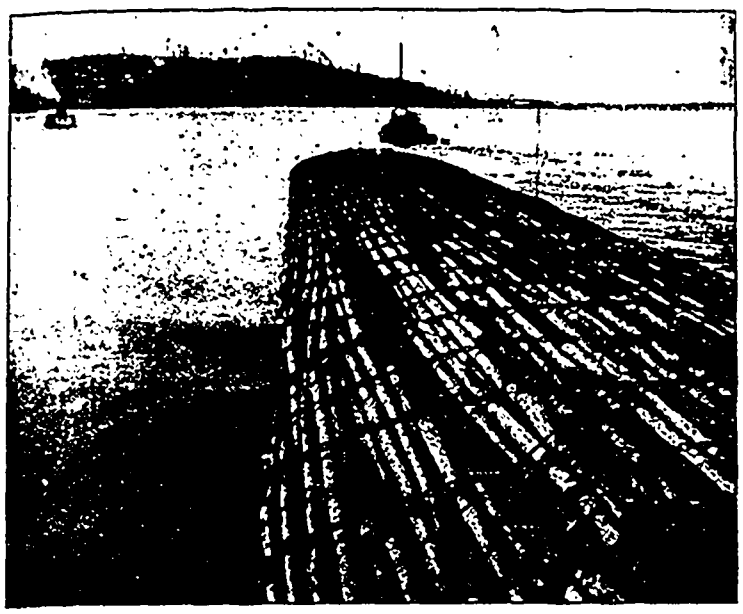
attempt is made to draw the hoops over the centre. The amount of chain used is about 80 tons.

The completed raft contains 450,000 lineal feet of timber, or in the neighborhood of 3,000,000 feet board measure. The average length of the piles is 55 feet, and the average diameter at the butt 14 inches. The spars are of special dimensions.

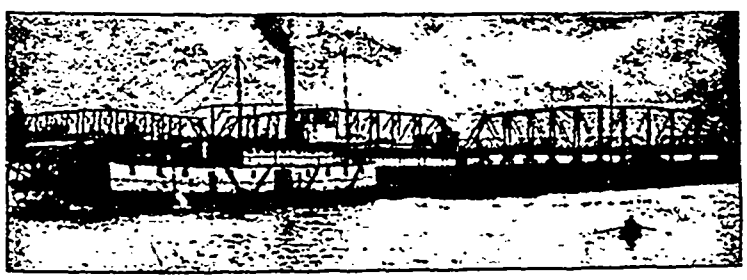


RAFT BEFORE ASTORIA, AT THE MOUTH OF THE COLUMBIA RIVER.

Auspicious weather is almost essential to a safe voyage of one of these unwieldy rafts, and they put to sea only at a time of year when storms are infrequent, though they successfully pass through weather much heavier than any that one would expect them to survive. In tow of an ocean steamer, the trip to San Francisco is made in about seven days. Several rafts have been taken out of Gray's Harbor, Washington, and this year will see the fifth start from the Columbia river. The first raft, in 1894, encountered a severe storm and went completely to pieces, but the succeeding ones reached their destination safely.

The shipping interests would gladly see the business discontinued, as there is always danger of several thousand logs being released on the face of the ocean—a great menace to the safety of vessels whose course lies in their vicinity. The risk which the owners assume when they put many thousands of dollars into such a venture will be more potent in keeping the number of rafts from becoming large than the fears of captains; but the method of transportation is so economical that doubtless considerable quantities of the piling used in the neighborhood of San Francisco will find its way there in this form.

Captain Robinson, who was interested in the first raft of logs built on the Bay of Fundy, and who is in charge of those constructed on the Columbia river, has patented his methods of building the cradle and of placing the chains.



LUMBER RAFT LEAVING PORTLAND, OREGON, IN TOW OF A RIVER STEAMER.

The first raft of lumber built to make the sea journey to San Francisco was constructed at Portland, Oregon, by Inman, Paulsen & Co., and left the Columbia river June 24, 1898, in tow of two tugs. It encountered a storm, and the wind, blowing at the velocity of seventy miles an hour, finally produced a sea which broke the raft in two. The fragments held together for two hours after the back of the raft had been broken, and finally one tug towed the forward part into the harbor of San Francisco, while the other succeeded after a time in picking up the remaining portion and towing it to the same port in safety. Only a tenth of the lumber was lost.

The raft which started in June contained 5,000,000 feet of lumber, and was 396 feet long by 53 feet wide. It is difficult to realize the immense quantity of material incorporated into this raft, though a comparative idea may be gained by considering the fact that the average capacity of large ocean vessels is little more than 1,000,000 feet. Portland already has the distinction of loading the largest cargo of lumber that ever left the Pacific coast, which was won last year when the Glenlochy took 3,000,000 feet of railroad material to Siberia. Now, to pile Pelion on Ossa, the new rafts appear.

The idea of shipping lumber in this way originated with Johan Paulsen, a prominent lumberman, whose attention was attracted to the subject last winter by the difficulty of securing vessels to take lumber to San Francisco, owing to the fact that the majority of those available had entered the Klondike and Alaska trade. Doubters scoffed at the idea of transporting lumber in such a form, but the long years spent by Mr. Paulsen in the lumber business had included experience in rafting on eastern rivers and lakes, as well as on the Baltic; so, after looking at the project from a scientific standpoint and carefully considering all the difficulties connected with it, he concluded that a method of construction suited to an ocean trip of seven hundred miles could be evolved.

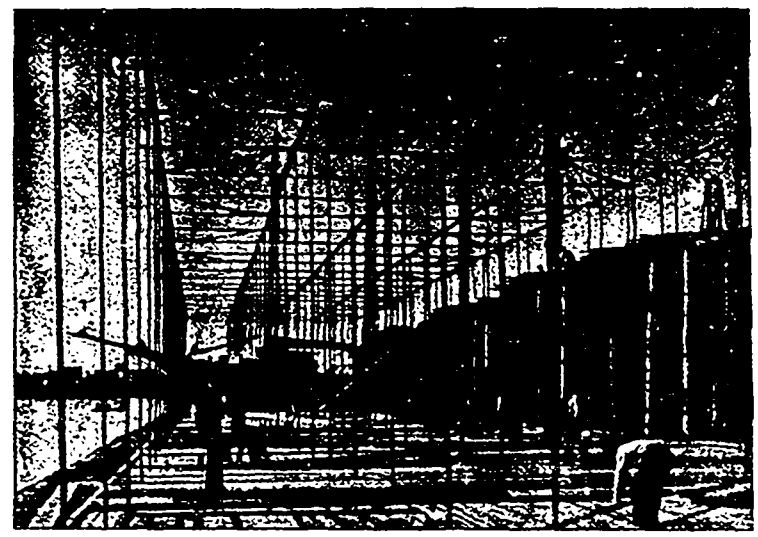
The raft projects very little above the surface of the water, and this greatly increases its chances for a safe trip, as the waves wash completely over it, encountering little resistance, instead of expending their force in battering it to pieces. This is a principle used in the construction of the famous whalebacks, and one which experience has proved to be valuable.

The first step in constructing this late arrival among the various types of marine architecture is to select a dock, or drive a line of piling, 400 feet long, as the basis of the work, and to supply a straight edge for the side of the raft. A stringer, or what might be termed a keel, is built for the entire 400 feet by fastening together five layers of two-inch plank with ends butted so as to ensure the greatest strength. Five of these stringers are made, and placed something like huge joists, ready for a floor, and are then planked over crosswise, making an immense platform 396 feet long and 53 feet wide. The bottom of the raft is now made, and the next step is to pierce each stringer, or joist, at intervals of 12 feet, and insert a long and heavy wrought-iron bolt, fitted with washer and nut below, certain planks being left loose up to this point, to allow their adjustment. The platform, which at first looked like a large dancing floor, is now so changed as to resemble an orchard with long rows of spindling trees. The purpose of these rods can be seen after the lumber is put in.

First, a layer of lumber is placed lengthwise; next, another crosswise; and so on, till a pile 21 feet deep is made, the raft gradually sinking as the load becomes heavier, and about a third projecting above the surface all the time. The rods serve to connect the bottom and top, and bind the mass into a homogeneous whole.

A very liberal factor of safety is allowed, as the aggregate strength of the 170 rods would support a weight of 25,000,000 pounds, while the weight of the completed raft is only 15,000,000 pounds out of water, and much less when submerged. The completed raft is encircled lengthwise by a 1¼-inch cable, to furnish a secure hold for the towline. The cable is of plow steel, and its strength is equivalent to that of a 14-inch hawser.

Before construction was commened, a prominent marine underwriter was approached in regard to insurance. He admitted that the danger of loss was not nearly as great as many people would suppose, but predicted that the promoters of the project would encounter difficulty in insuring the raft, because it is so radical a departure from the orthodox methods of transportation, and because, if successful, it would have a far-reaching effect upon the lumber-carrying trade on the coast. Mr. Paulsen has applied for patents on his novel lumber carrier, and he expects his raft to occupy a place beside the whaleback, which was at first an object of ridicule. An important feature in the construction of the raft is that only an insignificant percentage of the lumber is injured by nail or bolt holes, and even this can be utilized for firewood in California.



ARRANGEMENT OF BOLTS AND METHOD OF PLACING LUMBER IN RAFT-BUILDING.

One of the principal objections brought against rafting is the probable staining of the lumber by immersion in the muddy current of the Willamette river and the salt water. Many claim that the concession in the price of the lumber which will have to be made on this account will balance the saving in freight charges, and say that at best only low-grade stuff can be so shipped to advantage.

Rafting of this kind is still in the experimental stage, and it is early to predict the ultimate result; but, as this method of transporting lumber is only about half as expensive as the old, it is safe to assume that there will be a strong effort to make it a permanent success, and that the lumber trade of California and the Pacific northwest of America is likely to feel the effect of sea-going rafts.—The Engineering Magazine.

The American Monthly Review of Reviews for November makes an interesting assemblage of "Roosevelt cartoons," apropos of the Colonel's candidacy for the governorship of New York.