the stamp of general acceptance. There are, in fact, two standards by which metallurgical as well as other technical processes and practices are to be judged—the standard of absolute excellence and that of economical utility. The series of operations by which the minutest trace of each valuable constituent of an ore is recovered, represents no doubt the highest standard of the art of metallurgy; but on the other hand the process by which the most money can be made out of an ore in a given locality is generally awarded in practice the reward of adoption, even though it be wasteful and reprehensible from a scientific and technical point of view. Remembering that most of the larger mineral deposits of the United States are situated far from the centres of population and of chemical industry, where, therefore, by-products are of little or no value, where fuel and re-agents are dear, and where labor, owing to its scarcity and the great cost of living, commands higher wages than in any other section of the Union, it can readily be conceived that the simplest, not the most complicated, even though it be the most perfect; the speediest, not the most thorough process will be selected, with a view to saving only the most important constituents of the ore, regardless of its subsidiary and less valuable elements. Men who risk their money, and those who forfeit their comfort to recover what Nature has hidden in the wilderness are liable to overlook small savings in their hunt for wealth, and to be guilty of committing the crime of permitting heavy metallurgical waste so long as it does not involve pecuniary loss."

In dealing with copper concentrating at Lake Superior Mr. Douglas gives the costs of mining and concentrating at the Atlantic mine which are certainly worth reproducing. The ore is broken in a rock-breaker, crushed in steam stamps and concentrated by jigging in Collom jigs and the slimes by round buddles. From 200 to 300 tons of ore are crushed daily.

The following was the output and working cost last year:—

Rock stamped.....(tons)	315,626
Product of mineral.....(pounds)	5,687,665
Product of refined copper.....(pounds)	4,437,609
Yield of rock (per ton).....14 pounds—	0.703%
Total cost of mining, selecting, &c.....	$0.7518
Transport to mill.....	0.0303
Stamping and separating.....	0.2330
Total cost of mining and concentrating.....	1.0151
Freight, smelting and marketing.....	0.1771
Total cost of mining, treating and marketing the product, per ton.....	1.1923
Gross value of product.....	1.3376
Profit per ton.....	$0.14

Turning from the concentration of copper ores to that of galena, the methods and cost of working at the St. Joe mine are given, here the ore is crushed dry and screened through trommels with six more holes, then wetted and concentrated, and sized in 92 two-compartment jigs. Prof. Munroe, of Columbia College, attributes the success of thus jigging coarse and fine, including slimes, to the coarseness of the bed. He says: "The plan of jigging sands and slimes together, makes it possible to treat very much finer material with success, than has heretofore been supposed possible. The limit of successful work on jigs is generally placed at 1 mm. The successful jigging of stuff ⅛ mm. and less marks a decided advance in the art of dressing. The coarse grains form the intestrial channels in which this very fine stuff can be concentrated. It is well known that any attempt to treat stuff finer than 1 mm. by itself, results in very imperfect working of the jigs, the losses being large and the capacity of the jig small. The advantage of this system of jigging is the large proportions of sands successfully treated and finally disposed of by the roughing jigs alone. Out of 800 tons per day, only 136 required further treatment, viz: 30 tons raggings crushed and treated on the 3-sieve jigs, 66 tons of fine sand, also treated on the 3-sieve jigs, and 40 tons of slimes treated on the side bump tables"

The cost of concentrating is 36.4 cents per ton, being 13·1 cents higher than at the Atlantic mine.

The author next deals briefly with gold hydraulicing and the milling of free gold and silver ores. He strongly condemns the policy of the owners of the Comstock, where he considers that metallurgical economy has been subordinate to the exigencies of speculative owners and stock manipulators, who have required an enormous output, even though it involved heavy operating losses.

In dealing with calcining furnaces Mr. Douglas confines himself to three types, namely, rake furnaces, shaft furnaces with long drop, and cylinder furnaces. The most popular rake furnaces are modifications of the O'Hara. The Brown-Allan, O'Haras as used at Butte, are constructed with two hearths 100 feet long and 9 feet wide, with four fire-places, two on each side of the upper hearth They roast from 45 tons to 50 tons of concentrates per day, reducing the sulphur to 6 per cent. In some furnaces the lower hearths are produced beyond the limits of the furnace to serve as a cooling floor. When employed for roasting preparatory to smelting, the floor of the lower hearth may terminate in a hopper, whence the accumulated hot ore drops into reverberatories.

Mr. R. Pearce, of Argo, has designed a turret furnace, from which very good results have been obtained. In this furnace the machinery imparts a revolving motion to radial arms and ploughs; the arms are hollow tubes through which air can be forced on the surface of the ore at a certain stage in the roast, thus cooling the arms and ploughs and accelerating oxidation. The fireplaces supply extraneous heat. These furnaces may be built with several hearths above each other, thus prolonging the roasting where complete oxidation is required. Mr. Pearce says, "The turret roasting furnaces have been in constant operation at these works (Argo) for a period of about three years. I have had ample opportunities of testing their capacity on ores and mattes of different kinds The following results have been obtained from runs of sufficient quantity of material to ensure their correctness, and they are certainly very conservative. To test the capacity of the furnace for roasting, I made use of Gilpin County tailings containing 79·5% of pyrite, representing 42·1% of sulphur. Of this material the furnace was able to roast 9·8 tons per 24 hours down to 0.22% of sulphur at a cost of $1.15 per ton."

"Pyrite containing little or no foreign elements carrying 46% of sulphur, has been roasted to 4·46% of sulphur, at the rate of 14·76 tons per day and at a cost of 71 cents per ton."

"An ordinary mixture of ores, containing pyrite with from 20 to 30 of silica may be roasted to 4.75% of sulphur at the rate of 16 tons per day and at a cost of 70 cents."

"Matte containing lead to the extent of from 10 to 15% and 30 to 35 of copper, has been roasted to 6% per cent of sulphur at the rate of 13 tons per day and at a cost of $1.00."

The following table is well worth reproducing as it gives the cost and efficiency of four kinds of rake calcining furnaces in use in America:

			Improved.	
	Reverberatory.	Old Spence.	Segmental.	Rectangular.
Cost of construction at Butte	$4,500 00	$2,500 00	$8,500 00	$10,000 00
Yearly running time.	360 days.	320 days	340 days	360 days
Daily gross capacity	10 tons.	7 tons	30 tons	43 tons
Labor for 24 hours furnace and tramming	$ 9 33	$4 38	$11 50	$9 95
Fuel	10 00	None	1 00	2 50
Repairs and shut downs	1 00	$3 00	2 50	1 25
Power	None	2 50	1 00	1 00
Sinking fund (6 per cent.)	$0 79	0 42	1 42	1 67
Total Expenses	$21 12	$11 30	$17 42	$16 37
Cost per ton	2 00	1 91	0 58	0 41

In dealing with revolving furnaces Mr. Douglas instances the Bruckner with intermittent feed and discharge and the White-Howell with continuous feed and discharge. Both types do good work The former is used more as an oxidizer, while the latter is useful as a chlori