THE USE OF OIL TO STILL THE WAVES.

DURING the past six years the attention of mariners has been called to the value of oil for stilling waves by the publicity given to the experiments made by Mr. John Shields in Great Britain and by the published reports in the monthly "Pilot Charts" issued by Commander J. R. Bartlett, United States Navy, Chief of the United States Hydrographic Office, Navy Department.

Lack of faith in its efficiency has been the chief obstacle to its universal adoption. Many accounts of the use of oil, together with descriptions of appliances for facilitating its distribution on the stormy seas, have been published in different countries, and every effort to disseminate information will deserve the lasting gratitude of all mariners. Ocular demonstration seems to be necessary to convince unbelievers that the simple use of oil to lessen the dangerous effect of heavy seas is always advantageous, and often absolutely necessary for those in peril on the sea.

I purpose to consider the subject under two general heads, viz., "What is known of the use of oil to still the waves" and "What remains to be ascertained and done to make the use of oil universal."

In the first place this use of oil is clearly susceptible of scientific proof, and a brief notice of the nature of waves will assist in making it evident.

Lieutenant A. B. Wyckoff, United States Navy, in a paper before the Franklin Institute states:

> Dr. Benjamin Franklin made many experiments and left his views on record regarding the great utility of oil for this purpose, and gave a scientific explanation of the manner in which the oil acted. The molecules of water move with freedom and the friction of air in motion produces undulations. These increase in size proportionately to the depth of water, the distance they can proceed to leeward, the strength of the wind and the time it acts. The limit of height is about forty feet. A heavy swell is often the precursor of a storm. It may be perfectly calm when this swell reaches a vessel; it is simply a long, high undulation, started by the storm and traversing the ocean in advance of it. Off the coast of California tremendous swells are experienced, made by westerly winds across the immense stretch of the Pacific Ocean. These swells are as high as most storm waves, but can be safely ridden in an open boat. If a sudden gale spring up, like the "northers" in the Gulf of Mexico, these harmless swells become raging seas.

The friction of the wind, rapidly moving upon the exposed slope of the swell, produces little irregularities on the surface. These wavelets are then driven up the rear slope of the swell to its summit, while the forward slope has more and more protection from the wind and becomes steeper and steeper by its inertia. A sand dune within the trade-wind regions is a storm wave in permanent form — a long windward slope and an abrupt leeward face.

As the wind continues to blow, the crest of the storm wave constantly sharpens, and finally the crest is thrown over down in front with a force proportionate to its height and speed. When this storm wave meets a ship, she cannot rise up its abrupt front, but checks the progress of the base of the wave, the crest of which is thrown up and falls on the ship with tremendous violence, filling her deck and sweeping away men, boats, and everything movable. The storm wave is perhaps no higher than the heavy swell and chiefly differs in shape.

Oil changes the storm wave into the heavy swell. Its specific gravity causes it to float on the surface; it spreads rapidly and forms a film like an extremely thin rubber blanket over the water. Its viscosity and lubricant nature are such that the friction of the wind is insufficient to tear the film and send individual wavelets to the crest, and while the force of the wind may increase the speed of the wave in mass, it is as a heavy swell and not in shape of a storm wave. The effect is purely a mechanical change in the shape of the wave, and there is no evidence of any chemical action by the oil on the water.

This explanation is generally accepted as the true theory and needs no argument to support it.

WHAT IS KNOWN OF THE USE OF OIL TO STILL THE WAVES.

THE use of oil in calming troubled waters was evidently known to the ancients, as Aristotle, Plutarch, and Pliny refer to it. The divers in the Mediterranean still use it as described by Pliny — "taking oil in their mouths and ejecting a little at a time to quiet the surface and permit rays of light to reach them." Fishermen who spear fish pour oil on the water to calm it and enable them clearly to see the fish. Scotch and Norwegian fishermen have known this use of oil for centuries, and in crossing a bar or in landing through surf they press the livers of the fish until the oil exudes and then throw them ahead of their boats. Lisbon fishermen carry oil to use in crossing the bar of the Tagus in rough weather.

Whalers have used oil and blubber in severe storms for the last two centuries; they usually hang large pieces of blubber on each quarter when running before a heavy sea, to prevent

water coming on board. Besides these, recent experience has given definite knowledge concerning the quantity and kind of oil, methods of distribution, and circumstances when most efficacious.

The captains of vessels have been induced to report their experience with the use of oil to the United States Hydrographic Office, and out of 225 of these reports the kind of oil used is mentioned in 155 cases, viz.: Linseed oil, 48; fish oil, 31; lard oil, 12; pine oil, 10; crude petroleum, 9; colza oil, 8; sperm oil, 6; varnish, 5; linseed oil with petroleum, 5; paraffine, 3; fish oil with petroleum, 3; neat's-foot oil, 2; olive oil, 2; cocoanut oil, 1; tea oil, 1; and refined petroleum, 9.

In all these cases the oil proved to be efficient except the refined petroleum, which is reported to have been efficacious twice but of no benefit whatever in seven other cases. The thick and heavy oils are the best, and mineral oils are not so efficient. In cold weather, when soft oils are liable to thicken, it is advisable to mix with mineral oils.

The quantity of oil necessary is about two quarts per hour, according to the reports received. Vice-Admiral Cloué of the French navy states that the amount of oil used is mentioned in 30 reports out of 200 which he has examined: 17 vessels expended 1.61 quarts per hour when running before the storm, 11 used 2.37 quarts when lying to, and 2 life-boats used 2.42 quarts per hour. This is an average of two quarts of oil per hour.

The thickness of this film of oil may be readily calculated. A vessel running before the wind at 10 knots' speed has used two quarts of oil per hour, and the oil covered a surface 30 feet wide and 10 sea miles long. The volume of two quarts of oil is about 122 cubic inches, which, divided by the number of square inches to be oiled,— 10 miles long and 30 feet wide, or 25,920,000 square inches,—gives .0000047 of an inch as the thickness of the film of oil. This figure is inconceivable, but represents the actual dimension of the blanket of oil on the sea.

The manner in which oil has been successfully used to still the waves varies. Canvas bags filled with oakum saturated with oil and having small holes punctured with sail-needles were used on 101 occasions, when these bags were simply towed by the vessels. In twenty-five cases the oil was allowed to drip from water-closet pipes, the bowls of which were filled with oakum. In three vessels the oil was simply poured down through the deck scuppers. In three vessels it was dropped overboard slowly, while running before the wind. Cans of paint oil, uncorked and inverted, were used on two occasions, and on five attempts to land in boats through surf, uncorked bottles full of oil were thrown into the breakers with some benefit. The reports of the successful use of oil are much more numerous, but these enumerated are the only ones published which distinctly describe the means used to apply the oil.

The captain of the steamer *Wandrahm* reports that on a voyage from New York to Antwerp, 18th to 22d January, 1885, between 45° N. 53° W. and 47° N. 30° W., he encountered a gale veering from S. E. to S. and W., which culminated in a hurricane from N. W. for fourteen hours. During the last thirty-six hours a frightful sea was raised, which began to break over the stern, although the vessel was making eleven knots before the wind. At intervals of four hours it was observed that the water aft became remarkably smooth as if covered by some oily substance. On looking over the side some oily water was seen discharged by the bilge-pumps, which were working in the hold, where five hundred barrels of lubricating oil were stowed. There was then no doubt that this cargo was slightly leaking. The effect on the breaking seas was wonderful, and this accidental demonstration convinced all of the efficacy of oil to still the waves. The bilge-pumps were kept at work, and the frightful sea became a harmless swell where the oil was applied.

In about five hundred reports examined oil has been applied by dripping from bags, cans, pipes, and chutes in all parts of the ship, but in the majority of cases the best results were obtained by having the oil-distributer forward.

Among the recent reports to the Hydrographic Office oil has been successfully used to still the waves by 82 steamers, 21 ships, 28 barks, 6 barkentines, 11 brigs, and 20 schooners; and while all of these used it with great benefit, the captains of 28 state that without the use of the oil their vessels would have been lost.

There are many authentic reports of the use of oil by boats to facilitate the rescue of the passengers and crews of wrecks, in some of which it would have been impossible for the boats to get near the wreck without the use of oil.

Captain Amlot of the steamer *Barrowmore* reports that on the 24th January, 1885, in 51° N. and 21° W., he went to rescue the crew of the sinking ship *Kirkwood*. The sea was very heavy, but around the wreck it was quite smooth. He then saw that the crew of the *Kirkwood* had broken out the cargo of canned salmon and were pouring the oil on the sea from the cans. The oiled sea enabled his boat to go to the wreck and take off the crew of twenty-six men.

The captain of the ship *Martha Cobb*, loaded with petroleum, fell in with a sinking vessel during a heavy gale in the North Atlantic in December, 1886. The signal made stated the

vessel was sinking and that all her boats had been stove. The *Martha Cobb* had lost her large boats, her bulwarks washed out, and decks swept in the same storm; the only boat left was a small sixteen-foot dingey, which could not possibly live in the sea that was then running. The captain says he was puzzled and lay by for some hours hoping that the gale would moderate; but as there was no appearance of better weather and night coming on, he decided to make an attempt to rescue the crew of the sinking vessel. The *Martha Cobb* had a cargo of petroleum, some of which leaked, and the captain had noticed that the sea in the wake of the ship was much smoother when the pumps were worked.

He signaled to the other vessel to haul by the wind while he luffed to get to windward, and at the same time started the pumps; but the ship drifted faster than the oil, and while the oil made the sea comparatively smooth to windward, it did not cover the sea to leeward. He then ran down across the other vessel's stern, hauled up close under her lee, and started the pumps again; at the same time also he emptied a five-gallon can of fish oil down the scuppers. The effect was magical. In twenty minutes the sea between and around the vessels was broken down. The long heavy swell remained, but the combers and breaking seas were all gone. The little dingey with three men had no difficulty in pulling to windward, and the crew were saved. The boat was deeply loaded and did not ship any water, although the sea was breaking fiercely outside of the "charmed" space in which the vessels lay on oiled seas.

In June, 1885, the British ship *Slivemore* took fire and had to be abandoned when eight hundred miles north-east of the Seychelle Islands, Indian Ocean. The people took to the boats and made for Seychelle Islands. The third day after leaving the vessel a cyclone came up, and no one believed that the boats would live through it. Before they left the ship the boats had been supplied with oil for just such an emergency. Each boat got out a drag made of spars and oars lashed together, for what is known as a sea-anchor. Oakum saturated with paraffine was stuffed in long stockings hung over the bows of the boats. Before the oil was used the boats had been several times nearly filled with water and the occupants had to bail for their lives; but when oil was applied no further trouble was experienced. An oil-slick formed around the boats, which rode in perfect safety on tremendous swells which took the place of the previously breaking seas. Little if any water came over the sides of the boats, and the occupants could lie down and sleep. The boats eventually reached the islands, but every soul would have perished except for the forethought of Captain Conby, the captain of the *Slivemore*.

Mr. John Shields of England has demonstrated the value of the application of oil to quiet the waves at harbor entrances, by a long series of careful experiments at his own expense. Indeed he, more than any one else, is entitled to the credit of bringing into prominence this most valuable aid to navigation.

Many years ago Mr. Shields had noticed the effect of a few drops of oil spilled on a pond, after which he experimented on a brook in the bottom of which he laid pipes containing oil, in order to study the effect when calm and when troubled. He then experimented at Peterhead, and by simply throwing uncorked bottles of oil overboard from a tug he produced an oily swell at the harbor entrance, where the seas had been rolling in with tremendous violence, making it impossible for vessels to enter. This success encouraged him to devise a permanent apparatus to oil the seas at the dangerous parts of the harbor entrance. A model of his apparatus was exhibited at the great International Fisheries Exhibition, London, 1883, for which he received a medal. This apparatus consists of pipes with valves laid on the bottom and connected with a shore station containing oil-tanks and force-pump. The apparatus used at Aberdeen consists of a lead pipe 460 feet long laid on the bottom across the harbor mouth just inside of the bar. At one end, and at intervals of seventy feet, there are conical brass valves resting on flat iron sole-plates to be retained in vertical position twelve inches above the pipe, in order to prevent the mud from choking the valves. The other end of the pipe connects with an iron pipe leading from the station on shore where the tanks and pumps are placed.

The London Board of Trade had this apparatus tested during one of the most violent storms experienced in that stormy vicinity on December 3, 4, and 5, 1882. At 10 A. M., December 4, the sea both inside and outside of the harbor was a seething mass of broken water, and the waves made a clear break over the southern breakwater. The lighthouse at the end of this breakwater is eighty feet high, and it was almost covered by the spray.

The pumps were started, and after a few strokes smooth spots were seen, which soon formed a large mass of oiled surface, with smooth swell, while all around the sea broke furiously. The pumps were worked for three hours, and they expended 175 gallons of oil of different kinds: 70 gallons of seal oil, 40 of mineral oil, and 65 of colza.

The tide carried the oiled mass around the breakwater and out to sea, so that the mid-channel was smooth only when the pumps

were working. The next day the wind changed and blew into the harbor; this gave a more favorable set to the currents and better effect by having the oiled surface coincident with the course of the ship-channel. The official report to the London Board of Trade by its agent highly indorsed all that Mr. Shields claimed for his apparatus.

At Peterhead in January, 1883, the pipe was twelve hundred feet long across the harbor entrance, and there was some trouble in keeping the pipe anchored on the bottom. During a violent gale when the signal was made, "Too dangerous to enter," the oil was started, and its effect was wonderful: an oiled lane with smooth rollers stretched along the surface and permitted a tug with a vessel in tow to enter, and several vessels went out, which they would not have been able to do without the use of oil.

At Folkestone, England, Mr. Shields's apparatus consisted of three casks of oil with hand-pumps, connected with two lead pipes 1¼ inches in diameter extending along the bottom to a distance of 2950 feet; vertical sections of pipe fitted with valves and mud-caps were soldered at intervals of 100 feet along the main pipes. During a heavy gale the oil was forced by the pumps, each worked by one man, and in a very short time a broad glossy strip of water formed in the channel in which the life-boat, though tossed by the rollers, which no longer broke, rode in safety without taking in a drop of water. Outside of this strip the seas broke heavily. One hundred and nineteen gallons of oil were used in this experiment, most of which remained in the pipe for future use, and only a few gallons served to oil the sea.

Mr. Gordon, an associate of Mr. Shields, has invented a shell, filled with oil, to be fired from a mortar and arranged by a fuse to explode on striking the water and free its contents to oil the sea. This was also successfully used at Folkestone.

The British Government refused to conduct a series of experiments to test the inventions of Messrs. Shields and Gordon. In the House of Lords, Lord Sudeley observed that a great quantity of oil would have to be used, considerable expense incurred in laying pipes outside the proposed harbor of refuge and keeping them in repair, and that the various currents might often carry away the oil film before it could be utilized.

There are a number of reports from harbor masters and ship captains who have advantageously used oil to permit safe landing by boats through the surf on the beach, but the effect of the oil is not so decided as when used in deep water.

In order to illustrate the circumstances under which oil has been used advantageously, a few reports of captains of vessels will be of interest.

Oil Used by Steamers Running Before Gales.

CAPTAIN HENDERSON of the steamer *Napier*, from Baltimore to Cork, encountered a hurricane 26th January, 1885, in 37° N. 50° W. The wind was from the north-west, with a tremendous sea. One sea, larger than the others, pooped the ship, carried away companion, etc., and flooded the deck fore and aft. He intended to "heave the ship to" (lie head to the wind), but happening to think of the effect of oil, he took two canvas bags, punched holes in them with sail-needles, and put two gallons of oil in each. He then towed the bags in the water by lanyards from the fore-rigging. In this position they were swept on board by the sea. He then hung the bags twelve feet on each side of the stem just awash, in which position they served admirably. The oil kept the sea smooth to a width of twenty feet on each side, while it spread out like a fan astern. Huge breaking seas approached from astern to within sixty or seventy feet of the vessel, when, meeting the oil, they subsided, and the vessel felt only a heavy swell. He ran this way for three days and nights and not a drop of water came on board. He used lamp oil, and when that supply ran short used paint oil with equally good effect. He expended about three quarts an hour.

He left Baltimore in company with seven other steamers, two of which foundered and the others were three or more days longer in arriving, as they "hove to," while the oil allowed him to run in safety. He says that he believes the use of the oil saved his vessel from foundering, for in such a tremendous sea it is a question whether in bringing her up by the wind, or subsequently, had he succeeded, she would not have been boarded by the sea and sunk.

Captain E. E. Thomas of the steamer *Chillingham* reports that in March, 1883, when going from Philadelphia to Queenstown, he encountered a heavy gale from the south-west. For forty-eight hours he ran before the gale, shipped very heavy seas, and had the decks continually full of water fore and aft. He filled two bags with oil and hung them from the rings of the anchors on each side. The effect was noticed in a few moments: no seas broke in the wake of the ship, while outside of her wake they were breaking in every direction. Before the oil was used none of the crew dared go aft to heave the log, for fear of being washed overboard. After using the oil no heavy seas were shipped. He put about a quart of colza oil in each bag every four hours.

Mr. Kenneth Doyle, master of the Furness Line steamer *Stockholm City*, reports:

On 28th November, 1885, I left Boston for London, deep with general cargo, and cattle and sheep on the upper deck. At 8:30 P. M., December 4, we were caught in a heavy storm from W. N. W., barometer 29.20. The first hour of the storm no canvas could stand it. In latitude 44° 38′ N., and longitude 48° 28′ W., ship running under bare poles, the sea was then so high and dangerous I resolved to try the use of oil, having had it brought to my notice by information on the United States monthly pilot charts. I got two gunny-bags and a good wad of oakum wrung out in paint oil and hung over each quarter, just dipping in the water; also one over the scuppers in the midships. At 10 P. M. I got the lower topsail set, and continued to run until noon next day. By the racing of the engines my engineer reported to me that he could not run much longer, as the packing of the gland of the high-pressure engine was all worn out. I then got two more [bags] farther forward, with a hand in each water-closet forward, dropping oil through. By this means she kept steady on her course, engines stopped and sailing six knots, while the engineer did his work comfortably. I landed the whole of my cattle alive at Deptford, and never broke any of the cattle-pens.

As the immediate result of Captain Doyle's experience the British and Foreign Marine Insurance Company issued instructions for all "cattle-boats" from New York and other ports to carry oil and oil-bags for use in violent storms.

There are thirty-two similar reports of the use of oil by steamers running before the wind, and in every case the effect was highly beneficial, while many were undoubtedly saved from foundering by its use.

Oil Used by Steamers Hove To.

In violent storms it often happens that steamers cannot make any headway against the wind and seas, and it becomes necessary to lie to and steam slowly, just sufficient to keep steerage-way. A high sea will cause a steamer to pitch deeply, and while her stern is out of water the propeller will race violently, and if continued break down the strongest engines. The breaking seas come on board with tremendous violence unless the speed is reduced to allow the ship to ride gently up over the seas she encounters, and storm-sails are used to assist with this object.

The following reports show the advantage of using oil in this case:

Captain Tregarthen, steamer *Marmanheuse*, reports that off Hatteras on 2d March, 1886, he encountered a hurricane from north-west. A tremendous sea was running and seas came on board and did great damage. The vessel was lying to but very unsteady, and would not steer though steaming slowly. He could not keep her head to the sea. He then had the bowls of the water-closets filled with oakum, over which paint oil was poured to drip through. He also filled a bag with oakum saturated with oil and towed it by a line from the weather cat-head, so that the bag drifted ten to twenty feet to windward of the ship. The oil acted at once. The vessel rode easily, he had no more difficulty in keeping her head to the sea, and no water came on board, as the sea was without combers for thirty yards to windward of the ship when the oil had spread. He could have lowered a boat with safety. He says:

I feel no hesitancy in stating that with proper use of oil I will be willing to encounter the hardest gale that ever blew, and intend on the first occasion to stop the engines, place several bags to windward, and let the vessel drift, feeling sure that she will be as safe and comfortable as possible.

Captain McKnight of the Atlas Company's steamer *Claribel* reports using oil when hove to in a gale in the Gulf Stream, 29th April, 1886. The ship had been laboring much during the night when hove to, and large quantities of water came on board. He poured three and a half gallons of mineral sperm oil (the only kind he had) into a bag stuffed with oakum, which he stabbed in eight places with a small pen-knife, and then threw it overboard with a line attached. The effect was magical; in a minute a film of oil appeared to spread out, and as the steamer forged ahead the belt of oil extended along the weather side in the waist, where much water had been coming on board. Very little water was shipped after the oil was used; but if he had had fish oil the effect would have been better, though the mineral oil was beneficial.

Captain Bakkar of the steamer *W. A. Scholten* (since lost in collision) reports:

March 6, 1887, had a very heavy gale from N. N. E. to N. N. W. blowing in squalls of hurricane force. Could not keep the vessel to the wind: a tremendous sea running caused the steamer to fall off and bring the sea abeam. Having lost sails, etc., was compelled to heave to. At midnight, while lying to, shipped a very large sea which carried away starboard life-boat and nearly washed the officers and helmsman off the bridge. Stationed hands at the forward and after water-closets, filled the bowls with oakum, and poured on oil. Had the engineer to use oil copiously, which oil was pumped overboard from the bilges. Was hove to for 20 hours and used linseed oil continuously for 22 hours, expending in all about 22 gallons. No seas broke on board after commencing to use oil.

There are twenty-two similar reports, and the efficacy of the use of oil when lying to has been thoroughly demonstrated.

Oil Used when Steaming Head to Sea.

THE majority of those who have used oil claim that it can be of no use in this case, because if applied the steamer will steam ahead out of the oiled surface and derive no benefit from its use. In over four hundred reports I can only find two which claim success, while there are many which report failure.

Mr. T. A. Creagan, master mariner, of Glasgow, wrote on 1st March, 1882, as follows:

Some months ago I encountered a very heavy gale when crossing the Bay of Biscay, during which several steamers were lost. My ship was steaming head to sea, and making very little progress; and the sea, which was from the south-west, was breaking on board abaft the bridge, occasionally with great violence. I had two canvas bags made of conical shape, having the pointed ends punctured with small holes. A quart of common lamp oil was put in each bag, the mouths of which were then tightly tied up to prevent the oil escaping. The bags were then hung one over each bow with sufficient line to let them tow without jumping. After the oil commenced to flow through the punctured holes freely scarcely a sea came on board; each wave as it reached the oil ceased to curl, and, undulated, passed the ship without a break.

Captain McLean of the English steamer *Concordia* (date not given) reports:

On the passage from Glasgow to Halifax had very heavy weather from the westward, attended with very high, confused seas, which swept the decks and did considerable damage. Placed two oil-bags, filled with linseed oil, over the bows. The effect was very satisfactory; but as the ship was running into the sea, the bags were thrown back on deck, which greatly affected the result. Again, the linseed oil thickened rapidly (the weather was quite cold) and would not spread as rapidly as desired. But under these disadvantages the effect was very remarkable, as no sea of any consequence boarded the ship while the oil was being used. Had the ship been going slow, the oil would have had more effect; but she was running at a speed of ten knots.

Steamer Hove To and Riding to Patent Drag.

ON 10th October, 1886, Captain Krogsgard of the steamer *Lucy P. Miller* encountered the tropical cyclone in the Gulf of Mexico. The steamer must have been quite close to the center of the cyclone. The log states:

At 2 A. M. slowed to half speed and hauled up head to sea. At 4 A. M. stopped engines, hove to, and put out patent drag. Vessel dry and easy. The sea was one mass of foam and spray, and the vessel with the shifting of her cargo was thrown on her beam-ends. Immediately rigged out five corn-sacks (filled with oakum saturated with oil) from weather bow to amidships, the sacks having holes cut in them for the oil to drip through. This gave the greatest relief imaginable, the ship ceasing to take on seas and riding easier. At 10:30 A. M. concluded to run to south-east but found drag torn to pieces and rudder-head twisted off. Made and put out new drag (a lot of spars lashed together) and bored hole through stern to rudder-stock, through and to which secured two iron windlass brakes to serve as a tiller, and then lay to again.

The captain says his vessel would have foundered but for the oil.

There are several other reports in which oil was used by having a bag of oil attached to the drag, which necessarily caused the ship to have the full benefit of the oiled surface.

Oil Used by Steamers Entering Harbor.

THERE are a number of reports of the use of oil by steamers entering port, one of which will serve for all.

Captain Beecher of the steamer *East Anglian* arrived off the entrance to the Tyne when an easterly gale was at its worst, on the 11th of December, 1882. Great danger attended any vessel crossing the bar. He resolved to try the effect of oil, and stationed a man on each bow, each man having a two-gallon bottle of oil. The oil was slowly poured on the broken water, which became comparatively smooth, and the vessel passed into the harbor with little difficulty. Lard oil was used.

The use of oil by sailing vessels has been as successful as by steamers, and there are an equal number of authentic official reports of its use under different circumstances—running before the sea, lying to, and sailing with the wind abeam. The experience is similar to that of the steamers, and only one report, of its use when sailing with the wind abeam, need be quoted.

Captain Smith of the British bark *Wallace* reports:

21st September, 1886, while standing to the southward in the Gulf Stream had a gale from W. N. W., wind and sea abeam. Vessel making nine knots good. As the sea increased, the combers, striking the vessel on the weather side, would shoot high in the air, and then coming on board filled the decks with water. The captain had never tried the use of oil and did not believe in its efficacy, but wishing to take advantage of the favoring gale and at the same time not to endanger the vessel, he determined to try the experiment. A canvas bag filled with oil (in the proportion of one quart of paint oil to two quarts of paraffine) was placed in the bowl of the weather closet forward, through which the oil dripped from the pipe into the sea. By the time the oil reached the main channels, where most of the water had come on board, it had spread and formed an oil-slick thirty feet to windward. The result was as satisfactory as it was unexpected. The breaking combers on reaching the "slick" were reduced to harmless swells, over which the vessel rose without, as before, taking volumes of water on board. The gale continued for twenty-four hours,

during which by a continuous use of oil (expending three quarts every four hours) the *Wallace* was enabled to keep her course, and at no time was the speed reduced below eight knots. And though the sea continued high, the oil prevented the combers from breaking on board.

A number of regular lines of vessels have oil on board for this use. Mr. J. H. Barker, an oil merchant of New York, has a definite contract with the National Line of steamers to supply oil for this purpose. Ten vessels, including all the cattle-steamers, have been provided with the necessary appliances to use oil on occasion. The company's requisition calls for fish oil, but the recent experiments proved that it thickened too rapidly when in contact with water at the general low winter temperature.

To obviate this tendency Mr. Barker has mixed a mineral oil of low test with fish oil of comparatively high test. The mixture is an oil which coagulates at a much lower temperature than ordinary fish oil and is claimed to be equally efficient. Mineral oil has stood the test as a lubricant for railroads in cold weather, and when mixed with a proper proportion of fish oil will be very useful for sea purposes. During the mild and warm months fish oil only is used. The method adopted by this line is by means of punctured canvas bags filled with oakum.

FROM a careful examination of these reports the following facts must be conceded to have been established beyond dispute, and we therefore know:

1. That oil is efficacious in lessening the dangerous effect of heavy seas.
2. That it converts breaking seas into harmless swells.
3. That vegetable or animal oils are the best for this purpose.
4. That mineral oil is not suitable, especially if refined, though it may be used to advantage if no other is available.
5. That in cold weather it is advisable to mix mineral oil with soft animal or vegetable oils liable to thicken.
6. That the expenditure of two quarts of oil per hour has sufficed to prevent damage to ships and boats which without the oil would have probably foundered.
7. That the oil spreads rapidly in a thin film over the sea immediately after it is applied.
8. That a lavish expenditure of oil is not any more effective than the necessary quantity, which is about two quarts per hour for vessels and boats.
9. That the most effective manner of applying the oil is to facilitate its spreading to windward.
10. That the best results are obtained by applying the oil from the forward part of vessels.
11. That oil-bags and pipes dripping oil from oakum have been efficient.
12. That it is always advantageous for steamers and sailing vessels when running before the wind or lying to.
13. That it permits boats to be lowered in heavy seas which would otherwise swamp them.
14. That wrecks have been boarded and lives saved by using oil to still the waves to allow the transit of deeply laden open boats from wreck to rescuing vessel.
15. That permanent plants, like that devised by Mr. Shields, have proved to be efficient at harbor entrances wherein vessels have entered, when without the oil they could not have done so.
16. That at harbor entrances the currents are liable to carry away the film of oil from the exact channel intended to be covered, before it is utilized by vessels.
17. That the best results are obtained in deep water. Oil may be applied with advantage on the surf, but its effect is much less than in deep water.
18. That the best results are obtained by applying the oil at many different points of the surface to be quieted. This is done by dripping slowly from a moving vessel, or by permanent plants all along the channels of harbor entrances.

WHAT REMAINS TO BE ASCERTAINED AND DONE TO MAKE THE USE OF OIL UNIVERSAL.

THE kind and quantity of oil necessary to change breaking seas into comparatively harmless swells being known, there still remains much to be learned in regard to the circumstances when, where, and how to apply it most efficiently.

Since excessive use of oil does not give any advantage, economical oil-distributers should be used, even though the manner of using pipes and oil-bags, as described in the reports of captains of vessels, is efficient and not very wasteful.

The expense of any new appliance is the first question; and even when the efficacy of the use of oil was admitted, we see that the English House of Lords refused to go to the expense of conducting experiments with the view to adopting it for making harbors of refuge.

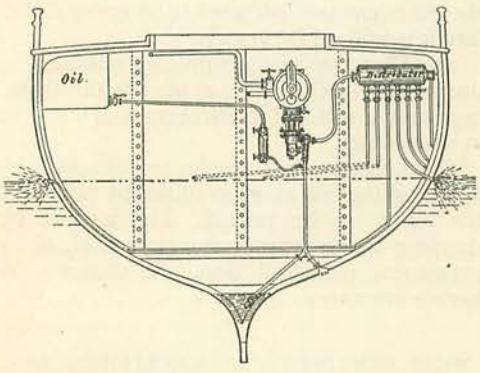
For a distributer on board ship it would be difficult to devise apparatus which would not be more expensive in first cost than the amount saved by the little excess of oil wasted by using oil-bags or the water-closet pipes, as described in the reports of captains.

The success obtained by the use of these improvised oil-distributers may, however, have a tendency to cause many to neglect preparatory measures, and in emergency it may be impracticable to use even such simple makeshifts, for want of oil, materials, or time to fit them for this purpose.

Special appliances must be supplied for this definite purpose; such outfits should come under the same head as axes, hose, and extinguishers supplied for use only in case of fire. Every vessel should have oil apparatus and oil for use only to still the waves.

A number of oil-distributers have been invented which claim to satisfy all the conditions of efficiency, economy, and special adaptation for stilling the dangerous seas.

The sketch illustrates a French system invented by M. Gaston Menier. This consists of



GASTON MENIER'S OIL-DISTRIBUTING APPARATUS.

a pump which sends a constant stream of water through a series of pipes, which discharge outboard at the water-line. The sketch shows six pipes, three to discharge at the water-line on each side.

These six pipes connect with a distributer which has a pipe to the pump, and a pipe leads from the pump to the bilge-well, or a water-tank in the bottom of the vessel, and has a branch to a tank of oil. This branch pipe has a valve and a glass gauge to regulate the expenditure of the oil.

When the pump works water is drawn up from the bilge-well or water-tank, and oil is also drawn from the oil-tank. The oil goes with the water to the distributer and outlets of the six pipes at the water-line. The water serves as a vehicle to convey the oil to be applied on the seas.

The oil-tanks, pipes, and distributer are the only items chargeable to the expense of this apparatus, as it is contemplated to use the bilge-pumps, and every ship must have a bilge-pump.

This apparatus fulfills all the conditions of an economical, efficient, and special plant for applying the oil at the exact place where and time when it is needed.

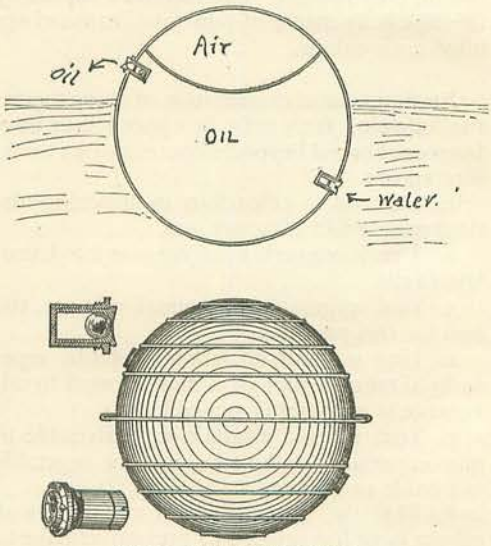
The economy in expenditure of oil will more than pay for the first cost, and as it is specially designed for applying oil, it will be always available for that purpose.

There is no account of its use or adoption in any vessel, and its efficiency lacks the demonstration of actual experience; but its simplicity commends it, and doubtless this system or some modification of it will come into extensive use.

Many of the reports of captains of vessels suggest permanent pipes for oil-distributers, and this plan will probably be received with favor for steamers and large vessels. It is evidently not suitable for small craft, open boats, etc.

A tank of oil in water-closets with pipe and drip-faucet to drop into the bowl and out of the pipe below the surface may be used advantageously, but there may be some difficulty in regulating an economical expenditure of oil by this simple means.

Captain Townsend of the United States Signal Office has invented a simple and efficient oil-distributer.



TOWNSEND'S OIL-DISTRIBUTER.

This consists of a hollow metal globe ten inches in diameter, with a capacity of about one and a half gallons of oil. It has an air chamber separated by a partition, to keep it afloat in a certain position, and there are two valves. When filled with oil the upper valve is adjusted to allow oil to flow out at any desired rate, while the lower valve admits water.

When placed in the sea it floats with the upper valve a little above the surface, and

water will enter to displace the oil from the graduated upper valve. The specific gravity of oil will keep it in the upper part of the distributer, and the motion of the globe on the breaking waves or swell will insure the ejection of the oil through the graduated valve in any quantity.

This is inexpensive, light, portable, and may be used from any part of the ship by tow-line overboard. It may be placed in the bowl of a water-closet and serve as an oil-tank with graduated valve. As it is buoyant it may be anchored at harbor entrances or in the vicinity of wrecks to permit the landing or transferring of the shipwrecked. This principle may be used in any shape of the distributer, for projectiles or buoys. It would be better than Gordon's shell, which explodes and discharges its entire contents of oil at one spot, whereas a Townsend oil-projectile could be fired from a gun and float on the surface where oil is needed, with a continuous flow of oil for a period of time.

These two forms of oil-distributers, or slight modifications of them, will answer all the conditions of simplicity, economy, efficiency, and special adaptation to oil the sea when and where desired.

To enter into a thorough consideration of all circumstances when the use of oil will be advantageous and how to apply it, it will be convenient to consider its use—

1. For ships, steamers, and large vessels.
2. For fishing-boats, life-boats, pilot-boats, etc.
3. For harbor entrances and channels.

1. FOR SHIPS, STEAMERS, AND LARGE VESSELS.

OIL is known to be efficacious when used by all kinds of vessels either running before the wind or lying to. But it remains to be seen if oil can be advantageously used under other circumstances.

There is conflicting evidence in the reports of the use of oil by steamers steaming head to the wind. Captain Sparks of the steamship *Assyrian Monarch* reports that he has tried oil when steaming head to the sea, but does not think it of any use, even when going very slowly. The two reports quoted cannot be accepted as conclusive evidence. In the report of Captain McLean of the steamer *Concordia* the advantage could not have been very great, because the oil-bags were thrown back on board when steaming at a speed of ten knots.

In order to have any benefit the seas would have to be oiled in advance of the steamer, and no distributer devised would oil the seas ahead of the ship, except, perhaps, oil-shells or projectiles fired from guns on board. Any such bombardment of the ocean is, however, manifestly absurd.

The fast steamers, especially the transatlantic liners, plow through the seas without waiting to ride the waves; and as the breaking storm-wave is not any higher than the oiled swell, one of these steamers would find about as much resistance from oiled swell as from the breaking seas, and therefore it would not be of any advantage, even if it were practicable, to apply oil on waves ahead of a steamer steaming against the sea.

When steaming with the wind free in a heavy breaking sea, a steamer may be exposed to great danger by taking seas on board over the weather side, and this may be prevented if oil is applied off the windward side of the vessel.

None of the methods described in the reports would be efficient for this purpose. Oil-bags towed alongside will be thrown back on board, as happened with the *Concordia*.

In 1869 the Harvey towing-torpedo created no little stir among the naval powers, all of which experimented more or less to produce an efficient towing-torpedo. The uncertainty of its action as a weapon became apparent, and its use has been discarded.

This experience, however, incidentally threw a great deal of light on the subject of towing-torpedoes, and the lessons taught may be utilized for towing oil-distributers.

The principle of the Townsend distributer may be applied to a towing-torpedo, from which the explosive charge and the diving appliances should be removed.

Such a towing oil-distributer with bridle, rudder, and double tow-lines would tow in a course parallel with a ship and from twenty to fifty feet to windward from outriggers or yard-arms. This application needs the test of practical experience, but I believe it to be desirable when steaming from eight to fifteen knots across breaking seas coming from four points forward to six points abaft the beam.

For sailing-vessels the oil apparatus will be the same as for steamers, and the circumstances when it may be used with advantage include when running, lying to, sailing with the wind abeam, and riding to a sea-anchor.

Its use when beating to windward has not been established to be efficacious. The spread of the oil on the water is one of its most remarkable characteristics, and perhaps experiments may solve some method like that of a towing Townsend oil-distributer, by which oil may be applied to windward of a vessel beating against breaking seas. The emergency requiring such a course will be rare, and needs no further consideration.

All vessels should carry from thirty to one

hundred gallons of animal or vegetable oil, depending upon the voyage. In cold weather about twenty gallons of mineral oil or a mixture of mineral and soft oils should also be carried.

2. FOR FISHING-BOATS, LIFE-BOATS, PILOT-BOATS, ETC.

THESE small craft could not be conveniently fitted with the system of pipes invented by M. Menier, but Townsend's distributer, or modifications of it, will answer every purpose in deep water.

In the surf on the beach or on a bar there are different conditions, and the effect of the oil is not so great as in deep water. The undulations roll in to the beach or the bar, often during a calm: they are harmless swells on the deep water to seaward, but when near the beach or the bar the swells increase in size and break with all the force of the storm wave.

The breaking seas in this case are not caused by the friction of the wind, but by the resistance of the shelving beach to the propagation of the undulating force of the wave.

This resistance causes an alteration in the shape of the undulation resulting in an increase of the wave in a vertical plane, because the horizontal progress is checked. This resistance increases as the wave approaches the beach: the forward slope of the wave becomes steeper and steeper until vertical. The undertow assists in carrying back the base of the forward slope, which is then inclined backwards and under the rear slope of the wave. The crest is then left unsupported, it falls over in breakers, and the undulation collapses on the beach. Oil on the surface cannot protect that portion in contact with the shelving bed of the sea; but if there is any wind the point where the swells break or become storm waves may be brought much nearer the shore, and in consequence permit boats to navigate much nearer. The use of oil will, however, be of some benefit in any case.

For fishing-boats all the circumstances of its advantageous use by sailing-vessels apply, and the oil will enable them to keep at sea longer and permit fishing, when without oil they would be obliged to go to port. Riding to a sea-anchor having a Townsend distributer attached will be a very desirable method.

For life-boats the use of oil is highly valuable. Oil will render approach to wrecks much easier and contribute to saving the lives of those on board. A number of oil-projectiles on the Townsend principle could be fired from the mortar of the life-saving station to dot the surface between the wreck and the shore at intervals. Each of these buoyant oil-projectiles will be the center of a sheet of oiled sea, and a number of them will form a safe lane between the wreck to near the few breakers close to the beach.

These oil-projectiles can be recovered after the storm subsides, though they will drift with the currents of the locality.

Dirigible torpedoes, or the Lay torpedo deprived of its fangs by substituting the Townsend oil-distributer for the magazine, might be utilized to make an oiled lane between the wreck and the shore—a good use for these torpedoes when the millennium comes.

For pilot-boats oil-distributers are valuable when boarding vessels in breaking seas. In this case the pilot-boat should stand to windward, apply oil, launch the small boat with the pilot and apply oil from the small boat in pulling to the ship. After the pilot is on board, the pilot-boat should run to leeward and pick up her small boat.

In cases where the pilots pull or sail off to a vessel outside in small boats which are brought back by the vessel, the special conditions of local features and the direction of the wind will determine how the oil should be used. The vessel taking the pilot should heave to, apply oil, and receive the pilot-boat in a comparatively smooth sea.

3. FOR HARBOR ENTRANCES AND CHANNELS.

THE value of oil at harbor entrances has been clearly established by Mr. John Shields, and his apparatus has proved to be efficacious; but it is objectionable on account of its expense for both the plant and the expenditure of oil.

The problem is to oil the surface merely at the time and place needed, for which I have devised a plan which will be economical, efficient, and always available.

This plan is to apply the principle of the Townsend oil-distributer to the can buoys which mark the harbor entrances or channels.

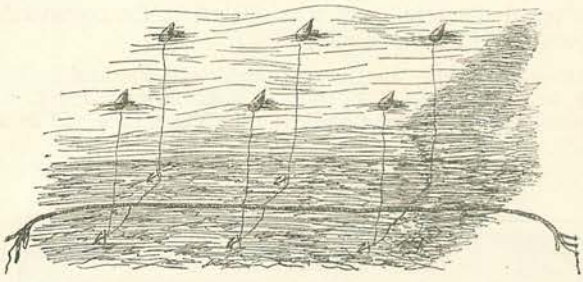
A cylindrical metal case is secured within a can buoy placed vertically and connected with a valve in the bottom to admit water. The top of the cylinder in the buoy is a little above the line of flotation of the buoy. The upper valve, from which the oil flows, has a pipe connecting with an orifice in the side of the buoy at the line of flotation.

The size of the oil-cylinder in the buoy will depend upon the size of the buoy in which it is placed. The quantity of oil will be such as to last for some time, as oil is only to be used when needed for a passing vessel.

The valves of the oil-cylinder are fitted with electric shutters connected with a submarine cable leading either to a lightship or ashore to a lighthouse. A number of these "oil-buoys"

marking the channel can be so fitted, and when a vessel desires to enter across the channel during a storm, the keeper of the lighthouse or the lightship merely presses the button which will cause the valves to open. Water will flow into the oil-cylinders in the buoys while oil is forced out, thereby oiling the channel just when needed. Oil will flow out as long as the electric circuit is kept closed, and as soon as the keeper allows the circuit to open, the valves will shut.

There are no difficulties connected with this arrangement. Torpedoes have electric connections, and the electrical features of this plan differ from those of an observation submarine mine merely in the substitution of an electric shutter for an electric fuse.



SKETCH OF ELECTRIC CONNECTIONS TO CHANNEL BUOYS FITTED AS OIL-DISTRIBUTERS AT HARBOR ENTRANCE.

The advantages of this distributer are that it will economically oil the sea at harbor entrances and in channels exactly when and where needed; that it can be applied to existing aids to navigation with but little expense; and that, in view of the proposed electric lighting of the buoys, it will be even less expensive, because the same cable can be used for the light and the oil-distributer, though with separate conductors. No labor, such as the pumping in Mr. Shields's system, will be necessary: the keeper in lighthouse or lightship can press the button while attending to his regular duties.

When empty, the buoys can be refilled with oil through a special filling-hole after the water is pumped out by the lighthouse tender. The appearance of the sea will indicate when the oil has all been ejected, and in the course of time experience will demonstrate the quantity of oil actually necessary for efficient use to still the waves.

RECOMMENDATIONS.

In view of our present knowledge of the efficacy of the use of oil to still the waves the following recommendations should be urged to all concerned, viz.:

1. That all vessels and boats be supplied with animal or vegetable oil (or a mixture of these with mineral oil for cold weather), which shall be kept constantly available for use on the seas upon occasion.

2. That special oil-distributers of the following description be supplied, to be used exclusively for applying oil on seas upon occasion:

a. A number of oil-distributers on the Townsend principle for vessels and boats.

b. Permanent oil-apparatus with either pipes similar to the Menier system, or oil-tanks with valve and pipes connected with water-closet pipes in vessels.

c. Or at least specially constructed canvas oil-bags filled with oakum, punched, and conveniently at hand, hanging by the side of tanks of oil, so as to be always ready to be filled with oil and used on breaking seas upon occasion. Lanyards should be attached to the bags. Oil-bags and oil to be used exclusively for this purpose.

3. That the state prescribe penalties in cases of marine casualties where evidence may establish that the disaster might have been avoided by the judicious use of oil; and that the regulations requiring passenger steamers to carry life-preservers, life-rafts, etc. be amended by including oil and oil-apparatus for use on seas.

4. That marine insurance companies encourage the use of oil on seas by allowing a discount on the rate of insurance, or other equivalent measures, in favor of vessels supplied with oil and oil-apparatus.

5. That life-saving stations be supplied with oil and oil-distributers, especially projectiles on the Townsend principle with guns or mortars, by which to make a safe lane of oiled sea between wrecks and the shore.

6. That dangerous harbor entrances and channels be marked by can buoys fitted as oil-distributers with electrical appliance which will enable the economical application of oil on breaking seas at the time when and the place where needed.

CONCLUSION.

The efficacy of oil to lessen the dangerous effect of heavy seas, and the means and circumstances for applying it, have been considered in regard to all the requirements of commerce; but the most important thing to be done is to make mariners use it.

Lack of faith in its power has been the chief obstacle, notwithstanding the fact that one trial convinces the most skeptical. Unimpeachable testimony as to the efficiency of the use of oil must be extensively circulated to convert those who do not believe in it.

The marine insurance companies are directly the most interested parties, for it is evident that the use of oil lessens their risks.

They should be willing either to defray all the expense of providing oil and oil-distributers or to reduce the rate of insurance to vessels which have them.

The boards of trade and chambers of commerce are interested as representatives of those who own the vessels and their cargoes. They certainly ought to be willing to take such simple measures to save their own property from destruction.

The state should lend its aid and prescribe penalties for those who may be responsible for the neglect of the use of oil in cases where such use would have prevented disaster. The duty of the state is to protect the lives and property of its citizens. There is no question of this duty in precautions against epidemics, and it is equally clear in this case. No vessel should be allowed to leave port without oil and oil-distributers for use to still the waves upon occasion.

There is no doubt of the efficiency of oil for this purpose, and that government which neglects to provide for the safety of its subjects in such a case as this fails to meet its obligations.

Those who go to sea as passengers have a blind confidence that all precautions are taken for their safe transit, and they should use their influence to have such a simple measure adopted.

The effect of oil is indeed magical, and its value has only recently been brought to light prominently, but it is in keeping with the scientific progress of the age. This progress of science, properly so called, reminds us of the Divine power of the Perfect Man, whom the wind and seas obeyed at the command, "Peace, be still!"

NOTE.—In preparing this article the author has availed himself of pamphlets and articles by the following: Commander J. R. Bartlett, U. S. N.; Lieutenants G. L. Dyer, E. B. Underwood, and A. B. Wyckoff, U. S. N.; Vice-Admiral Cloué, French Navy; Mr. John Shields; "Le Yacht, le Journal de la Marine"; "The Manufacturer and Builder."

W. H. Beehler.

DOWN TO THE CAPITAL.

I' BE'N down to the Capital at Washington, D. C.,
Where Congerss meets and passes on the pensions ort to be
Allowed to old one-legged chaps, like me, 'at sence the war
Don't wear their pants in pairs at all — and yit how proud we are!

Old Flukens, from our deestrick, jes turned in and tuck and made
Me stay with him while I was there; and longer 'at I staid
The more I kep' a-wantin' jes to kind o' git away,
And yit a-feelin' sociabler with Flukens ever' day.

You see, I 'd got the idy — and I guess most folks agrees —
'At men as rich as him, you know, kin do jes what they please:
A man worth *stacks* o' money, and a Congerssman and all,
And livin' in a buildin' bigger 'an Masonic Hall.

Now mind, I 'm not a-faultin' Fluke — he made his money square.
We both was Forty-niners, and both busted gittin' there;
I weakened and onwindlessed, and he stuck and staid and made
His millions: don't know what *I 'm* worth untel my pension 's paid.