WEEKLY ABSTRACT OF SANITARY REPORTS.

VOL. III. { Abstract No. 26. }

TREASURY DEPARTMENT,
OFFICE SUPERVISING SURGEON-GENERAL,
U. S. MARINE-HOSPITAL SERVICE,
Washington, D. C., June 29, 1888.

Abstract of Sanitary Reports received through the Department of State from foreign countries during the week ended June 29, 1888, *and information received through other channels.*

(Published in accordance with section 4, act approved April 29, 1878.)

England and Wales.—The deaths registered in 28 great towns of England and Wales during the week ended June 9 corresponded to an annual rate of 16.2 a thousand of the aggregate population, which is estimated at 9,398,273. The lowest rate was recorded in Birkenhead, viz., 12.5, and the highest in Manchester, viz., 25.0 a thousand. Small-pox caused 6 deaths in Sheffield, 1 in Bristol, and 4 in Preston.

London.—One thousand two hundred and nineteen deaths were registered during the week, including measles, 25; scarlet fever, 23; enteric fever, 8; diphtheria, 22; whooping-cough, 33; diarrhœa and dysentery, 18. The deaths from all causes corresponded to an annual rate of 14.9 a thousand. Diseases of the respiratory organs caused 185 deaths; different forms of violence, 51; and 8 suicides were registered. In greater London 1,534 deaths were registered, corresponding to an annual rate of 14.5 a thousand of the population. In the "outer ring" 7 deaths from whooping-cough and 5 from diphtheria were registered.

Ireland.—The average annual death rate represented by the deaths registered during the week ended June 9 in the 16 principal town districts of Ireland was 24.3 a thousand of the population. The lowest rate was recorded in Kilkenny, viz., 8.5, and the highest in Lisburn, viz., 43.5 a thousand. In Dublin 147 deaths were registered, including measles, 1; whooping-cough, 11; enteric fever, 3; scarlet fever, 3; and dysentery, 1.

Straits Settlements.—From the annual medical report of the civil hospitals, it is learned that "in Singapore sporadic cases of cholera occurred

in the middle of the year, but a great proportion of the patients were coolies, lately arrived from China, in some of the ports of which country cholera was prevalent at the time. One ship from China—the steamship 'Amigo'—was quarantined on account of cholera; her passengers were landed at St. John's Island, and cases of cholera appeared afterwards among them. Some other cases occurred also among a number of passengers from China who had been landed at St. John's Island from a ship—the steamship 'Bellerophon'—which came in with small-pox on board. Four Europeans died of cholera during the year, two of them having contracted the disease, as far as could be ascertained, on board the steamship 'Spaniel,' and the third, a sergeant of police, having become infected at a room in the central police station, where a lot of miscellaneous rubbish and property were kept. A native sergeant was also infected on the same day, and died. This room was at once cleared out, the rubbish burnt, and the place disinfected, and no more cases occurred. The fourth case was that of a boy who had recently come from another colony. It is possible that he brought the infection with him. A local outbreak of cholera occurred in the beginning of August in the old lunatic asylum. All the preventive measures we could use failed to stop the disease, and on August 12 all the patients were moved into the new asylum, which was fortunately nearly ready. After the removal, for a day or two, two or three cases occurred, which were promptly removed, and then the disease stopped. Thirty-seven cases of small-pox were reported as occurring during the year. In five of these cases death had occurred before any report was made to the police. Of the remaining thirty-two cases, twenty-five were treated at the small-pox hospital, Balestier Plain, with seven deaths, and the remaining seven—Europeans—were treated at the general hospital. Of the seven cases treated at the general hospital all recovered. In two only of these was infection contracted in Singapore. Of the other five cases, three were landed from ships, and two were children who had just come from Penang, where the disease was prevalent at the time."

Montevideo.—Three hundred and seventy-two deaths were registered during the month of April, including small-pox, 43, and enteric and typhus fevers, 13.

Santiago de Cuba.—The sanitary inspector reports for the week ended June 16 "no small-pox or yellow fever."

Havana.—Nine deaths from yellow fever and 1 from small-pox were registered during the week ended June 22, 1888.

MORTALITY TABLE, FOREIGN CITIES.

Cities.	Week ended.	Estimated population.	Total deaths from all causes.	Deaths from—						
				Cholera.	Yellow fever.	Small-pox.	Typhus fever.	Enteric fever.	Scarlet fever.	Diphtheria.
Glasgow	June 9	545,678	211						3	2
Amsterdam	June 9	389,916	154					1		2
Munich	June 2	275,000	159						2	3
Genoa	June 9	179,401	77							3
Trieste	May 19	154,500	85							1
Trieste	May 26	154,500	69			3			3	1
Trieste	June 2	154,500	73							2
Stuttgart	June 9	125,510	33							
Bremen	June 2	122,000	38							
Barmen	June 2	109,000	47							1
Mayence	June 2	65,802	31						1	
Cienfuegos	June 4	40,753	14			2				
Cienfuegos	June 11	40,753	18			7				
Sagua la Grande	June 9	15,605	24							
Carthagena, Col'a	June 9	13,000	3							
Matamoras	June 9	12,000	8							
San Juan del Norte	May 28	500	1							

UNITED STATES.

Quarantine near New Orleans.—At the request of the State Board of Health of Louisiana, a test of the efficiency of the methods of disinfection employed by that board has been made by Assistant Surgeon J. J. Kinyoun, United States Marine-Hospital Service, who was detailed for that purpose. The following is his report in full:

LABORATORY U. S. MARINE HOSPITAL,
New York, June 12, 1888.

Dr. JNO. B. HAMILTON,
Supervising Surgeon-General U. S. Marine-Hospital Service.

SIR: In accordance with your official order directing me to proceed to Louisiana, and there inspect the machinery and methods that are used by the State board of health in the enforcement of the quarantine regulations of that State, I have the honor to respectfully submit the following report of the inspection and work.

As it was the desire of the officers representing the State board of health to have the system thoroughly investigated and discover its defects, if any, it was found necessary to make quite a number of similar observations of different series before a definite conclusion could be reached. Considerable delay has occurred, owing to the fact that in the sulphur dioxide series all cultivations of the different micro-organisms thus subjected were found to be more or less contaminated from the air of the holds of vessels, and it became necessary to examine each cultivation by the "plate culture" method. Only a certain number could be thus treated each day. The principles of the methods of disinfection are correct, but faulty in their application. So far as it is possible, the methods now practiced will be so modified as to secure the greatest efficiency obtainable with the present form of apparatus, and as soon

as it can be done the station will be removed to another place, and a new plant erected, having sufficient capacity to handle and disinfect vessels thoroughly and expeditiously.

Arriving at New Orleans on the 5th of May, I called upon the president and secretary of the board of health, and made known to them the object of my visit. The president, Dr. C. J. Wilkinson, kindly perfected arrangements so that the quarantine station could be reached without delay. Leaving New Orleans on the morning of May 6, accompanied by Dr. Wilkinson, we embarked on the steamship "Alicia," arriving at the upper station at 11 a. m. Later in the day, together with the president and resident physician, Dr. Thos. Y. Aby, we visited the lower station, situated 1½ miles below the Head of the Passes, on Pass à l'Outre.

This station consists of a hospital and buildings for the resident physician and attendants; also, a small building situated about two hundred yards from the main building, and that was constructed for a small-pox hospital. No communication can be had with the main hospital save by boat. The buildings are erected on piles standing about 7 feet above the marsh, and during the season of high water there is at least 2 feet of water under the buildings. There are two wards—one for males and one for females. The male ward is 26 by 52 feet, and contains twenty-six beds; it is well ventilated and lighted, and is all that could be desired for the treatment of cases suffering from febrile diseases in a warm climate. The female ward is smaller, and is separated from the main building by at least 12 feet. It is divided by a partition, making two rooms about 12 by 20 feet. All buildings are connected, one with another, by verandas.

As a hospital, only one objectionable feature could be found, viz., that water-closets were placed within each ward, and no provision was made for the reception of the night-soil, it being allowed to drop into the water or on the ground below. We were informed by the resident physician that the closets were not intended for use in this manner, and that orders were given to that effect. In cases of an infectious or contagious nature, all discharges of patients were thoroughly disinfected by a strong, almost saturated solution of bichloride of mercury, which was constantly kept near. In cases of epidemic disease, where isolation of the sick and segregration of the healthy are required, the buildings are entirely too small for such purposes, and nothing better can be done than to retain them on board the vessel, as there is not sufficient dry ground near the station for the erection of tents.

To give an accurate description of the different stations—the methods *claimed to be practiced* in the disinfection of the baggage of passengers and crew, the cabin, deck, hold, and cargo—I have taken such parts as are relative thereto from the admirable brochure of Dr. Jos. Holt, ex-president of Louisiana Board of Health, entitled "The Quarantine System of Louisiana; Methods of Disinfection Practiced:"

"In describing the methods of disinfection used in the quarantine of Louisiana, it is necessary first to examine the system itself synthetically. There are three maritime approaches to New Orleans—the Mississippi River, which is the central and main avenue; the Rigolets, 30 miles to the eastward, a narrow strait connecting Lake Pontchartrain with Lake Borgne and the Gulf of Mexico; and the Atchafalaya River, near its debouchement into the bay of that name and Mexican Gulf, 82 miles to the westward.

"On account of the character of shipping coming through the two lateral approaches, 'light in tonnage and mostly from domestic ports,' the Rigolets and Atchafalaya are completely closed by a proclamation of forty days' detention against all vessels from quarantined ports, compelling such to seek the Mississippi as the only available route to New Orleans. This is done in order to avoid the immense expense of keeping up three completely equipped stations, and to concentrate at a single point the fight against infection.

"The quarantine in the Mississippi is a system composed of three stations, the first of which is an advance-guard inspection station, situated at Port Eads, 110 miles below New Orleans, where the waters of South Pass are jettied into the Gulf.

"When an inward-bound vessel comes into the offing she is immediately boarded by a thoroughly skilled medical officer, and a careful inspection is made of her sanitary record and present condition. If from a non-quarantined port and all is well, she is given pratique and goes on to the city. If from a quarantined port, but presenting a clean health record of voyage and no evidence of sickness of a dangerous or doubtful character, she proceeds to the upper quarantine station, situated on the left bank of the river, 70 miles below the city, where she is subjected to a full course of sanitary treatment, and is detained such length of time, not exceeding five days (except in rare instances, wherein further observation may be deemed necessary), as the board of health may provide.

"If upon inspection of a vessel entering the river she is found to be foul—that is, showing positive or suspicious evidences of infection, either in a person then ill or in a foul health record of voyage—she is at once remanded to the lower station, located on Pass à l'Outre, an unused outlet of the Mississippi, 103 miles below the city. The sick, if any, are at once removed to the hospital, where every provision has been made for them.

"The vessel, with the well on board, is dropped down-stream a few hundred yards and anchored. In the mean time the quarantine tugboat, with its complete disinfecting outfit, has been telegraphed for, and speedily arrives from the upper station, when the work of disinfection begins, and does not cease until the vessel has been subjected to the most vigorous application of the bichloride of mercury, her atmosphere below deck completely replaced with one heavily charged with sulphurous oxide, and every article of baggage and ship's wardrobe has been saturated with the mercuric solution.

"A ship known to be infected with one of the three great pestilential diseases—small-pox, cholera, or yellow fever—can stand and must endure extraordinary treatment, even if clothing is wetted and some articles damaged. They who go down to the sea in ships assume the perils of the voyage, among which is this occurrence of finding themselves on an infected vessel and being compelled to undergo a cleansing, for they have no right to bring their perils ashore and endanger others.

"The immediate segregation of the sick and the well and disinfection of the ship and all baggage(in the case of a cholera-infected vessel extended to the disinfecting, washing-out and refilling of the water-tanks, destruction of the food supply, and revictualing the vessel) constitute the treatment of an infected vessel at this station. The ship, together with all on board, is held for observation a period of ten days or more, according to circumstances, when she is released and pro-

ceeds to the upper station, where the processes of sanitary treatment are repeated, with the addition of the use of moist heat applied to baggage, ship's apparel, &c. (which latter process will be described hereafter), and the vessel is then allowed to proceed to the city.

"This course of treatment at the upper station, while probably unnecessary, is enforced purely as an extraordinary precaution.

"Inasmuch as infected ships are the exceptions, but inasmuch, also, as the board of health will take no risk in the case of vessels from known infected or suspected ports, regardless of bills of health, the vast majority of vessels are treated at the upper station.

"Arriving at this station, the vessel is brought alongside the wharf. All on board—officers, crew, and passengers—are at once sent ashore, where they find ample accommodation in commodious shelter provided for their entertainment during the time occupied in the sanitary treatment of the ship and all baggage.

"As soon as this is completed, they are permitted to return aboard ship, where they remain under observation during the prescribed period, determined by the remoteness or nearness of the port against which these precautions are taken.

"The object of this brief detention for observation after sanitary treatment of the vessel has been completed is to allow for a probable outbreak of an infectious disease already incubating in the system of any one on board. As an essential part of the service, there is a tugboat of sufficient power to move a sailing-vessel to or from the wharf.

"In addition to this requirement, this boat is equipped with a complete outfit for generating and applying germicidal gas for displacement of the entire atmosphere within the ship, transported perhaps directly from some infected port. In the hold of this tug is constructed a wooden tank of 2,000 gallons capacity, to hold the bichloride of mercury solution for the treatment of vessels in the Lower Quarantine as described. This tank is furnished with a steam-pump (made of iron, on account of the great resistance of that metal to amalgamation), supplied with ¾-inch rubber hose. (See Plate 1.) In the sanitary treatment of a vessel in quarantine there are three processes of disinfection concurrently applied.

"APPLICATION OF BICHLORIDE OF MERCURY.

"The first is the wetting of all available surfaces of the vessel, excepting cargo but including bilge, ballast, hold, saloons, forecastle, decks, &c., with a solution of the bichloride of mercury, made soluble by an equal weight of muriate of ammonia, in the proportion of one part to one thousand of water. * * *

"Immediately adjoining the Quarantine Wharf, and near its water edge, is constructed a heavy frame-work of piles, each 12 inches in diameter. This structure has an ample base, is pyramidal, and 45 feet in height above mean level of the river. On top of this is a circular wrought-iron tank, capable of holding 8,000 gallons of the mercuric solution. (See Plate 2.) In order to prevent contact of the latter with the iron, the interior of the tank is painted over with three coats of red lead and two of paraffine paint. The top of the tank is closed by a secure cover to prevent access of light to the solution. This, together with the general exterior, is painted black.

"On the top of this cover is placed centrally a 60-gallon wooden

cask, in which is dissolved the mercuric salt, which is then emptied into the tank through a wooden faucet. Seventy pounds are used for one charge.

"In the tank near the lower edge are three heavy galvanized-iron faucets, to each of which is screwed a lead of ¾-inch four-ply rubber hose, the farther ends of which lie on the wharf. These are lengthened by additional sections to reach any part of the largest vessel. To the far extremity of each hose is attached a short, wide nozzle, provided with a stop-cock.

"During this disinfection all three are simultaneously used—fore, aft, and amidships. For spraying we use a perforated heavy block-tin rose, 4 inches across the face, similar to an ordinary watering-pot spray. These are made with a shank about 6 inches long, to fit snugly into the open end of the pipe.

"On a single vessel we average 1,500 gallons of solution, but often use 3,000. The process requires from thirty minutes to two hours, according to circumstances.

"SULPHUROUS OXIDE FUMIGATION.

"As soon as the men have completed the work of 'bichloriding' below decks, the fumigating-pipe is then extended from the quarantine tug-boat lying alongside. (See Plates 1 and 2.) It is lengthened by sections being fitted together like stove-pipe, and conducted down a convenient hatchway to the bottom of the hold, or as near the keelson as possible, preparatory to the fumigation of the entire vessel (and cargo if any) with sulphurous oxide. In the case of a sailing-ship, one hatchway gives access of the sulphurous gas to the entire hold, but in large steamers the hold is subdivided by bulk-heads into two or more distinct compartments, which must be treated separately.

"In undergoing treatment the cargo is not disturbed, except when the removal of bags of coffee is required to permit the passage of the fumigating-pipe, which is 12 inches in diameter, down into the dunnage at the bottom of the cargo.

"I have given explicit instructions to coffee importers, whereby the expense of removing bags to make this well or shaft may be avoided, by allowing a clear inside space of 15 inches, placed in the center of the main hatch in a sailing-vessel, or in the center of each hatch in a steamship having bulk-head compartments. The frame-work of this shaft is set before loading, and should be cut flush with the top of the cargo.

"This simple arrangement avoids all handling and delay.

"When the connections are made and the fumigating-pipe is arranged, the fan on the tug-boat is started, and the process of displacing with sulphurous oxide the entire atmosphere within the ship begins. The length of time required to complete the fumigation varies from thirty minutes to three hours, according to size of vessel, number of compartments, &c. The quantity of commercial roll sulphur used varies from 100 to 700 pounds per vessel.

"The apparatus invented for rapidly evolving and supplying the germicidal gas consists in a battery of eighteen furnaces, each supplied with a pan to contain the sulphur during combustion. These furnaces open into a common reservoir, to the farther end of which is connected a powerful exhaust-fan, Sturtevant's, No. 29. (See Plates 3 and 4.)

"The gas drawn by the fan is driven into a 12-inch galvanized-iron pipe, through which it is conducted over the side and down the hatchway of the vessel into the bottom of the hold.

"The gas as it is driven into the vessel is quite hot, but would extinguish rather than create fire. The outflow should not impinge directly against bags of coffee or bales of textiles, if it can be avoided, in order to prevent formation of sulphuric acid and some slight injury therefrom at that point. In treating coffee, and for convenience in some other instances, the vertical lead of pipe into the hold is made of asbestus cloth, closely and heavily woven for our purpose.

"Every opening is closely battened during the process and remains so for at least eight hours after it is discontinued.

"The apparatus throughout is made ample in size and power for rapidity of work and economy in wear and tear by lessening velocity and friction. The fan is run by a special engine at a slow rate as compared with its capacity, but driving into the ship 180,000 cubic feet per hour of atmosphere surcharged with sulphurous oxide.

"APPLICATIONS OF DRY AND MOIST HEAT.

"While these two processes of sanitary treatment of the vessel are going on, all bedding, ship's linen, cushions, mattresses, flags, mosquito-nets, curtains, carpets, rugs, all personal baggage and wearing apparel of whatever description, are removed from the ship to a commodious building in close proximity (see Plate 5), in which these articles are treated by moist heat at a temperature of not less than 230° F.

"The apparatus for this work consists in a steel 40 horse-power steam-boiler (see Plate 9) for supplying steam to a superheating-chamber a few feet distant, and which I will now describe. (See Plates 6, 7, and 8.)

"The dimensions of this chamber, taken interiorly, or inside measure, are 60 feet long, 11 feet wide, and 7 feet high. The frame-work is composed of 3 by 3 inch seasoned pine lumber, joined as in the construction of a frame house. Upon the outside of this frame-work (and corresponding to the weather-boarding in the case of a house) is nailed tongued-and-grooved flooring-material ¾ of an inch thick by 6 inches wide.

"The inside, or interior of the ends, rear, and top of the chamber, is ceiled with the same material, and a flooring of the same is also laid. Upon these interior surfaces is tacked heavy 'Russian hair-cloth or felting,' and upon this, at intervals of 3 feet, are nailed parallel strips of wood, 1½ by 2 inches, and, in turn, upon these strips is fastened another sheathing or ceiling of flooring-plank, as already described. This secures an air-space between the hair-cloth and inner ceiling. Upon this now smooth interior surface of wood is finally tacked and held in place by very broad-headed nails, or, better, by nails supplied with tin disks or washers, a double layer of 'asbestus building-felt,' well lapped and securely tacked, thus rendering the interior of the chamber fire-proof.

"By the foregoing-described construction it will be seen that the walls of the chamber, which are 8 inches in thickness, consist of seven non-conducting media—first, the outer layer of planking; second, 3 inches of air-space; third, an inner ceiling of planking; fourth, one thickness of "Russian hair-cloth;" fifth, 1½-inch air-space; sixth, a

third layer of ¾-inch planking; seventh, a double layer or interior lining of heavy asbestus felting.

"The front wall is divided into forty panels 18 inches wide each (see Plate 6), which represents that number of racks contained within the chamber. Upon the bars of these racks the clothing, &c., is hung for exposure to disinfection by moist heat. (See Plate 7.) These racks are constructed with a front and rear panel united by horizontal bars, six to each side. Each rack is suspended overhead on traveling rollers upon an iron rod which extends from the rear wall of the chamber to a support 10 feet in front of the chamber, the rod, therefore, being 20 feet in length.

"By this arrangement overhead the racks may be drawn out and pushed in with facility, thus avoiding tracks or rods on the floor, obstructing the movements of employés.

"When drawn out the full length of 10 feet, the rear panels of the racks securely close the chamber, as do the front panels when the racks are pushed in, thus admitting the heat to the chamber during the time of hanging the articles of clothing, &c., on the rack-bars preparatory to disinfection.

"For this admirable device, and indeed for the entire skeleton of the superheating-chamber, including the dry-heat double steam-coils, we are indebted to the Troy Laundry Machinery Company, Chicago, Ill. We have found the purchase of this apparatus, constructed to include certain of our specifications, to be the most economical and satisfactory we could have desired.

"The interior surface of each front panel is lined with a layer of Russian hair-cloth, over which is applied a double layer of asbestus felting.

"At intervals of 7½ feet a bulk-head of 1-inch tongued-and-grooved flooring is constructed, subdividing the chamber into eight compartments. These bulk-heads, or partitions, are made fire-proof by a covering of a double layer of asbestus felting. The object of this arrangement is to provide against the spread of fire in the event of its occurrence.

"In addition to this provision, there is a double lead of 1-inch fire-hose connected with a steam-pump near the boiler, and at all times ready, within fifteen seconds' notice, to turn on two streams of water upon any rack on which fire might have originated. These minute specifications concerning provision against fire are particularly appreciated by ourselves. It cost us two fires and the destruction of a large amount of property to learn a lesson which experience alone could teach. Lacking experience and precedent, these accidents could not have been foreseen, and therefore could not have been provided against. They were the result of an underrating and failure to appreciate the prodigious force the contrivance invented placed at our will to invoke.

"Under the present arrangement, including early use of free steam, fire is hardly possible; but if it should occur, we are prepared instantly to draw out the burning panel, to strip it of clothing, and to put out the fire. With reasonable care and watchfulness on the part of the employés, there need be absolutely no danger of loss by fire.

"The superheating of this chamber is so provided as to furnish at will dry or moist heat, or both, and by a turn of the hand a temperature of 300° F. can be obtained.

"Within and at the end of this chamber next to and connected with

the boiler are two manifolds, one above the other, to which is connected a system of forty-five ¾-inch steam-pipes (aggregating 5,509 lineal feet), placed horizontally near the floor of the chamber, running its full length, and supplied with a "bleeder" for conveying off the water of condensation. This double coil furnishes the dry heat. (See Plate 8.)

"Above and in close proximity to this system of pipes is extended a horizontal screen of galvanized iron, ½-inch mesh, to catch and so prevent the coming in contact with the superheating-pipes any article falling from the racks. (See Plate 7.)

"The moist heat is supplied by a 1-inch steam-pipe, laid centrally in the midst of the above-described dry heat pipes, and running the entire length of the chamber, constituting a steam-main, connected with the boiler and controlled as the others, by a ball-valve on the outside. This pipe is perforated by eighty $\frac{1}{12}$-inch holes, so placed as to furnish steam to each rack.

"During the time of hanging the articles of clothing, &c., on the racks, the dry heat is turned on and the temperature raised to 190° F., made known by a thermometer having a large mercurial column and suspended near the center of the chamber, working on a slide of traveling rod in such manner, when it is desired to make a reading, as to allow of being drawn forward (by a cord extending outside) to a long narrow pane of glass set in the panel. This thermometer should have a scale of at least 275° F.

"As each rack is filled it is put back into place. By the time the last of the articles have been hung on the racks, the entire mass of the material within the chamber has attained a temperature between 190° and 200° F., when free steam is turned on; the thermometer speedily rises to a point varying between 230° and 240° F., at which it is maintained for a period of twenty minutes.

"The steam-pressure in the boiler at the beginning of this process registers between 100 and 110 pounds by the steam-guage; at the end of the process of blowing in steam the pressure will have fallen to about 60 pounds.

"The steam is now entirely cut off from the chamber, the racks are drawn out and their contents removed.

"During the process of steaming, every article is perceived to be saturated and intensely hot, the steam freely permeating to the interior of mattresses, double blankets, &c., but so great is the heat in the texture of the fabrics as to immediately expel all moisture upon drawing the racks and exposure to the open air. Shirts, collars, &c., instantly assume the crisp dryness they possessed before exposure, losing the musty smell of long packing in a trunk.

"Silks, laces, the most delicate woolen goods, show no signs of injury whatever from the treatment.

"Of course articles of leather, rubber, and whalebone would be injured by the heat, and are therefore disinfected with the mercuric solution, and not permitted to go into the heated chamber.

"Time required to charge chamber with apparel for disinfection, thirty minutes; time required for moist heat, twenty minutes; for removal of articles, fifteen minutes—a total of sixty-five minutes. A large steamship, particularly a passenger-vessel, may require two or three charges of the chamber. Amount of coal consumed, from two to four barrels per vessel.

"In the summer of 1885 we devised and put up a chamber of the

above general plan, but wholly inadequate as to size for the requirements of our service. This was replaced by one operating on the same principle, but 50 feet long and supplied with a 20-horse-power boiler, which latter proved too small for rapid work. This apparatus was burned last spring.

"Our present chamber and supply-boiler are of the dimensions given in the appended plates.

"We prepared the plans of the foregoing-described apparatus during the summer of 1884. Obtaining a liberal appropriation of $30,000 from the State legislature for the avowed purpose of establishing a new system of quarantine through the elaborations of purely experimental work, and thoroughly indorsed and sustained in all our efforts by the progressive spirit of the press of New Orleans and by the merchants, we put the new system into practical operation, and threw open the Mississippi to commerce June 10, 1885.

"As it stands to-day, we sincerely believe in a nearly perfected state, it is the consummation of experimental effort through a long and tedious process, beset with difficulties of the most perplexing and often disheartening kind."

* * * * * * *

Testing the efficacy of the methods practiced and materials used in the disinfection of ships, cargo, and baggage, &c., as set forth in the foregoing pages, was with special reference to the germicidal powers for which it is claimed.

Accordingly, before leaving New York, a large number of cultivation-tubes were prepared, containing blood serum, peptone gelatine, agar-agar, and rags. A large number of these were inoculated from pure cultivations of the micro-organisms here mentioned, viz:

Spirillum cholerae Asiaticae.
Spirillum Finkler-Prior.
Bacillus anthracis.
Bacillus typhi abdominalis.
Bacillus coli communis (Hueppe).
Bacillus murissepticus.
Bacillus pneumoniae (Friedlander).
Bacterium of yellow fever (Finlay).
Staphylococcus pyogenes albus.
Staphylococcus pyogenes aureus.
Streptococcus erysipelatus.

Several of the series of above-named micro-organisms were obtained of Dr. T. M. Prudden; also, one specimen of the micro-organism claimed to be the cause of yellow fever, by Dr. Finlay, of Havana, Cuba; another of the same organism was furnished by Dr. S. T. Armstrong, who had only a few days prior to my departure received it from Dr. Finlay.

Whether the organism referred to *is* the cause of yellow fever we leave for others to confirm or disprove.

In carrying out the following series of experiments, it was intended to show whether the process of disinfection applied to such vessels was sufficient to destroy the growth of these micro-organisms, and in but few instances was the process varied or the time lengthened from that which is practiced from opening of the quarantine season to June 1, when the time is lengthened to five days. It was also for the pur-

pose of deciding whether the time imposed on vessels prior to June 1 was sufficient for the prevention of epidemic disease.

In carrying out these experiments, several classes were conducted at the same time, and, to have them correspond with the description of the machinery, &c., the same order will be followed.

Since the opening of the season, vessels engaged in the fruit trade and plying between ports subject to quarantine are not subjected to the same treatment as others. Should they have any passengers aboard who have with them any baggage or articles of clothing save what they wear, they are compelled to stop at the upper station, where the baggage of passengers, crew, ship's linen, &c., are subjected to the steaming process, while the cabin and deck are washed down with bichloride solution.

If no baggage is aboard, they are given pratique to the city, where the cargo is discharged and vessel cleansed by washing the deck and burning sulphur in the hold. The quantity of sulphur used was not learned.

Whenever practicable, all the surfaces inside the hold of the vessel and between decks are wetted by a simple ¾-inch hose with nozzle, the rose being dispensed with, as it is claimed that there can be a more thorough wetting accomplished than by its use. This is invariably done before the vessel is treated to sulphur dioxide, in order to delay it as little as possible.

The flat surfaces of the decks are thoroughly washed with a rose sprinkler, but around among the corners, hatches, or perchance hogsheads of sugar that are sometimes on deck, the process is defective, because a great many places are not reached. The same can be said of the disinfection of the cabin, lockers, &c., only a partial disinfection is accomplished; for, to wet all surfaces, with the present arrangements it would be necessary to almost submerge them with the solution.

The carpets, rugs, rubber and leather goods, trunks, and valises are sprinkled with the same bichloride solution.

Several experiments were made upon the goods, clothing and surfaces thus treated, and it was found that the solution did not cover all the surface, for portions of carpets, scrapings from floor and underside of the forecastle, deck, &c., when placed upon sterilized nutrient media, showed evidences of germ development. No apparent difference could be noticed between portions removed from the floor of the forecastle after being saturated for one hour with the bichloride and other portions of the same that had not been reached by the solution. The last can be explained by the fact that the forecastle was in an extremly filthy condition, and, there being such an abundance of organic matter, the bichloride was rendered inert.

For the general application of this solution to the ship, especially to cabin, carpets, &c., we suggested that a spraying apparatus be substituted, made by leading a rubber hose from the boiler of the tug and connecting it with the supply-pipe of the bichloride solution in such a manner as to make a "Richardson's spray producer" on a large scale, so that by its use all surfaces, cracks, &c., can be thoroughly and evenly wetted.

Former experience teaches that placing dirty and greasy clothing in the heating-chamber is not a safe procedure with the present apparatus, for to them have been traced the cause of fires breaking out during the steaming process. They are now left on deck and sprinkled with

bichloride of mercury, in the following manner: One attendant stands ready with hose in hand while another places the clothing to be thoroughly wetted down on the deck, turning them over from time to time, while the other plays a stream of bichloride upon them.

The car upon which the clothing, bedding, goods, &c., is placed for the purpose of transporting them to the steam-heating chamber is not disinfected before the goods are placed upon it to be taken back to the ship.

The following tables were made for the purpose of demonstrating the variations of temperature obtained in the heating-chamber:

TABLE I.—*Heating-chamber empty.*

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments. 1. Panel 2.	4. Panel 20.	5. Panel 21.	6. Panel 31.	8. Panel 39.
		Pounds.		°	°	°	°	°
1	4:22	110	Dry	117	102	93.5	.....	99.0
2	4:32	100	Dry	123	110	106.0	.....	104.0
3	4:39	110	Dry	127	114	110.5	.....	106.0
4	4:50	100	Dry	129	116	116.5	110	107.5
5	5:00	100	Dry	129	119	119.5	110	115.0
6	5:11	110	Dry and moist	132	126	117.0	119	110.0
7	5:16	80	Dry and moist	132	126	127.0	116	115.0
8	5:21	70	Dry and moist	132	126	127.0	116	115.0
9	5:29	80	Dry	133	.....	124.0	116	110.0
10	5:35	80	Dry	133	126	123.0	112	111.0

Time, 53 minutes.

Thermometers placed in the center of the chamber, suspended from the cross-bars of panels. The greatest amount of heat was obtained in compartment No. 1, panel 2, where there is a large "header" for the dry coil.

TABLE No. 2.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments. 1. Panel 2.	4. Panel 20.	5. Panel 21.	7. Panel 31.	8. Panel 39.	Panel 37.
		Pounds.		°	°	°	°	°	°
*1	8:10	100	Dry	.....	.....	.....	.....	.....	(†)
2	8:55	105	Dry	105	83.5	106.6	69.0	88.0	.....
3	9:00	100	Dry and moist	112	101.0	107.7	77.0	95.5	.....
4	9:05	95	Dry and moist	.....	105.0	108.3	82.0	103.0	.....
5	9:10	85	Dry and moist	.....	101.5	118.3	86.0	104.0	.....
6	9:15	80	Dry and moist	115	100.5	119.4	87.0	105.0	.....
7	9:20	70	Dry and moist	118	104.0	120.5	87.0	105.5	.....
8	9:25	65	Dry and moist	120	104.0	120.0	90.0	106.0	.....
9	9:30	75	Dry	109	100.0	118.3	87.5	104.0	.....
10	9:35	80	Dry	109	96.0	116.6	84.0	105.0	.....
11	9:40	95	Dry	100	95.0	110.5	81.0	105.0	.....
12	9:45	90	Dry and moist	.....	96.0	110.5	.....	105.0	.....
13	9:55	75	Dry and moist	.....	103.0	120.5	100.0	106.0	.....

* Chamber filled with goods, and thermometers in position.
† Electric thermometer failed to register 120°.

In panels Nos. 2, 20, 31, and 39, U. S. M.-H. S. thermometers; in No. 21, quarantine thermometer was placed; compartment No. 1, filled with ladies' wearing apparel; compartments Nos. 2 and 3, partly filled with clothing of crew; compartments Nos. 4, 5, 6, and 7, filled with mattresses and blankets; compartment No. 8, mattresses and clothing of male passengers.

TABLE No. 3.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments.					
				1.	5.	4.	3.	8.	5.
				Panel 2.	Panel 21.	Panel 20.	Panel 12.	Panel 38.	Panel 24.
		Pounds.		○	○	○	○	○	○
	*9:00								
1	9:15	100	Moist	76.0	88.8	80.0	76.0		
2	9:20	95	Moist	103.0	112.2	90.0	83.0		
3	9:25	80	Moist	109.0	120.2	95.5	88.0		
4	9:30	75	Moist	111.0	131.6	97.0	94.0		
5	9:35	60	Moist	111.5	115.7	98.0	95.5		
6	9:39	60	Moist					100	
7	9:40	60	Moist	110.0	113.8	99.0	99.0		
8	9:42		Moist						82.5

*Chamber was filled with goods and thermometers placed.

Time, 27 minutes.

Compartments Nos. 1 and 5, nearest boiler, filled with bedding; compartments Nos. 3 and 4, filled with mattresses, blankets, &c.; compartments Nos. 5 and 6, filled with ship's linen, clothing of crew; compartments Nos. 7 and 8, filled with clothing of officers, and a few panels reserved for the clothing of attendants. U. S. M.-H. S. thermometers placed in panels 2, 20, 38, and 24. Electric thermometers placed in center of panel 38, and no clothing in at least one foot of it. Indication, 100° in 24 minutes. A self-registering thermometer placed among cultivation-tubes that were laid on mattresses registered 82.5°. Thermometers 2 and 20 placed in position same as in Table No. 1.

TABLE No. 4.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments.					
				1.	2.		3.	5.	8.
				Panel 2.	Panel 6.	Panel 10.	Panel 12.	Panel 21.	Panel 39.
		Pounds.		○	○	○	○	○	○
1	11:40	100	Dry and moist...	65.0		(*)	120.0	91.1	104.0
2	11:45	100	Dry and moist...	100.5			131.0	102.7	119.0
3	11:50	90	Dry and moist...	109.0			133.5	118.8	122.5
4	11:55	80	Dry and moist...	111.0			134.0	126.3	123.5
5	12:00	75	Dry and moist...	111.5			134.0	126.6	123.5
6	12:05	65	Dry and moist...	110.0			132.5	126.1	122.0
7	12:07		Steam turned off.		95.5				

* Failed to register 120°.

Time, 27 minutes.

Compartments Nos. 1 and 2, filled with mattresses; compartments Nos. 3 and 4, filled with mattresses and clothing of crew; compartments Nos. 5 and 6, filled with clothing; compartments Nos. 7 and 8, filled with clothing of officers and passengers. Nos. 2, 6, 12, 39, U. S. M.-H. S. thermometers; No. 21, quarantine thermometer. Electric thermometer, indicating 120°, placed in compartment No. 2, panel 10, at extreme end of panel, surrounded by a free air-space of at least one cubic foot. Self-registering thermometer, No. 6, placed upon and surrounded by mattresses filled with hair and excelsior. About 8 or 9 inches of air-space between goods and thermometer. Reading, 95°.

TABLE No. 5.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments.					
				1.		4.	5.	8.	
				Panel 2.	Panel 16.	Panel 20.	Panel 21.	Panel 36.	Panel 39.
		Pounds.		°	°	°	°		°
1	9:30	100	Dry and moist	80.5		100.5	97.7	(*)	99.0
2	9:35	80	Dry and moist	81.5		100.5	103.8		105.0
3	9:40	75	Dry and moist	90.0		101.5	112.2		109.0
4	9:45	65	Dry and moist	96.0		106.0	112.7		110.0
5	9:50	65	Dry and moist	102.0		107.0	112.2		109.0
6	9:55	55	Dry and moist	105.0		106.5	112.2		108.5
7	9:57	55	Steam cut off		76				

* Electric thermometer failed to register 100°.

Time, 25 minutes.

All compartments filled to their full capacity with goods of all kinds. Electric thermometer placed in panel 36, compartment No. 8, among mattresses and blankets, failed to indicate 100°, while panel 39, in free air-space, indicated 110°. Self-registering thermometer placed in panel 16, among mattresses, and a pillow thrown over it. Others, 2, 20, and 39, were placed in the usual manner through the panel, and allowing about 8 to 10 inches air-space to intervene between the bulb and clothing.

Despite the effort made to keep the steam above 60, it fell to 55 pounds.

TABLE No. 6.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments.			
				1.	5.	7.	8.
				Panel 2.	Panel 21.	Panel 34.	Panel 39.
		Pounds.		°	°	°	°
1	7:25	100	Dry				
2	8:00	100	Dry and moist	101.0	87.7		87.0
3	8:05	100	Dry and moist	111.0	100.0		88.5
4	8:10	90	Dry and moist	114.0	113.3		93.0
5	8:15	80	Dry and moist	113.0	111.1		97.5
6	8:20	75	Dry and moist	117.5	118.8		101.5
7	8:25	70	Dry and moist	119.0	122.2		103.0
8	8:30	60	Dry and moist	118.0	121.1	67	104.0

Time, 30 minutes.

All compartments filled with mattresses, ship's linen, and clothing of crew. Nos. 2 and 39, thermometers inserted through panel. No. 34, relf-registering thermometer suspended among mattresses. No. 21, free; nothing placed on panel. Greatest heat around mattresses was 67°.

TABLE No. 7.

Observation.	Time.	Steam-pressure.	Heat—character.	Compartments. 1. Panel 2.	3. Panel 12.	5. Panel 21.	7. Panel 34.	8. Panel 39.
		Pounds.		°	°	°	°	°
1	1:25		Dry			82.2		
2	1:40	115	Dry and moist	83.0		84.4		85.0
3	1:45	110	Dry and moist	100.0		92.2		88.0
4	1:50	105	Dry and moist	107.0		100.0		92.5
5	1:55	105	Dry and moist	101.0		110.0		98.0
6	2:00	100	Dry and moist	112.0		109.4	100	99.5
7	2:05	95	Dry and moist	115.0		111.1	*100	105.0
8	2:10	80	Dry and moist	117.0		116.6	100	109.0
9	2:15	50	Dry and moist	116.0		117.2	100	110.0
10	2:20	40	Dry and moist	116.5	99	116.6	100	113.0

*Above 100°.

Time, 35 minutes.

The chamber was lightly charged. Compartments Nos. 1 and 2, clothing of crew, mattresses; four panels empty. Compartments 3 and 4, same as above; three panels empty. Compartments 5, 6, 7, and 8, clothing and ship's linen. Thermometer inserted through panels in the usual manner. Self-registering thermometer placed on mattresses, indicating 99°. Electric thermometer placed among clothing indicated 100° in 20 minutes.

TESTING THE APPLICATIONS OF DRY AND MOIST HEAT.

I was informed by Dr. Aby that his instructions from the board of health were to the effect that clothing, bedding, &c., after being placed within the chamber, should be raised to a temperature of 85° C., after which the steam should be turned on, and kept for 20 minutes after the thermometer indicates 100° C. This manner renders fire less imminent.

The time of exposure of micro-organisms to the heating process was not varied from the prescribed rules, save in two instances.

Cultivations of micro-organisms on various substances were placed, in each of the following experiments, in positions where the minimum heat was to be expected.

EXPERIMENT No. I.—Cultivation-tubes of peptone agar-agar inoculated with—

Spirillum cholerae Asiaticae,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacterium of yellow fever (?),

were placed in a wire basket and hung in compartment No. 8, panel 39, the one most distant from the boiler, and upon which but little

clothing was hung. In 16 minutes the temperature (dry heat) reached 79.4°, when steam was turned on and kept 20 minutes, cultivations removed, and inoculations made therefrom, the temperature being ascertained by placing a self-registering thermometer upon the surface of agar-agar within the cultivation-tubes. Repeated examinations show all growths to have been killed.

EXPERIMENT No. II.—Cultivations of—

Spirillum cholerae Asiaticae on blood serum,
Bacillus anthracis on agar-agar,
Bacillus typhi abdominalis on agar-agar,
Bacillus coli communis on agar-agar,
Bacillus pneumoniae on agar-agar,
Bacterium yellow fever (?) on agar-agar,
Staphylococcus pyrogenes albus on blood serum,
Staphylococcus pyrogenes aureus on blood serum,

were suspended in among blankets and mattresses in compartment No. 5, panel 31. A quarantine thermometer registered 88.8° dry heat in central chamber. Steam turned on and kept 43 minutes. Temperature among blankets fell to 82.5°.

Inoculations made from these cultivations into peptone gelatine showed the baccillus anthracis and bacterium yellow fever alive; all others were dead.

The temperature was taken on the outside of the cultivation-tubes.

EXPERIMENT No. III.—Chamber filled with goods, consisting chiefly of bedding and clothing of the crew. The articles were not hung closely together, as the chamber was filled to only three-quarters of its capacity. Cultivations of—

Spirillum cholerae Asiaticae,
Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus pneumoniae,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacterium yellow fever (?),
Staphylococcus pyogenes albus,
Staphylococcus pyogenes aureus,

were placed in a basket and arranged upon and between mattresses. Thermometers being placed among cultivations, temperature registered 85.5° C. dry heat in center chamber. Steam turned on and allowed to remain 27 minutes. All micro-organisms dead except those of bacillus anthracis and bacterium yellow fever. Thermometer among cultivations indicated 95.5° C.

EXPERIMENT No. IV.—Chamber partially filled, compartment No. 7 containing principally the mattresses and clothing of the crew. A hair mattress was opened, and tubes containing cultivations of—

Spirillum cholerae Asiaticae,
Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacterium yellow fever,
Bacillus murissepticus,
Staphylococcus pyogenes albus,
Staphylococcus pyogenes aureus,

were placed within and exposed to moist heat for 25 minutes. A self-registering thermometer placed among tubes indicated 75°. Examination of growths showed those of bacillus anthracis, bacillus murissepticus, and bacterium yellow fever to be alive; all others were killed.

EXPERIMENT No. V.—Chamber well charged with goods. A series of cultivation-tubes containing rags (both cotton and woolen) that had been inoculated with—

Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus pneumoniae,
Staphylococcus pyogenes albus,
Staphylococcus pyogenes aureus,

were placed in among mattresses and blankets and exposed for 20 minutes to moist heat; temperature indicated, 62.5° C. Examination showed all growths dead save that of anthrax.

EXPERIMENT No. VI.—Clothing and bedding of steamship "Saturnina," from Cuba to New Orleans, placed in heating-chamber; all compartments filled. Owing to the uncleanness of the crew's bedding, we suggested that a longer time be given in the steaming process. Cultivations on agar-agar of—

Spirillum cholerae Asiaticae,
Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus pneumoniae,
Bacillus coli communis,
Staphylococcus pyogenes albus,
Staphylococcus pyogenes aureus,

were placed in compartment No. 7, panel 34, arranged on mattresses, and surrounded by pillows. Temperature of middle chamber (quarantine thermometer), 76.6° C. Left for 55 minutes; thermometer among cultivations indicated 67°; inoculations show all killed, except bacillus coli communis and bacillus anthracis.

EXPERIMENT No. VII.—Chamber was lightly charged, several panels in each compartment being empty. Cultivations made upon rags of the following:

Spirillum cholerae Asiaticae.
Bacillus typhi abdominalis.
Bacterium yellow fever.
Staphylococcus pyogenes albus.
Staphylococcus pyogenes aureus.

These were suspended among clothing, chiefly underwear, and allowed to remain 40 minutes. A thermometer placed in a tube containing similar media registered 99°. Inoculations from the tubes show that all have been killed except the bacterium of yellow fever.

EXPERIMENT No. VIII.—Chamber filled with goods—bedding and clothing. Cultivations of—

Spirillum cholerae Asiaticae,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacterium yellow fever,
Staphylococcus pyogenes albus,

were placed in heating-chamber, in its center, arranged upon blankets

and clothing. These were subjected to moist heat for 40 minutes. Temperature indicated near cultivations was 69°.

The bacillus anthracis, bacillus typhi abdominalis, bacillus coli communis, and staphylococcus pyogenes albus were found to be alive.

SULPHUR DIOXIDE FUMIGATION.

The quantity of sulphur consumed in the fumigation of each vessel is from 100 to 400 pounds, according to the size of the vessel. Those arriving at quarantine during our stay at the station varied from 100 to 2,000 tons burden. About 100 pounds of sulphur are consumed in an hour, and forms about 1,170 cubic feet of sulphur dioxide. If, as is claimed, 180,000 cubic feet of air per hour be driven into the hold or compartment of a vessel, the strength of the gas would be, approximately, $\frac{6}{10}$ per cent.

That that quantity of air is not driven into the hold is proven by the fact that in quite a number of volumetric analyses, made on various vessels at the close of fumigation (for the purpose of determining the quantity of sulphur dioxide present), shows from 2 to 6 per cent. to the 100 pounds of sulphur, the capacity of the compartments being about the same, viz., 20,000 cubic feet. This does not represent the full amount of the gas generated, for in all vessels there is constantly present a certain amount of moisture, which absorbs the gas.

In the generation of the sulphur dioxide there is formed in the "battery" a certain amount of nitrous oxide, and, the gas being quite hot (130°) as it enters the vessel, every factor is present for the rapid production of sulphuric acid. The greatest percentage of gas was found in holds containing coffee, still less in sugar, and least in those vessels that had been treated with the bichloride solution previous to fumigation. In these the percentage was notably diminished (2 per cent.), the gas being absorbed by the wetted surfaces, also uniting with the mercuric salt, forming a compound which impairs germicidal power of both and destroys penetrating properties of the gas.

We were informed that it was the custom formerly to put the exhaust-fan in operation for an hour before, driving pure air into the hold, thus aerating the vessel and cargo before fumigation was commenced. This was not put in practice during our stay. Vessels hailing from ports known to be infected are treated to a larger quantity of gas, 200 pounds or more of sulphur being used to each compartment.

In testing the germicidal power of the fumigating process it was for determining whether the short time of detention practiced prior to June 1 was of sufficient duration to insure complete disinfection of vessel and cargo.

Where the compartments are empty or communicating with the engine-room or chain-locker, the hatches are not sealed by the customs authorities, and there is no assurance that the sulphur fumes remain longer than a short time after the disinfection is finished.

It was noticed in several instances where the forward hatch communicated with the chain-locker or engine-room that the hatches were removed immediately after fumigation and a wind-sail put in place for the purpose of driving out the fumes, so as to enable the vessel to leave for New Orleans as soon as possible.

Vessels having their hatches sealed are insured of at least fifteen hours' disinfection. The forecastle, after being thoroughly wetted with bichloride solution, is treated to the "pot plan," the longest period of time being three hours, after which it was immediately permitted to be thrown open by the crew. The following experiments were made:

EXPERIMENT No. 1.—Spanish bark "Pedro," from Havana to New Orleans. Thoroughly wetted down with bichloride solution. A basket containing cultivations on agar-agar that had been inoculated fifteen days previously with—

Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacterium yellow fever,

was placed about 60 feet from the hatch where the fumigating-pipe enters. The cotton plugs were removed from the test-tubes. These were left for a period of 90 minutes, the time occupied in the fumigation. One hundred and fifty pounds of sulphur were used.

Inoculations made from time to time from these tubes show that all the growths were not influenced by the exposure.

EXPERIMENT No. 2, SO^2.—Steamship "Morgan;" rear hold compartment filled with sugar in sacks. A basket containing cultivations prepared for exposure was placed in the hold about 16 feet distant from the hose leading into the compartment; tubes containing—

Spirillum Finkler-Prior.
Bacillus anthracis.
Bacillus pneumoniae.
Bacillus murissepticus.
Bacterium yellow fever(?).
Staphylococcus pyogenes albus.
Staphylococcus pyogenes aureus.

Time of exposure, 2 hours and 20 minutes. One hundred and fifty pounds of sulphur used. Owing to the character of cargo, no bichloride solution was used.

Inoculations made from growth of each micro-organism show no effect upon them.

EXPERIMENT No. 3, SO^2.—Two baskets were prepared for placing in the forward hold of steamship "Morgan;" capacity, 101 tons; cargo of sugar in bags; basket No. 1 containing cultivations of—

Spirillum cholerae Asiaticae, blood serum, rags.
Bacillus coli communis, agar-agar.
Streptococcus erysipelatus, blood serum.
Basket No. 2—
Spirillum Finkler-Prior.
Bacillus anthracis.
Bacillus coli communis.
Bacillus pneumoniae.
Bacterium yellow fever (?).

Basket No. 1 placed 15 feet from the pipe; basket No. 2, 30 feet from pipe. Cultivations exposed for 1 hour and 20 minutes; fumigation lasted 1 hour. About 100 pounds of sulphur used. Cultivations had to be removed, as the vessel was ready to leave the dock; forward hatch was not sealed. All cultivations alive; no inhibitory effect noted.

EXPERIMENT No. 4.—Steamship "Floridian," from Colon to New Orleans, having but little freight; several compartments empty. Cultivations of—

Spirillum cholerae Asiaticae, blood serum,
Spirillum Finkler-Prior, blood serum,
Bacillus anthracis, agar-agar,

Bacillus typhi abdominalis, agar-agar,
Bacillus murissepticus, blood serum,
Bacillus cholera nostras, agar-agar,
Staphylococcus pyogenes albus, agar-agar,
Staphylococcus pyogenes aureus, agar-agar,
were placed in forward compartment (empty). Compartment fumigated for 2 hours, and allowed to remain for 8 hours and 30 minutes. Inoculations were made from time to time, and it was found that those of cholerae Asiaticae, Finkler-Prior, staphylococcus pyogenes alba and aureus, and bacillus murissepticus were dead. No effect was noted in any way upon anthrax, typhoid, and cholera nostras.

EXPERIMENT No. 5.—Cultivations prepared by placing a small quantity of sterilized cotton in test-tubes and moistening it with a small quantity of distilled water; the cotton was then infected with several growths of the following:
Spirillum cholerae Asiaticae.
Spirillum Finkler-Prior.
Bacillus anthracis.
Bacillus coli communis.
Bacterium yellow fever (?).
Staphylococcus pyogenes albus.
Staphylococcus pyogenes aureus.
These were placed in an empty compartment that had been thoroughly washed down with the bichloride solution. About 125 pounds of sulphur used. Volumetric examination of gas shows 8 per cent. Time cultivations were exposed, 3 hours and 50 minutes. Only that of cholerae Asiaticae was killed.

EXPERIMENT No. 6.—Cultivations on agar-agar, made only 24 hours before, of—
Spirillum cholerae Asiaticae (2),
Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacillus pneumoniae,
Bacterium yellow fever (?),
Staphylococcus pyogenes albus,
Staphylococcus pyogenes aureus;
Also, cultivations on cotton and woolen rags of—
Spirillum Finkler-Prior,
Bacillus coli communis,
Bacillus pneumoniae,
Bacillus typhi abdominalis,
Bacillus murissepticus,
Staphylococcus pyogenes aureus,
Streptococcus erysipelatus.
Both series were placed in the forward compartment of steamship "Lizzie Henderson," a small steamer plying between Tampa and New Orleans. After fumigation the hatch was battened down and the cultivations left until the vessel arrived in New Orleans, when they were taken out and inoculations made therefrom into fresh agar-agar. Time of exposure, 24 hours. Of the growths upon agar-agar, those of bacillus pneumoniae, Finkler-Prior, and cholerae Asiaticae were killed. None of those on rags affected.

EXPERIMENT No. 7.—Cultivations made 24 hours before upon the surface of agar-agar of—

Spirillum Finkler-Prior,
Spirillum cholerae Asiaticae,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacillus pneumoniae,
Bacterium yellow fever (?),

placed in forward hold of steamship "Hutchinson," down under bags of sugar. Fumigation for 1 hour and 20 minutes; then hatch closed; 15 hours later, while proceeding to the city, the hatch was thrown open, and 9 hours thereafter, on arrival in New Orleans, the basket was removed. All germs found living.

EXPERIMENT No. 8.—Potato placed in large test-tubes and inoculated with—

Spirillum cholerae Asiaticae.
Spirillum Finkler-Prior.
Bacillus anthracis.
Bacillus typhi abdominalis.
Bacillus coli communis.
Bacillus pneumoniae.
Bacterium yellow fever (?).
Staphylococcus pyogenes aureus.

These were placed in a basket and wrapped in an old mattress, which was lowered into an empty compartment of the steamship "Saturnina." Fumigated for 2 hours; 200 pounds of sulphur used. The mattress was taken out 4 hours after. All growths dead except anthrax, typhi abdominalis, staphylococcus pyogenes aureus, cholera nostras, and yellow fever. Test-tubes containing aga-aga and gelatine show that the gas in the above-mentioned time penetrates to the depth of three-quarters of an inch. Percentage of gas, 6 per cent. Hatch sealed by customs officer.

EXPERIMENT No. 9.—Recent cultivation on agar-agar of—

Spirillum cholerae Asiaticae,
Spirillum Finkler-Prior,
Bacillus anthracis,
Bacillus coli communis,
Bacterium yellow fever(?),
Staphylococcus pyogenes albus,

were placed in hold of bark "Antonio Georgio," in ballast from Havana to New Orleans. Ballast and interior of hold well washed down with bichloride solution; fumigation, 1½ hours; 150 pound sulphur used; time of exposure, 2 hours. No effect on the organisms.

EXPERIMENT No. 10.—A basket containing surface cultivations on agar-agar of—

Spirillum cholerae Asiaticae,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus coli communis,
Bacillus murissepticus,
Staphylococcus pyogenes albus,
Bacterium yellow fever,

was placed in forward compartment of steamship "Inventor," down

under bags of coffee, being well covered up; fumigation lasted 4 hours; 275 pounds of sulphur consumed. Hatch was then closed for 7 hours, when it became necessary, on account of the chain-locker communicating with the compartment, to open the hatch and place wind-sail in position, in order to drive out the gas, so that anchor could be raised.

The basket was removed on arrival in New Orleans, 20 hours after, at which time the fumes were still quite strong. Examination showed all cultivations to be alive, though slight inhibitory effect was noticed.

Cultivation-tubes containing agar-agar and gelatine that were exposed at the same time to SO^2 completely inhibited the growth of all micro-organisms tested.

EXPERIMENT No. 11.—Cultivations on agar-agar of—

Spirillum cholerae Asiaticae,
Bacillus anthracis,
Bacillus typhi abdominalis,
Bacillus murissepticus,
Staphylococcus pyogenes albus,

placed in rear compartment of steamship "Inventor," at a point farthest from the entrance of SO^2. Cargo, sugar; fumigation for 4 hours and 30 minutes; 300 pounds sulphur used; hatch then sealed. On arrival in New Orleans, 22 hours later, the hatch was opened and an attempt made to remove the basket, but the fumes of the gas were so strong that this could not be accomplished for 2½ hours. Examination of the cultivations showed that all micro-organisms were dead, except that of anthrax.

Cultivation-tubes, containing agar-agar and gelatine, showed the same inhibitory power as in the preceding experiment.

EXPERIMENT No. 12.—A liter of air was collected in sterilized vessels before and after the application of sulphur dioxide. Examination was made for the purpose of determining whether or not the gas exercised a germicidal effect on the micro-organisms of the air in the ship's hold.

A series was collected that had been exposed 1, 2, 4, and 8 hours, respectively, samples having been collected previous to application of the gas for the purpose of making control observations. None of the series showed diminution in number.

EXPERIMENT No. 13.—Cultivation-tubes, containing peptonized agar-agar, gelatine, and rags, exposed for 1, 2, and 4 hours, show a decided inhibitory effect on all micro-organisms that were tested. Those exposed for 6, 8, and 20 hours to sulphur dioxide killed all non-spore-bearing germs.

It has been our intention to show by the foregoing observations upon the methods practiced in carrying out the present system of quarantine at this station whether or not it is efficient; if not, to show its defects, and how remedied.

In the evolution of such an establishment, the many difficulties that must have stood in the way of such an undertaking, due credit must be given to those gentlemen who formulated the theory and put in practical operation the present system of disinfection.

From the series of observations made in determining the temperature of the chamber for the application of dry and moist heat, it is clearly shown that the time prescribed is entirely too short when the chamber is filled with goods; more especially is this noticed when the chamber is filled with such goods as blankets, mattresses, and cushions.

Unless a longer period of time is given to each charge, it is certain that only a partial disinfection is accomplished.

It was suggested to Drs. Wilkinson and Aby that the defects of the present style of steaming apparatus could be best overcome by adopting the application of dry and moist heat under a pressure of from 10 to 20 pounds. To accomplish this it would be necessary to have new machinery. Instead of the steaming-chamber now in use, to have constructed a large chamber of boiler-iron, capable of standing at least 25 pounds pressure to the square inch, and provided with one bulk-head door that could be properly secured to make it steam-tight, being provided with suitable appliances for ascertaining the temperature in any part of the chamber. In this manner the disinfection by steam and dry heat could be thoroughly accomplished and much more speedily than at present.

Lighter articles, such as clothing, &c., when not too much crowded, received sufficient heat to disinfect them.

We are informed by the president of the board, Dr. Wilkinson, that the matter was laid before the health board, and it was by resolution decided to remove the present location of the quarantine station to a place further down the river, in order that there could be complete isolation; and, guided by the result of the experiments undertaken, a heating-chamber capable of sustaining sufficient pressure from within will be erected, thus insuring an equal distribution of heat and the possibility of attaining and maintaining a much higher temperature than at present; also that an order would be given to the resident physician to the effect that the steaming-chamber should not be so heavily charged, and the time of exposure be extended to a sufficient limit to insure a proper degree of heat.

It is believed that if before the application of sulphur dioxide to the holds and cargoes of vessels, the holds be thoroughly aerated by means of the exhaust-fan and the use of a greater quantity of sulphur, confining the gas in the vessel, say, a period of not less than 36 hours, then the application of the bichloride solution to the hold and between decks will accomplish a thorough disinfection of the surfaces of vessel and cargo.

It is shown that in the short process of fumigation prior to June 1 the gas does not penetrate to any depth in such cargoes as coffee, sugar, &c. After June 1, the time of detention being five days, there is insured a thorough application of the gas in its greatest germicidal power.

The following conclusions may be drawn:

1st. That the application of bichloride solution to interior of the cabin, carpets, rugs, trunks, valises, rubber and leather goods should be made in such manner as to insure the moistening of all surfaces.

2d. The chamber should not be charged to more than half its capacity, and the time lengthened to at least one hour.

3d. That the time imposed on vessels that have undergone the fumigating process prior to June 1 should be longer, and the application of bichloride to the interior of the hold should be done after the gas has been confined at least thirty-six hours.

4th. That the establishment of the present style of apparatus is a great stride in the right direction, and has demonstrated its feasibility and the correctness of the principles involved.

The president, Dr. C. J. Wilkinson, asserts that whatever degree of heat has been obtained, it is certain that no case of yellow fever has developed on any vessel that has been subjected to this process, a fact, however, which was not uncommon under previous methods.

PLATES TAKEN FROM REPORT OF DR. JOS. HOLT, ON "THE QUARANTINE SYSTEM OF LOUISIANA." *

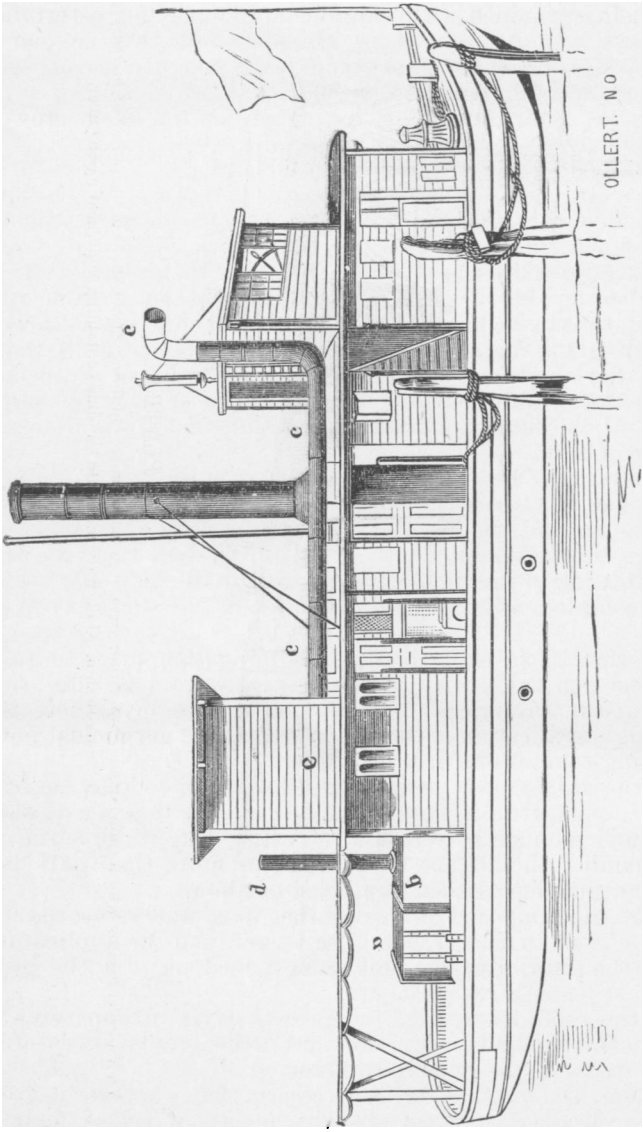

PLATE 1.—TUG-BOAT WITH FUMIGATING APPARATUS.

a. Furnace. *b.* Reservoir for reception of gas. *c.* Discharge-pipe, conveying gas to ship's hold. *d.* Escape-pipe for gas when fan is at rest and sulphur is burning; closed by a valve when fan is in motion. *e.* House protecting from weather the machinery for driving fan and containing accelerating gearing.

*Loaned by the State Board of Health of Louisiana.

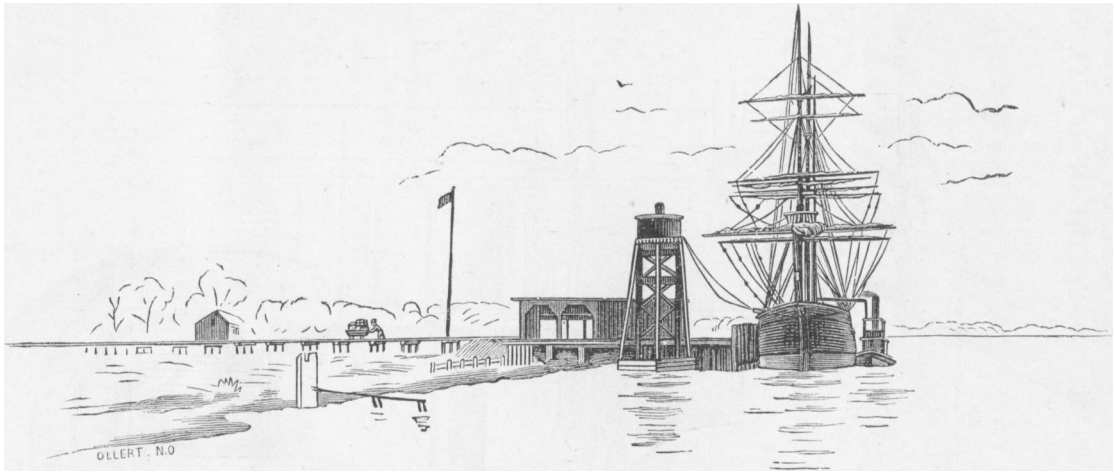

PLATE 2.

View of disinfecting-wharf, showing tug fumigating vessel; elevated tank containing 8,000 gallons of bichloride of mercury solution, 3 leads of hose from tank to ship. Gangway leading to building containing superheating-chamber.

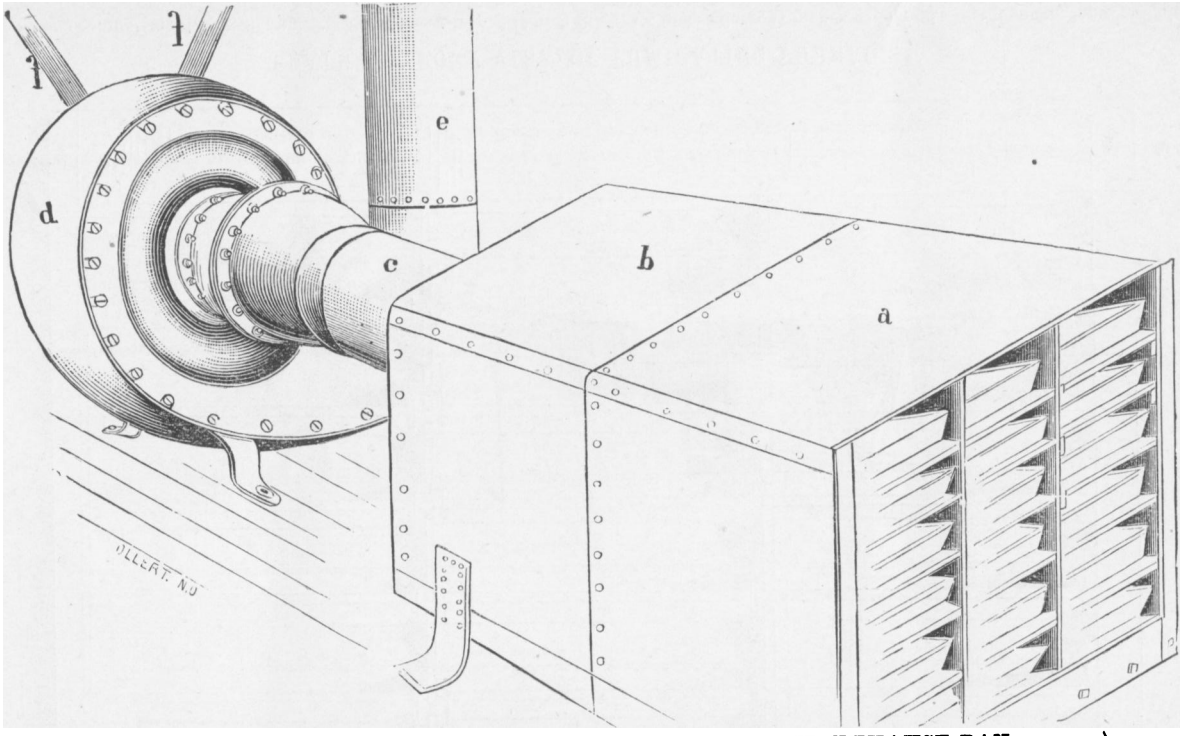

PLATE 3.—FUMIGATING-FURNACE, RESERVOIR, AND EXHAUST-PAN.

a. Furnace of cast-iron, ½ inch thick; 3 feet wide, 3 feet long, 2 feet high. Upper and lower plates grooved for reception of partitions, and sides shouldered for same, as shown in Plate 4. *b*. Reservoir, No. 10 iron, same dimensions as furnace. *c*. Exhaust-pipe connecting reservoir and fan. *d*. Exhaust-fan, Sturtevant's, No. 29, Medium Planing-Mill Exhauster. *e*. Discharge-pipe from fan made of No. 20 galvanized iron. *f*. Driving-belt. Height of legs supporting furnace and reservoir, 10 inches. On reservoir at letter *b* should be shown a 12-inch opening for escape-pipe, as indicated at *d*, Plate 1.

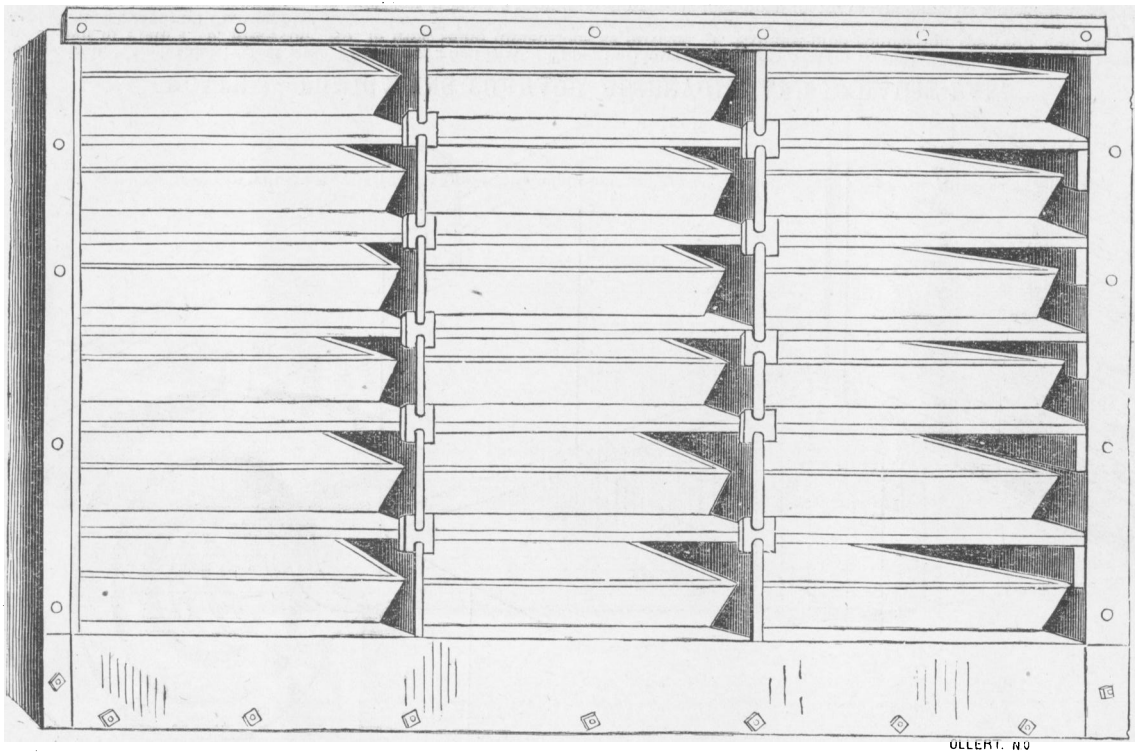

PLATE 4.—FRONT VIEW OF FUMIGATING-FURNACE.

Dimensions of each compartment, 12 x 3¼ inches. Pans of cast-iron, 5-16 inch thick, 1½ inches deep, 11 inches wide, and 2 feet 10 inches long, outside measure. Free space above pan, about 1¾ inches.

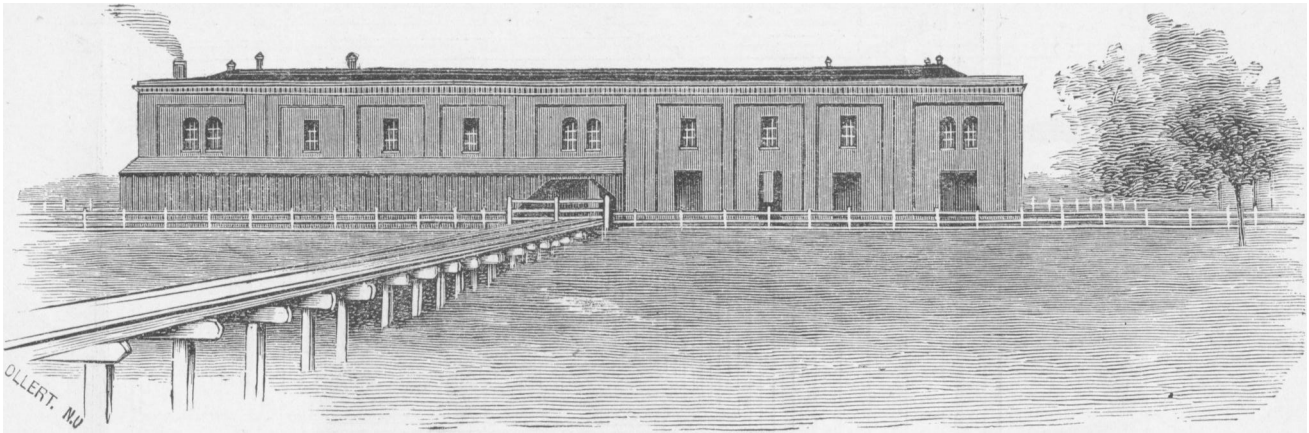

PLATE 5.

Brick building in which is located the superheating-chamber; gangway in front connecting with disinfecting-wharf.

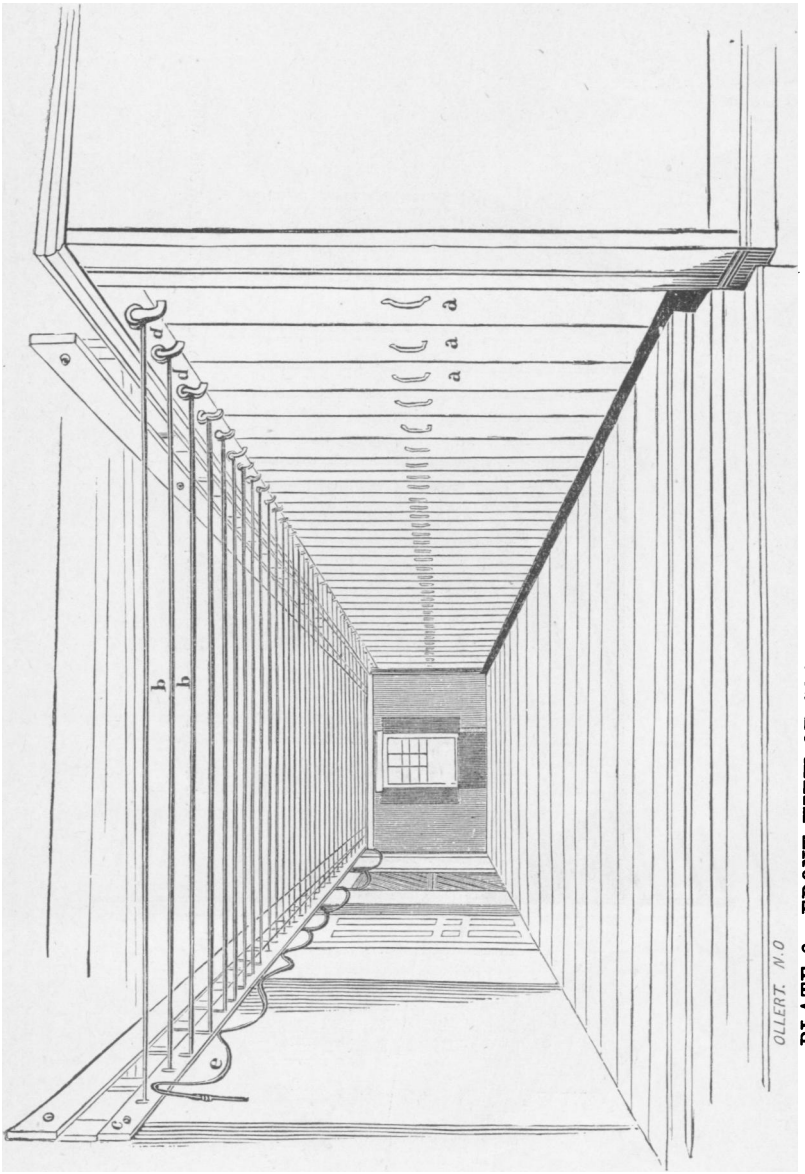

PLATE 6.—FRONT VIEW OF CLOSED SUPERHEATING-CHAMBER (60 feet long).

a. Panels. *b.* Rods upon which panels are suspended and travel. *c.* Outer support of rods. *d.* Rollers suspending panels on rods. *e.* Fire-hose.

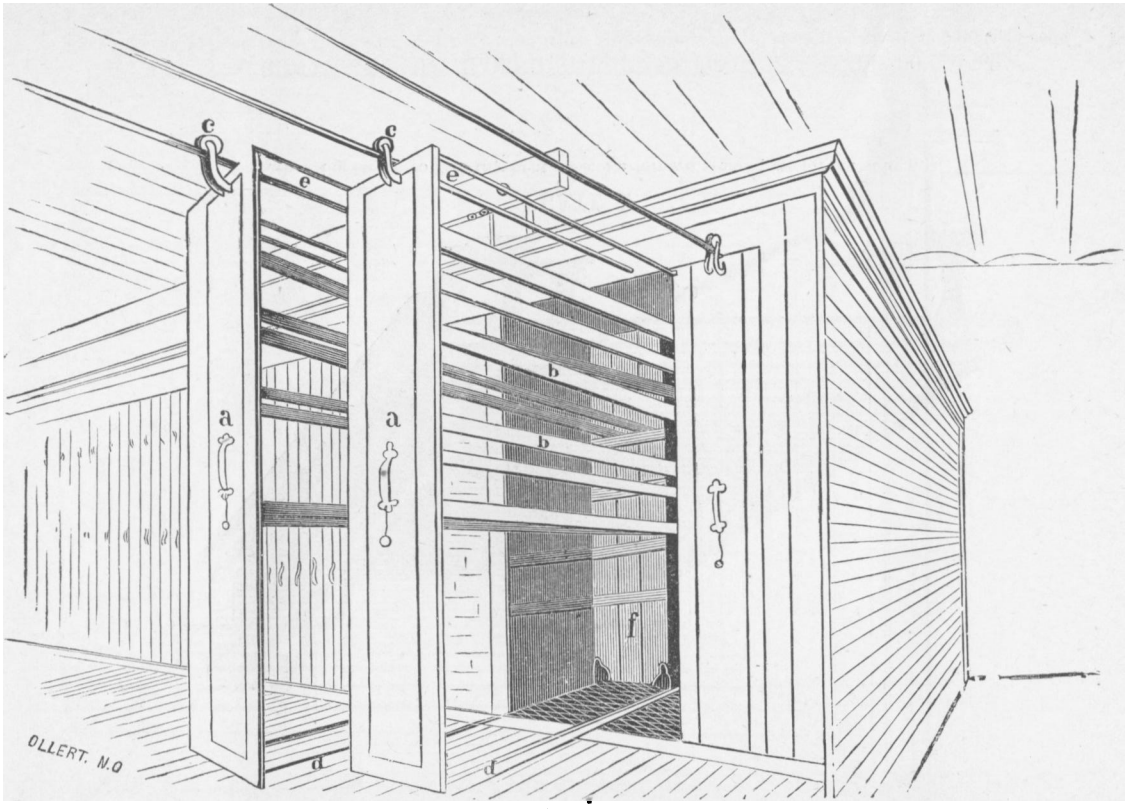

PLATE 7.—SUPERHEATING-CHAMBER; TWO PANELS DRAWN OPEN.

a. Panels. (Two lower rack-bars not shown.) *b*. Rack-bars. *c*. Rollers. *d*. Iron bars connecting front and rear panels. *e*. Rods upon which panels are suspended and travel. *f*. Rear panel. Galvanized-iron ½-inch mesh screen in bottom of chamber.

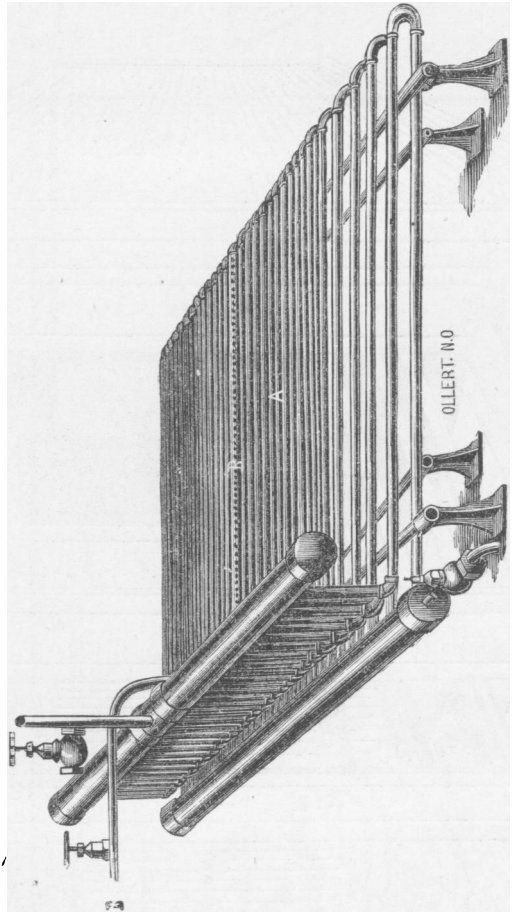

PLATE 8.

Superheating steam-coil for dry heat, *b-b*. Perforated steam-pipe for moist heat.

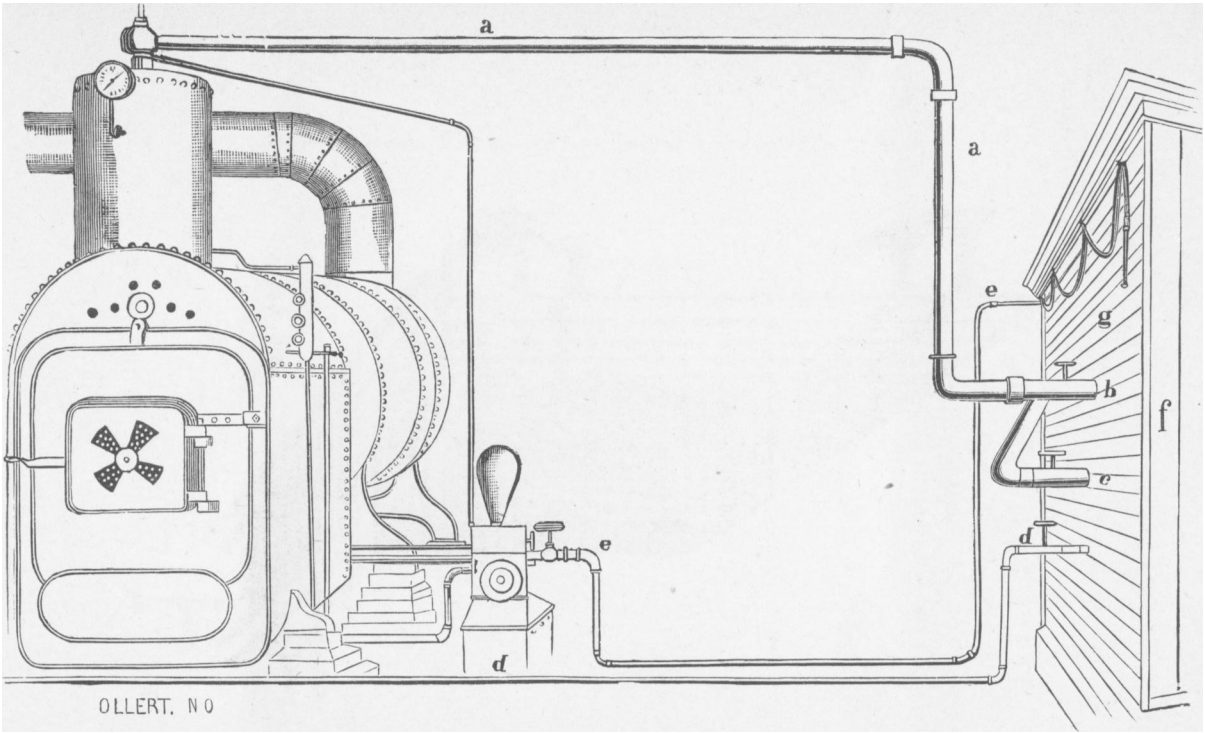

PLATE 9.—BOILER AND STEAM CONNECTION WITH SUPERHEATING-CHAMBER.

a. Steam-main from boiler. *b*. Pipe supplying dry heat. *c*. Pipe supplying moist heat. *d*. Bleeder. *e*. Pipe from pump supplying fire-hose. *f*. Front of chamber. *g*. End view of chamber.