THREE OUTBREAKS OF FOOD POISONING APPARENTLY DUE TO B. ENTERITIDIS, B. PARATYPHOSUS B (AERTRYCKE TYPE), AND B. PARATYPHOSUS A, RESPECTIVELY

There are recorded here three outbreaks of food poisoning of the same clinical type and apparently due to the same group of bacterial organisms. It is interesting to note that two of the outbreaks occurred in hospitals.

(1) OUTBREAK AT SACRAMENTO, CALIF.

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This outbreak was investigated in the field by one of us (Gray). The epidemiologic and bacteriologic data are as follows: On January 20, about 60 women and their families, members of a lodge auxiliary, attended a banquet in honor of visitors from outside cities. The banquet hall was situated in the basement of a building, and the kitchen in which final preparations were made was found to be in an unclean condition. Dishes were kept on shelves in a cupboard known to be rat infested. No definite information was obtainable, however, as to measures used previously to destroy rats, but it was admitted that such efforts had been made. The cooking utensils were imported from numerous private homes. The menu consisted of a chicken-veal-cream-sauce mixture, tomato sauce made from commercially canned tomatoes, commercially canned peas, fresh cauliflower, coconut and chocolate nut cakes, and coffee.

The meat dish was prepared at the banquet hall early in the evening of the 19th. The chickens had been killed on the 18th and cooked and "boned" that evening. The meat from these was left overnight in a pan. The veal was purchased from a market in an outlying district on the morning of the 19th. During the day the veal and chicken were "diced" at the hall. The chickens and veal were originally prepared by the same person. The "dicing" of

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At this point one of the numerous difficulties as to classifying causative bacteria now arises, because of the terminology for subtypes of *B. paratyphosus* B. The term "Salmonella group" is often used to add to the confusion, while, Savage and White (11) refer to "Mutton and Derby types." Jordan (12) has attempted to classify the matter of types by using the term *B. paratyphosus* B "Schottmüller type" and limiting such a type to organisms coming from human sources. Many investigators, however, classify another type of *B. paratyphosus* B "aerycke type" where the source is presumably from animals.

It is interesting to note, particularly in outbreak No. 3, the absence of infections as would be indicated by prolonged fevers. There did occur, however, three cases of appendicitis in those affected with symptoms of food poisoning shortly after outbreak No. 2. All these different types of organisms isolated in these three outbreaks and considered to belong to the same biological group produced to a varying degree heat stabile poisons. Furthermore, the original food involved in outbreak No. 2 caused symptoms in a monkey, when fed directly by mouth, that resembled very closely those of food poisoning in human beings.

Bibliography


**SOME ASPECTS OF SHIP FUMIGATION**

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The fumigation of ships for the destruction of rodents is a problem which has received much study and attention from various officers of the Public Health Service. The use of suitable cyanogen products has practically replaced the use of sulphur in fumigation at all of the quarantine stations of the larger ports.

Several cyanogen products have been used at San Francisco during the past few years. These, together with the methods, include the following:
1. The generation of straight hydrocyanic-acid gas by a mixture of sodium cyanide, sulphuric acid, and water.

2. The generation of hydrocyanic-acid and cyanogen-chloride gas by a mixture of sodium cyanide, sodium chlorate, hydrochloric acid, and water.

3. Liquid hydrocyanic acid with either cyanogen chloride or chloropicrin as a warning gas.

4. Zyklon-B, which consists of an earthy substance impregnated with liquid hydrocyanic acid and marketed at present with 5 per cent chloropicrin as a warning gas.

The two latter methods of fumigation afford a saving in time and labor and have almost entirely displaced the generation methods at the San Francisco station. Generation of cyanide gas on shipboard with the use of crocks and barrels was a laborious process.

**LIQUID HYDROCYANIC ACID**

Liquid hydrocyanic acid is also called liquid gas or liquid cyanide, and may be correctly termed prussic acid. This acid when of high-grade purity is exceedingly volatile in warm dry air, and its boiling point is about 74° F. The cylinders containing liquid cyanide should not be exposed to the hot sun for long periods. In use it appears that the vaporization of the gas is more complete on warm days at higher temperatures. It is a colorless liquid and less than three-fourths the weight of water. Hydrocyanic-acid gas is inflammable when concentrated but not so when diluted. Care must be taken not to ignite the concentrated gas.

The liquid hydrocyanic acid is manufactured for commercial use by the generation of gas from a mixture of sodium cyanide, sulphuric acid, and water. The gas is led from the closed generator through a series of refrigerated pipes and condensed to a liquid. The liquid can be distilled to separate excess water from the acid until a purity of 96 to 98 per cent is obtained (1).

In general, liquid cyanide is used chiefly for the fumigation of fruit trees or fruit products for the control of insect pests and for ship fumigation for the destruction of rodents and insects. The use of liquid cyanide for tree fumigation was begun in this country in 1916 and has become a popular method of insect control (2).

The use of "liquid gas" in ship fumigation was started at the San Francisco station in 1925 and was extensively used during 1926. Our records show that this method was employed in whole or in part in the fumigation of about 1,000 vessels during the period July, 1927, to April, 1930.

The liquid cyanide has been used with either 20 per cent cyanogen chloride or 10 or 5 per cent chloropicrin as a warning gas. In the
former case the cylinders as purchased are labeled to contain hydrocyanic acid not less than 76 per cent, cyanogen chloride not less than 20 per cent, and inert matter not more than 4 per cent. In the latter case the labels read: “Hydrocyanic acid not less than 91 per cent, chloropicrin not less than 5 per cent, and inert matter not more than 4 per cent.”

The liquid cyanide is shipped to this station from the manufacturing plant in heavy metal cylinders containing 75 pounds avoirdupois each. This method of shipment conforms to the Federal interstate regulations.

The equipment necessary for ship fumigation consists of a small motor attached to an air pump and a supply of dosing cylinders equipped with the proper valves and rubber hose.

The dosing, or applying, cylinders are about 2 feet tall and have a capacity of about 10 pounds. They are made from heavy-gage metal and weigh about 21 pounds when empty. The liquid cyanide is forced from the large shipping cylinder into the small dosing cylinder by compressed-air pressure. It is customary to use one cylinder for each hold or other large compartment. Having a record of the cubic capacity of each hold, the dosage is computed on the basis of 60 gm. (2 oz.) per 1,000 cubic feet. The small cylinder is balanced upon a pair of scales, and then the scales are set to weigh the desired amount of liquid.

A rubber hose leads from the air pump to the large cylinder and another hose from the large cylinder to the dosing cylinder. When air pressure is applied and the valves are opened, enough liquid is forced over from the large cylinder to bring the small cylinder up to the required weight. (Fig. 1.)

Before taking the small cylinders to the vessel, compressed air is pumped into them to give a pressure of about 100 pounds, which is indicated upon a gauge on top of the cylinder. (Fig. 2.) A rubber hose about 10 feet in length is attached to the cylinder before use. This hose has a fine nozzle on the end of it. When ready for use, the hose is put down through the hatch opening into the hold and a valve on top of the cylinder is opened. (Fig. 3.) Then the compressed air forces the liquid cyanide through the fine nozzle, and it is expelled as a mist, which immediately becomes gas. The liquid is subjected to atomization and is discharged in a vapory spray. The gas diffuses and permeates through the open spaces of the compartment or hold.

The cylinders and hose are washed out frequently and the apparatus checked over before use. The applicating cylinders when loaded rarely exceed 30 pounds in weight and can be transported by launch to the vessel and easily handled.

An apparatus has been recently supplied for the use of small doses in individual compartments. This is a metal portable container for
FIGURE 1.—Air pump and motor in background, connected by rubber hose with shipping cylinder and dosing cylinder, the latter being shown on the scales, which are set to the desired amount.

FIGURE 2.—Air pump with hose connected for applying pressure to dosing cylinder.
FIGURE 3.—Method of dosing holds with liquid hydrocyanic acid. Rubber hose is inserted under tarpaulin covering hatch.

FIGURE 4.—Dosing cylinder with hand air pump and measuring device for dosing small compartments.
the liquid cyanide, to which is attached a hand-operated air pump and accurate measuring devices. A rubber hose with a spray nozzle is attached to the cylinder or container. (Fig. 4.) An upward stroke of the pump draws a graduated amount of the liquid into the pump, which is expelled in a fine mist on the downward stroke of the pump. This is very convenient for dosing a series of isolated rooms requiring only a few ounces each.

Both of the warning gases which have been used with liquid cyanide produce a tear effect. The effect of the 20 per cent cyanogen-chloride gas is greater than that of 5 per cent chloropicrin, i.e., lachrimation is much more marked; and it is believed that, on account of the tear effect, a person unfamiliar with fumigation could escape from a small room containing hydrocyanic-acid gas with 20 per cent cyanogen chloride before inhaling a dangerous amount of cyanide.

The lachrimation which is produced by 5 per cent chloropicrin is much less, and even when used by experienced fumigators it would seem desirable to have a more pronounced warning effect. One should always use test animals to see whether a ship's hold is free of cyanide gas after using this irritant as a warning gas.

Liquid gas with 5 per cent chloropicrin is quoted at a cheaper price than with 20 per cent cyanogen chloride. Since the former mixture contains 91 per cent hydrocyanic acid as against 76 per cent in the latter mixture, more lethal power is purchased for less money. Experiments at this station with roaches indicate that the former mixture is more deadly for that insect and presumably so also for rats.

**EQUIVALENTS**

The quarantine regulations prescribe that when using the generation method there shall be used for killing rats 5 ounces (150 gm.) of sodium cyanide with an appropriate amount of sulphuric acid and water per 1,000 cubic feet.

It is stated (2) that, based on chemical determination, 1 ounce (30 gm.) of 97 per cent sodium cyanide (containing not less than 51 per cent cyanogen) with 93 per cent gas generation equals 20.44 cubic centimeters of liquid gas, 98 per cent purity at 60° F. Then, 5 ounces (150 gm.) of sodium cyanide under the same conditions would equal 102.2 cubic centimeters. At 60° F. 40 cubic centimeters of 97 per cent liquid gas weighs 30 gm., so that the equivalent of 150 gm. of sodium cyanide would be 76.5 gm. of liquid gas.

It is probable, though, that under actual working conditions, with varying temperatures, not more than 60 to 80 per cent of the potential amount of gas is generated and liberated. Allowing 80 per cent generation, 63 gm. of liquid gas, 98 per cent pure, should be considered as at least the equivalent in lethal effect of 150 gm. of sodium cyanide.
July 3, 1931

The regulations prescribe that when generating hydrocyanic-acid-cyanogen-chloride mixture there shall be used 4 ounces (120 gm.) of sodium cyanide with 3 ounces (90 gm.) of sodium chlorate and an appropriate quantity of hydrochloric acid and water. Then 120 gm. of sodium cyanide at about 80 per cent generation would yield 52.5 gm. of liquid gas 98 per cent pure at 60° F.

In practice it is customary and desirable to use 60 gm. of liquid cyanide, mixed with either 20 per cent cyanogen chloride or 5 per cent chloropicrin per 1,000 cubic feet for rat and vermin destruction. However, we know that under laboratory conditions a very much smaller dose of cyanide will kill rats promptly.

ZYKLON-B

Zyklon-B is liquid hydrocyanic acid absorbed by an earthy substance called "diatomite" and packed in strong tin containers. Cans are provided containing 15 grams, 120 grams, 480 grams, and 1,200 grams of hydrocyanic acid with 5 per cent chloropicrin as a warning gas. The cans at present are packed with a slight vacuum, which is shown by dents or sinking in of the sides of the cans.

The fumigator opens the cans by knocking holes in each end with a special hammer and sprinkling the contents on the floor of the hold or spreading in a thin layer on canvas or paper on the floor of a compartment. The hold may be dosed by a fumigator standing on deck, and the residue of diatomite, which is left after the hydrocyanic acid has evolved, may be left on the floor of the hold (3). It is customary to throw the residue overboard after use in the superstructure compartments.

Directions on the cans state that Zyklon-B may be satisfactorily used in the proportion of 60 grams per 1,000 cubic feet. Experiments by Akin and Sherrard (3) show that rats are killed under laboratory conditions in 30 to 45 minutes by one-twelfth of this dose, or 5 grams per 1,000 cubic feet. This applies to straight liquid hydrocyanic acid 96 to 98 per cent pure and should equally apply to Zyklon-B. Experiments at this station on ships show that it is not safe to rely in practice upon less than the standard dose of 60 grams per 1,000 cubic feet.

The time of exposure is prescribed as two hours for an empty vessel and four hours for a vessel with cargo aboard. The longer time allows for more complete penetration. It must be understood that all holds or compartments are tightly sealed during fumigation.

SAFETY MEASURES

Gas masks must be worn by fumigators when in any way exposed to the fumes of cyanide gas in dangerous concentration. This is necessary when opening cans of Zyklon-B, when dosing compartments with
liquid cyanide, and when opening up compartments for ventilation. The canister attached to the mask is charged with chemicals which neutralize hydrocyanic-acid and cyanogen-chloride gas. These absorbent chemicals are a caustic silicate and an impregnated charcoal (4). They offer little resistance to breathing and are effective for several hours' use. The absorptive and neutralizing capacity of the canister becomes exhausted gradually, so that ample warning is given to replace the worn-out canister.

Two men should always work together in any place where there is danger from gas, such as in the holds or in compartments not immediately adjacent to an exit.

Test animals, such as rats or guinea pigs, should always be lowered into holds following fumigation, to test for the presence of gas in dangerous quantity before the fumigator himself goes below to make the final inspection.

Hydrocyanic-acid gas is one of the most deadly gases known and should be used with great care and caution. A person exposed for a short period to a strong concentration of cyanide gas, even though wearing an efficient gas mask, will suffer a marked effect from the gas. This is probably explained by absorption through the clothing and moist skin.

**COMPARATIVE MERITS**

At present the cost of liquid hydrocyanic acid with 5 per cent chloropicrin is slightly less than that of Zyklon-B.

The two fumigants possess equal lethal power. They are both convenient to use and require an equal number of fumigators on shipboard. In dosing the holds it is necessary only to open a valve when using the liquid gas; and the new cylinder which delivers small accurate doses is convenient for use in small rooms.

In using Zyklon-B it is necessary only to knock holes in the cans and sprinkle out the contents. The empty cans are thrown away.

The preparations for the use of liquid gas require a little more attention, as the dosing cylinders must be accurately checked, weighed, and filled with compressed air before proceeding to the vessel.

At a station where there is regular routine ship fumigation and cylinders of liquid gas can be received at frequent intervals, this fumigant is very satisfactory. Loaded cylinders, however, should not be stored with air pressure applied, as there may be a degree of deterioration of the gas.

If only infrequent fumigations are done, Zyklon-B would be very satisfactory, as this material can be stored for a longer time before use.

The opening of many small cans of Zyklon-B in a closed space is attended with danger from absorption through the clothing, especially
if fumigators are perspiring. In using liquid gas the operator need not be in intimate exposure to the applied gas. It is found that a combination of the two methods makes an ideal way of fumigation. It is common practice at this station to use both methods in combination on the same vessel.

REFERENCES

(2) U. S. Department of Agriculture. Farmers Bulletin No. 1321.

COMPARATIVE CURRENT STATE MORTALITY STATISTICS

The present report on mortality from certain causes covers, for a majority of the States included, the months January to March, 1931. For some of the States the data for all of these months are not available. The present plan is to publish about three current reports during the year, covering periods of approximately 3 months, 6 months, and 9 months, respectively, with a more complete annual summary of death rates for the calendar year at as early a date as possible in the following year. It is impossible to present data for all of the States on this basis of 3, 6, and 9 months, but each State is included in each report for as many months as possible with rates in each case for the "year to date" and comparative rates for the same period in preceding years. This arrangement makes it possible to compare the mortality of the current calendar year with the mortality of preceding years in the same State.

The rates are computed from current and generally preliminary reports furnished by State departments of health. Because of (a) some lack of uniformity in the method of classifying deaths according to cause, (b) some delayed death certificates, and (c) various other reasons, these preliminary rates can not be expected to agree in all instances with final rates published by the Bureau of the Census, which are based on a complete review and retabulation of the individual death certificates from each State. The preliminary rates given in the accompanying table are intended to serve only as a current index of mortality until final figures are issued by the Bureau of the Census.

Populations used in computing rates are estimates as of July 1 of each year, based on the 1920 and 1930 censuses.

1 From the Office of Statistical Investigations, United States Public Health Service.