and in part to altered furnace practice, as a result of experiment with such ores. The specific gravity of the mattes was between 4.7 and 5.0, and of the slags between 3.6 and 3.8.

"Of the total ore smelted, 62.8 per cent. was burnt ore, 22 per cent. raw sulphide ore and 15.2 per cent. raw custom ore—or 62.8 per cent. burnt ore and 37.2 per cent. raw ore, from which a shipping matte of from 40 to 45 per cent. copper was produced in one smelting operation. Comparing the furnace work of the past six months, as shown above, with the last annual statement, it will be seen that the capacity of the furnace has been raised from 177 tons to 249.6 tons, an increase of 72.6 tons per day."

NOTES ON THE CONSTRUCTION OF MINE BULKHEADS.

(By William Thompson, Rossland, B.C.*)

The writer was recently called upon to design and erect a number of mine bulkheads which required to be absolutely free from danger of collapse and fracture and possibilities of leakage. After consideration of the many classes of material available for this purpose, and various designs of construction, the following general design was decided upon and followed:

MATERIALS—Materials chosen for the erection of the bulkheads were hard burned, repressed brick, manufactured from clay found at Clayton, in the State of Washington, U. S. A., Portland cement imported directly through Vancouver agents from White Brothers, of London, England, and clean river sand found locally. Before being used samples of all materials were tested in the laboratories of Dr. J. T. Donald and McGill University, Montreal, Quebec.

DESIGN OF BULKHEADS—In each case the pressure exerted from the head of water to be retained was in one direction. Bulkheads were, therefore, erected in the form of an arch set against footings cut into the solid rock, footings also being cut into the roof and floor of the workings to remove loose or fractured material and make perfect seal against leakage at point of contact between brick work and walls of drift. The first arch was re-inforced by a second arch of similar design and the space between the intrados and extrados of the two arches filled with strong cement concrete. The extrados of the final arch was also sealed by strong cement concrete faced with two-inch cedar plank. The strongest and most perfectly shaped brick were chosen for the construction of the main arches and the mortar used consisted of two parts sand to one cement, freshly mixed as required.

STRENGTH OF MATERIALS—Brick—Transverse Test—Distance between centres of support in each case, six inches; specimens tested on flat. Breaking load at centre in pounds, arch brick, 6,500 pounds; breaking load at centre in pounds, face brick, 3,900 pounds.

COMPRESSION TEST—Load in pounds per square inch at initial failure, arch brick, 6,600 pounds; load in pounds per square inch at initial failure, face brick, 2,117 pounds; maximum load in pounds per square inch, arch brick, 8,320 pounds; maximum load in pounds per square inch, face brick, 3,242 pounds.

CEMENT—Tensile strength in pounds per square inch: Neat cement 20 per cent. water, at end of 60 days, 699 pounds; one cement and one standard quartz sand, same period, 540 pounds; one cement and one sand used, same period, 498 pounds.

PLAN OF BULKHEADS—Diagram No. 1 shows vertical section, and Diagram No. 2 plan of bulkhead erected to withstand pressure due to 475 feet of water.

A three-inch wrought iron pipe was laid through each bulkhead to carry off water accumulating during construction, this pipe being sealed when water was allowed to accumulate against the face. Bulkheads were maintained free from pressure until material had become thoroughly set.

RESULTS—Results obtained proved eminently satisfactory, bulkheads proving watertight, and owing to large factor of safety are free from any danger of collapse or fracture.

*Paper presented at the March meeting of the Canadian Mining Institute.

THE CORRECT DIMENSIONS OF OPEN FLUMES.

(By Thornhill Cooper, Mine Manager, Westport, New Zealand.)

A matter recently came under my notice regarding the correct dimensions of open flumes so as to insure the greatest carrying capacity consistent with using the smallest quantity of material. From personal observation and inquiry I find that this subject receives but little attention, and therefore take the liberty of bringing it before your readers' notice.

I find by calculation that by modifying the dimensions of a flume it is possible to materially increase its capacity without any corresponding increase in the quantity of timber used in its construction. The correct relation of sides to bottom appears to be as 1 is to 2.

Taking, for instance, a commonly used flume of 2 feet by 2 feet, and say 12 feet long, we obtain an area of 4 square feet, and a capacity of 48 cubic feet, requiring for its construction 72 square feet of timber. Now, modify the dimensions in accordance with the proportion above laid down, making the sides to be 1 foot 6 inches and bottom 3 feet. We then obtain an area of 4 feet 6 inches, and with the 12 foot box a capacity of 54 feet, still using only the same quantity of timber—72 feet.

Other examples work out similarly, *e.g.*:—

Sides.	Bottom.	Length.	Area. Sq. Ft.	Capacity. Cub. Ft.	Timber. Sq. Ft.
3 ft.	x 3 ft.	x 12 ft.	9	108	108
2 ft. 3 in.	x 4 ft. 6 in.	x 12 ft.	10·125	121·5	108
2 ft.	x 3 ft.	x 12 ft.	6	72	84
1 ft. 9 in.	x 3 ft. 6 in.	x 12 ft.	6·125	73·5	84
3 ft.	x 4 ft.	x 12 ft.	12	144	120
2 ft. 6 in.	x 5 ft.	x 12 ft.	12·5	150	120
4 ft.	x 4 ft.	x 12 ft.	16	192	144
3 ft.	x 6 ft.	x 12 ft.	18	216	144

In these examples I have—in order to simplify calculations—taken no account of the loss of timber entailed at the junction of sides and bottom, but this will not affect capacity results.