

## ABSTRACT OF PAPERS

### TWENTY-SECOND ANNUAL SUMMARY OF CHEMICAL LABORATORY REPORTS

#### South African Sugar Factories, Season 1946-47.

By H. H. DODDS and J. L. DU TOIT.

For the third successive year rainfall, 32.02 inches, and humidity have been very low, though the rainfall was not quite so unfavourably distributed as in the two preceding years. The mean annual temperature, 69.4°F., was considerably above the average, and the total hours of sunshine, 2,446.3 or 56.3 per cent. of the total hours of daylight, were the highest on record at the Experiment Station.

During the 1946-47 season 3,990,017 tons of cane were milled to make 474,769 tons of sugar, 98.70 pol., which represents 2.27 per cent. of the cane sugar and 1.51 per cent. of the estimated total world production of sugar. Largely as a result of the drought conditions, the average sucrose and fibre contents were high, 14.21 and 16.21 per cent. respectively, but the purity of mixed juice low, 85.86 per cent. The peak of purity of mixed juice and the lowest reducing sugar ratio occurred abnormally early in the season, during June.

The proportions of Uba and Co.290 continue to diminish, only 1.91 and 2.65 per cent. respectively being crushed, while the Co.301 has increased to 28.16 per cent., and Co.281 still constitutes the bulk of the crop, 63.25 per cent.

Extraction, 93.07 per cent., and boiling-house recovery, 89.12 per cent., are both somewhat lower than the previous season; but the reduced overall

recovery, 83.82 per cent., continues to rise and is a record for Natal. The ratio of cane to sugar, 8.36, is one of the best ever recorded. Moisture in bagasse remains high at 50.32 per cent. Losses in filter cake fell to the new low level of 0.28 per cent. of sucrose in cane. The average loss of sucrose in molasses cannot yet be calculated, but the molasses purity, 41.75 per cent., is the lowest yet attained in Natal for a season.

Of the 19 factories reporting, two crushed at a rate in excess of 133 tons per hour (about 21 tons fibre per hour) to make 55,562 and 53,810 tons of sugar for the season, and two had a crushing rate of less than 25 tons of cane per hour.

Agricultural Census Returns for the year 1945-46 show that European planters harvested 163,474 acres out of a total area under cane of 343,149 acres, or 47.64 per cent. of the total area under cane, and produced 4,201,699 tons of cane. The average yield, 25.70 tons of cane per acre, is considerably lower than the two preceding seasons. This decrease in yield is due to the cumulative effects of the drought cycle extending from November, 1944, and the continued fertilizer shortage. Native and Indian planters were responsible for the production of 405,356 tons of cane or 8.8 per cent. of the total crop.

### SUGAR MILLING IN NATAL AND SOME OBSERVATIONS ON THE VARIABLES CONNECTED WITH MILLING.

By J. H. G. ROYSTON.

The paper is based mainly upon data compiled from a comprehensive questionnaire filled in by sugar mills in Natal. It goes further than analysing the data collected, however, by introducing certain conclusions and theories relative to milling practice, which offer scope for further research.

In defining milling as a "process of extracting sucrose from cane by means of repeated pressure expressions of a rotary nature," the author qualifies this by detailed analyses of the variables which govern the extent of extraction. These are listed as: (a) Capacity rating, (b) Preparation for the milling process, (c) Roll pressures, (d) Maceration, (e) Peripheral speeds, (f) Mill settings.

The main points under these headings are as follows:—

**Capacity rating.**—Tonnage crushed in Natal increased between the years 1937 and 1945 by 11.7 per cent., with increased recovery of sugar as well. This increase in capacity was due largely to the development of new cane varieties and to added technique in operation.

The author develops his formula for assessing the capacity rating of a plant under Natal conditions as

$$\text{Tons cane crushed per hour} = \frac{D^2 \times L \times N}{6.17}$$

where  $D$  = diameter of rollers in feet;

$L$  = length of rollers in feet,

$N$  = number of expressions in milling train.

*N.B.*—For Natal, a shredder should be regarded as equivalent to one expression.

**Roll pressure application.**—Here the author treats the whole subject of hydraulic pressures applied to mill top rolls, on a mathematical basis. He asserts that milling action as between feed and discharge openings, gives a resultant in the pressure applied of over  $30^\circ$  to the vertical. As a consequence of which the actual pressure exerted by the top roll on the feed side is only one-sixth of that on the discharge side. Hence at feed/discharge ratios of 2:1 and over, no volumetric reduction is attained at all on the feed side. Proof of these contentions is given by force vector diagrams and an analysis of compression tests made on wet bagasse.

**Maceration.**—The effect of hot maceration is problematical, and the effective limit of application is 40 per cent. by weight of cane crushed.

**Peripheral speeds.**—High and low speeds are analysed, and the conclusion is that there is not sufficient evidence to indicate the most efficient speed between the limits of 15 and 30 feet per minute.

**Mill settings.**—Volumetric reduction of the cane mass leads to higher bagasse densities. In fact, the whole theme of the paper centres on attaining a standard bagasse density of 75 lbs. per cubic foot, which corresponds to a final moisture of 45 per cent. and 95 per cent. extraction, irrespective of the fibre content in cane. Here the author develops his theory of setting mills by means of bagasse coefficients and explains fully the methods of calculating  $U$  both by evolution and by graphs.

The paper is well illustrated by diagrams and graphs. Tables and statistical data are also provided.

## SOME DEDUCTIONS ON THE EXTENT AND CHARACTERISTICS OF THE STEAM DEMAND OF VACUUM PANS.

By G. A. DUNN and W. F. NELSON.

The authors review the process steam requirements of vacuum pans in sugar factories and refineries from a somewhat new standpoint.

Emphasis is placed on the severity of the fluctuations which characterise this service, and a method is described whereby the curve of unrestricted steam demand of any conventional sugar boiling house can be calculated from particulars of the pan capacities, initial charges and the boiling sequence.

This method is applied to a representative working day in a selected sugar factory and refinery, and the

curves so derived are related in time to that of the high-pressure steam pressure chart for that day, thus illustrating the association between the rate at which the pans draw steam, and the fluctuations which take place in boiler pressure.

The authors describe the principles underlying the application of the steam accumulator to variable process steam demands, and also the method for determining the extent to which the demand is out of balance, and therefore the theoretical storage capacity required to stabilise boiler output.

## LABOUR-SAVING DEVICES (FACTORY).

The Factory Labour-Saving Appliances Committee issued a questionnaire to 18 factories and 12 replies were received, but these were often not sufficiently detailed. Apart from the installation of plant in the high-cost category, surprisingly little has been achieved in the past three years. There are many small effective devices which can be installed at a small cost, and will pay handsome dividends in labour units saved.

Some remarkable results in labour saving have been accomplished by the installation of moderately-priced machines. Thus in one case 47 units of labour were saved at an initial cost of £2,160. It is difficult to evaluate new modern plant on a labour-saving basis only, for it is often associated with improved manufacturing technique.

Quite a number of labour units could be dispensed with if rearrangement of plant were considered, but

this was often difficult in the old factories. Centralization of the laboratory inside or close to the factory, to facilitate sampling and the possible preservation of samples, offered possibilities in saving labour in chemical control.

Labour-saving must not be carried so far as to impair the efficiency and control, and it should not become uneconomic in outlay and maintenance.

Members of the Factory Labour-Saving Appliances Committee were :—

G. C. WILSON.

J. H. G. ROYSTON.

G. C. DYMOND.

A. H. RISHWORTH.

G. SEYMOUR.

F. B. MACBETH (*Chairman*).

## CORRELATION AND ITS APPLICATION TO CERTAIN PROBLEMS IN THE SUGAR INDUSTRY.

By. W. O. CHRISTIANSON.

Casual examination of South African sugar factory returns shows a general improvement year by year in extraction of sucrose by milling and recovery of sucrose from mixed juice.

This improvement is due to increased factory efficiency, and is so great that it masks the effect of the "quality factor" fibre per cent. cane and purity of mixed juice. As a consequence of this masking, doubts have been expressed about these "quality factors" having any effect on the extraction and recovery figures. A statistical examination was therefore made of these results.

A brief description of the terms, correlation coefficient and regression coefficient, both total and partial, is given, and methods of calculation of these coefficients are shown.

Average figures, covering the seventeen-year period 1929 to 1945, for the twelve factories which reported regularly to the South African Sugar Association's Experiment Station, were then subjected to analysis by statistical method.

The method followed in the analysis of the averages is to fit regressions on time for the varieties involved and to correlate the residuals from these regressions. After thus eliminating the improvement associated with time the following conclusions are reached:—

1. There is a highly significant association between fibre per cent. cane and milling extraction. The partial correlation coefficient for the seventeen-year period is  $-.74$ , and for the eleven-year period, following the bad locust year, 1934, the coefficient is  $-.87$ .

2. No correlation can be proved to exist in these averages between sucrose per cent. cane and milling extraction. This is explained by a highly significant correlation between sucrose per cent. cane and sucrose per cent. bagasse.

3. A highly significant association is found between purity of mixed juice and boiling house recovery, the partial correlation coefficient being  $+72$ .

## FOOD YEAST.

By F. O. READ.

The Food Yeast Development Co. started erecting a semi-commercial plant at Merebank in 1945, to investigate the possibility of producing food yeast locally, determine costs of production, and simultaneously to provide sufficient quantities to allow it to be efficiently tested under South African conditions.

Numerous production difficulties were encountered initially, primarily due to lack of suitable equipment during war-time and insufficient knowledge of aeration, foaming and infection problems. The production technique has now been mastered and the single

generator, working continuously for a week at a time, has been producing at a steady rate of 610 lbs. per working day for several months. This represents 7.3 lbs. of food yeast per cubic foot of generator capacity per day. Some further increase is likely. This rate is considerably in excess of production rates published for any other food yeast factory.

Whether or not the Union Government is to foster food yeast production on a large scale is largely dependent on the outcome of feeding tests still in progress.

## AN ITEM IN CONSERVATION.

By G. C. DYMOND.

The conservation of land, water and fertility have assumed great importance. In Bengal, farmers are encouraged to turn the water hyacinth into a composted manure, and Sir Albert Howard has recently suggested that the watercress be used in England, and the hyacinth in the tropics, for trapping fertility lost in sewage effluent.

In South Africa the water hyacinth has recently been deproclaimed as a noxious weed. Planters have started raking the plants from the choked Zululand rivers and putting them on the land. The water content of the hyacinth is exceedingly high, about 94 per cent., and collection and transport may easily be uneconomic. A simpler and less costly method

would be to drag it on to the banks of the rivers and compost it there. Analyses of the dry material vary considerably, but where grown on water high in nutrient it is found to be very rich in N.P.K. and with its very rapid rate of reproduction it may prove

the only practical way of recovering some of the vast quantities of fertility lost and wasted to-day.

Sorghums are another potential source of raw materials for composting in some parts of Natal.

## AN INVESTIGATION INTO SUGARCANE BREEDING IN SOUTH AFRICA.

By P. G. C. BRETT.

The total rainfall during December, January and February may be of importance in Natal in determining the amount of flowering of sugarcane during the following winter. Though sugarcane does set seed in Natal, its low fertility increases the importance of the technique used in crossing. No improvement was found on the Hawaiian solution of 0.01 per cent. phosphoric acid and 0.01 per cent. sulphurous acid for preserving cut canes, but a solution containing 0.008 per cent. of each of six acids (benzoic, acetic, nitric, sulphuric, phosphoric and oxalic) appeared nearly, if not quite as good. By rooting cut canes in

pots placed above the preserving solution, it was possible to preserve in a healthy condition canes from the time of the first indication of flowering until seed cutting, and indications were found that by preserving canes by this method and keeping them under artificial conditions which included high temperatures and humidity and increased length of day, pollen fertility could be increased. Crosses carried out in the glasshouse gave a larger number of seedlings than similar crosses made in the field. The total number of seedlings raised during the last three years from seed produced in Natal is 11,878.

## SOME RECENT IMPROVEMENTS IN AGRICULTURAL MACHINERY USED IN THE SUGAR INDUSTRIES OF LOUISIANA AND QUEENSLAND.

By H. H. DODDS.

The need for labour-saving agricultural methods and appliances in the sugar industry of this country is pointed out, and developments of new implements in other countries that might be adapted to South Africa are mentioned, having regard to our special conditions and requirements.

Cane harvesters, cane loaders and other agricultural machines in Louisiana are described and discussed.

E. R. H. Behne's report to the Queensland Department of Agriculture on a visit to Louisiana and other countries to study the mechanical harvesting and

loading of cane and other aspects of the sugar industry is abstracted.

Mr. Behne's description of cane harvesters and loaders designed and used in Queensland is also quoted in some detail.

The conclusion is arrived at that, for various reasons, Queensland cane harvesters and loaders are probably more adaptable to South African conditions than those evolved in Louisiana.

A note of preliminary inquiries made into labour-saving devices on sugarcane plantations in this country is included.

## TRENDS IN CANE AND SUGAR YIELDS IN NATAL.

By J. L. DU TOIT.

The yield of cane per acre has increased about 50 per cent. in Natal since the introduction of new varieties. This increase is not entirely due to the new varieties which are now planted to the near exclusion of Uba, for the yields of these varieties as a group and Uba by itself have also increased very appreciably, indicating increased soil productivity. There

are no signs of soil deterioration to be found from an analysis of cane yields in Natal from 1922 to 1944.

Contrary to expectations, the average sucrose content of cane has not increased, but higher cane yields have ensured a correspondingly greater production of sucrose per acre. Factory efficiencies have

improved from about 73 per cent. overall recovery in 1925 to more than 83 per cent., and about  $3\frac{1}{2}$  tons 96° pol. sugar are now recovered per acre from the two-year cane crop.

Zululand has profited most from the introduction of new varieties, although the sucrose per cent. cane has not increased. In 1926-30 the yield of sucrose per acre harvested was 2.75 tons and for 1940-44 the average was 3.69 tons per acre. Soil productivity, assisted in certain cases by irrigation, has reached new high levels on the North Coast, which is now the highest yielding area. The trend in sucrose per cent.

cane has been slightly downwards here, but this area has shown the greatest increase in tons sucrose per acre—from 2.73 tons in 1926-30, to 3.94 in 1940-44. On the South Coast cane yields are somewhat lower than in the two previously mentioned areas. The new varieties do not outyield Uba by the same margin as in Zululand or on the North Coast, consequently the same increase cannot be expected. This area has also suffered most in the recent drought cycle, and there is a tendency to cut rather larger proportions of old ratoons. The average sucrose per cent. cane has, however, been decidedly on the increase in this area.