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MEETING HELD ON FRIDAY, 24TH MARCH, 1899, AT THE
QUEEN'S HOTEL, LEEDS.

Mr. W. HEMSWORTH LINLEY in the Chair.

The following paper, illustrated by photographic lantern slides, was read and discussed:—

The Manufacture of Flaked Malts.

By J. A. FAWCETT, F.C.S.

IN my paper entitled "Some Remarks on Flaked Malts," I stated that brewers had a right to be informed of the nature of the materials they used in their brewing operations. I now propose to go a stage further than on the last occasion, and by the aid of photographs of machines and diagrams thrown upon the screen, to illustrate to you the method and processes employed in the manufacture of flaked malts. I may take the opportunity of saying I claim to be the inventor of flaked grain (subsequently called flaked malts) as an adjunct in conjunction with barley-malt for the production of beers, hence the subject has special attractions to me. The grain principally used for the manufacture of flaked malts are rice and maize. Barley has been tried with only moderate success; the causes of failure being, I believe, partly owing to imperfect process in manufacture and want of knowledge of the varieties of barley best suited for the purpose of flaking. However, I need not pursue this part of the subject further, since at the present time rice (*i.e.*, dehusked rice) and maize are cheaper than barley, and will produce more beer weight for weight.

It may be instructive for a few moments to consider these two kinds of grain. I therefore propose going over perhaps familiar ground. Rice is said to be the staple food of one-third of the human race. It is an annual grass, and grows to the height of 3 feet. The cultivated varieties are exceedingly numerous. At the Calcutta Exhibition held in 1884, 4,000 apparently distinct forms of Bengal rice were shown, arising from difference of climate and varieties of soil. There are 1,400 different specimens in the Calcutta Museum, and there are 1,300 names of rice. Some kinds are better adapted for growth in marshy lands, and others upon the hill sides. The knowledge of rice carries us back into ancient history, and a ceremonial ordinance in relation to the planting of rice was established by a Chinese Emperor who reigned 2,800 years B.C.

There is proof of its culture in the valley of the Euphrates 400 B.C. It is indigenous to China, but was early cultivated in India and is grown in Japan, Siam, Burmah (which is said to be the rice granary of the

world), Java, Egypt, and Brazil. It is largely grown in America, notably in the States of Georgia, Louisiana, and South Carolina, which is probably the finest variety known, a fair proportion of which comes to this country and is used for domestic purposes. It was not introduced into Carolina until A.D. 1700. Our chief supply is drawn from British Burmah. The imports of it annually into this country from all countries are about $4\frac{1}{2}$ millions of hundredweights. The actual figures for the last three years are given in Table A (p. 558).

Rice is not so valuable an article of food as some other cereals, inasmuch as the proportion of nitrogenous matter is small compared, say, to wheat. Payen gives 7 per cent. as the proportion of gluten in rice as compared with 22 per cent. in the finest wheat. The fatty matter is also less in proportion than in other cereals, but to the brewer this is an advantage, as the oil is valueless to him if not actually dangerous, which it may be regarded in those cases where it may have become rancid. Rice has long been used as the source of a potable spirit in India, and the national beverage of Japan, saké, is prepared entirely from it. In Europe the cultivation of rice is most extensively carried on in the plains of Lombardy and Valencia in Spain. It has been grown experimentally on the low-lying banks of the Thames. At one time the decorticating of rice was done in this country, but this is now largely done abroad, and what we know as rice is the grain with the outer coverings removed. There are in the capital of Siam fifteen rice dehushing mills driven by steam (the husks of the rice are used as fuel), besides hand and horse power machinery.

In British India there are more than sixty millions of acres under rice cultivation. In Ceylon 605,000 acres.

I now beg to draw your attention to maize; what wheat is to Europe, rice to Asia, maize is to America. There it has been known from the earliest times, and maize corns have been found in the tombs of its prehistoric people. It was well known to the Red Indians, who are said to have worshipped it as a direct gift from Heaven. Its culture also extended over Asia, Africa, and Australia, and in Europe it is grown in Southern Russia, Roumania, Bulgaria, Turkey, also in France and Spain. The climate of Great Britain is not suitable to ripen the grain perfectly, and a slight degree of frost kills it in all stages of its growth. For a long time very little was imported into this country, and what did come was known as Turkey wheat or corn. During the

twenty years previous to the year 1846, only about 230,000 cwts. were received into Great Britain and Ireland. The potato famine in Ireland of 1846 caused attention to be drawn to this cereal as an article of food, and it then came largely into consumption in Ireland. America is the country of its greatest production and the figures are truly astounding. There are about 120 millions of acres of land under its cultivation. The varieties of the grain are numerous, about 300, and they differ more amongst themselves than any other cereal. When sown, some come to maturity in two months, other kinds require seven months. Some varieties will grow as high in feet as other varieties will grow in inches. Some with kernels eleven times larger than others. They vary in shape of ears, colour of the grain—white, yellow, dark purple, striped, and red. It is this latter variety only which will grow in this country with any chance of coming to maturity in a very favourable season. The kinds vary in chemical characteristics—in short, in all those characters in which the different species of grains differ among themselves. In America there are four kinds principally grown. The flint variety is most common east of Lake Erie and North Maryland. The Dent varieties are the common ones west and south of these points. The Horse-tooth variety (specimen exhibited) are grown extensively in the South. These three classes pass into each other by every gradation, and the grain from all is similar in chemical composition. The sweet varieties are not grown for ripe grains, but for boiling corn and that the stalks, when cobs removed, may serve as green fodder. The Mexicans take the small young shoots and serve them at table as we do asparagus. Chemical analysis as well as common experience shows that maize is a very nutritious article of food. In the tropics it can be grown from the level of the sea to an altitude equal to that of the Pyrenees.

In a good season the quantity grown in America is about 50 millions of tons of grain. The principal area in the United States may be described as a rude ellipse 900 miles long from east to west by 600 miles wide, with Springfield, the capital of Illinois, as its centre. This region produces about 1,500,000,000 bushels or nearly three-quarters of the total crop of the entire country.

As an article of food, maize is one of the most extensively used grains in the world, besides being very rich in nitrogenous matter; it contains more oil than any other cereal. It is usually sown in April

and drilled, three seeds or grains being placed in a hole made in the ground, each hole being 1 yard apart and the rows $\frac{1}{2}$ a yard from each other. Its vital power is great, and in four days the young shoots can be seen coming up. It is largely grown for forage, and gives a very heavy crop, as much as 80,000 lbs. (green) per acre. In the treeless western prairies it is often used for fuel, as in many places fuel cannot be procured so cheaply in any other way. A quantity amounting to 100 bushels of ears is equal in heating power to a cord of hardwood, and may be grown at a cost less than a cord of hardwood can be bought in the large cities.

Besides being an article of food, its uses are various; oil (specimen exhibited) extracted from maize is a good illuminant. When it is cultivated for grain, the dried leaves are used as fodder. The stalks are used as thatch and fuel, and for making baskets. The fibres of the culm and leaves make a durable kind of yarn. The husks are elastic, and can be used for stuffing chairs, saddles, and to the manufacture of good durable mattresses, which have become a profitable trade in Paris and Strasburg. The husks are much used for packing oranges and lemons, and in South America for cigarettes, and a good paper can be made out of them. Hollowed corn cobs make homely but serviceable pipe heads for smoking tobacco. In Europe the most suitable countries for the growth of maize are those of the Danube. The general configuration of the country is an inclined plain sloping down from the Carpathian Mountains to the northern bank of the Danube, and it is traversed by numerous watercourses (many of which are dry in summer) taking their rise in the mountains and falling into the great river, and which render the countries well adapted and suitable for its growth.

TABLE A.—Imports.

Years.	European maize.	American maize.	Rice.
	cwts.	cwts.	cwts.
1898.....	57,169,000	37,463,000	4,546,000
1897.....	53,785,000	39,645,000	5,178,000
1896.....	51,772,000	27,427,000	4,531,000

From the above table you will notice the European countries are the chief source of supply to Great Britain and Ireland, and indeed it is

the maize grown in Europe which is preferred by the English makers of flaked malts, and which, in considering the manufacture of flaked malts, we must keep in mind. Fortunately for the makers of flaked malts, this class of maize is more regular in size and more approaches to the round in shape; indeed, on the markets it is called round maize, and is chiefly shipped to this country from Odessa and Galatz. Climate has much influence on its physical characteristics, and it is a noteworthy fact that seed of American maize grown in Europe loses its distinctive character. The first year's growth being less in height, and in three successive years nearly lost all resemblance, and in six years has completely changed and cannot be distinguished from the native grown variety. The same feature is noticed if seed from European maize be sown in America, the plants quickly adapt themselves to their new conditions and lose their distinctive European character. The same features are observable with this cereal when grown in America, as certain varieties will not grow and flourish in both the Northern and Southern States. It is very prolific and will multiply in some cases over 1000-fold. Mr. Darwin, in his *Animals and Plants under Domestication*, notices the following facts, and writes: "Some kinds a single grain equalled in weight seven grains of another variety. The grains of some kinds were broader than long; some kinds the grains were longer than broad. They differ greatly in precocity, and have different powers in resisting dryness and the action of violent winds. A white variety is grown on the Pyrenees and on the plains of Piedmont; it has been cultivated for nearly a century and undergone no change of colour." Mr. Darwin also says the different races or kinds vary in height from 16 or 18 inches to 18 feet.

The Corn Palace Festival is usually held in late September or early October. This palace is built entirely of maize stalks, ears, and grain, and consists of all sorts of rooms and apartments with balconies. The effect of the different hues—dark red, white, and light orange exhibited by grain of different States is very striking. This annual festival of the Corn Palace is held to give a practical exhibition of the great capacity of the United States for rearing Indian corn or maize, as it is termed in this country.

The following table may be taken as fairly representative of the composition of maize, flaked maize, rice, and flaked rice. They are the averages drawn from as many sources as I can get, yet it must not

be understood the flaked maize is from actually the same maize or the flaked rice from actually the same rice, but the analysis may be taken as approximately correct.

Chemical Composition of Rice and Maize.

	Maize.	Flaked maize.	Rice.	Flaked rice.
	Per cent.	Per cent.	Per cent.	Per cent.
Starch	69·33	83·61	78·48	81·36
Water	13·35	4·81	11·58	8·13
Albuminoids	9·45	8·69	6·73	7·21
Oil	4·29	0·94	0·88	0·83
Fibre	2·29	1·60	1·51	1·64
Ash	1·29	0·45	0·82	0·83
	100·00	100·00	100·00	100·00

There followed an exhibition upon the screen of the various machines used in the manufacture of flaked malts, and their respective action explained. The process of manufacturing maize into flaked maize taking about two hours.

The following diagram illustrates the flow of the materials, maize or rice, to flaked maize or flaked rice.

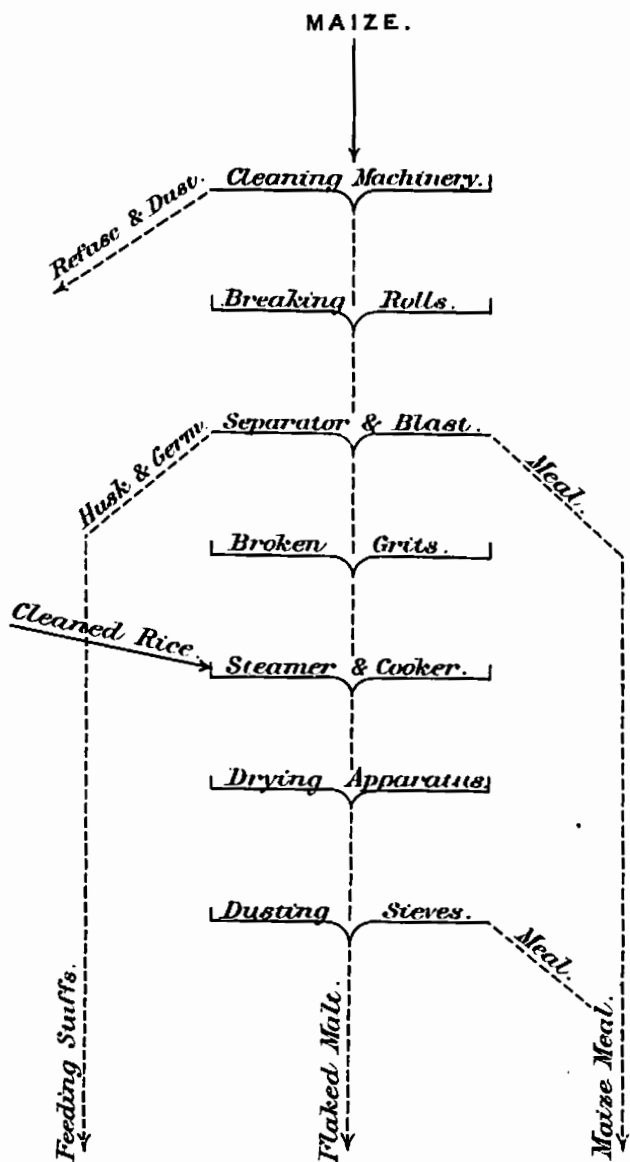
Rice, as explained earlier, is now almost entirely decorticated abroad, hence, as we know it, it is cleaned and ready for use, therefore does not require a preparatory process like maize. It joins the flaking process at the steamer and cooker process, see diagram "Cleaned Rice." The rice may have been subjected to a few hours' immersion in water to soften and swell the starch granules.

DISCUSSION.

Mr. W. O'CONNOR said he understood that flaked maize contained less albuminoids than maize itself, and that had been put forward in recommendation of the former.

Mr. FAWCETT replied that was so as regarded soluble albuminoids.

Mr. A. J. MURPHY said it added greatly to the interest of a paper of the sort they had listened to when the author claimed to be the actual inventor of the material dealt with, and it would doubtless be



interesting to many of them to know something about the date when the author claimed to have invented the materials known as flaked grain. With regard to the analysis of the sample of maize, the percentage of oil seemed to him very much smaller than usual, 4.29. He had been under the impression that the average would come out somewhat higher. That might perhaps be an exceptionally good specimen. Could Mr. Fawcett inform him whether maize had actually been malted? He meant had it been passed through the ordinary malting process, and if so, did the malt contain any considerable amount of enzyme. He could imagine that if it furnished enzymes at all in proportion to the amount of albuminous matter present, it would have all the elements of making a very first-rate flavoured malt, as no doubt the flavour of malt was due very largely to the albuminoids.

Mr. FAWCETT, in reply, said within the recollection of most of the gentlemen present, there was an alteration in law in relation to the change of charge from malt duty to the charge on the mash tun. That law came into operation on the 1st October, 1880, and if they searched the Patent Records they would find his name as the patentee for the process, so that when he put forward this claim he was on sure ground; or if they liked to send 8*d.* to the Patent Office they can have a copy of his specification, dated October 1st, 1880. The percentage of oil given was the average of many samples. It was well known that the oil varied very largely in different corn, and he agreed with Mr. Murphy that it was perhaps lower than might be expected. He had dealt largely with American maize, and should say it was 5 per cent. Maize was malted in this country; he had a book, at least 60 years old, in which the process was described. There was no doubt maize contained *cytase*, which was one of the enzymes Mr. Murphy had alluded to, and there was also no doubt that the action upon the starch would be practically the same as in other cereals, and in this respect there was not much variation.

Mr. MURPHY said he supposed he might take it that the malting of the maize was a failure?

Mr. FAWCETT replied that, on the contrary, it was a success.

Mr. ARTHUR ROGERS inquired if yellow maize contained more oil than white maize.

Mr. FAWCETT said he thought not. He believed there was no very striking difference.

Mr. C. V. MATTHEWS inquired if there was less oil in European maize than American maize.

Mr. FAWCETT replied that the oil varied ; in European maize it was about 5 per cent. He did not think there was an excess of oil in European maize.

Mr. W. O'CONNOR said he had much pleasure in moving the vote of thanks to Mr. Fawcett for his interesting paper. The vote of thanks was seconded by Mr. GODDARD, and carried unanimously.