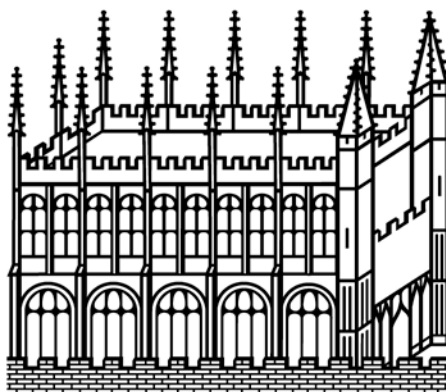




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MODERN
NAVAL HYGIENE.





MODERN NAVAL HYGIENE.

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TRANSLATED FROM THE FRENCH
BY JOHN BUCKLEY, STAFF-SURGEON,
H.M.S. "ENDYMION."



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DEDICATED, BY PERMISSION,

TO

SIR A. ARMSTRONG,

K.C.B., LL.D., F.R.S.,

DIRECTOR GENERAL OF THE MEDICAL DEPARTMENT
OF THE ROYAL NAVY,

IN RECOGNITION OF HIS UNCEASING EFFORTS

TO IMPROVE THE

HYGIENIC CONDITION OF THE ROYAL NAVY.



TRANSLATOR'S PREFACE.

THIS, I believe, is the first attempt to present in an English dress the mass of knowledge we have acquired on a subject full of interest to Naval Surgeons.

I hope it will prove of some assistance to my brother officers when they are consulted on matters liable to affect the general health of the ship's company, and I venture to hope that Commanding Officers of ships will derive some benefit from its perusal by having their attention directed to matters, trifling in appearance, but which in the long run exert an injurious influence on the health of the men, for Captains and Doctors must work together to attain the desired end,—the physical well-being of the seamen committed to their joint charge.

The article on lead poisoning is very exhaustive but fortunately for us does not possess the same melancholy interest which it does for our colleagues of the French Navy.

I ask my readers to blame the translator for any deficiency of style, the original being perfect in matter and form, and it is solely with the view of calling attention to a deeply interesting work that I have undertaken the task. I hope it may prove the first stone on which a solid superstructure of Naval Hygiene will be reared; and we cannot do better than conclude with the words of a distinguished French writer on Naval Hygiene: "Well constructed ships, well-drilled crews, and sound sanitary measures, are indispensable elements of a powerful navy."

H.M.S. 'Endymion,'

HULL.

July, 1875.

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ON THE
Progress of Hygiene

FROM THE INTRODUCTION OF STEAM INTO
THE FRENCH NAVY.

PURE breathing air is the first condition of health, and accordingly hygienic principles are more limited, as the exigencies of a calling modify to a greater or less degree the atmosphere in which those who follow it are obliged to live.

This explains the great difference we find in a seaman's life as the attention is directed to the subject of short or long voyages.

However rough and perilous a calling it may be, the life of a fisherman or sailor engaged in the coasting trade is one of the healthiest. Making allowance for the accidents of the sea, it ranks as high in a sanitary point of view as the agricultural labourer, and with respect to longevity, probably higher. The atmosphere in which the fisherman passes the greater part of his life is free from fault, his stay on ship-board is short, and even if the air be vitiated, it has not time to affect the system ; the shortness of the cruise does not entail any change in the dietary ; vicissitudes of climate are reduced to a minimum, and the constant change

The dangers to life on board Ship.

from life on board to the shore cannot be otherwise than beneficial to the general health. Accordingly, we find on the sea-board of the maritime nations of Europe the most perfect types of strength and development. The hygiene of this class of sailor is included in the general principles of sanitation.

From the moment a sailor steps on board a ship bound for a long voyage, especially in a man-of-war with a large complement, he is exposed to two great dangers to life—effluvia from the bilges and overcrowding, with the attendant ill-effects, and this in addition to the many diseases peculiar to the climates in which he sojourns. For a long time the difficulties which were experienced in regulating the diet during the course of a long voyage caused some more pressing dangers—scurvy, to wit. Since this problem has been solved successfully, ventilation is the great question of Naval hygiene, and its improvement occupies the attention of all who are called on to watch over the well-being of the sailor.

Every modification in ship building, particularly in the internal economy, exercises a direct influence on the health of the ship's company, and there has been no more important change than the introduction of steam as a motive power.

Our duty being to review briefly the improvements affected in Naval hygiene, we cannot do better than take this striking fact as a starting point. It is difficult even now to realize its importance. Although the first steamers date from

The rapid changes in Ship-building.

1820, we cannot take into consideration their influence on the health of the men, until they increased in number.

1840 shall, then, be the starting point of this brief retrospect.

Before enumerating the successive changes recently adopted with the view of improving the men's health, we must, first, briefly recapitulate the new hygiene conditions that have arisen since the introduction of steam, otherwise it would be difficult to understand the new questions to be solved, the unexpected dangers against which we have to guard, and duly appreciate those which still exist.

The complete revolution which the matériel of the Navy has undergone, was not all gain in a sanitary point of view. The strides are so rapid that the hygeist is every year left behind in this race towards an ideal not yet realized—he follows the naval constructor from afar. Yesterday's type is already out of date. That adopted to-day has just been laid down on the slip when it has to give place to another the plan of which is only in embryo. From this we can understand the difficulty of our task, and it will cause less surprise if we are unable to lay claim to any notable progress in sanitation capable of counteracting the elements of disease engendered by the incessant transformations which the exigencies of naval strategy bring forth.

Over-crowding increased in Screw Ships.

was as fruitful in its results as it was entirely unexpected.

The substitution of the screw for the paddle-wheel, as the motive power of ships, solved an important question, namely, how to apply to a vessel-of-war all the advantages arising from the use of steam, and retain the powerful armament and great spread of canvas of the old sailing ships.

Placing the engines below the water-line and immersing the propellor, rendered the ship less vulnerable and gave a clear gun-deck, and owing to the ingenious designs of M. DUPUY DE LÔME, speed and facility of evolution were developed beyond all precedent. The NAPOLEON type of ship in which these qualities were combined, excited the envy and admiration of the maritime nations of Europe when she appeared in the Black Sea.

The whole matériel of the Navy was quickly transformed by the prompt efforts of an enterprising Board of Construction, and this time, at last, it seemed as if the perfect type of a ship-of-war was reached.

She was necessarily overcrowded, the capacity not having increased in the same ratio as the machinery and the complement.

Undoubtedly, the engines, although increased in power, took up less room owing to the constant improvements introduced in their construction, but on the other hand, increased horse-power required more coal.

Steam v. Sailing Ships—lower rate of mortality.

The gun-deck was clear of machinery certainly, but the seaman element continued as numerous as before, there being no change in the number of guns and spread of sails, and was further increased by the addition of the engine-room staff. The sanitary conditions, bad enough in broadside ships, were further aggravated in smaller ships, some of which rivalled in insalubrity the worst types of the old Navy.

The rapidity of the voyage and the frequent calling into harbour, neutralized to a certain extent the evils arising from overcrowding.

With the help of the screw, France was able to terminate successfully and without too many losses, a distant military expedition, the thought of which 20 years before would have seemed chimerical.

In the months of November and December, 1859, 18 ships (13 screw and 5 sailing) left, carrying a small army, destined to avenge the insult to the French and English flags at the mouth of the Peiho river. This flotilla anchored in the roads of Chefoo in July of the following year.

Whilst traversing the immense distance which separates France from the Celestial Empire, out of a total of 12,000 sailors and soldiers 109 died. The 5 sailing ships, with a total of 3,765, lost 45, they only dropped anchor once during the long voyage. The steamers, out of a total of 8,117, had only 64 deaths to record, but then they called in at from three to seven ports. This difference of a third in

Health depends on type of Ship.

the rate of mortality in favour of the steamers is undoubtedly owing to the increased speed with which the voyage was accomplished and in great part to more frequently putting into port. Were the screw transports by any accident reduced to their sails alone, they would no doubt have presented the same rate of sickness and mortality as the sailing frigates.

This voyage shows that the health of the seaman depends on the type of ship to which he belongs, and how Naval hygiene is obliged to accommodate itself to the naval architect's plans, more especially in the complete metamorphoses of the third stage which we are now about to describe. Whilst the *Napoleon*, that beautiful type of fast steamer, was developing her admirable qualities in the Black Sea, three shapeless masses, the armour-plated batteries, *Devastation*, *Lava*, and *Thunderer* succeeded in dismantling in a few hours the forts of Kinburn.

With the floating batteries, which were initiated by the Emperor, came some other novelties of construction ; in particular, coating the wooden sides with iron plates of a certain thickness.

Regarded, at first, as an exceptional type, these novel engines of warfare required to be towed into the thick of the fight, and were looked upon as only suited to the attack of fortified places, but improvements were rapidly effected in the armament, and a battle began between the offensive and defensive,

No fighting Ship complete if not healthy.

between the shot and the shield, and it soon became evident that every fighting ship must be covered with armour.

It was necessary to endow the floating batteries—aptly compared to a turtle asleep on the water—with the speed and facility of manœuvring of a swift cruiser. France was, again, the first to solve this problem.

Eight years sufficed to float ships of the *Gloire* (1859), *Solferino*, *Flandre*, and *Magenta* class, each of which bears witness to the constant efforts made to give those terrible engines of warfare the greatest resistance and destructiveness. We cannot, at present, foresee the issue of the struggle. The hygieist would have been obliged to confine himself to the simple duty of spectator if the armour-plating and increased size of the guns had not introduced into naval architecture some modifications which might have affected the health and even the very existence of the men.

It is his imperative duty to point out that the most formidable iron-clad however much she may improve in fighting qualities, would be a helpless log on the water, if at the same time she proved an unhealthy habitation to the men living on board. It is not sufficient that the construction and armament fulfil all the requirements of naval warfare, the men who endow it with life and fight the ship must retain the fullness of their physical powers, and on this condition only can the fighting machine attain its full value.

Iron-clads generally healthy.

It would be absurd to connect hygienic conditions with such exceptional types as the torpedoes and monitors, almost under water: it behoves us to apply them only to frigates and iron-clads. The men live on board these ships which are not eccentricities of construction. As a class, they are expected to last, and now less than ever. Can we forget the necessity of sanitary measures? What M. FOUSSAGRIVES said ten years ago holds good to-day: "Well-constructed ships, well-drilled crews, and sound sanitary measures are indispensable elements of a powerful navy."

As a necessary consequence of plating the sides and diminishing the number of guns, due to increased calibre, the ports in the battery were much reduced both in dimensions and number.

The complement of iron-clads when compared with vessels of older date was much reduced, and the sleeping space allotted to each man was nearly double; but it is not sufficient to calculate the cubic contents of the sleeping accommodation and breathing space, we must take into account the facility with which the air is renewed, not only during the day, at anchor in fine weather, but more especially at night, at sea and in bad weather. There are other important elements to take into consideration: the stagnation of the strata of air in the holds, effluvia from the bilges which vitiate the air of the sleeping places. If, indeed, iron-clads are favourable to health, with their magnificent

Rise of temperature in Steam Ships.

batteries which look like a barrack square, the same does not hold good of the deeper parts of the ship. Many difficulties have been overcome, but a complete system of ventilation has yet to be discovered—it is a want more felt every day. In this rapid glance over the changes which the matériel of the navy has undergone, we have only taken into account the overcrowding arising from the introduction of steam as a motive power; let us now consider its influence on the effluvia arising from the holds, and the vitiation of the atmosphere of other parts. The smell of bilges is very peculiar and disagreeable to those not accustomed to ship life, and is the result of the decomposition of different organic substances. The bottom of the ship in contact with salt water of a higher temperature than the external air is always more or less in a state of decomposition.

When steam was introduced into a ship, all the elements of putrefaction were increased, namely, heat, humidity and organic substances to be acted upon. A few quotations will suffice to give an idea of the enormous rise of temperature of the holds and consequently of the other decks—according to the degree of ventilation—when the ship has been a few days under steam.

In this respect we remark a notable difference according to the class of ship. As a general rule the temperature is always lower in paddle-wheel, whether large or small, than in screw ships.

Bilges of Steamers more inimical to health.

In 1850, M. FOUSSAGRIVES, registered a mean of 100° F. to 113° F. on board the paddle-wheel frigate, the *Eldorado*, at Senegal. The large ships, frigates, and screw liners, where the engines are placed low down in the ship, beneath two or three decks, and the stokers work between two rows of fires, the maximum is usually much higher, about 140°. In the gunboat *Eclair* during the summer of 1855, at Algiers, when the thermometer in the shade stood at 95°, 158° F. and 167° F. were registered in the stoke hole.

In the gunboat *Avalanche* during the month of June, 1857, in the straits of Malacca, the fires being alight for several days before, the thermometer placed in the stoke hole out of the glare of the fires rose to 107° F.

The temperature of the lower and main decks of steam ships, although not very high, still remains sensibly increased for several days after the fires have been drawn, more especially at night.

To the other well-known causes of moisture in the bilges, we must add the water for feeding the boilers and cooling the bearings, liable to become over-heated from friction. The process of blowing-out the boilers, when steam is no longer required, floods the bilges with hot water, loaded with saline and greasy matter.

The greater part of this is pumped out, but more or less remains, giving a nauseating and warm damp sensation to the air. Also the grease, required to

Seasoned wood all-important.

lubricate the machinery, gets mixed up with the hot water, bits of cotton-waste, coal dust, etc. From all this results a fetid, thick, greasy mud, from which it is difficult to completely clear the bilges.

All these sources of impurities receive fresh impetus from the employment of steam, and exercise a deleterious influence on the general health. A new class of men has been added to the complement, engineers and stokers, always employed in the work of the engine-room and upon whom the debilitating influences press in a more special manner.

In addition to the ordinary dangers of ship life, engine-room artificers suffer from all the inconveniences and dangers of a calling carried on in a high temperature. Also, we must not omit to take into account the frequent use of preparations of lead in steam ships which frequently gives rise to insidious poisoning. Further on we will discuss more in detail the subject of phophylactic measures adopted to counteract this danger. At present the progress of Naval hygiene during the period of this short sketch occupies our attention. Of the measures taken to keep the ship wholesome, ranks first the process of preserving the wood used in its construction. "By a lucky coincidence," says M. Fous-sAGRIVES, "the soundness of the timber is intimately connected with the general health of the crew, and such important questions for the ship-builder as the

A new process of preserving wood.

preservation, selection and cutting of the wood, are equally momentous to the well-being of the crew.

The moisture which impregnates the timber of ships built in a hurry is a foe to the hull and the crew.

No doubt the best means to keep the wood from rotting is to build slowly, and leave the ship a long time on the stocks, the timbers exposed to the open air. Take the case of the 90-gun ship, the *Austerlitz*, which was begun at Cherbourg, April, 1832, and launched in October, 1852, having been thus 20 years on the slip. No sooner was she floated than it was decided to alter her into a screw, and she was accordingly placed in the hands of the dockyard and her after section altered for the reception of the screw. The work was carried out with the utmost despatch. Six years after it was found necessary to replace this new stern, although the rest of the old timbers and planking were quite sound and still remain in a most satisfactory condition after a period of 30 years. At an epoch like the present when changes are more rapid, such a process of preserving wood is not possible, two years being sufficient to complete an armour-plated frigate.

M. LAPPARANT, Director of the Board of Construction, struck by the simple practice of olden days, which consists in charring the superficial layers of wood, has substituted an ingenious

Unwholesome bilges produce slow blood poisoning

method and certain in its operation for the defective and dangerous one formerly employed in the English Dockyards.

The wood is subjected for a short time to a lighted jet of gas only a very superficial layer of which is charred. By this process a considerable degree of heat is developed which has the effect of expelling the moisture from the superficial layer and to dry those parts which are most liable to become rotten. The same result is arrived at by long exposure to the atmosphere.

Beneath the charred superficial layer there is another, saturated with the products of wood-distillation, the antiseptic properties of which are well known.

The process is now employed in the construction of all ships-of-war.

The end which M. LAPPARENT strives after is also the aim of hygiene, as rotten wood is one of the most important elements in the poisonous effluvia from the bilges, and the destructive process is materially hastened by the high temperature of steam ships.

Of the measures adopted to clean the bilges. The holds of a ship bear some resemblance to the cellars of a house, so far as they are dark, of a higher temperature than the other parts, and damp, but they differ essentially in the effects produced by the more or less poisonous atmosphere. The air of the cellars never communicate directly with the

Improvement in the arrangement of the hold.

rooms above, it is only by accident that the deleterious gases gives rise to sickness. The effluvia from the bilges have, on the contrary, a tendency to permeate every part of the ship.

If it is impossible to particularize the diseases arising from these emanations, there is no doubt that a chronic blood poisoning results. This permanent source of putrefaction causes undoubted tendency to disease and aggravates all other maladies which are apt to arise from different sources during the course of a long voyage. Also the holds are capable of retaining for a considerable period the germs of infection from which disease is indefinitely propagated.

For these reasons, then, the bilges call for our most earnest attention and constant care. To purify thoroughly this part of the ship they must be kept constantly clean. We arrive at this result by preventing the organic débris from the provisions or machinery mixing with the water from the boilers. The floors ought to be so arranged that no dirt can collect about, and that the broom reaches every nook and cranny. The bilges ought to be flushed frequently with the water from the boilers and then pumped out as dry as possible to prevent stagnation, and finally, a powerful current of air to lower the temperature and drive out the damp.

All this seems very simple, but nevertheless is very difficult to carry out, and it is only quite

Free circulation of water necessary.

recently that any real improvement has been effected.

The system of stowing the holds is also of great importance, for on it depends the ventilation. The plan proposed by Captain LUGEOL, although not an hygienist measure, was infinitely superior to that in force in 1839.

The system was very defective, it divided the hold into four compartments by bulkheads running from side to side. These compartments were completely cut off from each other as regards free circulation of the air and water. M. LUGEOL effected a considerable improvement by the opening of uninterrupted passages, some running fore and aft, others in a transverse direction. They served two ends—ventilation, and facilitated working in the holds.

In spite of the ingenious arrangements devised by this distinguished officer to support the heel of the mast with chocks of wood bored to allow a free passage of the water to the pump-wells, from many causes these openings were liable to be choked and the whole arrangement rendered useless. More recently the iron shoe was done away with, not being required as ballast since the introduction of such heavy weights as the engines and their position on the sleepers. The interstices in the floors were filled up and trays were arranged to catch the surplus grease used in lubricating the machinery. All these measures tended to prevent

Dry bilges to be preferred.

the formation of that black fetid ooze, a mixture of grease and rust which choked the suction-hoses. The obstacles to a free circulation of water were lessened.

The system of clear passages and bulkheads with openings has now been adopted in all ships, but owing to the difference of type we cannot generalize with regard to the present arrangement of the holds, except to remark that a good deal still remains to be done in regard to putting in motion the strata of air.

A great improvement has been effected in the method of cleaning the bilges. Until recently they were freely washed down, and this was quite effective in iron ships.

M. FOUSSAGRIVES wrote in 1854: "Any system of town-sewerage is faulty where the water is not propelled through the pipes with a certain degree of force—not allowing the elements of putrid fermentation to collect—in like manner letting in the seawater is indispensable to cleaning the bilges of a ship." But we must not forget that the floors of the bilges are wood, an organic material very liable to be acted on by damp. Also, salt water contains in itself the elements of rapid putrescence, and the bilges are not a closed pipe and cannot without danger to the general health be turned into a river. The opposite to this, the dry method, is every day becoming more general, and has already given excellent results. Dr. BOUREL-RONCIERE, senior

Disinfectants not to be depended upon.

surgeon of the training ship *Jean Bart*, has signalized the important benefits derived from it. She was commanded on her first voyage by M. DIEUDONNE, an officer most anxious about the wholesomeness of the holds, and on all other matters relating to the well-being of the men confided to his care.

The following are the steps taken to obtain perfect cleanliness and dryness of the bilges.

When the greater part of the water is taken up by the fixed pumps, a small hand-pump is placed in the run of the screw passage behind the large pump. The suction-hose is placed each side of the keelson, where the water naturally tends to flow, and it is sufficient in ordinary circumstances, when the ship is under sail, to pump out all the water which settles in the after-hold.

When the engines have been at work for some time the donkey-engine pumps overboard the greater part of the overflow from the boilers, the rest is removed by the small pumps and should any remain it is swabbed up carefully until the bilges are quite dry. When the floors of the engine-room and screw-alley have been well dried, the plates are removed and windsails lowered to within a few inches of the keelson in order to thoroughly ventilate them and remove all damp, and lastly, the floors are whitewashed.

In order to be able to inspect and thoroughly scrub the floors, the bilge-plates must be all taken

Ventilation necessary—constant and self-acting.

up. The timber saturated with grease must be carefully scraped, and this must be always done after steaming.

To allow a free flow from forward to aft, sluice valves have been cut in the bulkheads. The foregoing applies only to the after part of the ship. A different mode of proceeding is required for the forepart and the stoke-hole bilges. The water which tends to accumulate under the stoke-hole is stopped by a barrier and is directly pumped out. These measures have been very successful, and when they can be thoroughly carried out, dispense with the use of disinfectants which, at best, are only palliative and must be looked upon as an extreme measure to which it is much better not to have recourse.

Recently, in order to diminish the dangers arising from effluvia from the holds of some ships, a solution of the sulphate of iron has been substituted for the chlorides which have a tendency to oxidize metal, and accordingly a certain quantity of this salt, in proportion to the size of the ship and the length of the proposed voyage, has been supplied. It is very efficacious and direct in its action, but is liable to cause some inconvenience if the place is not thoroughly cleansed and dried after using it.

Free flushing through the bilge-cocks is required, otherwise the salt, being decomposed by its presence, sets free the noxious gases which it tried to destroy. The purification of the holds is com-

Steam, an importer of disease.

paratively easy and complete when we can get an air-space beneath the cargo. By a fortunate coincidence altogether apart from Naval hygiene, this step has been gained in iron-clads. To counteract the excessive roll the weights were raised, and now a man can pass from forward to aft along by the keelson under the water tanks, etc.

We can easily understand the importance of this air-space, the inmost parts of the ship can be thoroughly inspected, the water has a free course from bow to stern, and it is the indispensable starting point of every complete system of ventilation.

The ship will breathe like a human being when with this air-chamber, ventilators are constructed in the timbers communicating with the funnel or the ash-pits of the stoke-hole, or the bottom of the great hollow iron-masts. At one and the same moment we improve the health of the crew, keep the cargo in a sound condition, the bilges sweet, and have solved the most difficult part of our problem, viz., the salubrity of a ship.

This plan has been adopted in many emigrant ships with excellent results.

When a ship during her stay in harbour has carried away the germs of infection, it is of paramount importance that she should possess some system of ventilation, self-acting and constant, which keeps in motion the strata of air in the holds and lower deck, otherwise the infected ship becomes

Quarantine ineffectual.

a centre of contagion—a source of danger to the inhabitants who communicate with her.

The danger is all the greater as the voyage is shorter.

Steam has brought the different peoples of the world closer together, has established free exchange of ideas and products, and has also unfortunately led to free trade in disease.

For the past 50 years this tendency has been manifested in sad, yet instructive facts.

Cholera and yellow fever, imprisoned from time immemorial in their birth place, have now become cosmopolitan and spread along the great ocean highways. Their geographical distribution has extended itself.

Rarely indeed does civilization advance a step without some attendant evil, and public health often pays for the marvellous triumphs of commerce.

Quarantine regulations were adopted to prevent the importation of disease from beyond the sea, but they are only useful in so far that we know the germs have ceased to act on the inhabitants of the infected vessel, but when once she is admitted to pratique there is no guarantee that the labourers who come to clear the holds, offering a fresh soil to the germs, will not be attacked in their turn.

With a complete and constant system of ventilation the lower strata of air beneath the cargo are being constantly renewed—the cargo resting on perforated metal plates. The purification of an

Methods of purifying an infected Ship.

infected ship commences from the moment she leaves the suspected anchorage and continues during the cruise. On her arrival in harbour millions of cubic feet of air having passed through the cargo in every direction, quarantine can be abolished with safety. Only the sick require isolation and the cargo can be cleared without danger.

We have other efficacious means of clearing the holds of infected ships without causing any damage on the cargo or hull, or the health of the labourers engaged in an occupation which was formerly so much dreaded.

Quite recently when the *Anna Maria* imported yellow fever into Saint Nazaire, the germs of disease still lurked in the stagnant atmosphere of the holds. Recourse was had to an extreme measure, energetic in appearance, but unfortunate in its results both for the owners and the salubrity of the ship.

After clearing out the holds, she was beached, and planks removed here and there to allow a free passage to the tide. After this proceeding, which undoubtedly shook the framework of the vessel, she was again floated, washed out, dried as well as could be done, and whitewashed. Looking upon this proceeding from a sanitary point of view, a serious objection presents itself. The timbers of a ship which has been treated in this fashion are liable to remain damp and generate miasma. The

Improvements of ventilation in the depths.

germs cling to the wooden flooring of the bilges, submersion does not totally destroy them, but fire, the great purifier, is most efficacious. A process invented by M. LAPPARANT, which was described in a former page when speaking of seasoning the timber used in ship-building, and which consists in superficially charring the wood with a jet of gas is a cheap and expeditious method for purifying the hull of an infected ship, and does not present any drawback. Before using it, the ship must be thoroughly cleared out this is at present quite safe ; if the men are provided with the breathing apparatus of ROUQUAYROL or GALIBERT which we shall have occasion to speak of further on. By a judicious combination of the recent scientific applications, the infected ship can be rendered as wholesome and as sound as the first day she was launched.

Whilst describing the transformations which have taken place in the matériel of the navy, we made mention of some causes which increased the overcrowding in the lower decks and batteries of composite ships and aggravated the vitiated atmosphere of the lower decks of iron-clads. Many systems of ventilation have been tried but none officially adopted. The system proposed by Dr. EDMONDS, surgeon of the English Royal Navy, and which has been applied to many ships of the Royal and Commercial Navies of England, is now being tried with some slight modifications in one of our dockyards,

Sick, better accommodated.

and will, we believe, soon be in general use.

The ventilation of the holds and different decks, although not yet perfect, has improved very much.

Iron cowls have been substituted for wind-sails—being considered better—but they are not so efficacious as might be expected.

By doing away with all superfluous partitions the steerages were made roomier; wide wing-passages were made along the ship's side, by the lower deck and officers' cabins. The engine-room is no longer cut off from the rest of the ship, the foremost bulkhead having been removed, and the same was done to the gun-room which now enjoys the benefit of numerous air-holes. Many officers' cabins in the steerage have been done away with and removed to the main-deck where they are provided with a large port.

In many iron-clads, the gun-room in the lower battery has been rendered more salubrious, and in a word, efforts have been made to improve that portion of the ship set apart for the berthing of the officers and men.

By removing the large hen-coops which were formerly a fixture in the batteries, the chances of atmospheric vitiation were much lessened. When at sea they are replaced by smaller ones which can be taken away when empty, and the ship's hospital in all iron-clads, with the exception of the *Provence*, has now been placed on the upper-deck. In this class of ship, the hospital is forward

Nothing trivial in sanitary improvements.

under the top-gallant fore-castle, it is spacious, with plenty of light and air at all times and seasons. The sides are smooth without depression or projection ; the sick bay is free from guns and cables ; the sick are away from all noise ; the forge is not overhead, nor is the galley close beside ; it is of easy access : in fact, the isolation of the sick is as complete as can be expected on board a ship. The sick can walk about the upper deck without the necessity of climbing ladders. The deck is not washed down or holystoned, it is covered with a waterproof or a thin coating of wax, and a water-closet is set apart for the use of the sick. No better use could have been made of the space gained by doing away with the bowsprit and its necessary gear.

In this innovation, deserving of all commendation, sanitation has gained one of its happiest triumphs since the introduction of iron-clads.

Many intelligent ship-owners, looking to their own interests and careful of the health of their men, now berth the crews under the fore-castle instead of confining them in dark and narrow cribs deprived of light and air.

Fixed bunks, receptacles of dirt, have been replaced by hammocks. Most of the Trans-Atlantic steamers provide abundance of light and air. Here, again, sanitary science and commercial interests are in harmony.

As in hygienic matters there is nothing too

Condensed not so wholesome as spring water.

trivial, we must not forget to note the benefit derived from the substitution of stearine candles for smoky oil lamps, which lighted in olden days the lower decks and batteries ; they gave out a good deal of heat and filled the lower deck with foul smells and hydro-carburetted products. It is to be hoped that candles will soon come into general use.

Of the improvements in the dietary—next to the purification of the atmosphere—there is no question so urgent as the diet. In the beginning of the period of which we are treating in this article, a great stride was made in adopting iron-tanks (circular of 13th February, 1825), the introduction of the distilling apparatus of PEYRE and ROCHER, the regular issue of fresh bread on a long sea voyage, and coffee at breakfast. Although it may not be our pleasing duty to have to record measures of equal importance, yet the authorities have not ceased in their efforts to improve the condition of the sailor.

We will now make a few remarks on recent improvements on Naval Sanitation.

CHAPTER I.

FIRST—OF THE DRINKING WATER.

The introduction of steam as a motive power, shortening the time spent at sea and necessitating frequent calling into port, has also diminished the stowage of water, formerly required in sailing ships, and shows the great advantages derived from the employment of condensers, as the space given up to the engines and coal-bunkers was taken from that allotted to the water-tanks.

Both in the Royal and Commercial Navies condensers are now generally employed. The dimensions and yield vary with the class of ship. By a circular of the 4th July, 1848, the condensing apparatus of a ship of the first class, distilling for 10 hours, gives 800 gallons, or about $\frac{3}{4}$ gal. a man, that is to say, quite sufficient for the wants of the ship's company.

In addition to the incontestable fact that distilled water is not equal to good spring water, we must also take into consideration certain defects in its manufacture, which are a source of danger to health. Those dangers are aggravated in the tropics when the quantity of water consumed by each individual increases with the temperature, and anæmia and malarious cachexia help to lower the system.

Iron drinking tanks wholesome.

Also, the tubes, pure lead in some places, badly coated throughout, yielding a considerable proportion of salts of lead, often produce the first manifestations of lead poisoning. Dry or lead colic, as it arises from other sources beside drinking water, we beg to refer the reader to a special paragraph where the measures taken to guard against this danger are treated of. It is one of the most important improvements in Naval Hygeine for the last few years. The apparatus of PEYRE and ROCHER was defective in other respects, and after many unsuccessful attempts to fit the condensers to the engines, the invention of PENROY, of the Board of Construction, was generally adopted. By it, the water is made at a low temperature, is well mixed with air, and is quite free from the usual greasy flavour of condensed water, it can be drank immediately, and does not generate damp or unpleasant smells in the holds.

The crews of the great Trans-Atlantic steamers, owing to the high rate of speed and short well-timed voyages, only make use of good shore water, of which a fresh quantity is always shipped before leaving port. Condensed water is used for scrubbing the decks, for baths, and washing clothes, and is never issued for cooking or drinking purposes.

Before we proceed to speak of the steps taken to guard against the chance of lead-poisoning arising from the drinking pipes in the main-deck tank, we must first take note of an improvement introduced

Stokers suffer from over-indulgence in water.

into their manufacture. An order of the 16th October, 1858, issued with the intention of diminishing the effort of suction which the men are obliged to make as the water falls low in the drinking tank, directed that these receptacles were to be made broader and lower, and the larger one replaced by two smaller, placed one above the other, and the diameter of the drinking tap reduced. On the representation of many naval surgeons, the main-deck tanks are now made of iron, wood is cleansed with difficulty, and water in contact with it for some time acquires a disagreeable flavour arising from the decomposition of organic matter. By an order of July, 1860, men employed in the French West Indian Colonies, and the tropics generally, are allowed daily a small quantity of sugar, brandy, and vinegar, for the latter, as occasion offers, fresh limes or oranges are substituted. These substances are mixed with water and make an acidulated drink. It is the opinion of many naval surgeons that the allowance of vinegar might be diminished with benefit to the digestive functions. It is difficult to fix upon a good wholesome beverage suitable to the stokers when employed on the fires.

“It is impossible to realize,” says Dr. BOUREL-RONIERE, “the enormous quantity of plain or acidulated water consumed by a stoker in the course of a watch, more especially in hot countries. In Europe it amounts, on an average, to three or four quarts, and is, at least, doubled in the tropics.

Stokers suffer from over-indulgence in water.

The health soon suffers from this excess and over-excitement of the secretory functions of the skin. The immediate results are profuse sweats, insatiable thirst, and subsequently, atony of the digestive organs, colic, diarrhœa, a feeling of heaviness and sinking in the epigastrium, a flabby and inert condition of the muscles, absence of colour in the skin and mucous membranes. This over indulgence in drinking water is certainly most injurious to the stoker's general health, and the injury is all the greater as there is no restriction to the quantity consumed. Already, in 1853, in my doctor's thesis, I recommended the issue of a more wholesome beverage than the regulation acidulated mixture : I then proposed a weak solution of coffee with the sugar and brandy already allowed. M. FOUSSAGRIVES in his treatise on Naval hygiene, and many other Naval surgeon's, are of my opinion, and we hope that our wish may soon be fulfilled.

CHAPTER II.

OF BREAD, VEGETABLES, &c.

The excellent quality of the bread issued to the French sailor has always caused a feeling of astonishment in all foreign navies. The best wheat, either native or foreign, is only used, it

A new process of preserving vegetables.

must be freshly ground, free from all foreign matter, of good taste and smell, and perfectly dry ; it must contain 8 per cent. of gluten extracted at a temperature of 212° F., it must be freed from husk, flour of inferior quality and seconds, and must not contain less than 10 per cent. of water or more than 13 per cent. The ovens used by the competing contractors are previously examined with great care by Naval Inspectors, and the flour is submitted to whatever test the examining board thinks fit.

An order of September, 1866, introduced some improvements into the ship's ovens by which a liberal issue of fresh bread is now secured. The drying process employed by CHOLLET and MASSAN to preserve vegetables, was recommended by the several Commissioners ordered to report upon it, and these preparations form part of the present regulation allowance.

No doubt vegetables preserved by this firm are better than those simply dried, but it would be a mistake to suppose them endowed with antiscorbutic virtues. Vegetables when prepared in this manner lose the greater portion of their juices, and the only advantage they possess is that they are less tasteless and more digestible than ordinary dried vegetables, and serve to diversify the ordinary rations.

CHAPTER III.

OF MEAT.

The custom of taking live stock to sea has become more general since the introduction of steam and short voyages, and in this the State gains as well as the general health of the crew, fresh meat being substituted with advantage for salt or preserved however well it may be prepared ; but many circumstances restrict the application of this excellent measure,—the limited space allowed to the live stock, the difficulty of keeping them in good health and providing them with wholesome food. It would indeed be a great gain if the re-victualling of a ship could, by some process of preserving, be accomplished as easily as the watering ship.

M. FOUSSAGRIVES, in his treatise on Naval hygiene, pointed out one of the defects in the dietary and it has at last been remedied. The issue of salt beef has been discontinued, also the use of preserved mutton, which was difficult of digestion, not very appetising in appearance, being coated with a thick layer of grease, not at all suited to the weak stomachs of invalids for whose use it was more especially intended.

Some inconveniences of preserved meat.

The 8ozs. of salt beef—the sea-ration, was replaced by 6½ozs. preserved by the process of FASTIER, which is only a modification of APPERTS' ; the water is mixed with some substance which retards the boiling point to 262° F., the tins are plunged into it, the steam generated repels the air, and the orifice is closed with solder. This was defective in some respects, some solder dropped into the tin, and if the meat fermented, a considerable quantity of lead became mixed with it.

M. LEFEVRE, manager of the Victualling Department of Rochefort, where the preservation of meat is carried on on a large scale, has removed this source of danger by fitting a small tin tube to the orifice, and with pincers of his own invention he closes the tube when the air inside the tins has been expelled, and then closes the orifice with solder. Meats preserved in this manner keep their flavour, look appetising, and possess all the restorative qualities of fresh meat.

Since the adoption of PASTIER's method many others have been tried but not found so good.

The victualling department, anxious only for improvement, has listened to the suggestions of inventors and submitted their experiments to the thorough test of a long voyage and the judgment of different commissions, but none have given any definite good results. We will not enter into details on any of these methods with one exception, which seems based on a sound idea, but we must

A new and improved method.

not withhold our praise from these inventive efforts. The problem of meat preserving is very complex, it is not sufficient to prevent fermentation, we must be able to carry out the process quickly and easily on the spot where the live stock is procured. A vessel cruising could, on putting into port, renew in this manner her supply of preserves. Another requirement is that it should be fit for cooking in a variety of ways. One of the great inconveniences of the meats prepared by FASTIER is the sameness, although the same remark applies to salt meat, nothing to excite the appetite—always weak in hot climates.

A distinguished professor of chemistry in the Faculty of Science at Strasbourg, M. LIESBODARD, has attempted to fulfil the foregoing conditions. His idea is to take the meat fresh from the slaughter-house in tins hermetically sealed. The only addition is water, containing a substance which has a great affinity for oxygen; accordingly, all the oxygen is absorbed, and fermentation cannot take place. If the tin has been hermetically sealed, we find, on opening after a considerable time has elapsed, the meat as fresh and as good in every respect—taste, smell, appearance and nourishing qualities—as the first day. Washing the meat in ordinary water is quite sufficient before handing it over to the cook. A great variety of dishes, and good soup, can always be procured from it.

The metal of the vessels does for the meat what

Frequent alterations necessary.

the iron tank does for water—keeps it sweet and wholesome.

We hope that these experimental efforts, which are being tried in every climate, will continue to give satisfaction.

Changes in the Dietary.

For the past twenty years considerable alterations for the better have been introduced since the scale was fixed by the circular of February, 1823, which re-produced, in its most essential features, the decree of FLORIAL of the third year of the Republic, also that of January, 1806, and another circular of the 1st April, 1813, all of which form the basis of the present dietary.

The circular of October, 1848, modified by addenda of January, 1853, is a simple reproduction of that of 1823, with the addition of some articles for the use of the sick, and alterations in the quantity of some others.

M. FOUSSAGRIVES in his treatise on Naval Hygiene, published in 1856, predicted that after a few years it would be necessary to revise the dietetic code. The manifest advantages derived from the use of vegetables dried after the manner of CHOLLET and MASON and the meat preserved by FASTIER brought forth the circular of July, 1860, which is at present in force.

Old and new Diet-scale.

We reproduce here a comparative table showing the sea ration of 1853, and as it is at present :—

				1860	1853		
SOLIDS.	..	Biscuit or	}	18 oz.	18 oz.		
		Fresh Bread		25 oz.	18 oz.		
		Flour	.. ..	18 oz.	18 oz.		
		Preserved Beef	.. ..	6½ oz.	8 oz.		
		Salt Pork	.. ..	7½ oz.	7½ oz.		
		Fresh Meat	.. ..	10 oz.	10 oz.		
		<i>Dry</i> <i>Vegetables</i>	Calavances	}	4 oz.	4 oz.	
			or Peas				
			Beans or	}	3½ oz.	4 oz.	
			Potatoes				
Rice	.. ..	3 oz.	1 oz.				
Cheese	.. ..	3½ oz.	4 oz.				
Coffee	.. ..	¾ oz.	¾ oz.				
Sugar	.. ..	1 oz.	1 oz.				
LIQUIDS	{	Wine	.. ..	1 pt.	1 pt.		
		Brandy, Rum,	}	½ gill	½ gill		
		or Lafia					
CONDIMENTS.	{	<i>Acid</i>	Sauce Krout	.. ..	¾ oz.	¾ oz.	
			Pickles at Meals	.. ..	¼ oz.	¼ oz.	
			Prepared Sorrel	.. ..	½ oz.	½ oz.	
			Vinegar—a small quantity to mix with drinking water.	.. ..			
		<i>Fatty</i> <i>Substances</i>	Butter	.. ..	¾ oz.	¾ oz.	
			Olive Oil	.. ..	½ oz.	½ oz.	
		<i>Stim- ulat- ing.</i>	{	Mustard. Pepper, Salt.	A small quantity of each.	According to the nature of the repast	¾ oz. ¾ oz.

During a cruise there is no change in the rations except such as may arise in provisioning at different Ports of call.

Extra issue of wine and bread to stokers.

Here follows the distribution according to the days of the week.

Breakfast always remains the same, being composed of coffee, with brandy, biscuit or fresh bread.

Dinner.

Biscuit, or	}	..	..	6½oz.	} Sunday, Monday, Tuesday, Wednesday, Thursday, Saturday.
Fresh Bread	}	..	..	9 oz.	
Wine					
Preserved Beef, or	}	..	..	7 oz.	
Salt Pork	}	..	..	8 oz.	
Calavances and Peas, or	}	..	..	2 oz.	} Friday.
Dried Vegetables	}	..	..	½oz.	
Cheese				3½oz.	

Supper.

Biscuit, or	..	..	6½oz.	
Fresh Bread	..	..	9 oz.	
Wine				
Calavances	..	..	4 oz.	3 days a week.
Peas	..	..	4 oz.	
Shelled Beans, or	}	..	3½oz.	} 1 day a week.
Dried Potatoes	}	..	3½oz.	
Rice	..	..	2¾oz.	1 day a week.
Sourcrout, or	}	..	¾oz.	} Every evening at supper.
Preserved Sorrel	}	..	¾oz.	

In addition to the above, a circular of July, 1860, allows to all employed in the engine-room when under steam for more than 12 consecutive hours, an extra issue of 19oz. of biscuit or 26oz. of fresh bread and one pint of wine. This allowance is reduced one-half when the engines have been working only 12 or less than 12 hours. We quite agree with the conclusions arrived at by

Surplus of nitrogenous elements.

Dr. BOUREL-RONEIERE in his thesis, that this scale leaves nothing to be desired as far as the nutritive elements are concerned. Taking as a starting point, the quantities of nitrogen and carbon, laid down by GASPANI as necessary to keep the system in order and repair the daily waste, we have the following :—

	For simple support of life. Grammes.	To repair the waste caused by work.	Total.
Nitrogen ..	12'51	12'50	25 01
Carbon ..	264'06	45'03	309'09

If we compare this with the calculations of FOUSSAGRIVES as to the quantity of nitrogen, carbon, and fatty matters, furnished by the foreign service ration, we have—

Total. Grammes.	Nitrogen.	Carbon.	Fatty Matters.
1'419	26'91	308'86	49'85

Here we find that by a curious coincidence scientific principles agree with common practice. The dietary is even richer in plastic material than is theoretically required.

Very little improvement to be recorded.

CHAPTER IV.

Of the Improvements introduced in the Dress of the Sailor.

The different changes introduced during the past 25 years in the soldier's uniform teach us what a delicate matter it is to inaugurate a change, and how a seeming amelioration is often a change for the worse. Very little, indeed, has been done to improve the sailor's kit, although he is exposed to frequent and rapid changes of temperature. The regulation dress prescribed by orders issued in 1856 was partially altered by a circular of 1858.

When a question of change of uniform arises, it must not be forgotten that a detail, trivial at first sight, can after a time, exercise a considerable influence on the health of a great number of men.

Here we must not omit to notice that many of the wise provisions recommended by FOUSSAGRIVES have already been realized in the recent changes of uniform. According to a circular of May 1858, two soft cotton shirts of a dark blue colour were added to the bag. They descend half way down the thighs and are excellent in every respect, material, shape, and size, and are much prized by the seaman. There is no better proof of this than that

A jumper an inconvenient article of dress.

soldiers, officers as well as men, were most anxious to get them in the Crimea, China, and Mexico. This shirt takes the place of one of the blue cloth jumpers. On this subject FOUSSAGRIVES has the following:—"This jumper scarcely covers the chest, each effort draws it higher up and further away from the trowsers, leaving the loins exposed and liable to attacks of lumbago. It confines the wrists and armpits." "Take away," says he, "one of the jumpers, and give the sailor another cotton shirt, and his health will gain by the change." At last the prayer of the sanitary reformer has been heard.

For a long time the French seaman borrowed from the American the custom of wearing a knitted cotton shirt of close fibre. It is made of raw cotton and thread which has been dyed in indigo. This forms alternate stripes of white and blue. It is worn next the skin, and is not only pleasing to the eye, but also in a sanitary point of view excellent. It combines all the advantages of a flannel vest, without any of its inconveniences. It is kept clean, easier, and is much cheaper. These shirts, at first purchased by the men on their own account, are now included in the regulation kit.

The sailor's hat has been the subject of much adverse comment, and justly too, but for many reasons it has not been much altered. The sailor cherishes it as the badge of his calling, and moreover there has never been any serious proposition

Weight and material of the hat.

to do away with it. Persons who have busied themselves fashioning the soldiers' shako know how difficult it is to combine hygiene and elegance.

The sailor's hat weighs now much less than formerly ; instead of a pound or even a pound and a half it is at present only about 9oz., chin stay included.

Formerly it was made of round plaits of straw, closely sewn together and thickly coated with layers of black paint until a perfectly even surface was produced. It is at present of felt, coated with a thin layer of varnish, composed of a mixture of oil and soot, and lined with calico. The chin-stay is of leather, as we recommended in 1850. The administration supplies both black and straw hats. The latter, so much needed in hot countries are issued when required. The straw hat forms part of the regulation-kit. It is made of sennet grass, plaited and sewn together, and is lined with glazed calico. The paymasters of ships stationed in the tropics issue a white hat cover. It has long been issued in British India.

It is a matter of regret that the regulations do not include a sou-wester and waterproof trowsers, with which some boats' crews are provided. Boat service even in fine weather entails the almost daily possibility of wet garments, hurtful alike to the health and the pocket of the sailor. On this subject Mr. LANVERGNE has the following remark :
—“The clothes' bag is stowed in a rack in the

Damp clothes not to be stowed below.

steerage. When a man happens to get wet, a wise provision orders him to change immediately into dry clothes, but where does he put the wet garments? Of course in his bag, which is retained to his place in the bag-rack. This practice presents two inconveniences, clothes, especially cotton, when once saturated with salt water, remain damp for a considerable time. From this heap of wet clothes arises a moist vapour, which fills the steerage and increases the humidity.

It also touches the sailor's pocket, as he pays for his clothes, and there is nothing so liable to injure them. The general health is also affected by the increased space. On board the large trans-atlantic steamers an attempt has been made to remove some of the inconveniences arising from this cause. The men are berthed in the bows of the ship, underneath the top-gallant forecastle. Along the ship's side open cupboards are arranged, where the dripping garments can be hung up, the water drains off them into a tray beneath, and thence runs away to the outside.

The company has adopted a water-proof, invented by a naval surgeon, attached to one of their ships. It is fitted with a system of valves or flaps, which do away with some of the inconveniences arising from the wearing of waterproofs.

A general bath indispensable.

CHAPTER V.

OF PERSONAL CLEANLINESS.

“If cleanliness, which may well be called physical chastity, is required by the laws of decency and health everywhere, on board ship it becomes sacred duty which one owes to society under the penalty of endangering the health of oneself and others.” These are the remarks of FOUSSAGRIVES on this first and most imperative requirement of naval sanitation, and which becomes every day better understood. The inspection is no longer confined to the dress and exterior of the men. Captains and Senior Lieutenants impress on their men the imperative necessity of cleanliness of the whole body. Although the use of the general bath is not required by the regulations, as recommended by M. FOUSSAGRIVES, there is abundance of fresh water in steamers forward of the engine-room, large baths or basins are placed for use of stokers, we can understand how necessary it is for that class. This was ordered in 1855.

CHAPTER VI.

OF DRILLS, ETC.

One of the principal causes affecting the health of the seamen is the excessive strain to which his system is liable. Man is endowed with a certain amount of force which he can expend with safety, if the period of effort be followed by an interval of repose and the waste repaired by suitable food.

The requirements of hygiene and the service agree in dividing the day into alternate intervals of labour and repose. Sea and harbour routine has been often the subject of frequent changes. The regulations affecting the engine-room staff vary with the type of vessel. The arrangement and number of fires make a good deal of difference in the amount of work required from the stokers and coal-trimmers. For example : Corvettes have 12 fires arranged in two stoke holes, and require 24 stokers, while 13 are sufficient for vessels of 220 horsepower with eight fires in one stoke hole, but whatever we may do, there will always be a great difference in the work of a big ship where the stokers are divided into three regular watches, and that of a smaller one where it is watch and watch and sometimes worse. In the former each stoker

Coloured men make better stokers.

enjoys a good night's rest of from seven to eight hours, six of which are uninterrupted ; in the latter case, the small ship, one half are on watch while the other sleeps, thus each man is 12 hours a day on the fires, and only enjoys four consecutive hours of slumber ; and there is another fact which we must take into consideration,—small ships usually cruise in distant stations where the temperature is very high.

An excellent measure has been adopted with the view of lightening the stoker's labour, an additional number of natives in proportion to the complement are shipped on all tropical stations. The coloured races stand the firing and coal-trimming much better, and they are also very useful for boat service during the hottest time of the day. Next to stoking the hardest work in steamers is coaling ship in which the whole crew take part.

For the past three or four years, steam launches have been supplied to all large ships, reducing the boat work not only of the ship they belong to but also of the smaller ships, as they are used to tow their boats. It is a pity that so valuable an invention is not in more general use.

In the mercantile marine steam is used in heaving up the anchor, pumping the ship out, working the large sails, discharging cargo, &c. : in fact, it is utilised in every way to economise human labour.

Before the screw propellor came into general use, diving operations were rarely required. In the

Gymnastic training often saves life and limb.

present day, the necessity has become more frequent, and a diving dress is regularly supplied to all screw ships.

The apparatus of RONQUAYROL, on the principle of condensing the air, is undoubtedly much superior to the old dress, both as regards safety and its effect on the health of the diver. Lieutenant DENAYROUSE has conferred a great boon on the service by altering it so as to make it suitable for submarine operations as it was intended at first only for the use of miners.

Liabie as the sailor is to accidents of all kinds whilst following his dangerous profession, there can be nothing better for him than a thorough gymnastic training,—often it would be a means of saving life or limb.

Gymnastic training is good for all, but it is indispensable to the sailor, teaching him how to utilize his strength, and gives precision and suppleness to all his movements. Accordingly, we are pleased to record as a step in the right direction the fact that a certain number of sailors are sent every year to the Gymnasium of Joinville-le-pout. These men in their turn become first-rate instructors to the men afloat.

Having finished the review of hygiene measures adopted from time to time to secure the physical well-being of the seamen and the efforts to mitigate the sources of disease which encompass him, it now remains for us to speak of the steps taken to

Scurvy under widely different conditions

guarantee him against the two diseases to which he is more particularly liable, although not confined to a sea life ; these are scurvy and lead colic.

Prevention of Scurvy.

This is one of the very few diseases against which a man can protect himself in ordinary times. This plague of the sea, as LIND has well called it, has nearly disappeared in our day, or at least it has become of rare occurrence and its severity mitigated, after having devastated all the nothern counties of Europe in the 15th and 16th centuries, and more than decimated the memorable expedition of VASCO DE GAMA, QUARTIER, ANSON, &c.

Scurvy is not confined to sailors, it is a complex morbid condition, affecting the function of nutrition and consequently the composition of the blood ; it extends its ravages to prisons, beseiged cities, amongst soldiers in the field as well as sailors on a long voyage, to cold and damp climates, within the Arctic circle ; and in the highest temperature of the tropics, wherever it is found there is always the same defect of nutrition and its nature is identical. It varies in intensity according to the length of time that the cause has been acting on the system and the predisposition of the individual affected.

If, indeed, we must allow that its ravages are more felt on board ship it is because the circumstances favourable to the growth of the disease are

Arises from many causes.

here concentrated and always in action. At the outset we are met with the difficulty of feeding the men during a long voyage; it has been overcome partially by the issue of preserved meats, but this process deprives the meat of much of its nutritive qualities. The scale of diet is limited and contains no fresh vegetables. To these causes we must add the bad quality of drinking water, the effluvia from the bilges, the overcrowding, the constant damp, excessive fatigue,—in a word, all those causes which tend to lower the system. From all this we can easily understand that the man who faces the dangers of the sea is more exposed to scurvy, and it is more difficult to protect him against its ravages.

As the disease arises from disregard of the principles of hygiene, in the elementary precepts of this science are to be found the prophylactic measures. It was from having misunderstood this cardinal principle that vain efforts were made to discover in drugs or pretended specifics the prophylaxis of this destructive malady. As it arises from defective nutrition, the attention ought to have been directed in the first place to the dietary.

Experience has proved that the want of fresh vegetables, of fresh meat, the sameness of the rations, long continued privation of certain articles of food, are the primary causes.

This is the most striking fact in the etiology of the disease. Group round this, as a common centre, all those causes which tend to lower the system,

Origin in disregard of ordinary hygiene.

and the disease is certain to appear sooner or later in varying degrees of intensity. Nevertheless, it sometimes happens that those debilitating circumstances may attain such a degree of intensity as to produce a form of scurvy which the diet of itself could not produce. This must be fully understood, otherwise we might put our trust in one class of remedies to the exclusion of important hygienic measures. This explains how scurvy tends to disappear from ordinary sea-life without any appreciable change of diet, as voyages get shorter, ships cleaner, less crowded and better ventilated ; as the men are better dressed, less overworked : in a word, treated more like human beings, drinking better water, and free from elements of putrefaction.

To enumerate all the circumstances attending all those happy changes it would be necessary to write a complete history of naval hygiene.

It will be sufficient to mention one important change, a stride forward, and only recently introduced into the French navy,—the regular issue of lime juice. Although LIND, in my opinion, laid too much stress on a damp cold atmosphere as an element in the causation of scurvy, he was the first to point out the correct treatment of the disease, showing the value of all kinds of fresh vegetables both as prophylactic and curative, provided their juice contains no noxious principle, the question then arose how to provide ships with this inestimable resource. Limes and oranges contain

Lime juice only lately issued in the French navy.

abundant juice. Sea faring nations were long acquainted with this fact, but the fruit did not keep sufficiently long, it was necessary to find some means of preserving the juice so as to ensure a regular issue on a long voyage.

According to Sir GILBERT BLANE, we owe to him the formula for the preparation of lime juice. The regular and general issue in English men-of-war, dates from 1757, and is due to the recommendation of YEO, a surgeon in Admiral WATSON'S East Indian squadron. Although from this date the English navy have used it, and Lieut. Bellot, in every page of his diary, extols its use and the benefits derived from it in the *Prince Albert*, it is only quite recently that our men have been allowed it. Already in 1855, FOUSSAGRIVES asked, "Why don't we borrow from the English this acid preparation, which can be easily procured from our Colonial possessions where limes abound. It costs very little, and it is of inestimable benefit on a long voyage. "About the same time GALLERAND, surgeon of the *Cleopatra*, when cruising in the White Sea, had an opportunity of appreciating its effect on the health of the crews of the *Phenin* and *Mæander*, English ships of war, cruising in the same seas. In his report, he calls most emphatically for a regular issue of lime juice. An order of April, 1856, fully meets his views. A commission, composed of three chief apothecaries, was ordered to assemble at Toulon, and report on the

Occasional fatal cases of scurvy.

best method of preparing and preserving lime juice. It awarded the prize to the process of adding 2oz. of alcohol to a quart of lime juice in its natural state.

Now, all our ships-of-war setting out on a long voyage are amply provided with this excellent prophylactic. England, in her care for her navy, is not satisfied with placing an ample supply on board, but also prescribes rules for its issue, the quantity allowed to each man, (to be served out daily in the presence of an officer), and has imposed the same obligation on the mercantile marine, as we read in para. 3 and 4 of the 'Merchant Shipping Acts.' She procures an ample supply from many of her Colonial possessions, particularly from the island of Malta, where limes are plentiful. Our maritime code takes no notice of the supply or distribution of lime juice to the merchant sailors when on salt provisions, although scurvy is very common every year amongst those engaged in the cod fisheries on the banks of Newfoundland.

Its effects are felt in proportion to the severity of the season and the amount of fatigue entailed on the men. On an average, five or six deaths from this cause are annually registered at St. Piene. Nevertheless, we must here take the opportunity to remark that if the regulations relative to the supply and issue of lime juice were as strictly adhered to by us as by our neighbours, they would not be sufficient to completely remove scurvy from the

Scurvy sometimes occurs in English ships.

list of diseases incidental to a sea life, as we remarked in the beginning of this paragraph. It arises from a group of conditions all unfavourable to health and in the midst of which the sailor lives. As a proof of this, although in England it has altogether disappeared from the Royal Navy and in the great lines of steamers to India, China, and Australia, officers and men are rarely attacked, we must remember that in spite of the stringent regulations of the 'Merchant Shipping Acts,' scurvy still exists in the Mercantile Marine.

According to a report presented to the Board of Trade, we find death often arising from this cause, and it has prevailed to such an extent that ships' companies have lost from 12 to 90 per cent. of their strength. The number of cases would no doubt be much greater if the enquiry had included ships trading north of the 37th parallel, along the eastern coasts of America, the banks of Newfoundland, and Nova Scotia, and where the issue of lime juice is not compulsory.

In vain, do our neighbours across the channel enforce the most stringent regulations on this subject, and institute enquiries into each case of disease: the end will never be attained in their merchant navy nor in ours; until captains and owners are more enlightened to the true interests of commerce which go hand-in-hand with the claims of humanity, and strive to assimilate the sanitary conditions of their men to that prevailing in the

Great mortality in Spanish navy.

Royal Navy. This result can be achieved all the easier as it is only a question of money, never having to yield to the imperious emergencies of warfare, which often brings in its train the destructive epidemic, against which human provision is of no avail.

Quite recently, in 1866, we learn from the medical returns of the splendid Spanish frigate, *La Blanca*, at one time cruising off the coast of Chili, that she had during the voyage from Valparaiso to Ferrol 229 cases, with the enormous proportion of 19 deaths, from scurvy alone.

The addition to the daily rations of an ounce of lime juice in ships bound on a long voyage, is a step in the right direction, much to be commended, and which ought to have been carried out long before. But let there be no mistake on this head, scurvy will not disappear from sea life until the improvements called for by the laws of hygiene are carried out in their entirety.

Of the Prophylaxis against Lead Poisoning.

Of the diseases which are frequent in ships stationed within the tropics there is one which, by its gravity, frequency, obscure origin, and its raging occasionally as an epidemic, calls for the particular attention of the naval surgeon. The onset is marked by obstinate constipation, violent colic with bilious vomiting. The return of the attack is irregular,

Lead poisoning very frequent in French navy,

after a time motion and sensation are seriously affected, and if it proves fatal, it is always after a succession of epileptic seizures.

The paralysis, which ensues, affects the extensor muscles of the forearm and renders it a serious affection. The constipation and violent cramps are the most constant symptoms, for which reason the name of dry colic has been generally adopted in France, often in mild cases. They are the only manifestations of the poison. It would be useless to enumerate the different theories which have seen the light during the last century. It gave birth to many works, and has been the particular study of French naval surgeons for the past 30 years.

At present, it will suffice to say that all are agreed on one point, that this affection is exactly similar to the colic of Poitou, of Normandy, Madrid, Devonshire, Surinam, Cayenne, and vegetable colic, and on the other hand differs in nowise from lead or painter's colic, or the affection which attacks persons engaged in glazing porcelain. On the origin of the disease there are two theories, one which attributes the train of symptoms solely to the absorption or preparation of lead, influenced by the state of health of the individual or other general circumstances, the other theory without absolutely denying the possibility of impregnation of the system by lead, points out that a train of nervous symptoms, similar to those induced by

Increased since the introduction of steam.

lead poisoning often manifests itself in ship's cruising within the tropics.

This nervous disease has received various names : Neuralgia of the sympathetic (SEGOND), Rheumatic Gastro-Enteriè, Neuralgia (LANGEVIN), Endemic Nervous Colic of hot countries, (FOUSSAGRIVES), Stoker's Colic, and according to the advocates of the second theory arises from divers causes, the relative value of which has not been sufficiently determined.

There is no divergence of opinion as to the fact that cases of this disease have increased very much since the introduction of steam, owing to the use of different preparations of lead, minimum, litharge, and white lead in the machinery. The first duty of the surgeon ought to have been to weigh fairly and appreciate at their just value any fresh elements of disease without troubling himself with theories ; he ought to have directed his attention to the study of the circumstances favouring the absorption and of the measures necessary to ward off the ill effects. Unfortunately the history of this disease was only yet in its infancy. M. TANQUEREL DES PLANCHES had not yet written, and confusion arose from the train of morbid phenomena being designated under widely different names.

If, indeed, all agreed on the description of the symptoms, the conviction that a similar group of symptoms existed quite independently of metallic poisoning had its effect on the course of investiga-

Supposed to have a climatic origin.

tion, rendering conclusions doubtful or fruitless : and from this fact arose a most regrettable delay in the adoption of preventive measures.

According to a report issued by the health officers of Senegal and Cayenne, all the stokers and engineers of the steam ships which first came to these Colonies suffered from the most violent colic, many died of it, some remained paralysed and required to be invalided.

Swayed by traditions of the olden time the doctors attributed the diseases to climatic influences, more especially to those sudden changes of temperature to which the engine-room staff is exposed. M. FEGOND, the chief surgeon of French Guiana, made a careful study of the disease, which he believed to be of recent origin. He helped to disseminate the notion that it was produced independently of the absorption of lead.

His pamphlet, entitled "Essay on the Neuralgia of the Great Sympathetic," was printed at the Royal Printing Office, in 1837, by order of the Minister of Marine, and issued to the surgeon of each ship, as a guide to the treatment of a disease which increased in proportion to the number of steamers. Convinced that no source of lead poisoning existed at Guiana and other places where the disease was most frequently met with, he endeavoured to lay down the essential difference which existed between this neurosis and lead colic. Following in the footsteps of MERAT, he believed

Very frequent on tropical stations.

he found in the sporadic character of the disease the proof that neuralgia of the sympathetic, like most other epidemics, had its origin in the atmosphere. His successors adopted this theory when they saw the disease spread to sailing ships, although more of the special causes, such as are to be found in steam ships, existed.

From 1850 to 1854, the disease spread: most ships on tropical stations suffered, it favoured steamers, although many sailing ships were not exempt, and on shore, many of the outlying stations in the Senegal presented cases.

Attracted by the fact of its frequent appearance amongst the ships of the West Coast of Africa squadron, two surgeons who were at the head of the sanitary department of that station, made an attentive study of the phenomena. Dr. RAOUL, well known through the naval service for his great experience in the diseases of hot climates, was a partizan of SEGOND'S ideas as to the climate origin of Dry Colic. When he was appointed some time afterwards Professor of the Medical School of Brest, he changed his opinion and attributed all the symptoms to one source—introduction of lead into the system, the abdominal pains marking the onset of the disease.

His successor in the sanitary department of the West Coast of Africa, Dr. FOUSSAGRIVES on his return from a tour of service in the steam frigate *Eldirado*, published in a medical journal an

Some looked upon it as an affection of the nerves.

excellent article on the history of the nervous Endemic Colic of hot countries. In this monograph, which was a model of clinical observation, the writer expressed his profound conviction in the climatic origin of the disease. When he was called upon to fill the chair, vacant by the premature death of Dr. RAOUL, he there sustained his opinions with so much talent, and argued so ably with his opponents in the medical journals, and in the "Medical Faculty of Paris," that his ideas were adopted by the greater number of naval surgeons. Opinions were thus divided, when Dr. LEFEVRE was appointed Director of the Board of Health and of the Medical School of Brest. About that time, 1854, the arrival of the hospital transports and the return of ships from tropical service, filled the naval hospital at that port with convalescents from diseases contracted in hot climates, and amongst them this affection—dry colic, was frequently met with, whether in the acute stage, localized in the abdominal cavity or in the more chronic form, pains in the joints, paralysis of the extremities, precipient amaurosis and varying degrees of cachexia.

M. LEFEVRE, struck by the resemblance existing between this tropical, endemic malady, the nature of which had been so much discussed and the group of symptoms characteristic of lead poisoning, directed his attention to the state of his patients gums.

Lead used in many ways on board.

The slate-coloured line of Burton, the pathognomonic symptom of impregnation of the system by lead, was found in all the patients. Confirmed by this in his opinion, in order to prove that dry and lead colic were one and the same affection in their nature and origin, M. LEFEVRE took advantage of his position as Chief Officer of Health which gave him the right to visit the different workshops of the Dockyard, and sought out with wonderful patience and sagacity all the sources from whence lead poisoning could arise on board ship.

It was beyond a doubt that the different salts of lead used in the preparation of paints, in the protection of wood and iron, and in the joints of the boiler-tubes, were capable of affecting the health of the persons engaged in preparing and applying the paints.

Following up the thread of his investigations, he made special enquiries into the nature of the different articles used in ship-building, and in the machinery he made a careful study of the victualing according to the class of ship and presumed length of the voyage.

He also took into account the different ways of preparing the lead mastics, whether it was necessary to grind them, and in what form they were applied. He visited the workshops where the fresh-water tanks were manufactured ; he inspected the iron-tanks, the wooden tubs and the drinking tanks in which the water for the ships'

Distilled water absorbs lead freely.

companies daily use is kept ; he found the tubes through which the water is sucked up from these reservoirs was made of tin roughly soldered together, and when in contact with the acidulated beverage used in hot climates, capable of yielding a considerable quantity of the soluble salts of lead. The condensing apparatus of M. PEYRE and ROCHER of Nantes was introduced into the navy in 1840, and about the same time there was a great increase in the number of cases of dry colic ; he examined it and found the tubes were leaden, and although brass tubes coated with tin were substituted, yet in a great number of vessels the discharge pipe continued to be made of lead, capable of being rapidly acted upon by the distilled water, which takes up in its passage a varying quantity of the metal. From this fact, he was able to give a satisfactory reason for the apparently capricious occurrence of cases of dry colic on board French men-of-war, whilst ships of other nations enjoyed a perfect immunity, simply because they were not fitted with the same kind of condensers.

One class of men, subject to the same climate influences and presenting otherwise the same kind of affections could not have enjoyed perfect immunity from this one disease, if the latter had not been subjected to the action of special causes.

In the course of his enquiry, M. LEFEVRE found that the tin vessels used in naval hospitals and ships contained sometimes as much as 50 per cent.

Wine in tin vessels dissolves the lead.

of lead, and the proportion was always higher than 18 per cent., the amount of alloy prescribed by the regulations. We can easily understand how wine and other acid fluids kept for a time in vessels of this kind became impregnated with a considerable quantity of lead. From this source arose the manifestations of lead poisoning which frequently developed themselves in the attendants on the sick, stewards, cooks, etc.

The preserved meat tins in extensive use in the navy and the colonies contained a considerable quantity of lead used in coating the inside. These tins when empty are frequently used by our sailors, and more especially by the cooks and the convicts in Guiana to replace a missing utensil. Here we find the explanation of many accidents, the origin of which was not understood at the time.

At last, after a careful study carried out during many years with a rare patience, the able Director held in his hand the proof that a mistake had been made in stating that nothing could be found in a French ship to explain the possibility or even the probability of lead poisoning. He informed the Minister of Marine of the result of his investigations, and submitted to him the measures he considered necessary to guard against the spread of this dreadful disease. The Inspector-General of the Naval Board of Health, Mr. TUOY, adopted the conclusions of M. LEFEVRE.

At no time had the Minister of Marine been

The use of lead proscribed on board ship.

called upon to decide so important a hygienic question. In a circular of October, 1858, he issued the following regulations :—

1st. All pipes used in ships of war to convey fresh water are to be made of iron, except when the curves are so sharp as to positively require the employment of lead.

2nd. The custom of coating the inside of water-tanks as done in certain dockyards is strictly forbidden.

3rd. The police regulations of February, 1853, regarding the tinning of cooking utensils, will be strictly enforced in the navy.

4th. The suction pipes in the main-deck tanks are to be manufactured of wood, and readily removable.

The Minister at the close of his despatch thanked M. LEFEVRE very warmly for his painstaking research on so important a question of naval hygiene.

As might have been expected cases of lead poisoning diminished : nevertheless, to satisfy the sincere and earnest convictions of those who denied all idea of lead poison, he published the different researches which led him to form a contrary opinion.

He published in June, 1859, the result of his investigations. It was entitled,—“*Researches on the origin of dry colic, as seen in the French Navy, more especially in the tropics and on the prophylactic measures to be adopted.*”

In publishing this work, the author rendered a

Charcoal filters retain particles of lead.

great service to the French navy, but he was not yet satisfied.

In the beginning of 1860, he pointed out the benefits to be derived from handing over to a special body the duty of superintending the fabrication of cooking utensils and condensers, and ascertaining the purity of the water. This proposition was approved, and a special commission was ordered to inspect and report on the fitting-out and paying-off of each ship.

Two new circulars were issued, the first prescribed the amount of alloy to be used in the fabrication of cooking utensils and the steps to be taken to ascertain this fact on the first issue or any subsequent inspection, the second indicated the nature of the lining coat in the tubes of condensers.

By fine tin, 3 per cent. of lead was meant, it was not required to be chemically pure, always pre-occupied with the tendency of distilled water to absorb lead and so affect the general system. He proposed a charcoal filter which would retain any particles of brass or lead; it was made from designs of Mr. ORTOLAN, Chief Engineer and Professor at the Naval School. Encouraged by the satisfactory result obtained in the laboratory of the school, a circular of July, 1861, authorized its issue to a frigate, ordered to cruise on the West Coast of Africa, and on her return home the surgeon made a most favourable report.

During a sojourn of more than two years on a

Diminution of cases of lead poisoning.

station which was formerly the chosen abode of dry colic, the ship's company remained perfectly free from it. A new circular ordered it to be issued to all ships fitted with condensers. A committee of officers in each ship are ordered to report thereupon, and on their reports depends the general issue of this filter.

A circular of June, 1863, brought under the notice of the different chambers of commerce and ship-owners the necessity of carefully looking after the manufacture and working of the distillery apparatus.

In this despatch the Minister thinks it is sufficient to indicate the possibility of such a serious accident as lead-poisoning to make owners and captains take all necessary precautions to ensure a supply of good condensed water.

That small portion of a ship's company—the staff of the engine-room, who by the nature of their work are more particularly exposed to the action of lead, derived great benefit from the use of the mastic, Serbat or Le Renard, instead of red lead which was formerly in general use, and the application of a layer of dried oil and iron silicate over the paint work.

The mastic, Serbat, contains about 50 per cent. of sulphate of lead—a harmless preparation; the mastic Renard contains gutta-percha: unfortunately however, as they are patented, they cannot be made in the dockyards, which prevents them from

Stokers more subject.

coming into general use. An enormous quantity of lead in some form or other is used about the machinery. A circular of 1858 directs the application of a coating of red lead to all parts of the boilers that can be reached, and many parts of the engines are coated with the same. The boilers rest on a flooring well coated with a putty of red and white lead. The intense heat generated in the boilers causes a great heat to evaporate. "We can easily understand," says M. LEFEVRE, in the work already quoted, "to what imminent chance of lead poisoning, persons working in the engine-room are exposed, and in fact they suffered so much from it that many surgeons called it Stokers' Colic." Thanks to all these precautions, we are able to register a constant annual decrease in cases of this dreadful disease, the honour of which is due to the patient researches of M. LEFEVRE.

This fact is fully established by the reports coming into office from the different stations. A brief resumé of one will be quite sufficient for our purpose.

The squadron engaged in the operations in China and Annam was composed of two divisions, one which left France before the hygienic measures enumerated above were adopted, and the other fitted out with the latest appliances.

During the War in China, there was not a single case of Lead Colic in the second division, whereas the first presented many cases of relapse: they

English ships quite free from this complaint.

partook of the epidemic character, which is always observed in this disease.

Later on in 1863, DR. D'OMANY presented the following report to the Governor of Cochin China, "sailing ships enjoy an almost perfect immunity from Lead Colic, with the exception of the attendants on the sick, who persist in keeping their wine in tin vessels—this is due to improvements introduced by M. LEFEVRE. Some of the steamers cruising in Chinese waters are not quite free from cases ; this fact is all the more noticeable, that the steamers of the English Navy engaged on the same operations, were quite free, although they make use of red and white lead in the engine-room, but there are some points deserving of attention. :—

1st.—In English men-of-war, sailing ships or steamers, not a single tin vessel is allowed on board, all are of bronze or brass.

2nd.—No wine is allowed, the men always drink grog.

3rd.—Paints are never ground on board English ships, and all putties are prepared as much as possible on shore.

The fact that English ships cruising in the same waters as ours are quite exempt from cases of lead poisoning, proves the absence of all endemic character in the disease.

Since the prophylactic measures have had time to operate, reports come in from all quarters of the globe, recording the gradual decrease. French

A debt of gratitude is due to Lefevre.

surgeons serving on board ship, or on shore on the West Coast of Africa, at the Senegal and the Gaboons, where the disease was formerly so prevalent.

For example, on board the hospital ship *La Caravane*, at Gaboon, dry colic was not seen once during the year 1863, and the first quarter of 1864, and on a total of 576 sick under treatment, there were only three cases of this disease.

The whole navy owes a debt of gratitude to M. LEFEVRE who has given a splendid example of patience and perseverance in the interests of science) to the body to which he belongs, and which he has honoured by his labours. Whatever opinion is adopted in the nature of a similar affection but of a purely miasmatic and climatic nature, we can never forget what we owe to one man.

Also, we must not forget the influence which M. FOUSSAGRIVES' treatise has had on the progress of Naval Hygiene.

Many recent improvements are the realisation of his wishes. Many defects which he pointed out have not yet been remedied, and many others, due to changes in ship building, have arisen since he published his work. This treatise issued to all commanding officers and surgeons turned the attention to hygienic matters as manifested in the theses and reports from health officers, and no doubt it has powerfully contributed to the establishment of chairs of hygiene in all the naval

An efficient system of ventilation wanting.

medical schools, and a course on the same subject in the cadets' training ships. The translation of this work by the maritime powers of Europe is a proof of its excellence and redounds to the honour of the author.

Much has been accomplished, but much still remains to be done. Ventilation is the backbone of naval hygiene, and the health of the crew, as well as the safety of the sea-board, calls for an efficient system. When we look back on the naval hygiene of the last century and compare it with that of to-day we understand the progress we have made, and at the time when the type of fighting ship is still under discussion, sanitary science loudly calls for an innovation desired by all who have an interest in the navy.

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