permeates the whole vessel. At these times windows and port holes should be kept closed to exclude all this dirt.

Each ward was supplied with a white enamelled glass and iron dressing table and a suitable outfit of instruments, dressings, and appliances for ward treatment. Each bed was numbered, had a record clip for the patient's history, charts, etc., and had a sea-can secured by its handle to the rolling board conveniently at hand for seasickness. Each ward had a small refrigerator for the keeping of such articles as required ice for preservation and to keep cool drinks and beverages for the sick. A ward table with drawers and compartments proved of great convenience as a place to keep the various articles needed in ward work.

In the ward toilet-rooms were small closets in which was kept cleaning gear, such as mops, brooms, brushes, cloths, etc., used in ward police; suitable racks were also arranged for bed pans and urinals so that they might be secure when not actually in use. Small electric diet kitchens were installed in each ward and proved valuable accessories to the central diet kitchen.

The operating room was 24 by 12 feet, on the main deck next the principal gangway. It was finished in white enamel and was fully equipped. It was supplied with an autoclave, instrument and dressing cabinets, irrigating stands, stands for bowls, bunch lights for night work, an electric transformer, formalin apparatus, etc. There was hot and cold water distilled from the condensing apparatus of the ship. Oil stoves were at first used for boiling water and preparation of instruments, but later electric stoves were supplied. The usual outfit of instruments and apparatus was furnished and modern surgical methods were strictly observed; the equipment was complete. The operating tables, two, were secured to the floor; the movements of a vessel make it necessary securely to fasten in some way all loose objects when at sea.

A wheel litter was found of service in transporting patients from wards to operating room, being more easily managed than an ordinary litter. There was installed near the operating room a fine *x*-ray apparatus. When it was placed on board it was found impracticable to put it in a dark room because of lack of space, so it was available for use only at night. It proved of great use in many cases.

Very little skiagraphy was done, but the fluoroscope was used to advantage in locating missiles or making diagnoses, and operation if indicated followed.

There was a small dark room for photographic and skiagraphic work with the necessary supplies and equipment. This room was also used for eye, ear, and throat work when necessary.

The pathological laboratory had a complete equipment and much interesting and valuable work was accomplished. While at sea it was hardly practicable to undertake more than ordinary clinical pathological work, but while serving as a floating hospital at anchor there was no limit to the investigations which might be conducted.

An ice plant, the ammonia machine of De La Vergne, was installed on board for the production of ice and for refrigeration. It produced all the ice required by all on board and kept a large chill room at proper temperature for preservation of perishable food supplies. While this machine gave excellent satisfaction, one which does not require ammonia, if equally good, would be preferred. On several occasions during overhauling and repairing the fumes of ammonia escaped to such an extent as to render that portion of the ship intolerable. A serious accident occurred on the *Bay State*, afterward the *Aid*, in which the ammonia machine exploded, killing one man and seriously injuring about a dozen others. An accident occurring to an ammonia machine while at sea, causing escape of the gas, might be followed by most disastrous results. The use of such machines is prohibited in our naval vessels, and dense air machines are used almost exclusively. It is hardly necessary to state that refrigeration will not be successfully accomplished unless great pains are taken to secure proper insulation.

Having proper refrigerating facilities, articles of food can be preserved for weeks and thus suitable diet be furnished the sick for extended periods. This is an important point and must not be overlooked in making preparation for caring for large numbers of sick at sea. The ice plant is also of value in ventilating systems for cooling when necessary air delivered to any portion of the ship. This was not done on the *Relief* which had no special ventilating system, but on our transports the ventilating system has been so arranged that air is furnished cooled by means of the refrigerating device. This system has not yet been sufficiently tried to warrant positive assertions as to its utility under the varying conditions to be met at sea. The ventilation on the *Relief* was "natural." There was no system for providing fresh nor for exhausting the vitiated air. In this respect the vessel was defective. However, her wards were all in the superstructure, extending from side to side and had numerous large windows opening on the outer deck. There were also hatches and openings in the domes of the upper wards; the lower ward, aft, opened into the ward above by a large well, an oval opening, above which were hatches on the hurricane deck which were always kept open. In bad weather when windows, doors, and hatches had to be closed the air was very poor, but fortunately it was nearly always practicable to have openings on the leeward side of the vessel. In the lower decks the air was never as good as it should have been. Small port-hole openings existed and in good weather the large cargo ports were kept open, but in bad weather the ventilation was very unsatisfactory. Much fresh air reached this portion of the ship by means of ventilating cowls on the upper deck which conducted fresh air down to the boiler and engine rooms. But this was totally inadequate. In tropical waters and in good weather when everything could be kept open there was but little fault to be found, but in stormy weather it was different. The system of ventilating adopted on our transports could very properly be installed on our hospital ships, as was done in the case of the *Missouri*. This system is worked by two sets of fans, one forward, another aft, on the spar deck, with metal air ducts leading to all berth decks. These fans are either intake or exhaust, as may be required, and deliver air at the outside temperature or warmed, cooled, or filtered, according to the needs of the situation. The rated capacity of each fan is 25,000 cubic feet of air per minute. There is an air-cleansing and cooling device attached to the fan through which when tested the air current passed at a velocity of 1,000 feet per minute with a discharge velocity at the farthermost point from the fan in the lower troop deck of 950 feet per minute. Such a system, or one similar, should be placed in all hospital ships and fresh air carried to every compartment and store-room in the vessel.

A carbonating apparatus fully equipped was installed on board the *Relief* when the vessel was fitted out and gave great satisfaction. Large quantities of carbonated water were sent ashore in Cuba and Porto Rico in ordinary bottles; that for ship's consumption was put up in siphon bottles. The distilled water made on board was charged at but trifling expense. All effervescing drinks are grateful to patients at sea, and this carbonated water with fruit juices, or without, was in great demand. The ice plant and carbonating plant were on the main deck and were operated, as were all appliances or machinery requiring steam, by the engineer's department. On this deck was installed a disinfecting and laundry plant. The former was a large Kinyoun steam sterilizing or disinfecting apparatus so arranged that formaldehyde could be used as well as steam. An apparatus of this kind seems essential and a desirable portion of the equipment. Many days or months may elapse when it is of no use, but when receiving patients from an infected district it performs an important service in assisting us to prevent access of disease to ship board through patients' effects. The laundry was

equipped with a washer, a rotary dryer, mangle, and other appliances necessary in a place of this kind, and an ample drying room. Its operation on ship board was sometimes subject to interruption at sea owing to lack of fresh water, but in port at all times plenty of fresh water could be procured and no difficulty was experienced in cleaning the bed and table linen of the whole ship. The situation of the laundry on the *Relief* was an objectionable one. It was adjoining the boiler room and difficulty was experienced in excluding coal dust and smoke which soiled the clothes and made the work unsatisfactory. A location should be secured where such annoyances could be avoided. With competent laundrymen it would seem that all laundry work might be done in a laundry of this kind, but as a matter of fact only the work above mentioned was performed satisfactorily. All pieces requiring hand work could not be done satisfactorily; the reason for this was because of inadequate water and facilities for rinsing, starching, and the subsequent handling of the clothes in a place free from dust. Two civilian laundrymen were employed and three men of the hospital corps detailed for operating the laundry. A hospital steward was given general charge and kept check of the clothing passing to and from it.

The lowermost deck of the ship was given up to storerooms. Of these there were many, for all the various departments of the ship must have abundance of supplies for long voyages; the commissary department needs room for thousands of rations and special articles; the quartermaster suitable room for clothing and equipage, and the medical department much room for the great variety of supplies it must necessarily have in readiness. All these stores must be placed with due regards to space, convenience of handling, and accessibility and security. When the articles can be so arranged, their disposition should be by some system, alphabetical or supply table lists, so that account of stock may be readily taken or articles easily located when needed. A separate strong room should be used for all liquors, well secured by proper locks; this will preserve the liquor and trouble will not arise among members of the crew because of whiskey on board coming from sources unknown.

Bedding and clothing not in use should be frequently taken on deck and aired. All store-rooms should be often inspected and contents verified from time to time by a commissioned officer. All stores should be replenished when necessary by proper requisition, the responsible officer bearing in mind that he will be held accountable for any suffering which may result from his failure to ask for supplies when it is evident that they will be needed.

Fresh-water tanks should be provided so that an ample supply of fresh water may always be available. Instead of putting in quantities of iron for ballast it would have been much better on the *Relief* had she had more tanks to take additional amounts of fresh water for ballast. All water used for cooking, drinking purposes, and for the sick on board was distilled or made in the ship's condensers. This was aerated by a fresh-air intake pipe coming from the upper deck near the pilot house, and this water was also filtered before being used.

The equipment of the ship for fire in addition to life rafts, boats and life preservers, included fire plugs and fire hose and in all store-rooms hand grenades.

Deck chairs were furnished in abundance for patients and all others which when not in use were stowed in racks provided to secure them. A well-selected medical library was furnished by the Medical Department, manuals of reference by the Adjutant General's office, and a good library of about five hundred volumes of history, biography, travel and fiction was presented to the vessel by interested people of New York City. This library, a fine music box, and an Æolian, also gifts, furnished much entertainment to convalescents and added materially to the comfort and contentment of all.

A hospital ship should have dynamos of sufficient capacity to operate a lighting system, searchlights, electric fans, and electric heaters in ample quantity for all needs. Two such dynamos should be installed, each of sufficient capacity to meet all requirements, so that while one is in use the other may be receiving such repairs as may be required; with two one may be available at all times, with only one there would be times when light would be wanting. A competent electrician should be employed on board to attend to the electric appliances.

The *Relief* was well equipped in this way, though at times the dynamos proved of insufficient capacity to meet all requirements. Electric fans were placed in every portion of the vessel and were of material value in ventilation and of great comfort to all when the vessel was in tropical waters. When we consider the management of the hospital ship for hospital purposes it is found to be essentially the same as that of a shore hospital. We have our medical officers, our hospital corps detachment and nurses, and such civilian employees as may be necessary. The hospital force of the *Relief* at first consisted of a commanding officer and six other medical officers. There were three hospital stewards and twenty-nine privates of the hospital corps, ten graduate male nurses and ten graduate female nurses. Experience caused some modification in these numbers. The male nurses were dispensed with and more hospital corps men detailed and the number of women nurses reduced to eight. At times when at sea the efficiency of our working force was much reduced because of seasickness, for but few of all our staff had ever had sea duty before.

The duties of the medical officer commanding have already been partially outlined: in the hospital department he assigns his assistants to various duties and has charge of the general administration of everything concerning the welfare of the sick. One medical officer he selects as his executive officer, usually the next in rank, to aid him in his supervision. His duties are practically those of an adjutant to a commanding officer; he has charge of the office and records and sees to the details of men for special duty; the keeping of the clothing accounts of men on duty and patients under treatment rests with him and he should supervise the preparation of all regular reports, promulgate all orders, and conduct the general correspondence. He distributes patients received for treatment, and generally looks after the welfare of the patients and management of the hospital as an aid to his superior. It is not necessary that an executive should perform these duties; the commanding officer may be his own executive either in whole or part, and indicate to his assistant such duties as he desires him to perform; but the performance of the duties by an executive as outlined will relieve the commanding officer of many details and much routine work.

There should be assigned to each ward one medical officer, or if the number of patients or the character of the diseases or injuries warrant it, then more than one. All serious cases should be reported by the ward medical officer to the executive or commanding officer and consultation held as to treatment, surgical or medical. A roster should be kept, and at all times there should be a medical officer of the day. He is always on duty ready to respond to any calls in the wards at night; he should have a sick call every morning for the enlisted men and employees on board if some officer is not regularly designated to look after these, which is perhaps the better plan. When any one of these employees is excused from duty because of sickness he should be shown on the morning sick report and properly reported on the reports of sick and wounded.

Of the hospital corps detachment there is required one hospital steward in charge of records in the office; one in charge of property and returns pertaining thereto; one in charge of the general police of those portions of the ship occupied by the medical department. There should be an acting hospital steward in charge of the dispensary, one in charge of the laundry, and one in charge of each ward. The steward in charge of general police should have charge of patients' effects. With these non-commissioned officers, though more could be utilized, the work of ships of the capacity of the *Relief*, 250 patients,

can be very well managed. There should be for this number about forty privates of the hospital corps; six on duty in each ward of fifty men, one as assistant in the dispensary, three in the laundry, two in the operating room, one in the office, and the others for special duty in various capacities, as clerks, diet assistants, etc. Regular instruction should be given these men for at least twenty hours per month as prescribed by Army Regulations; they should be well disciplined and every effort made to maintain the high efficiency required at the present time for men of the hospital corps. Frequent inspections should be held and each man's clothing and equipment seen to be in proper condition. Men on ship-board duty need not be furnished the ordnance equipment issued men of the corps on shore duty; they have no possible use for anything but the belt and waist belt plate. Other articles of ordnance should be kept in the general store-rooms for issue when men are detached and sent for duty ashore. The hospital corps pouch is also an unnecessary incumbrance on ship board and there is no necessity for its issue to the men; it too should be kept in the general store-rooms. Each man of the detachment should have a barrack bag to hang on his bunk and a stationary locker for storing and securing his clothing and personal effects. All boxes and trunks should be kept below in the trunk rooms. Certain days should be established as trunk days when the men may have access to their boxes and belongings for such articles as they may not be allowed to retain in locker and bag. It is impracticable for them to display their shoes under their bunks, and their other equipments upon them as is customary for inspections in shore hospitals; the movements of the ship will not permit. The duties of members of the hospital corps on sea duty differ but little, if any, from the requirements on shore. The Army Hospital Corps is discussed in another portion of THE HANDBOOK to which reference may be made for full particulars on this subject.

Women nurses did excellent service on board the *Relief*, beginning when the vessel first sailed and continuing up to the winter of 1899–1900 when their service was discontinued. At first ten nurses were on duty, but later it was found that eight were all that could be satisfactorily employed. No night duty was required except in special cases. Two nurses were assigned to each of the three larger wards, one to the officers' ward, and one in charge of the operating room and the diet room. They were employed under contract and later under the regulations governing the nurse corps. Considerable friction existed at times between these nurses and the members of the hospital corps in regard to division of duties and responsibility, and much tact was required to get the best services from both. The men disliked the idea of being subjected to the authority of a woman nurse in all matters; it was finally arranged that the nurse in the ward should be responsible for the nursing proper, and the acting hospital steward in charge be responsible for the discipline and police, the two to consult together in all matters pertaining to the welfare of the sick in the ward. By this arrangement the ward work was in most cases satisfactorily performed. Divided responsibility, however, is always unsatisfactory and best results cannot be thus attained. With good hospital-corps men as nurses it is believed that the place for women nurses is not on board hospital ships. Their presence requires separate arrangements for sleeping apartments, toilet, and mess rooms, which in the cramped conditions found on ship board works at times disadvantageously. The *Missouri* employed no female nurses, but instead had graduate male nurses whose services were reported satisfactory.

Ten male nurses were at first employed on the *Relief*, but they were relieved after the first voyage and additional hospital-corps men secured. There was constant friction between them and the women nurses and the hospital-corps men, and it seemed best to dispense with the male nurses. Some of these afterward enlisted for service on board and gave excellent service when they understood the requirements as to discipline demanded of enlisted men.

All the cooking on the *Relief* was performed in one small galley. This arrangement was most unsatisfactory, but the plan of the ship did not admit of more galleys. Had it been practicable there should have been at least a galley for the sick and hospital-corps detachment and employees drawing a ration, and another for the ship's crew and officers. This arrangement is suggested because of the sources of the food supplies or subsistence. The sick if not requiring special diet, all the enlisted force and rationed employees are subsisted on the ration, but the others above mentioned are subsisted by the commissary department on such articles of food as may be required, not to exceed a certain fixed per-diem value. It thus becomes necessary to know just the value of the foods consumed by the latter class, that the authorized allowance may not be exceeded. The management of the ration is the same on hospital ships as in shore hospitals. Savings can be made and a fund established to purchase such additional articles as may be desired. Those of the sick requiring special diet are supplied as noted in the beginning of this article from a special forty-cent subsistence fund in lieu of the ration.

The conditions on shipboard differ so much from those ashore that it is economy to employ a competent experienced man as ship's steward and a suitable number of employees as mess men, cooks, pantry men, cabin boys, etc., to constitute the steward's department. This department should be conducted as is done on large passenger steamships, and subdivided under as many assistant stewards as may be required to conduct the separate messes. A mess room should be provided for the hospital-corps detachments, but experience seems to indicate that the sick may be better served by individual service on trays. If the ship be commodious it might be practicable to have mess rooms for the convalescents, but in actual practice on the *Relief* it was found more satisfactory to give each patient, whether up and about or confined to his bed, his meals served on a tray. This tray was prepared at a diet kitchen on the upper deck situated just over the ship's galley from which the cooked food was sent on dumb-waiters. This diet kitchen had numerous steam-heated warming tables where the food was kept hot during its preparation for the tray. This room also had several boilers for making coffee, bouillon, chocolate, and other liquid foods; ample drawer and shelf space was here provided for dishes and cutlery. At mealtime the special diet patients requiring food in bed were first served, then those on the regular diet; each convalescent able to report for his tray came for it at the diet room and passed on to his bunk or any suitable place adjoining to eat his food. Meals were served to one ward at a time; convalescents, when able, assisted the attendants in the distribution of the trays. The soiled dishes were returned for cleansing to the diet room at another window. A nurse was always on duty when the meals were being given out and superintended the arrangement of the trays to make them as inviting as possible. She received lists from each ward showing the number and kind of diets required, supervised their preparation, and kept check on the issues. Japanned trays were first used but were not desirable; they soon became corroded and of unsightly appearance: heavy china dishes and plated silver ware were used. Dishes required constant replenishing owing to frequent accidents. It would be economy to use white enamelled ware for all dishes and trays. It is open to the objection of chipping but is very durable. The main diet kitchen requires an ample force of attendants to facilitate rapid handling and serving of food that it may reach the patient in a palatable condition.

Little supplementary electric diet kitchens in each ward are of great convenience in preparing foods and hot drinks outside of regular meal hours.

The galley had a fixed range, boilers for steam cooking, shelves, racks, etc., for cooking utensils. Adjoining the galley was a bake-shop; the butcher-shop was in a small room next the cold-storage room on the lower deck.

In receiving patients on board a hospital ship it is oftentimes necessary to send ashore the ship's boats for transporting the sick to the ship. Each of these boats will accommodate four patients on litters or about twenty if they are able to sit up. When thus loaded the boats are towed by steam launches, it being impracticable to row when they contain patients. One launch can tow a string of three or four boats and patients can be taken on board very rapidly. Litter squads are detailed as loading parties to accompany the boats; others remain on board and unload and distribute the patients when received. If the ship's construction will permit it much labor may be saved by rigging up block and tackle and lifting the patient on the litter to the deck by means of the steam windlass. The construction of the *Relief* prevented such an arrangement and all patients were received on board by gangways. Of these there were two; they were especially constructed, were broad and long so that when lowered the incline was gradual. The small boat drew alongside, the bearers made ready, and at a propitious moment when the boat was on the crest of a wave or swell, passed the patient over to the other bearers waiting on the gangplank to receive him. In rough weather loading was difficult and at times had to be suspended. The bearers learned to be very expert, and in all the hundreds of patients handled there was never an accident, though at times the up-and-down play of the small boats at the gangway was many feet. The patient was carried up to the main deck and assigned to a suitable ward. Stimulants and hot foods were in readiness when needed. If the condition of the patient would permit he would be given a tub bath; if not, then a sponge bath in bed, and given fresh hospital clothing. His valuables were properly listed and cared for by an officer assigned to such responsibilities. Such of his clothes and such toilet articles as he might have or need might be left in his clothing bag hanging at his bunk. All other clothing was placed in bags designed for patients' effects. These bags were made of strong bed ticking with draw string, and were about three by two feet in dimensions. They were furnished by the medical department and their expenditure was authorized; in other words, they were expendable. Shipping tags were provided and each man's bag had tied to it a tag giving his name and military address, his ward and bed number. These bags were placed in store-rooms so arranged that the tags were exposed, the arrangements being made by wards to facilitate accessibility. Such property as he might have which could not be put in bags—trunks, chests, etc.; volunteers will have quantities of such,—were tagged and put in the trunk room. When the patient was transferred ordinarily he was given the bag which bore his name on the tag and identified it as his in his further movements. If too sick to take charge of it himself, it was simply turned over to some responsible person representing the authority of the hospital to which he was destined. This system was very satisfactory and after it was devised but little trouble was experienced with patients' effects which prior to that time had given rise to an endless amount of trouble and confusion. On the *Missouri* a checking system was devised in which the bag was checked and a duplicate issued for the patient. It proved satisfactory, it is believed, to the authorities on board the *Missouri*, but it is not considered to be as well adapted to the needs of hospital ship service as the method used on the *Relief*. A patient received on board should be accompanied by a transfer slip giving his medical history and a descriptive list. When he is discharged the hospital his new commanding officer should be informed as to his accounts. Great care must be taken to keep proper accounts for each man while on board. The regulations governing muster, payments, issues of clothing, and all matters pertaining to administration must be strictly observed.

The dead should be buried at sea or properly embalmed and placed in metallic caskets; the former is to be preferred, but it is customary as a matter of sentiment to do the latter.

In the past sick and wounded have been moved by boat whenever the seat of war made it feasible to resort to water transportation. Steamers have been used on navigable rivers and sailing vessels and steamers on lakes and the ocean; in some instances canal boats have been utilized when battles have been in localities where canals existed: they were used after the fight at Balls Bluff during the Civil War, and the British have used them in Egypt. Small boats, barges, etc., may at times prove useful in emergency, but their discussion hardly comes within the limits of this article where the hospital ship proper is the subject under consideration.

England seems to have been first in preparing floating hospitals and transports for the sick, but there seems to be very little record of any systematic preparation previous to the Crimean campaign of 1854. During this campaign a fleet of "well-appointed" steamers, the *Orient*, *Poistiers*, *St. Hilda*, *Clifton*, *William Jackson* and others, carried in twenty-two months 114,668 patients. In 1858 the British fitted up two hospital steamers, *Mauritius* and *Melbourne*, for the use of their forces in China. In the former the lower troop deck was fitted up for the sick and wounded with berths ranging fore and aft. Heat was supplied by the engine-room and by swinging and cabin stoves, and ventilation secured by hatchways, port-holes, and tubes arranged from the galley fires. One thousand gallons of fresh water were supplied daily from the condensers. The *Melbourne* was in a general way fitted similarly to the *Mauritius*. Each had a surgery 15 by 10 feet, and a dispensary. The berths were 6 feet 3 inches by 2 feet 6 inches, with metal bottoms; good bedding and table furniture and good diet were provided. Each steamer had wash-rooms, washing or laundry rooms, and the usual butcher room, bake-shop, and store-rooms. In fitting up it seems to have been intended that these steamers should be used exclusively as hospital transports.

In 1873 England converted the line-of-battle ship *Victor Emmanuel*, a wooden, screw steamer, 5,157 tons, 2,414 horse-power, into a hospital ship and transport for service on the Cape Coast, Africa. The alterations were made at a cost of about $200,000, and accommodations were provided for 142 patients, with an additional capacity on deck for from 60 to 80 convalescents. Fifty-five men were detailed for hospital service on this ship: 16 non-commissioned officers and 39 privates; in actual service at Cape Coast more aid was required. In addition to these there were men employed for general purposes, as bakers, cooks, etc. Reference to Figs. 1192–1195, in Vol. III. of the former edition of this HANDBOOK, will show the arrangement of this vessel.

Spain fitted up two ships for hospital transports in her struggle with San Domingo. These are said to have done good service, but no detailed description of them can be obtained.

The United States used no special boats for the sick in the war with Mexico, 1846–1848, and early in the Civil War the disabled were transported on the ordinary passenger steamboats of the Western rivers. Later these were fitted up as hospital boats, but little alteration being required to make them well adapted for hospital service; they usually had large well-lighted and well-ventilated cabins, and the removal of the thin partitions between staterooms made other wards or rooms suitable to accommodate patients. Col. Joseph R. Smith, to whose writings the writer is indebted for this brief historical review, states that he found records showing that more than 100,000 patients were carried on hospital boats during the Civil War. Of these a great number were carried on the river steamer *D. A. January*, which in forty months handled 23,738 patients. This boat was 230 feet long and 65 feet wide. Its ordinary capacity was considered about 400, though it carried as many as 554 patients.

The hospital steamer *City of Memphis* was 330 feet long and 70 wide and carried comfortably 750 wounded. The *Empress* was 266 feet long and 45 wide, with an ordinary capacity of 500 patients, though she at one time carried

817. These vessels on the rivers frequently passed towns and landing places where supplies could be obtained and did not require the same equipment and stores as are needed for sea-going vessels. In addition to wards each of these vessels had rooms for officers and attendants, store-rooms of various kinds, kitchen and special diet kitchens, pantries, dumbwaiters, linen rooms, dispensary, operating room, bath, water-closets, etc. Water was supplied from a refrigerating apparatus by faucet in convenient places. Medical officers, hospital stewards, ward masters, and nurses were detailed in sufficient numbers. The medical officer or surgeon-in-chief was in absolute control and responsible for the administration. Figs. 1196–1199, in Vol. III. of the former edition of this HANDBOOK, show the arrangement of these boats, the *January* being taken as a type.

In May, 1862, the Medical Director of the Army of the Potomac asked for hospital steamers sufficient to carry 5,000 patients; from this time water transportation was recognized as a method of moving the disabled and a medical officer was placed in charge, known as "medical director of transportation." During the war it is said that as many as thirty well-fitted hospital steamers were used at different times in the East and West.

The best ocean transport of those times was the *J. K. Barnes*. She was a side-wheel steamer, 1,400 tons, 288 feet in length, 35 feet 2 inches in width, 22 feet 9 inches depth of hold. Her total capacity was 477 patients; she was used but ten months, during which time she carried 3,655 patients. Her plans may be seen in Figs. 1200–1202, of Vol. III. of the former edition of this HANDBOOK.

During the recent South African war a hospital ship known as the *Maine* was fitted up by American women. This vessel is a duplicate of the *Missouri* and her equipment was similar. Her operating room was complete, and said to be the best in South Africa. She had accommodations for 218 patients, an *x*-ray machine, electric lights, fans, and diet kitchens, a completely equipped laundry, a steam disinfecting apparatus, refrigerating plant, etc. Her hospital force consisted of six medical officers, five women nurses, eleven male nurses, ten orderlies, and two apothecaries.

The *Trojan*, *Spartan*, and *Prince of Wales* were other ships fitted as hospital transports; the capacity of all four being about one thousand patients. These ships participated in the China campaign of the allied troops in 1900. During this campaign the Japanese, Germans, and French also had hospital transports, but the details of their equipment cannot be ascertained. It is said, however, that our own hospital ships, especially the *Relief*, were far superior to all others in equipment and facilities for caring for the disabled at sea.

Alfred E. Bradley.

HOT BORATE SPRING.—Lake County, California. This remarkable spring is situated near the town of Lakeport and on the edge of Clear Lake. The spring flows 18,000 gallons per hour, and has a temperature of 124° F. (July, 1888). On analysis it is found to contain the following mineral ingredients:

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Sodium chloride	86.82
Sodium bicarbonate	75.40
Sodium biborate	201.75
Potassium iodide	.12
Potassium chloride	Trace.
Potassium bromide	Trace.
Potassium bicarbonate	4.26
Ammonium bicarbonate	96.20
Magnesium bicarbonate	.73
Calcium sulphate	Trace.
Alumina	2.04
Silica	7.96
Organic matter	9.07
Total	484.35

Free carbonic acid gas, 30.75 grains.

An analysis by Dr. Moore shows a much smaller percentage of borax—103 grains per gallon. The spring is remarkable on account of the excessive amount of borax and ammonium salts which it contains. Professor Whitney states that the water is changeable both in its rate of flow and in its proportion of mineral ingredients. It is used in Lakeport and vicinity for kidney and bladder troubles. It is claimed that the water has dissolved a stone in the bladder. *James K. Crook.*

HOT SPRINGS, BATH COUNTY, VIRGINIA.—POST-OFFICE.—Hot Springs. Hotels and cottages.

ACCESS.—Viâ Hot Springs Branch of the Chesapeake and Ohio Railroad. Connection is made at Covington, Virginia. Through sleepers to Hot Springs are run in the summer. The Virginia Hot Springs Company run a line of first-class stages to the Warm Springs, five miles north, and to the Healing Springs, three miles south of the terminus at Hot Springs. The valley containing the Hot, Warm, Sulphur, and Healing springs of Virginia is located in the heart of the Appalachian Mountains, in the first of several lofty ranges that lie east of and parallel with the main Allegheny divide. Some two miles in width, the valley extends for more than a dozen miles between towering mountains, from the crests of which, 4,000 feet above the sea, villages and farm-houses with intervening stretches of country, over 1,500 feet below, are spread out to the view of the observer as a beautiful panorama. The visitor can drive for miles over new boulevards and carefully constructed roads. The streams formed by the various springs in the valley have pierced the western range and divided it into a series of five tall distinct mountains, narrowly separated from each other by chasms and gorges. Meandering roads and romantic bridle-paths and footways, bordered with ferns and mosses, penetrate these rugged and secluded passes. The altitude of the valley (2,300 feet) and its protection by the surrounding mountains from wind-storms and sudden changes combine to produce a temperature safe in winter and delightful all the rest of the year. The air is clear and dry, mists and fogs being rarely seen. The highest summer temperature observed during a series of recent observations was 87° F., the monthly mean for June, July, and August being 68.5° F.

The Hot Springs have been resorted to for three generations of white men. Physicians of wide reputation and abundant experience have pronounced them equal to the most effective similar waters of the European spas. The drinking-waters are also of great variety, and besides the hot springs there are magnesia, sulphur, soda, and alum springs, each of which is widely recommended for medicinal purposes. The bath-house at Hot Springs is a substantial four-story structure of stone and brick, built in the Colonial style of architecture at a cost of over $100,000. It is fitted up in a sumptuous manner with all the requisites of a modern institution of this kind. All varieties of baths will be found here. The old bath-house has been converted into two large swimming pools, one each for gentlemen and ladies. The hotels at Hot Springs are the "Homestead," a charming house of the true old Colonial style, which has been entirely remodelled and modernized, and the "Virginia," a new hotel built in the latest fashion, and supplied with every comfort and convenience. This hotel is kept open all the year. Ten new cottages cluster close by, each with a broad porch and veranda. This hotel is connected with the passenger station, but so arranged that no noise or annoyance is caused by railroad trains. The waters of the Hot Springs have been analyzed by several well-known chemists. The Spout, Boiler, and Sulphur Springs were examined by Professor Clarke, of the Smithsonian Institution in 1884, and the last two, together with the Soda and Magnesia springs, have recently been analyzed by Messrs. Dickoré and Morgan, of Cincinnati, Ohio. The several results in the examinations of the same waters have been practically identical. Following are specimen analyses:

BOILER (BATH) SPRING.
(Analysis by Dickoré and Morgan.)

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Magnesium sulphate	8.48
Magnesium carbonate	3.02
Calcium sulphate	1.89
Calcium carbonate	23.08
Sodium sulphate	3.68
Potassium sulphate	.69
Potassium chloride	.54
Silica	1.95
Total	43.33

Temperature, 108° F.

SODA (DRINKING) SPRING.
(Analysis by Dickoré and Morgan.)

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Magnesium sulphate	5.90
Magnesium carbonate	2.61
Calcium sulphate	3.22
Calcium carbonate	17.55
Sodium sulphate	2.02
Potassium sulphate	.88
Potassium chloride	.21
Silica	.49
Total	32.88

Temperature, 74° F.

SPOUT BATH SPRING.
(Analysis by Professor Clarke.)

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Silica	1.37
Alumina	.15
Potassium chloride	.54
Potassium sulphate	1.09
Sodium sulphate	1.64
Calcium sulphate	8.32
Magnesium carbonate	7.02
Calcium carbonate	13.96
Total	34.09

Temperature, 106° F.

These waters resemble considerably in chemical composition those of the Hot Springs of Arkansas. They also resemble those of Aix-les-Bains in France, the French spring having a somewhat higher temperature. Both for internal use and for bathing the waters of the Virginia Hot Springs have gained a wide celebrity in the treatment of many of the ills to which human flesh is heir. The baths here are especially to be commended. The excellent thermal waters with the elegant and elaborate methods of using them may be expected to render all the service in diseased states which can be accomplished by this means. It is especially desired that all those who visit the springs with the intention of using the baths consult a resident physician in regard to the use of the waters.

The Healing Springs Hotel, three miles from the railway station at Hot Springs, is reached by a comfortable line of stages. It is connected by telephone with the depot and with the hotels at Hot and Warm Springs. No place in the Virginia Mountains is more pleasant or picturesque. The air is pure, dry and bracing, the temperature being uniform and delightful, throughout the season. The rooms in the hotel and cottages are large and cheerful; they are kept scrupulously clean, and the management throughout is charmingly homelike and in harmony with the surroundings. The supply of water is abundant, being derived from four springs of essentially the same character, and is beautifully bright and crystalline. Its temperature is uniformly 85° to 88° F. The bathing accommodations have been greatly extended and otherwise improved by the erection of a new bath-house, and by the addition of several apartments to those already built. The waters of these springs, as will be seen by the analyses, are almost identical with those of Schlangenbad and Ems in Germany. These were made by Prof. William E. Aiken, of the University of Maryland:

ONE UNITED STATES GALLON CONTAINS:

Solids.	Healing Springs. Old Spring. Grains.	Healing Springs. New Spring. Grains.
Calcium carbonate	17.90	18.72
Magnesium carbonate	1.24	1.96
Iron carbonate	.07	.28
Calcium sulphate	1.32	1.26
Magnesium sulphate	7.25	7.39
Potassium sulphate	2.21	2.53
Iron sulphate	.18	.10
Ammonium sulphate	.23	.23
Potassium chloride	....	.25
Potassium carbonate	.24	
Sodium chloride	.27	.29
Silicic acid	1.89	1.82
Organic acid (crenic?)	.86	.88
Carbonic acid	2.20	2.29
Sulphureted hydrogen	Trace.	Trace.
Bromine	Trace.	Trace.
Sodium	Trace.	Trace.
Total	38.56	38.00

The bubbles of gas that rise from the springs contain in 100 parts: nitrogen gas, 97.25; carbonic acid gas, 2.75.

These waters have proved valuable in a considerable range of diseases; they are diuretic, somewhat laxative, and tonic in their effects upon the system. The best results have been observed in chronic congestion of the liver, in irritability of the bladder from cystitis, in enlarged prostate, etc., in the early stages of Bright's disease, and in debilitated states generally.

The *Warm Springs* are located five miles north of the railroad terminus at Hot Springs. The court-house and county buildings are located here. The springs are picturesquely located in a grand old grove and lawn in the centre of a tract of about 1,800 acres, which in width includes the crests of the mountains on either side of the valley. The remarks concerning the scenery, atmospheric conditions, etc., in the description of the Hot Springs apply with equal force to the Warm Springs. An excellent hotel, built in the Colonial style, charmingly situated and well-kept, will be found. There are also a number of comfortable cottages. For three generations the springs have been visited by people from all over the United States, with not a few from foreign countries, and even when it involved a long and tiresome journey in primitive stage coaches they were a favorite resort of the wealth and fashion of Virginia and the South. The grand boulevard recently completed between the Hot and Warm Springs is a magnificent driveway, and passengers will be transported from the Hot Springs station in comfortable carriages in the brief space of forty minutes after a most enjoyable ride. The gentlemen's bath is an octagon forty feet in diameter and holds 43,000 gallons of water. The ladies' bath is circular in shape, with a capacity of 60,000 gallons. These pools are supplied from separate springs discharging upward of 60,000 gallons of water per hour, at a temperature of 96° F., which, charged with myriads of bubbles of sulphureted hydrogen gas, rises naturally from the bottom of the pools, affording a delightful and luxurious bath. There are also private baths of various kinds, and ample provision for the comfort and convenience of bathers. An old analysis of one of the springs, made by Prof. A. A. Hayes, shows the following solid constituents:

ONE UNITED STATES GALLON CONTAINS:

Solids.	Grains.
Calcium carbonate	5.22
Calcium sulphate	14.53
Potassium sulphate	1.38
Ammonium sulphate	.36
Sodium silicate / Magnesium silicate	1.72
Iron crenate	2.50
Carbonic acid	6.92
Total	32.63

Gases: Sulphureted hydrogen, carbonic acid, and nitrogen.