Sanitation aboard American Flag Vessels

By EDMUND C. GARTHE, C.E., M.P.H., and HOWARD W. CHAPMAN, B.S.C.E., M.P.H.

When the S.S. *United States* sailed on her maiden voyage a few weeks ago, three decades of maritime sanitary engineering experience in the Public Health Service went with her. This newest, largest, fastest, and costliest passenger ship ever built in this country was constructed in full compliance with every standard of vessel sanitation.

The 12-deck, 2,000-passenger liner is 990 feet long and grosses 53,000 tons. Her crew numbers 1,000. Built into her is the capacity to carry from 12,000 to 14,000 troops in the event of war. On her first trans-Atlantic round trip, she broke the existing speed record for both the east and west crossings. From her red, white, and blue stacks down to her keel, she is a sleek, sturdy beauty, designed and built for comfort and safety as well as speed.

The Public Health Service became involved in the protection of American citizens aboard interstate carriers because State and local health departments were under obvious handicaps in attempting to enforce the most basic sanitary measures. Since then, the sanitary engineers of the Service have built up a fund of knowledge and have developed many features and techniques of sanitary construction and maintenance. These began to flow into the *United States* while her very first plans were still on the architects' drawing boards.

Except for the vast size of this liner, and the glamor associated with her, she represents to the Public Health Service simply one more conveyance built with due regard to health and sanitation. When the trial voyage was completed, a Public Health Service vessel inspector presented the Certificate of Sanitary Construction—the same certificate awarded to any ship built in accordance with established standards.

Mr. Garthe, chief of the interstate carrier branch of the Division of Sanitation, Public Health Service, participated in the meeting of the International Labor Organization's Committee of Experts on Accommodation and Welfare of Migrants on Board Ship, Geneva, September 22–27, 1952. Mr. Chapman is assistant chief of the branch.

It seems to be axiomatic that while accidents and epidemics appear to be dramatic, safety and health do not. That Certificate of Sanitary Construction may never be seen by any of the thousands of passengers the *United States* will carry. Yet, it will be of great personal importance to them. Accompanied by correct operation of facilities, it is their assurance of safe drinking water and sanitary food service; their protection against the diseases borne by rats and other vermin; their guardian against infection from practically any foreseeable environmental source.

Early Sea-going Sanitation

The roots of the Public Health Service vessel-sanitation program date back to the later years of the 19th century. It has been marked by continued cooperation between the Service, the Maritime Administration, and the shipbuilders, naval architects, and ship operators. Objections to high standards of construction and operation were rare, with one of the results being the acceptance of these practices by maritime interests throughout the country.

It was not until 1917, however, when the Interstate Sanitary Districts were established by the Service, that the development of sanitary standards for interstate carriers, and the supervision of their operations affecting public health, became a regular, working function of the Service.

In those earlier days, water supply was practically the only sanitation factor given serious consideration aboard vessels, and for practical purposes only river and Great Lakes vessels were inspected. Efforts were made within the foreign quarantine responsibilities of the Service to improve sanitary conditions aboard ships flying the Stars and Stripes in foreign commerce. An all-inclusive sanitation program began to emerge in 1944.

The Holzendorf Concept

The earlier emphasis in sanitation on ships arriving from overseas ports was on rat control, since the chief purpose of quarantine was to prevent entrance of certain diseases—principally plague—into this country. The fumigation measures used in efforts to eliminate rats aboard ships in the early days were rather costly and time-consuming, and, therefore, understandably unpopular with the operators. In 1920, Public Health Service Pharmacist Benjamin E. Holzendorf conceived, and began working on, the idea of ratproofing ships while they were under construction. He reasoned that it should be possible to build a ship in such a manner that rats would have few places to harbor and nest. This would keep the rat population so limited that fumigation would not be required. Holzendorf was able to demonstrate his theory, and since then through the course of the years definite specifications on the ratproof construction of ships have been developed and have become widely accepted by the industry. The ratproof construction of ships is now an integral part of the over-all sanitation program.

The Interstate Carrier Branch

The purpose of the vessel sanitation program, of course, is to minimize the transmission of disease aboard vessels and to promote the health of crew and passengers. These floating communities must provide all the health facilities which landbound communities in this country are expected to supply—safe water and food, sewage disposal and sanitary facilities. It is difficult enough to provide such facilities and services ashore; to provide them aboard a ship involves problems vastly more complex and difficult. However, very few epidemics traceable to ships have been reported within recent years, and most of these have been traced chiefly to vegetables and other uncooked foods which have been loaded in foreign ports.

The interstate carrier branch of the Division of Sanitation carries out virtually all of the Service's carrier-sanitation responsibilities, including those on railroads, airlines, and buses, as well as ships. Most of the actual inspection work is carried out through regional offices, with the central office establishing policy, preparing and revising standards, and providing technical assistance.

As early as 1930, the Maritime Commission (now Maritime Administration) established a

still-existing policy that all ships constructed under its jurisdiction and subsidized by it must be constructed in accordance with Public Health Service sanitation standards. Virtually all American flagships today are built and operated in compliance with them.

Vessels Under Construction

A vessel which is constructed or reconstructed in accordance with Public Health Service vessel sanitation standards is isued a Certificate of Sanitary Construction (*1*). When it is established that a vessel is to be constructed in accordance with these standards, all pertinent plans and specifications are submitted to the appropriate regional office for review and approval prior to construction, usually in sets over a period of time as the design work progresses. During actual construction, the Service's vessel inspectors in the region follow the work closely to be sure that the standards are being followed, and to advise on items which may not have been shown in the plans. This procedure assures that defects will not be built into the ship which will require costly changes later.

Features of public health importance are the potable-water system, the wash-water system, drainage and waste disposal, food-sanitation facilities, ratproofing, and special facilities such as swiming pools.

Potable Water

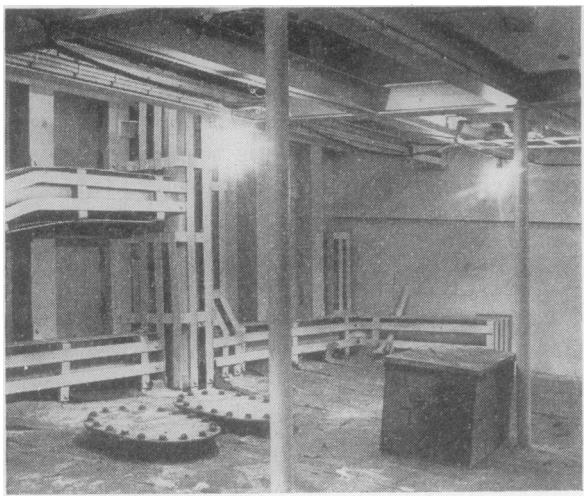
Water of drinking quality can be obtained from almost any port in the United States. However, if the water should not be of drinking quality, or if it should be stored improperly aboard the vessel, it must be adequately treated before being used. The minimum treatment, if any is required, varies with the original quality of the water and the method of storing, as indicated below:

Source of Water	*Treatment*
Safe shore water, delivered to the ship and stored satisfactorily	None.
Overboard water from uncontaminated areas in Great Lakes	Chlorination.
Safe shore water stored improperly aboard the vessel	Chlorination.
Polluted overboard river water	Distillation.

Vessels in foreign trade usually do not have sufficient storage capacities to provide needed fresh water (including potable water) for the entire trip. (It has been estimated that 0.7 gallon of drinking water is required per day for each person aboard a vessel.) In these cases, it is necessary to manufacture fresh water from overboard salt water. For this purpose, either of two types of distillation processes may be used: high-pressure evaporation (atmospheric pressure or above), or low-pressure evaporation (low-pressure or partial-vacuum distillation). Most ocean-going vessels utilize the low-pressure method since it is much more efficient and produces fresh water at lower cost.

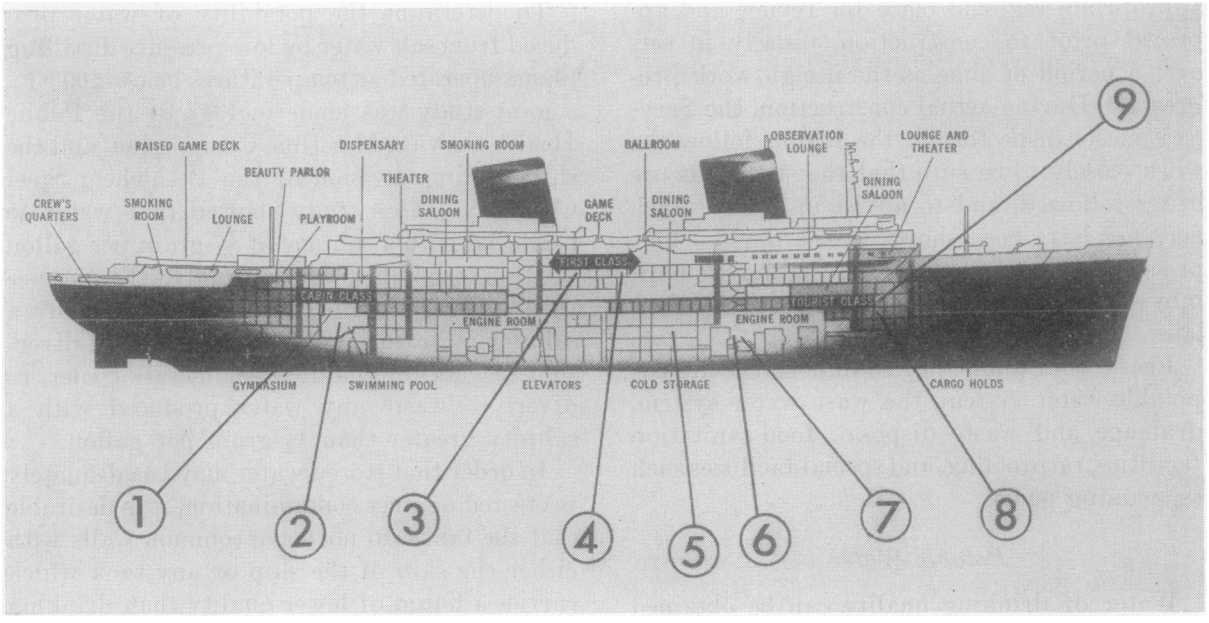
To determine the potability of water produced from salt water by low-pressure distilling plants operated at temperatures below 165° F., a joint study was made in 1947 by the Public Health Service, Maritime Commission, and the shipbuilding division of the Bethlehem Steel Company. This study showed that water so produced with a salinity of ¼-grain per gallon or less is potable. Accordingly, the Service ruled that such units must be equipped with a salinity indicator and an automatic flow-diversion valve after the final condensate cooler, to divert to waste any water produced with a salinity greater than ¼-grain per gallon.

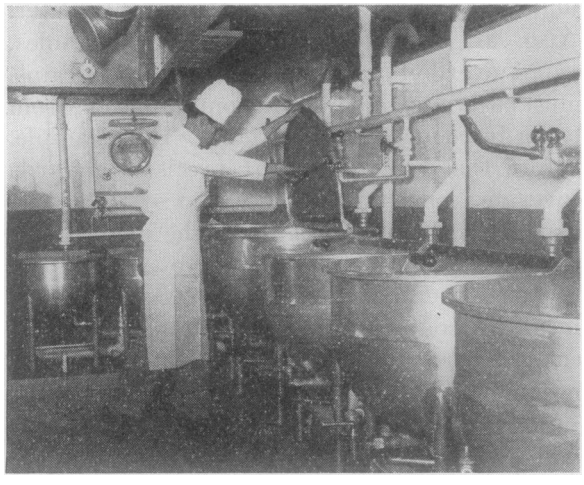
In order that stored water may be adequately protected against contamination, it is desirable that the tanks do not have common walls with either the skin of the ship or any tank which carries a liquid of lower quality than drinking water, since any leak in the tank wall may go undetected and contaminate the potable water. Also, all appurtenances, such as manholes, vents, overflows, depth indicators, and drains, must be designed to prevent contamination from being introduced into the tank. For example, before the development of precise standards covering construction of water systems, the usual method of determining the quantity of drinking water in a tank was to insert a rod through the manhole or vent—an excellent means of contaminating the water. The present standards permit the use of pet cocks placed at intervals in the side of the tank, a glass gauge in the side of the tank, or other type of indicator which is entirely enclosed. No drain lines are



① ◀

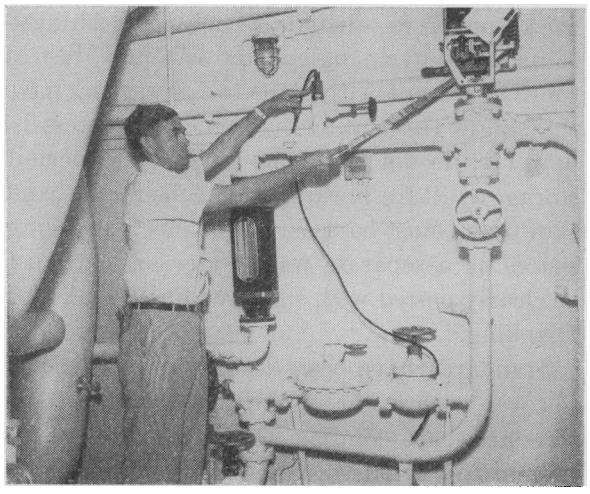
② ▶


RAISED GAME DECK
DISPENSARY
SMOKING ROOM
BALLROOM
OBSERVATION LOUNGE
LOUNGE AND THEATER
BEAUTY PARLOR
THEATER
DINING SALOON
GAME DECK
DINING SALOON
DINING SALOON
CREW'S QUARTERS
SMOKING ROOM
LOUNGE
PLAYROOM
FIRST CLASS
CABIN CLASS
TOURIST CLASS
ENGINE ROOM
ENGINE ROOM
GYMNASIUM
SWIMMING POOL
ELEVATORS
COLD STORAGE
CARGO HOLDS
1
2
3
4
5
6
7
8
9

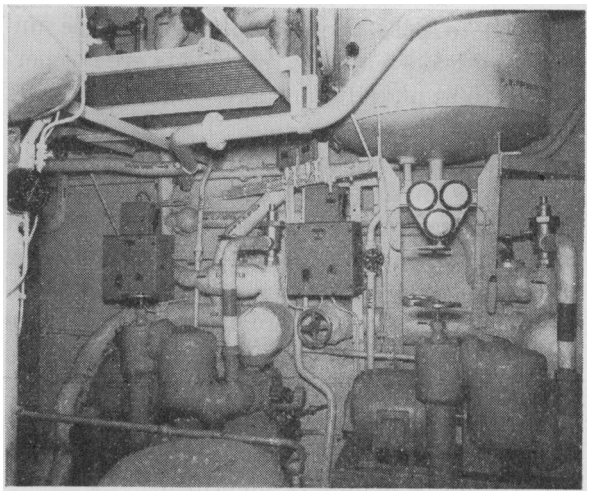


③ ◀

④ ▶



⑤ ◀

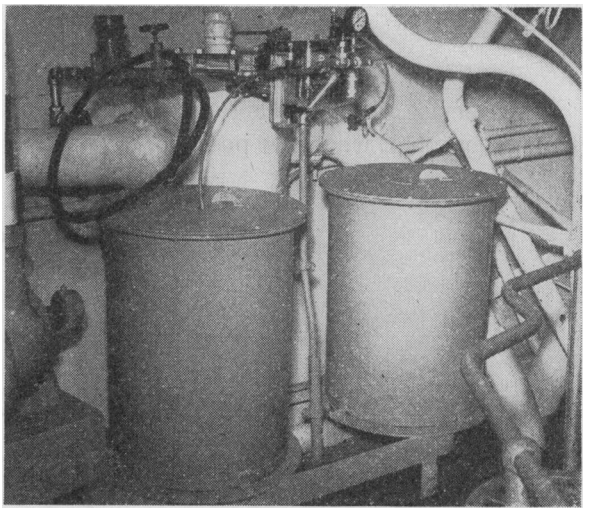


⑥ ▶

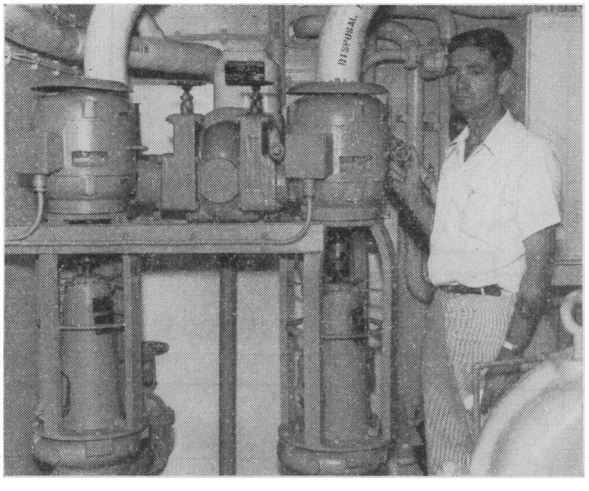
Sanitary Features of the S. S. *United States*

① Ideal type of pipe protection for rat-proofing, in baggage room. ② Swimming pool of monel metal. ③ Steam kettles in vegetable room of main galley. ④ Larder with undercounter refrigeration. ⑤ Automatic solenoid dump valve for a water-distillation plant. ⑥ Potable-water pumps and pressure tank. ⑦ Mechanical water chlorinators, showing solution tanks. ⑧ One of 25 sewage-disposal tank-and-pump units. ⑨ Facilities in a tourist-class stateroom.

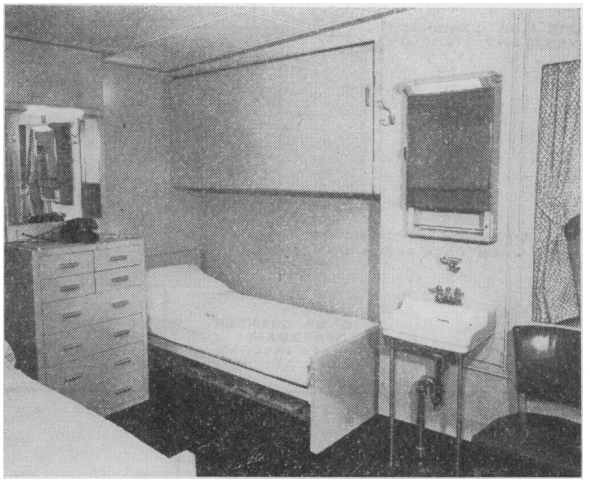
—Diagram based on illustration by courtesy of Rolf Klep, New Rochelle, N. Y. Photographs courtesy of Newport News Shipbuilding and Drydock Company.



⑦



⑧ ◀



⑨ ▶

allowed to pass through the tank, since unobserved leaks may occur. Toilets are not permitted to be placed immediately above the tank manhole.

From storage tank to ultimate outlet, the water system should be entirely self-enclosed. Cross connections to other water systems of lower quality are not permitted, and plumbing defects, such as submerged inlets or direct connections to equipment, are allowed only if approved vacuum breakers are used. To assist in preventing a line leading from a nonpotable-water system from tying into the potable-water system, the standards require that all potable-water lines be definitely identified.

Before a newly constructed or newly repaired ship goes into service, the entire potable-water system must be adequately cleaned and sterilized.

Wash Water

The Service recommends to shipbuilders and shipowners that, whenever possible, fresh water for all purposes—drinking, cooking, washing—be provided by a single water system. Most of the vessels built within the last few years have the single fresh-water system. Some vessels, however, do not have enough space to permit storage of all fresh water in detached tanks, and skin tanks must be used. All faucets in living spaces on a separate wash-water system must be clearly posted with signs reading, "Unfit for Drinking."

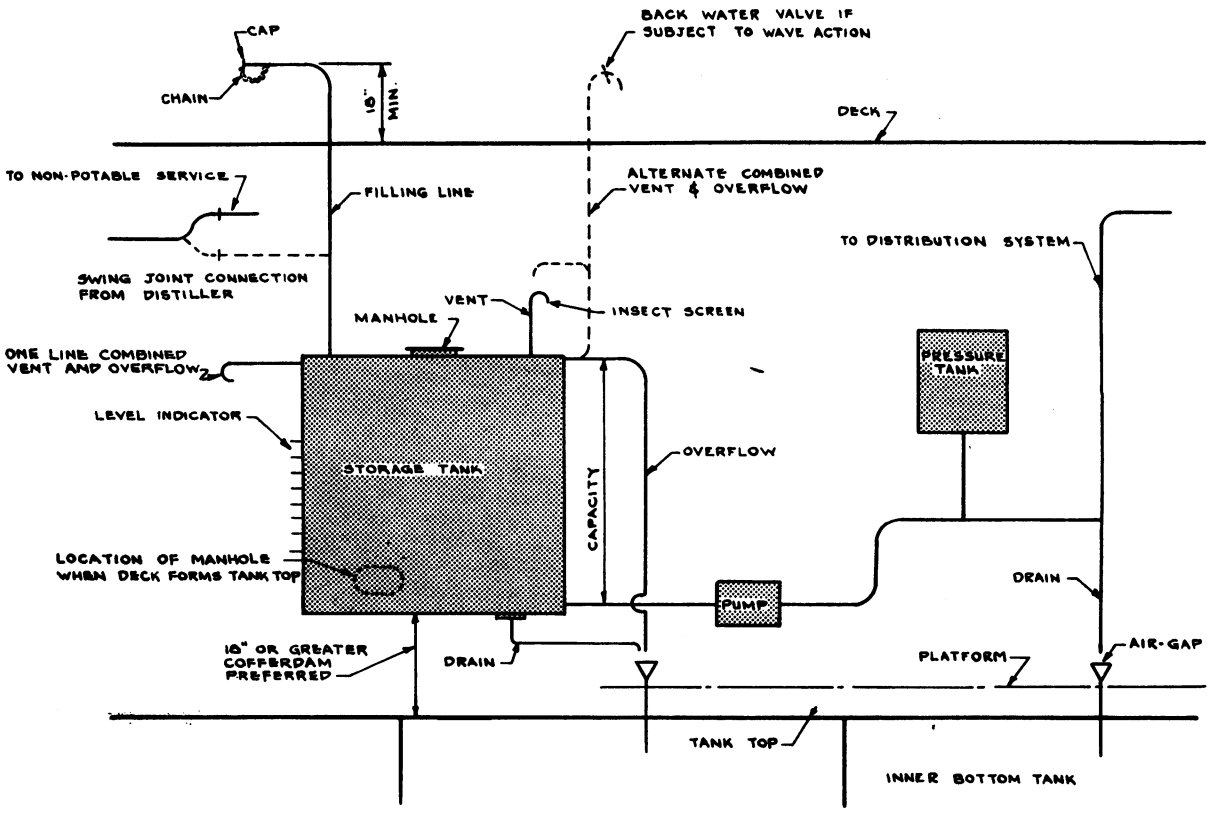
Standards have been developed specifically to cover wash-water systems. In general, these standards are similar to the potable-water standards previously discussed, with the following exceptions:

1. Safe shore water may be stored in skin tanks.

2. Water from unpolluted areas in the Great Lakes need not be chlorinated.

3. Polluted overboard river water may be used, if treated by filtration and chlorination.

Figure 1. Typical independent water system.



Swimming Pools

Most of the large ocean-going passenger ships built in recent years have swimming pools which are of the flowing-through type, utilizing overboard salt water. In the design and construction of these pools, the standards of the American Public Health Association are used. Special consideration must be given to the quality of salt water taken aboard for use in the swimming pool. An independent water system for this purpose is preferred; however, with certain safeguards, water from the fire or sanitary system may be used.

Food Sanitation

In general, the standards set forth in the Ordinance and Code Regulating Eating and Drinking Establishments (*2*) govern food-service areas and equipment aboard vessels. When a ship is to be built in accordance with Public Health Service standards, detailed reviews are made of plans showing food spaces and equipment, including layout plans showing the arrangement of equipment and plumbing, bills of materials for food equipment, and specifications of materials covering deckheads and bulkheads. The obligation to approve or disapprove trade-marked equipment sometimes requires considerable time for investigation and study.

A food-service problem peculiar to seagoing vessels is the large amount of storage space which must be provided. A large proportion of the storage space must be refrigerated and with specific optimum temperatures provided for each type of food.

In general, vessels constructed in the last few years have up-to-date galley equipment and food-service equipment. This applies to small towboats and river boats as well as to ocean-going vessels. Most operators make every effort to provide their crews and passengers with the best in food and food service.

As compared with shore food-serving establishments, vessels have some unusual features which must be taken into consideration. For example, the general complexities of ship construction and the tight space limitations often make it necessary to pass soil and other waste lines through the deckheads of food spaces. Special precautions must be taken to prevent leakage.

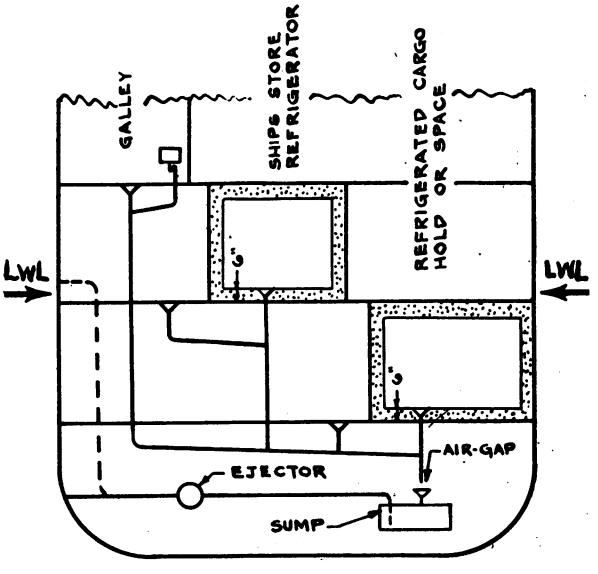
On the other hand, in one feature of galley sanitation at least, vessels have an advantage over the usual shore establishment: the matter of an adequate hot-water supply. Vessels generally have an abundant supply of steam or electrical power which can be used for water-heating purposes. The installation of booster heaters in hot-water lines to dishwashing machines, as well as of auxiliary heating units in sinks, is a well-established practice.

Drainage and Waste Disposal

The drainage of a ship poses significant sanitary problems. Two kinds of drainage are of primary concern to the Public Health Service—human and hospital liquid wastes, and drainage from decks, food spaces, and food equipment. Vessel drainage systems include the usual features of traps, cleanouts, and vents, which are well defined in plumbing codes.

The main objective is to keep the two types of drainage systems separate so that human sewage cannot contaminate food spaces and equipment or living spaces. When it is necessary to combine the two types of drainage for discharge overboard, specific safeguards have been developed to prevent backflow into food spaces and equipment. When there is any pos-

Figure 2. Broken drainage system—overboard-water-operated ejector.



sibility of such backflow, the drain must pass through an air gap (fig. 2).

Ratproof Construction

Ratproofing is strongly recommended for all American ships engaged in foreign trade. To the shipowner, one of the virtues of ratproofing is that it facilitates passage of a ship through quarantine by eliminating the need for fumigation or other rodent-control activities which might delay the ship.

Essentially, ratproofing a ship means designing and building it in such a manner as to eliminate or make inaccessible to rats any spaces affording harborage where they may nest and breed or have access to food.

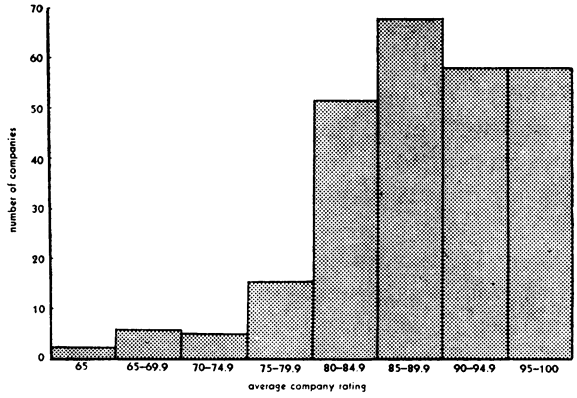
Over a period of years, detailed specifications have been developed on how to ratproof virtually every space in the ship, including cargo holds, refrigerated spaces, and food areas. In general, ratproofing involves either the use of rat-resistant material to prevent the passage of rats, or the utilization of "open-type" construction. In evaluating materials as to their rat-resistant characteristics, special consideration must be given to their ability to withstand shock in certain areas, such as cargo holds.

Before certifying that a ship is ratproof, the vessel inspector examines every part of the ship. Openings greater than one-half inch, leading into uninspectable spaces or food spaces, must be closed. Collars of sheet metal must be installed around penetrating fixtures, regardless of size or location. Edges may be required to be flashed to prevent gnawing. Uninspectable areas, such as those above wireways and ducts, may have to be closed. In short, as an inspector once said, one of his most important qualifications is his ability to think like a rat first—and then like a ratproofer.

Vessels in Operation

The program as it relates to vessels in operation is concerned with the routine maintenance of high sanitation standards. A ship may contain the best equipment to provide a safe and sanitary environment for its passengers and crew, but if the members of the crew are either uninformed or uninterested in correct sanitation procedures, the effort and expense will be in vain.

Figure 3. Number of companies having certain average vessel sanitation ratings.



Through a program of inspection and education on vessels in both interstate and foreign trade, efforts are made constantly to improve sanitary practices. Comprehensive inspections are made at 6-month intervals by regional vessel-sanitation inspectors, covering every phase of environmental sanitation. The standards set forth in the "Handbook on Sanitation of Vessels in Operation" (*3*) are used as guides, and the inspectors use a formal inspection report form. Numerical values are assigned to the various items on the inspection form, from which the vessel's sanitary rating is determined. Vessels which obtain a rating of not less than 95 percent on sanitation items and not less than 90 percent on ratproof construction are awarded the Public Health Service Certificate of Sanitation.

The Certificate of Sanitation (which is issued, also, to railroad dining cars) is a comparatively recent development in the carrier-sanitation program of the Public Health Service. While still virtually unknown to the fare-paying public, its presence on board a vessel is becoming more and more a matter of great importance to the merchant mariners to whom their ship is, for considerable periods of time, both their home and home town.

Every 6-month period finds more and more American ships meeting the certificate standards of the Public Health Service. Over 2,700 vessels of all classes, operated by approximately

270 companies, come under the vessel-sanitation program. The 1951 report shows that the average rating was 87.9 percent (fig. 3).

Another element of the program concerns sources of safe water, milk, and food for operating vessels. In cooperation with State health departments, the Public Health Service inspects and classifies all water and milk sources reported in use by vessel-operating companies throughout the United States. Periodically, it publishes lists of sources, classified as "approved," "provisionally approved," or "prohibited."

Because vessel watering points pose a special problem to engineers and inspectors, the Service has prepared special standards, which are to be published soon. The standards for certifying milk sources are those developed by the Public Health Service over the past 30 years, a new edition of which is in press (*4*).

REFERENCES

(*1*) U. S. Public Health Service: Principles of sanitation applicable to the construction of new vessels. Washington, D. C., Public Health Service, 1949, 101 pp. Processed. (New edition being prepared.)

(*2*) U. S. Public Health Service: Ordinance and code regulating eating and drinking establishments. 1943 recommendations of the Public Health Service. Public Health Service Publication No. 37. (Formerly Public Health Bulletin No. 280, reprinted 1948.) Washington, D. C., U. S. Government Printing Office, 1950, 60 pp.

(*3*) U. S. Public Health Service: Handbook on sanitation of vessels in operation. Public Health Service Publication No. 37. Washington, D. C., U. S. Government Printing Office, 1951, 44 pp.

(*4*) U. S. Public Health Service: Milk ordinance and code, recommended by the U. S. Public Health Service, 1939. Public Health Bulletin No. 220. Washington, D. C., U. S. Government Printing Office, 1940.

Training Vocational Rehabilitation Counselors

A national program to help emotionally disturbed persons get and hold jobs that will support them was started in July when the first of a series of short courses for training counselors in vocational rehabilitation was held at San Jose State College, San Jose, Calif. The 2-week course at San Jose was attended by 20 counselors from 12 State vocational rehabilitation agencies in Arizona, California, Colorado, Idaho, Louisiana, Montana, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming.

A second course, similar to the one at San Jose, will start at Columbia University, New York City, on January 12, 1953, and will run for 2 weeks also. Another course will be held later at Menninger Foundation, Topeka, Kans.

The San Jose course covered five training objectives: (1) development of leadership for programs of vocational rehabilitation; (2) practice in skills and techniques needed in rehabilitating persons with neuropsychiatric disabilities; (3) appreciation of community resources and consultative services for effecting rehabilitation and placement; (4) provision of information about human behavior and personality disorders; and (5) development of personality adjustment patterns to bring about favorable attitudes toward counseling, training, and placement of the mentally ill.

The program is under the joint sponsorship of two units of the Federal Security Agency: the Office of Vocational Rehabilitation and the National Institute of Mental Health of the Public Health Service.