is notably durable under water, either fresh or salt, and has been used for the sills of the miter gates in the Canal locks.

Pumping System.—The pumps installed within the caisson are designed to regulate the water ballast, determining the depth of immersion, and to unwater any portion of the locks between the upper and lower entrances. Of all the lock chambers, the only ones which can be cleared of water without pumping are the two in the upper flight of Gatun Locks, because they are the only ones the floors of which are below the level of the water at the lower end of the flight. The floor of the intermediate level at Gatun is 13⅔ ft. below sealevel. The floor at Pedro Miguel Lock is at elevation plus 9, which is 46 ft. below the normal level of Miraflores Lake. The upper of the two levels at Miraflores is 18½ ft. below mean sealevel, which means a minimum depth of water in it of about 8 ft. at low tide of the Pacific. Moreover, the caisson dams will afford the only means of working in the dry on the outward faces of the guard gates, and the sills for the emergency dams.

The main pumping system will consist of 4 vertical-shaft centrifugal pumps, having a 20-in. discharge and a 22-in. suction. The practical test governing its design is that it shall be able to pump out in not over 25 hours all the water in the upper and lower chambers of one flight of Miraflores Locks, between mean sealevel and the top of the sill of the lower chamber (El.—50 ft.), the tidal level to be at El. 0 when the pumping is begun, and the tide rising. The total quantity to be pumped out, including 518,000 ft. for leakage, will be about 10,285,000 cu. ft. The average discharge under these conditions, for the entire period of pumping, would be about 13,000 gal. per min. for each of the 4 pumping units. Two of the pumps are to be arranged for pumping out the caisson when it is to be removed from its position against the sill.

Inasmuch as the sill for the caisson is higher than the level of the floor, suction extension pipes are to be provided to cross the sill on the bottom of the chamber, to allow its complete unwatering. The suction extensions will be lowered by cranes on the deck, and attached from a pontoon, similarly handled.

An auxiliary pump, with suitable pipe connections, will be used to regulate the end trimming tanks, flush the scuppers, and scour the sills.

Electrical Equipment.—The caisson will have no means of auto-propulsion, but will be towed from place to place. Its motors will be for operating the pumps, and their details will be determined by the pump characteristics. Four 2,200-volt motors will drive the main pumps, and one of 220 volts potential will operate the auxiliary pump. Another 220-volt motor will drive a ventilating fan. Current will be received at 2,200 volts from chambers in the lock walls, through four flexible cables, and a three-phase transformer is to be provided for the 220-volt motors, and for the lighting equipment. A switchboard will be installed in the operating room, which is on the operating deck, 37 ft. above the base line.

Miscellaneous Parts.—There will be four portable cranes on the top deck, to handle various loads. Each must be capable of raising another at a radius of 14 ft., by 2-man power. The pontoon for making the suction extension attachments will be stowed on the top deck and handled by cranes. A deck capstan, hand-operated, will be provided at each end of the top deck. It must be able to withstand a pull of 10,000 pounds.

Two ventilators, 16 in. in diameter, with hoods of U.S. Navy standard type, will be placed on the top deck, for ventilating the operating room. One, discharging a short way below the 49-ft. deck, will have a multivane exhauster, motor-driven. Twelve 2-in. air vents, to allow the escape of air and gases from the interior compartments, will lead to the top deck. Two skylights, 8 by 16 ft., will be set in the top deck, symmetrical with the axes of the caisson. The covers will be made in two parts, for portability, and a hand-operated device will be provided for raising and lowering them. The skylights will be watertight against a hose discharge under 50 pounds pressure.

Fixed ballast, composed of pig iron punchings and concrete, is to be placed in the bottom of the hull to a normal thickness of about a foot and a half. The pig iron will at all points be at least six inches from the sheathing. Two 70-ft. lengths of anchor chain will be provided for mooring the caisson when it is not in service, and chain lockers for them will be built of reinforced concrete at the ends of the 37-ft. deck.

Programme of Construction.—Only one caisson is being built at present, though it is expected that two will be provided for the operation of the canal. The first is to be completed about September, 1914, and towed to the Isthmus for test at the lower end of Miraflores Locks. The test may suggest modifications; if not, the second caisson will be constructed like the first. The patterns for all the castings in the structure will become the property of the Isthmian Canal Commission on acceptance of the caisson, and will be delivered with it. Fabrication and erection of the first caisson are being supervised at the plant of the contractor by Mr. Lewis A. Mason, assistant engineer, who was associated with Mr. Henry Goldmark, designing engineer, in working out the design, plans, and specifications.

A LARGE CENTRAL HEATING PLANT.

About 22,000 tons of coal is the annual consumption of the central heating plant of the University of Wisconsin, at Madison, Wis. Only 10% of the total fuel is chargeable to power uses. All power exhaust, together with low-pressure live steam, is used for heating. At present 42 buildings are heated from the central plant, including practically all of the University buildings and the United States Forest Products Laboratory. The distribution system includes 2 miles of tunnel and 1 mile of conduit. The maximum pipe size is 16 in.; on this a total thickness of 3 in. of 85% magnesia insulation is used. The heating pressure is 5 to 10 lb., and no difficulty in maintaining pressure at the receiving end has been experienced.

The world's production of copper, during 4 years, as given in a recent issue of the "Engineering and Mining Journal," is as follows, quantities in metric tons:—

Country.	1910.	1911.	1912.	1913.
United States	492,712	491,634	563,260	555,990
Mexico	62,504	61,884	73,617	58,323
Canada	23,810	25,570	34,213	34,880
Cuba	3,538	3,753	4,393	3,381
Australasia	40,962	42,510	47,772	47,325
Peru	27,375	28,500	26,483	25,487
Chile	38,346	33,088	39,204	39,434
Bolivia	3,212	2,950	4,681	3,658
Japan	50,703	52,303	62,486	73,152
Russia	22,700	25,747	33,550	34,316
Germany	25,100	22,363	24,303	25,308
Africa	15,400	17,252	16,632	22,870
Spain and Portugal	51,100	52,878	59,873	54,696
Other countries	24,888	26,423	29,555	27,158
Totals	882,351	886,855	1,020,022	1,005,978