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By WILLIAM JAGO and
By WILLIAM C. JAGO
Leading Authorities on the Subject

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Last year the world produced £97,000,000 worth of gold against £92,000,000 in 1914. The Transvaal produced £38,627,000, or 40 per cent of the world's total. The United States came second with £20,300,000, and Australia third with £9,200,000 worth. Other important gold producing countries are Canada, Mexico and Russia.

The Milling of Rice

By F. B. WISE and A. W. BROOMWELL, Grain Standardization Branch, U. S. Department of Agriculture.

The milling of wheat and of rice are fundamentally opposite. In milling wheat the chief product, flour, must be ground very fine; in milling rice the grains must be kept as nearly whole as possible. According to the present commercial conception, an efficient rice mill is one which properly cleans, scours, and polishes the rice grains with a minimum amount of breakage. This fact must be kept in mind in the study of each machine.

Rice Milling and Machinery.

Screens and Fans.—The rough rice from the thrashers, stored in bags in the warehouse or in bulk in the elevator bin of the rice mill, generally is thoroughly screened and fanned in a combination screen blower before being conducted into the hopper of the hulling stones. Chaff, weed seeds, mud lumps, and other foreign substances are thus removed, which, if present, would damage the machinery or introduce impurities into the finished products.

Hulling Stones.—The first real milling operation consists of removing the hulls from the grain between the hulling stones. These latter are a perfected form of those employed in the old mortar-and-pestle mills, and differ little from the stones which are widely used for grinding corn. In a modern rice mill of a daily capacity of 600 barrels of 162 pounds each, two sets of stones are generally employed. Since the revolving motion of the stones tends to keep the grains on end and all the grains in a lot of rice are not uniform in length, it is found most economical to adjust the stones at a sufficient distance apart so that the best and longest grains are not broken and at the same time a maximum percentage of rough rice is hulled. If the stones are set too close together, it is also found that the germs are removed from some of the grains instead of remaining to be scoured off with the bran. The average results of the mechanical analysis of several samples of rice of the Honduras type collected directly from the stones are as follows: Hulled rice, 65.5 per cent; rough rice, 15.3 per cent; and hulls, 19.2 per cent.

Fans.—From the stones the mixture of hulled rice, rough rice, and hulls is elevated to the upper mill floor to be fanned. The fanning device is very similar in this case to the one used in removing the dust and weed seeds from the original rough rice. The same forced air that separates the hulls from the rice usually takes them to the fuel house near the boiler room, where they are eventually used as fuel for the mill, or, if they are not to be burned, to a grinding machine, where they are prepared for the market. Practically all rice mills make use of the hulls as a source of power for heating the boilers. Analyses of many samples of the Honduras type of rice taken from the fans show how efficiently the loose hulls are removed in this machine. The average results are as follows: Hulled rice, 81.9 per cent; rough rice, 17.2 per cent; and hulls, 0.9 per cent.

Paddy Machine.—The paddy machine is a device designed to separate the rough from the clean rice in the mixture, which has been fanned practically free from hulls. Essentially it consists of a large inclined mechanically operated shaker, the surface of which is interrupted at regular intervals with small vertical metallic plates which divide the rice and aid gravity in making the separation. As the shaking proceeds, the rough rice grains, being lighter, gradually move upward from the centre feed and pass over the high side of the machine into a trough, while the heavier, hulled grains are collected under the lower side. The separation may be varied by changing the speed of shaking, the angle of incline of the platform, or the rapidity of the feed. Four to six paddy machines are generally employed in a mill of 600 barrels daily capacity.

The rice from the rough side of the paddy machines is returned to a pair of small stones which are set close together, where the short kernels are hulled and then combined with the rice from the first stones. The rice from the clean side is now practically free from hulls, but the grains retain the thin brown bran layer as well as the eye, or germ, intact.

Hullers.—The name "huller," given to the next machine in the milling process, is very misleading, because in reality this machine is used for removing the bran layer from the grain which has been hulled by the stones and freed from rough rice by the paddy machine. The word "huller" is universally understood in this connection in the rice industry, and hereafter when the word appears in this article it will designate the machine which receives the rice

from the paddy machine and scours off the outer bran layers. The name was probably inherited from the similar machine, the plantation huller already described, which removed hulls as well as bran. The modern huller is somewhat smaller but otherwise very similar to that already described, and six or seven machines are necessary in a 600-barrel mill. The grain from the clean-rice side of the paddy machine is conducted to the feed hopper of the huller and thence passes into the cavity of the machine. A part of the bran layer on the outside of the grain and most of the germ are removed, largely by scouring between the rough inside iron walls of the tapering cylinder and the grooved surface of the rapidly revolving core.

Bran Reel.—The bran reel receives the product from the hullers and separates the rice from the powdery bran. This reel is composed of a large octagonal framework covered with fine wire screen, the square meshes of which are 14 per linear inch. The reel is set on a slight incline and its slow revolving motion takes the rice, which enters at the higher end, through its length 9 feet in about 5 minutes. As the reel revolves, the rice constantly falls from side to side and forces the bran through the wire covering.

Pearling Cone.—The pearling cone, which has recently been introduced in many mills to supplement the work of the hullers, is essentially the same machine that is used in the pearling or barley. The principal working part of the machine is a frustrum of a cone covered with a composition stone; this is surrounded by a sieve mantle composed of close-meshed heavy iron wire. The rice is fed from above between the stone and the sieve and is thoroughly rubbed before passing out at the bottom. The severity of the scouring is regulated by raising or lowering the stone, thus decreasing or increasing its distance from the wire screen. The best milling practice now approves the use of the pearling cone, because with its use the grain may be more gradually scoured than where the hullers alone are used and the breakage can also be kept lower. The loosely adhering bran resulting from the action of the pearling cone is removed from the rice in a bran reel. This bran is generally combined with that removed by the hullers, but is occasionally mixed with the polish from the brush or even bagged and sold locally as rice meal.

Brush and Brewer's Reel.—The brush is the last scouring machine in the milling process. On account of the rapid feed necessary in securing the best results from the brush, the rice from the bran reel following the pearling cone is stored in large bins situated above the brush. This latter machine has already been described as the polisher of the mortar-and-pestle mill. In the modern mill it has been found advantageous to substitute pigskin for moose hide or sheepskin and to increase the speed of the machine. The very thin layer of bran which is rubbed off is forced through the surrounding screen as a light-brown powder, called rice polish. The rice kernel at this point is reduced approximately 10 per cent of its weight after the removal of the hull. As a rule, when a coating of glucose and talc is to be applied later in the process, the rice is not subjected to such a severe scouring in the brush as when it is to be sold as uncoated rice. From the brush the rice, containing all sizes from the most nearly perfect whole grains to the smallest particles, is passed into the brewer's reel for the first step in grading. This reel differs from that which removes the bran only in that the wire screen covering has 10 meshes instead of 14 to the inch in each direction. The brewer's rice which passes through the screen of this reel is never coated with glucose and talc, since its value is small and not increased by such a process involving extra expense.

Trumbles.—When the rice is to be coated with glucose and talc, as it generally done, it is trans-

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