staff of men was specially employed to carry out the trials, and most complete and detailed records were kept.

The tests extended over more than a year, and a considerable amount of money was expended in testing many variations of conditions, such as varied angles of screen frames, heights of discharge and of drop, and different methods of water introduction into the upper portion of the mortar-box.

The following statement illustrates some of the many experimental runs:—

	(A) Single Discharge Mortar. Ordinary Mill Feed.	(B) Single Discharge Mortar. Ore from Rolls set 0·5 in. apart.	(C) Double Discharge Mortar. Ordinary Mill Feed.
Running Weight of Stamp	1343 lb.	1342 lb.	1356 lb.
Set Height of Drop	7½ in.	7½ in.	7½ in.
Drops per minute	98	98	98
Duty per Stamp per 24 working hours	5·85 tons	5·68 tons	5·81 tons
Height of Discharge	2¾ in.	Level	3¾ in.
Screen used and Aperture	700 (·024 in.)	700 (·024 in.)	700 (·024 in.)
Ratio of Water to Ore by Weight	7·67 to 1	8·35 to 1	10·70 to 1
Percentage of + 60 (0·01 in.) grade in screen pulp	29·00 %	27·50 %	26·00 %
Ore Feed + 1⅜ in..	54·8	1·1	49·9
− 1⅜ + ¾ in.	14·3	19·3	16·3
− ¾ in.	30·9	79·6	33 8

The results of the above typical trials with a double discharge mortar-box and with fine breaking before stamp-milling are almost identical within the limits of experimental error.

The above conclusions were confirmed by the fact that the average stamp duty on ordinary mill-feed for six pairs of parallel trials was 5.82 tons with a double discharge mortar, and 5.82 tons with a single discharge mortar.

The average stamp duty for four pairs of parallel trials on the product of rolls set ½ in. apart was 5.64 tons with double discharge mortar, and 5.78 with a single discharge mortar. There was no increased duty to compensate for the extra cost of preliminary fine breaking,[4] and the only difference with the double discharge mortar-box was a considerable increase in the amount of water used.

This last conclusion is in accordance with the fact that the ordinary single battery screen has about 40 per cent. of its area available for discharge, or, say, 1½ sq. ft. of discharge area for the small stream of pulp yielded by five stamps.[5] It will be observed that in trial (B) many flat pieces of ore which had passed the rolls set ½ in. apart yet remained on a coarser screen used in the grading analysis.

Finally it became obvious that to crush more rock it was necessary to strike a heavier blow. This was sought by affixing helical springs round the stem above the tappet so as to be compressed by the upper guide during the stamp's rise, and so that when released the stamp would fall more rapidly, rendering a higher drop practicable, and would likewise strike harder. Whilst this object was in some measure fulfilled, the noise in the mill was much increased and the life of the springs did not promise to be long. Hence, finally, the conclusion was reached that a simple increase of stamp weight was the best course.

A series of runs were then made, whereby direct comparisons could be obtained of the actual tonnage milled by alteration in the weight of stamps. The table on p. 5 exemplifies the increased tonnage obtained by increased weight of stamp on ordinary mill feed, both under ordinary milling conditions and with a high discharge and back water feed to obtain a very fine product.

Another run with 1,337-lb. stamps having a height of discharge of 2 in. and a 64-mesh screen gave a duty of 10.23 tons per 24 working hours, of which 52.8 per cent. remained on a 60 screen. The water-feed adopted in this test consisted of inlets at an angle of 45 degrees at the back of the mortar-box, as suggested by the late Mr. H. T. Pitt.[6]

Encouraged by the results of these and many other tests, including a duty of approximately 6½ tons through 1,500-mesh screening with stamps weighted up to 1,622 lb., the writer felt justified in recommending that the next 360 stamps erected by Consolidated Goldfields Companies, namely, at the Simmer East, Robinson Deep and Luipaards Vlei, should have a weight of 1,550 lb. each when new.[7]

Such a departure excited much adverse comment among experienced millmen generally, on the ground that no foundations could stand the shocks, but the reasoning that if foundations could be built to endure the blow of the colossal steam stamps, it would be possible for them to be built to withstand gravitation stamps, proved correct. All the above mills are satisfactorily at work to-day after periods of service ranging up to three years, and the foundations promise to last as long as did their lighter predecessors.

In accordance with the present changed state of professional opinion, all Rand batteries lately erected or designed have stamps of a weight not long ago deemed extravagant, and aided by the installation of tube-mills, stamp duties of 8 tons are as common as of 4 tons but a few years previously.[8]

Whilst in the United States and in Mexico the relatively light stamp is still generally upheld, there is at least one notable exception in the recently built mill of the Boston Consolidated Copper Co., which is equipped with 312 single Nissen stamps of 1,500 lb. weight each and with a 9-ton duty.[9]

The accompanying diagram, Fig. 1, illustrates a modern heavy gravitation stamp with its mortar-box, as used in the Simmer Deep Jupiter joint mill.

The tabular statement illustrates the results obtained on a large scale under regular working conditions by the use of heavy stamps, and further shows in

[4] See also Journal of C. M. & M. Society of S. A., vol. vi, Jan., 1906, p. 215.

[5] See Lock's "Gold Milling," p. 79.

[6] See Trans. Inst M. & M., 1904, vol. xiv, p. 164; also Journal Chem. Met. & Min. Soc. of S. A., 1908, vol. viii, p. 374.

[7] See Annual Report of Con. Goldfields of So. A. for 1905, p. 32; also Report for 1906, p. 27, and Report for 1907, p. 28.

[8] See the S. A. Mining Journal, p. 802, Sept. 19th, 1908; p. 1016, Nov. 14th, 1908; p. 1100, Dec. 5th, 1908; and p. 1348, Feb. 6th, 1909; 1860-lb. stamps with a 12-ton estimated stamp duty are to be erected on the West Rand Consolidated property (South African Mining Review, p. 232, Nov., 1908).

[9] See Eng & Min. Jour., 14th Sept., 1907, p. 433.