Original Articles.

HOSPITAL SHIPS. THE "BAY STATE."

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THE care of the sick and wounded has in recent wars taken on exceptional importance, and at this time we find in the medical departments in all military and naval forces a fulness, variety and skill of equipment, both in material and personnel, that would astound those in control even twenty-five years ago; not to speak of the days of the Crimean War, from the horrors and inhumanities of which the civilized world recoiled, though the leading and at the time the most enlightened nations took part in it. Soldiers and sailors are no longer hirelings, they are directly and continuously from the people, and modern large forces are, to a great extent, schools for the bulk of their members.

In England and America, where the voluntary system of service still exists, the grade of the regular forces is perhaps not so near the general people, yet still the soldier and sailor are as well cared for, probably better, than in the armies and navies where the conscription or universal service holds.

It may be said that, from the period of the Crimean War, humanitarianism and the power of the forces of modern development compelled the beginning and continuous evolution of the arts and sciences of hygiene, medicine and surgery as applied to military and naval life; hence one can easily trace the gradual improvements in means, methods, the foresight and the growth in efficiency of their medical departments. So that now these departments are, as a rule, quite up to civil establishments; nay, more, there is a watchfulness exercised over soldiers and sailors regarding food and water supplies, disease causes and prevention, re-vaccination and general hygiene not to any extent customary in civil communities anywhere.

It must not be imagined that "hospital ships" are a present-time evolution, they are simply in evidence as the mark of progress in naval medicine and surgery. Their equipment and very apparent usefulness at this time is, however, striking. Owing to the great development of offensive power in modern warships, and the crowded complexity necessary, there has almost ceased to be room on board for hospitals; and once the list of casualties exceeds five per cent. of the personnel all attempts at surgical relief become a hopeless task. The usual space set apart for a hospital in ordinary times is in battle abandoned, the armored or protected sections alone at that time containing the crews—men and officers of all descriptions; so that the surgeons are equipped mainly for first-aid work, and must work as best they may and can, circulating about the fighting guns' crews or in their immediate vicinity. Operative procedures of the most pressing nature are alone to be attempted. Casualties in the proportion of from 20 to 60 per cent. must be expected in naval combats—from the history of such engagements during the past thirty years. Rapid fire and machine guns, in the hands of those knowing their use, in addition to the frightfully destructive effect of the modern explosive shell and penetrating power of the present naval ordnance, tend to end such battles within an hour; and in a ship's complement of 450

—the average number in a large cruiser or battleship — the state of affairs with a casualty list of 33 per cent., the general estimate now looked for in naval battles, can be easily imagined. The casualties in the recent engagements in Manila Bay and off the port of Santiago de Cuba, on the Spanish ships, were much above this figure, approximating nearer 60 per cent. in the majority of the ships. It is now known that the killed and wounded from the effects of a few of the single shells, in these battles, that reached the interior of crowded decks, numbered as high as seventy. There was one instance in the Yalu battle, between China and Japan in 1895, reported to the writer by Commander McGiffen, an American, who served in the leading Chinese battleship as second in command, where 102 men were placed *hors du combat* by one large exploding shell. A shell exploding produces at once a wide area of white fusing heat and flame, with an innumerable number of irregular missiles; these effects being exaggerated when the explosion occurs within confined decks, spaces and turrets. Supposing that a conflict were to occur between ships well matched in ship, men and ordnance, casualties mount up to 80 per cent., as has happened in a few instances. Probably the greatest slaughter of modern times occurred in 1879, when the Chileans with two ships took the Peruvian ship the *Huascar* (all ironclads). So that it can be readily seen that with fighting ships and fleets there must be ships equipped solely for hospital uses. There is no room on board a modern fighting ship or machine for an injured or sick man. All available space is consumed for purposes of offence and defence, and the intricate complexity of a typical and admirable ship of war must be seen to be appreciated.

For the past several years naval authorities have been reluctantly coming to the hospital ship for strictly naval uses, and at the Moscow International Medical Congress last year, the American naval delegate, the present Surgeon-General, Wm. K. Van Reypen, presented a paper on this subject, with detailed plans. It was hoped that sooner or later such a craft would be provided for our naval service. The present war hastened matters, and a fine mercantile steamer of 3,800 tons displacement was at once procured, and, being hastily fitted and equipped, reached the scene of active operations in Cuba to be of most important use, being at that time the only vessel of the kind ready.

She was placed temporarily at the service of the military arm of the government. Hospital ships for the use of armies when engaged in distant military enterprises may be more appropriately named transport ships, for their services may be radically different. Naval hospital ships, under the protection and neutrality of the Geneva Red Cross Convention Articles, must save and help both sides in a conflict, regardless of nationality, and keep the sea with the fleet to which they belong. The credit of early procurement, rapid equipment, and quick despatch of the naval hospital ship *Solace* rests with the Honorable Secretary of the Navy, Mr. Long, who at once seconded all the efforts and energetic steps taken by Surgeon-General Van Reypen. President McKinley approved the expenditure out of the fifty millions' war appropriation, and the *Solace* took shape. Several hospital ships are now proving their value, and as each successive one goes forth to succor and to

save, the experience gained bears fruit in many minor details in the equipment and fittings.

In the great French fleet, gathered by Richelieu in 1693, there were 190 ships of all classes, including three hospital ships. There were 7,654 guns and 44,700 men all told in this fleet. But this was an exception rather than the rule. In the China-Japanese war, at the battle of the Yalu, the latter power had present a well-equipped hospital ship, having recently transformed for the purpose a merchant steamer of about 3,000 tons. She did good service in that conflict, the wounded being transferred during and after the engagement. There are numerous hospital ships anchored in many colonial harbors, for both army and naval uses, but the complete hospital ship as we now understand the term in this country — an active, complete, self-sustaining vessel, thoroughly able to render competent and scientific medical and surgical aid, sailing under the Articles of the Geneva Convention — is distinctively an American creation of this present time, and the navy has gained the credit of being first in this beneficent field, with the sailing of

all times, pure water; a good ice plant with cold-storage rooms, an electric lighting system, a laundry, a steam disinfecter; an operating and dressing room equipped with hot and cold running water, sterilizer, and the modern fittings, clinical laboratory, x-ray apparatus; ambulance appliances and apparatus, including boats by steam and barges; dispensaries, diet kitchens, lavatories, baths, water-closets; offices, store-rooms of all kinds; a carefully selected staff of physicians and surgeons, a pharmacist, nurses, cooks, and the usual attendants. A section must be set aside for isolation uses, and an infectious or contagious ward, complete in itself, must be provided, preferably on an upper deck well aft. The usual size of berths is 24x75 inches (28 inches width would be better). They should be made of iron piping one inch, with the upright stanchions running from deck to deck, on which the berths rest, of two and five-eighths inches; finished in white enamel. Various methods of construction are in vogue. The *Bay State* berths are very convenient and secure, the frame resting in deep hooks (at the four corners) encircling by a band the

FIG. 1.

Bay State. Main hospital deck, general arrangement. Air ports, ventilating tubes, etc., not shown. Ice plant, cold storage, store-rooms and additional berths on deck below. Cabins, etc., of personnel on upper deck houses (galley, etc.); over all light flying deck.

FIG. 2.

Stanchions and berth framing.

the *Solace*. The articles (VII to XV) of the Geneva Convention, relating to the Marine, were adopted in 1868. Aid must be rendered both sides, regardless of nationality, the ships being neutral, and men once rescued during battle are debarred from further activity as combatants for the war. Military hospital ships are distinguished by their white color with green strake (a broad stripe on each side); civil aid society ships with red strake on the white. They can carry no contraband stores, nor any means of offence or defence. When fitted at the expense of aid societies, a naval officer must certify that he has controlled and inspected their equipment and fitting out, and that they are in accordance with the terms of the Geneva Convention, and this officer is appointed by the sovereign or executive of the country under whose authority the ship is fitted out and commissioned.

An original design or model for a hospital ship would probably have more beam to length than is common in the merchant craft available, for the purposes of stability and easy motion at sea, and for more agreeable spacing of compartments. It is not essential to have great speed, as this involves the use of enormous space for machinery, increased heat, and exaggeration of vibration and noise. Fair speed, large coal endurance, an easy model, somewhat high between decks, and not too large a type of ship, are essential points. To answer her purpose well she must berth her patients conveniently and agreeably, with ample facilities for suitable dieting, good air at

stanchions between every two berths, the space between the ends of the berths being several inches. It also allows of the whole berth being removed and transported bodily. Berths are in two tiers, with a passage of from 20 to 30 inches between the lines; the average cubic capacity or air space per berth, 250 cubic feet. Woven wire springs and hair mattresses, and side bars complete the berth.

Systems of ventilation are essential, and fan blowers, usually run by steam, are employed, though electricity is used for fans up to 24 inches diameter. The tubing or air ducts should extend throughout the structure below the main deck, and careful calculation and construction are necessary for success. Artificial ventilation in ships, I have no hesitation in stating, should be by the plenary method — *forcing air in* to the compartments and spaces needing ventilation. It is easily shown that really pure air is hardly attainable in a complicated structure, such as a ship is when the air is extracted, the distal parts necessarily getting the air which has filtered through the other compartments in reaching it — passing over decks, beds — more or less respired and robbed of its oxygen, and having accumulated dust and gaseous emanations. Most systems are arranged to work both ways. A fair maximum number of revolutions of the blower must be insisted upon and it must be kept running constantly.

Ice plants are not perfected to an extent desirable. The Allen patent, in use in naval vessels, of producing

cold by the alternate contraction and expansion of common air, is usually successful; and though in the tropics the capacity shrinks fifty per cent., the one-ton machine (daily ice-making capacity plus cold-storage) answers an excellent purpose in the naval medium sized cruiser. The ammonia process is being improved rapidly, and is simpler than the compressed air patent. The ammonia ice plant in the *Bay State* will have a capacity daily of producing 5,000 pounds of ice (with tropical conditions), and preserving one cold-storage room of 1,386 cubic feet at 40°, and one of 630 cubic feet at 25° F. There will be an ice-storage of 230 cubic feet. It is the Hendrick machine and patents, and uses anhydrous ammonia and calcic chloride brine of a fixed specific gravity. It promises admirably and surpasses some of the ice plants in hospital ships of much larger tonnage and size now in service. In outside conditions of air and water, temperatures under 65° F., this capacity will be doubled. A feature of the construction here is the complete incasing of the machine proper in a one-fourth inch steel box containing separate pump, ventilating system, etc., to remove possible chemical *débris*—a constant annoyance usually. It is possible that ultimately liquid air may be utilized in refrigeration and ice making, but at present this substance, on passing into the gaseous state, is not practically controllable.

The apparatus to condense sea water, filter it, and furnish a pure fresh-water supply has a capacity of 3,000 gallons daily. This will provide an ample supply for all possible uses. Storage tanks containing several times that amount are also in the ship. Sea water is also supplied for baths.

The steam disinfecter is set up adjoining the laundry. It can be charged from the deck, the sterile contents being then removed to the laundry. Its size is about 48x60 inches, capable of receiving two mattresses with complete bedding, etc., at once. The laundry is composed of a washer, wringer, and small engine, and will be competent to finish up in one day the hospital's bed linen, towels, cloths, etc.

The cooking is done on the spar deck (upper deck), and the food is sent down to the deck below—the hospital deck—by dumb-waiter. Serving tables, fitted up appropriately, and made of metal, with carefully devised shelving, lockers, etc., are conveniently placed to receive and distribute the food. The diet scale of the *Bay State* has been carefully gone over, and in most competent hands. It will include every luxury and necessary element to be found in the most liberal establishments, and is proportioned to the various messes on board, from the seamen, engineers' force, officers' messes and the patients' dietary particularly. Facilities to properly prepare all food substances are present in the very complete galley installed contiguous to the engine bulkhead on deck.

The electric lighting plant, dynamo and appliances are estimated on supplying about 200 lights of 16-candle power each. Electric fans to the number of about forty, with 12-inch fans, are provided. These were very kindly given, on the basis of one to every four patients. There is no question of the extreme usefulness and comfort to be derived from these admirable contrivances when in the tropics.

The baths are of good size (five feet two inches), of enamelled metal, and with the hand-bowls stand free, the former to be enclosed with canvas suspended from a rod overhead. An excellent compound valved supply

stand-pipe will furnish hot, cold and salt water as desired. The slop-hoppers and water-closets are distributed in three localities, easy of access from the main berth sections. A hopper and siphon trap-bowl is affixed to the drain (directly through the ship's side), which has an additional valve at its exit. It is so arranged to be well above the water line. Ships' water-closets are not by any means perfected contrivances when placed at or near the external water-line; and, though there are many patents and kinds in use, they do not, as a rule, function well without a vast amount of looking after.

The *Bay State* will have one "alba naphtha" launch, of 30 feet length, and four pulling boats of 24 feet length, and one of 12 feet. The launch will be able to tow the boats in transporting patients, and carry on the daily work between ship and shore when in port—mails, marketing, stores, etc. The cots and stretchers to be supplied can be placed in the pulling boats when containing patients, and on arrival along side the ship, the booms fitted to each mast, with convenient tackle, will readily lift cots with patients to the side doors and into the ship. Other ambulance appliances will include some "Lowmoor jacket stretchers," United States Navy cots and stretchers. The jacket stretcher retains firmly in any position a patient by means of broad canvas bands across the chest, under the arms, under the perineum, buckling to the two coming over the shoulders, and transversely over the legs. With a willing and earnest staff, such as the *Bay State* will possess, the transfer of patients can give no anxiety.

The operating-room, though small, will satisfactorily accomplish its purpose. It is supplied with sterilizing apparatus (Kny Scheerer make), an x-ray apparatus, hot and cold water, a fixed, operating, metal table, sufficient shelving, lockers for instruments and the usual appropriate surgical gear. The floors of this room, disinfecting room and laundry are of asphaltum, draining to the usual outboard scuppers and waterways, common to the whole hospital deck alongside the skin of the ship. The air ports or deadlights will during daylight furnish sufficient light, and the electric light will supplement it. A small clinical laboratory outfit is also provided.

The personnel of the *Bay State* will consist of about 48 people. The deck and engine force gives a total of about 22; the stewards, cooks and attendants of about 8; and the purely medical and surgical side of about 18. There is the purser, the man of business and accounts. The principal medical officer will be the surgeon superintendent, Dr. Herbert L. Burrell, assistant professor of surgery in the Harvard Medical School. He will have the aid of four assistant surgeons. There will be six female nurses and six baymen (competent nurses and attendants); all have been carefully selected, and have promised to serve for three months, signing the usual shipping articles of agreement to that effect. The commanding and directing head of the ship is the surgeon superintendent, subject only to the navigating officer, Captain Butnam, upon questions of navigation or control when the safety and well-being of the vessel may be threatened. The executive committee of the Massachusetts Volunteer Aid Association finally governs the general direction and objects sought to be attained by the ship.

It may be interesting to compare costs of hospital

ships, calculating them to the unit of fixed berth. From what has gone before in the acquirement, equipment, rearrangement and outfitting of these self-sustaining hospital and ambulance craft, it is well known that they are complex, liable to failure at important points of detail, and very expensive. We are, in fact, evolving satisfactory hospital ships at this present time. It is a new art and with each ship definite points of improvement in details are pointed out. Ice plants fail, ventilation becomes faulty, dynamos need replacement, the personnel needs rearrangement, and some questions arise in placing of berths—spacing, dimensions, securing them—and kinds of materials. Transportation of patients is also a matter of experience. Much depends upon the kind of work to be done. Surgical cases may shortly disappear, and the ship's berths be crowded with purely medical cases—malaria, typhoid, dysentery and heat effects. However, it is the recognized part of a hospital ship to be equipped for all manner of medical and surgical work, at all times.

A vessel of 4,000 tons displacement, in this country, if new or nearly so, costs at least a half million dollars. Her equipment and fitting out as a hospital ship will then foot up from \$60,000 to \$75,000. She will have a company, complete in all departments, of not less than 100, probably 120. With crowding she may have 350 fixed berths, with a maximum capacity of possibly 400. At this rate the cost will be about \$1,640 per fixed berth. The ships now afloat have cost much more, approximating more nearly to \$1,900 per berth, whilst the rearrangement from mercantile and passenger uses has not been as complete and satisfactory as was desired because of urgent need for hospital and military purposes. The *Solace* was in good time, was on the spot during the first battles of the war. She has wooden-framed berths, an additional ice machine has been added, and she carries her honors handsomely, even though she was rushed day and night when fitting out. When the first hospital ship is designed and constructed, from the first keel plate as such, then may we expect to see probably a more perfect and complete craft.

The *Bay State* will be admirable (for her size), and distinctly possesses some superiorities. She is but 200 feet long, 27 feet maximum width, single screw, bark rigged, 780 tonnage displacement, is built of three-eighths-inch steel (Scott & Co., Bowling, Scotland, 1886), and is rated 100, A. I. Speed, 12 knots; draft, 14 feet; steaming radius, 3,000 miles. She was owned by the Boston Fruit Company, and was sold to the Massachusetts Volunteer Aid Association for \$50,000. Her fitting out and virtual internal reconstruction will cost about \$60,000, making a total of \$110,000, or cost per fixed berth of about \$1,200. She is not palatial, but she possesses solid advantages and comforts for her work, and no ancient upholstery or useless wooden fittings. Her hospital deck compartment is new work, mainly metal, and she is virtually aseptic. The space is given up for patients' needs and uses, while the personnel on board, for the charge and care of them, are far from being housed and berthed luxuriously.

It is to the credit of Massachusetts, to her cultivated and patriotic citizens; and to the medical profession here—who give all their services eagerly and gratuitously—that the State has the noble distinction of being the first civil community anywhere

to send out at its own expense a complete hospital ship for the humane uses of all the men, naval and military, who are bearing arms for our common country.

SIR ASTLEY COOPER, BART.¹

AN ESTIMATE OF HIS CHARACTER AND CAREER.

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ONE of the most interesting and picturesque figures in all surgical history is that of Astley Paston Cooper. Well born and bred; highly gifted both mentally and physically; of enormous industry and ambition: living at a time of revolutionary changes in the world's history—changes social, political and intellectual—he was a fit contemporary of such men as Fox and Canning and Mirabeau and Hamilton—less mercurial than the first and only less brilliant than the last.

Somewhat younger than those distinguished men, he was brought under the same great influences; and though he died near the middle of the present century, he had known Dr. Johnson, had heard Hunter, had seen Robespierre and George III, had experienced Waterloo, and had lived to be honored by the Citizen King. Whatever there was in life for the finding, that Cooper found, and amid all the changes and chances of an extraordinary era he is seen always steadily advancing.

Astley Cooper was born on the 23d of August, 1768, one year before the great Napoleon. In France old Louis XV was living; in Germany Frederick was resting on his laurels; in America Washington was an obscure country gentleman, and in England George III was still a young king. There was peace at home and abroad, though the great undercurrent was already at work, destined to overturn the geography and dynasties of the world. Of all the peoples about to become embroiled in this turmoil, the English and Americans alone were to emerge with added strength; and parallel with the fluctuating but always advancing fortunes of his people, Cooper's life developed in vigor, resourcefulness and success.

A great deal has been written and said about this man, but I do not find that his true significance has been appreciated. He was not a hero; perhaps not one of the world's great men; but like a few others of that day, he early felt the import of what was being done by the wide forces behind men, and in his own sphere of life he grew to typify the revolution in which he lived.

Great changes in politics, philosophy, literature and science do not come suddenly, full grown, as we know. It is evolution that leads to what men call revolution. Rousseau preceded Jefferson; Descartes preceded Darwin, and John Hunter preceded Astley Cooper.

The traditions which lay behind and surrounded the young Cooper were certainly not of a kind to develop his natural genius. His ancestors belonged to the country gentry class; his father was an excellent clergyman of independent fortune, his mother a fond, sweet woman who wrote moral poems and tales for the young and found a publisher. He was born a younger son to this couple at Brooke, in Norfolk.

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