The Preservation of Hulls, A Problem of Wooden Shipbuilding.

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A problem that offers more difficulties from the standpoint of wood preservation than the protection of the interior framing of wooden vessels, is the protection of the outer sheathing or planking of the hulls. The salt waters of the ocean, harbor a number of wood-destroying organisms that in some places make short work of unprotected wooden bottoms. These organisms are the molluscs known as ship-worms, commonly called xylotrya and teredo, and a number of crustaceans, the most destructive being the common limnoria. In addition to the problem of preventing the attacks of these, some means must be provided for preventing the accumulation of barnacles and seaweed, which materially affect the speed of a vessel. One of the earliest expedients adopted for this purpose was the charring of ships' bottoms. The planking was periodically charred to a depth of about a quarter of an inch with a slow fire. This was effective for only a few months, when it became necessary to again char the hull. Such charring resulted in the partial destructive distillation of the outermost portion of the wood, liberating small amounts of wood tar containing a high percentage of phenoloid bodies, which are highly distasteful to ship-worms. As these are, however, soluble in water, they soon leached out, leaving the wood unprotected. The charred surface also prevented the accumulation of barnacles. for as soon as a free-swimming larva attempted to attach itself to the charred surface, the charcoal, being very friable, would break loose, releasing the barnacle. The destruction of the wood, due to repeated charrings, makes this method impracticable.

Later the sheathing of bottoms with lead was attempted with only partial success, as it developed that the lead corroded very rapidly around the fastenings, and the adhesion of barnacles was not prevented. Iron sheathings were also found to be impracticable, due to rapid corrosion, though iron sheathings in the form of flat-headed nails driven so closely together that the subsequent rusting forming a complete coating of iron oxide are still used to a limited extent, both for the protection of small ships' bottoms and piling exposed to the attacks of ship-worms. Zinc sheathing also failed to give satisfactory results, corroding very rapidly, possibly due to the galvanic action between the zinc and the fastenings used in attaching it to the hull. Copper and brass sheathings have proved to be by a considerable margin the best protection for ships' bottoms. Brass composed of from 50 to 60% of copper, alloyed with zinc, has given very satisfactory results. If the alloy is not complete, however, such sheathings will disintegrate very rapidly, as corrosion will spread very rapidly from the small nodules of zinc in the metal. Cold rolled furnace copper is the best of metal sheathings for the protection of ships' bottoms. As ship-worms cannot bore through metal, copper, of course, accomplishes its purpose in this regard. The most valuable property of copper, however, lies in the slow and very uniform corrosion of this metal. Though barnacles readily attach themselves to the metallic surface, they do not have time to reach their full development before the slow wasting of the copper loosens their attachment to the copper, compelling them to drop off. As a general thing, 20 to 30 gauge sheet copper is used. The amount of copper sheathing per gross ton, of course, varies widely with the shape and size of the hull of the vessel, small boats requiring as much as 60 lb. of copper per gross ton.

At present, the high cost of copper prohibits the use of this material in the sheathing of ships. The life of copper sheathing is at the best only from five to seven years, when it is necessary to renew the sheathing. The cost of copper has led to the development of substitutes in the form of paints, which are applied directly to the surface of the wood. There are a number of different brands of paints for this purpose in the market. Some are positively useless, others accomplish their object to a satisfactory degree. The composition of such paint is invariably supposed to be a profound secret—and some of the secrets are truly laughable. One method of preventing the attacks of ship-worms, devised by one of the Anthony Comstocks of New York city in the early part of the nineteenth century (his name has been forgotten), consisted in pitching the hull with hot coal tar pitch, and before the pitch had hardened liberally sprinkling the surface with Scotch snuff. He reasoned that as tobacco was such iniquitous stuff, the ship-worms would surely be discouraged.

Some "copper" paints, are, however, quite effective. The writer will not attempt to say which is the most effective. As the pigment of these paints is invariably copper oxide, they commonly are spoken of as "copper" paints. The nature of the vehicle varies widely, from linseed oil with a high percentage of linseed driers, to soya bean oil and kerosene. "Princess metallic" is very commonly used. Viewing the matter from an impartial standpoint, the writer feels that there is a tremendous waste of good copper oxide in marine paints. Whiting could be made to do very well, for the toxicity necessary to prevent the ingress of ship-worms can readily be supplied through the addition of small amounts of mercuric chloride, or such alkaloids as acridene. Aside from the toxic effect of the paint upon wood-borers, the basic principle in the manufacture of a successful "copper" paint seems to lie in the compounding of the paint in such a manner that the surface will slowly waste away, preventing the adhesion of barnacles and the seaweed which these will gather, and at the same time adhering properly to the wood. From the foregoing it becomes apparent why creosoting or the application of coal tar is not effective in the treatment of ships' bottoms. Either will prevent the ingress of ship-worms, but anyone who is familiar with the use of creosoted piling for dock construction will recall that such piling quickly becomes covered with a healthy growth of barnacles.

"Copper" paints, like all other paints, should only be applied to dry surfaces. In painting scows, tugs and other bottoms, the first or priming coat, which is applied after the seams have been properly caulked, is thinned with refined coal tar creosote or benzine in equal proportions, or one gallon of the paint to one gallon of the thinner. Care must be taken to cover the surface of the planking thoroughly before the painting is continued with a second coat. The caulking seams are then filled with a mixture of Portland cement and sand, in the proportions of about three parts of cement to one part of sand. Some shipbuilding concerns make a special point of the use of only pure white silica sand in this connection, but the writer feels that this is unnecessary. Care should be taken to use fine sand, however, to enable the smooth troweling of the seam. The mortar is not allowed to completely fill the caulking seam, the point of the trowel being used to remove surplus mortar. When the mortar has thoroughly set, after the course of several days, surplus mortar that has slopped upon the surface of the planking is removed with coarse sandpaper. The hull is then ready for the second coat. While cement adheres very strongly to the caulking seam, its use is objectionable when it becomes necessary to re-caulk a seam, due to the difficulty of removing it, as in time it becomes almost flint hard.

The writer has experimented with mastic for this purpose, composed of paving pitch, asphalt and wood pulp, thinned with engine distillate until it acquires a workable consistency, with seemingly favorable results. A definite statement cannot, however, be made at this time. Some ship owners require the first coat to be unthinned copper paint, though the necessity for this is disputed by some experienced shipbuilders.

After the seams have been cemented, the second coat of copper paint, full strength, is applied. As these paints have approximately the consistency of ordinary paint, though in some cases they may be a little thicker, no difficulty is experienced in finding painters who are capable of doing the work.

After the second coat has dried for at least two days, the application of a third coat is necessary. As an example of the antique ideas that have survived since the earlier days of our shipbuilding industry, the writer regretfully cites the following requirement of one "expert" inspector who is supervising the construction of vessels for the United States Emergency Fleet Corporation at one of the Pacific Coast yards. This inspector has ruled that the third or final coat of paint shall not be applied to the hull until at least the day before the launching of the vessel; preferably the day on which the vessel is to be launched. The effect of such a procedure is, of course, bad in every respect, as the wet paint is washed from the surface of the wood, making the third coat quite useless. Rational practice demands that the final coat be given at least three days before the launching of the vessel, allowing at least time enough for the paint to set before the ship goes down the launching ways.

Formerly all copper paint was applied to the planking by the brush method. This method is almost entirely used in the smaller yards. On the Pacific Coast, however, the larger yards are using paint "guns," or sprayers, which are operated by compressed air. With this method the paint is quickly and evenly applied to the surface of the wood, with a considerable saving in the labor cost of painting. Five good painters, with brushes, will cover the hull of a typical vessel about 250 ft. long in one day. When the "gun" is used, two men will cover the same vessel in one day. Though some paint is, of course, lost when the "gun" is used—about 15 gallons in giving the vessel three coats—this expense is more than compensated for by the saving in labor costs and the added convenience of the method. In spite of the fact that the paint is applied more