk	0	0	1
West Virginia:			
Charleston	0	0	1
North Carolina:			
Raleigh	0	0	1
Florida:			
Miami	0	0	1
Tennessee:			
Knoxville	0	0	1
Louisiana:			
New Orleans	0	0	2
Shreveport	0	1	0
Colorado:			
Denver	0	0	1
Washington:			
Seattle	0	0	2
California:			
Los Angeles	0	0	1

Encephalitis, epidemic or lethargic.—Cases: Pittsburgh, 1; Topeka, 1.
Pellagra.—Cases: Charleston, S. C., 1; Montgomery, 1; Los Angeles, 2.
Typhus fever.—Cases: Raleigh, 1; Savannah, 1; Montgomery, 1; New Orleans, 1; Dallas, 1.

TERRITORIES AND POSSESSIONS

HAWAII

Influenza.—The mild epidemic of influenza in the Territory of Hawaii has apparently terminated. For the week ended November 22, 960 cases were reported, and for the week ended November 30 there were 449 cases.

Plague.—A rat found on October 25, 1940, in Paauhau Area, Hamakua District, Island of Hawaii, has been proved positive for plague.

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FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended November 2, 1940.—During the week ended November 2, 1940, 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		3		2	8			2	2	17
Chickenpox		6	8	106	251	62	40	92	35	600
Diphtheria		38	6	51	1	7		3		106
Dysentery					2		1			3
Influenza		4			2	1			53	60
Measles		32	2	83	222	103	25	77	50	594
Mumps				21	51	28	1	11	9	121
Pneumonia		3			15				6	24
Poliomyelitis				1	3				1	5
Scarlet fever		16	6	122	100	8	8	19	28	307
Trachoma									5	5
Tuberculosis		1	3	58	33	5		2		102
Typhoid and paratyphoid fever			1	40	8	1	2		3	55
Whooping cough		3	9	290	111	35	11	27	5	491

NOTE.—No cases of the above diseases were reported from Prince Edward Island for this period.

GUATEMALA

Vital statistics—Year 1939.—Following are vital statistics for Guatemala for the year 1939:

Population, Apr. 7, 1940	3,284,269
Number of marriages	6,118
Number of marriages per 1,000 population	1.98
Number of births	104,809
Number of births per 1,000 population	33.99
Number of deaths	66,046
Number of deaths per 1,000 population	21.42
Deaths under 2 years of age	33,376

SWITZERLAND

Notifiable diseases—June 1940.—During the month of June 1940, cases of certain notifiable diseases were reported in Switzerland as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	44	Paratyphoid fever	16
Chickenpox	99	Poliomyelitis	5
Diphtheria and croup	22	Scarlet fever	328
German measles	78	Tuberculosis	272
Lethargic encephalitis	2	Typhoid fever	6
Measles	870	Undulant fever	12
Mumps	50	Whooping cough	164

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 November 29, 1940, pages 2246-2249. A similar table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Plague

Argentina—Cordoba Province.—During the month of October 1940, 3 cases of plague were reported in Cordoba Province, Argentina.

Yellow Fever

Colombia.—During the month of August 1940, 1 case of yellow fever with 1 death was reported in Colombia, no specific location being given.

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