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NOTES AND COMMENTS

U.S. sugar crops[1].

The 1965 sugar beet production of 20,915,000 tons was the third largest on record, being exceeded only by the 1964 crop of 23,389,000 tons and the 1963 crop of 23,328,000 tons. Growers harvested 1,248,000 acres of beets, 1% less than for the preceding year when the acreage was not restricted. The yield per acre was 16·8 tons, the same as a year earlier but 2·1 tons below the record yield in 1963.

Production of sugar cane for sugar, at 22,785,000 tons, was 1,532,000 tons less than in the preceding year. The Mainland crop totalled 12,047,000 tons, 13% less than the 1964 record. Reduced output largely resulted from a 12% decrease in the acreage harvested owing to acreage controls in 1965. Growers in Hawaii produced 10,738,000 tons of cane for sugar, 2% more than in 1964 and the third consecutive record crop. The 98·0 tons of cane harvested per acre in Hawaii also set a new record, surpassing by 3·3 tons the record set in 1964.

Production of beet and cane sugar amounted to 5,223,000 tons, raw value, down from 5,614,000 tons in 1964. Beet sugar production of 2,901,000 tons was 387,000 tons less than for the preceding year while cane sugar output of 2,322,000 tons was only 4000 tons less. A decrease of 43,000 tons in Mainland cane sugar production was practically offset by an increase in Hawaii. The 1965 Hawaiian output of 1,218,000 tons set a new record.

* * *

Argentina sugar industry re-organization.

The Argentine sugar industry is in process of rationalization. A Government decree closing seven mills in Tucumán province has not come as a surprise except for the rapidity with which the decision was reached[2]. This brought the total of closures to eight since Ingenio San Antonio was closed a little earlier and declared bankrupt.

As C. Czarnikow Ltd. comment[3]: "Argentina has always been a relatively high cost producer, aiming to cover domestic requirements with, perhaps, only marginal quantities for export. The Minister of Economy, who is at present in Tucumán with the chairman of the National Sugar Board for the purpose of drafting future plans for the industry, is reported as saying that production costs in Argentina are about five times the return obtainable on the world market. Following the high carry-over stocks from last season of some 400/500,000 tons, legislation was introduced some time ago limiting the maximum quantities of cane which could be delivered to the factories this season, details of which appeared recently[4]. It appears that the action taken by the authorities during the past week regarding several mills in Tucumán is a forerunner of a more widespread policy of rationalization within the industry.

"Although Tucumán is by far the largest sugar producing province, the average yield of white sugar from cane over the past five seasons stands at 7·829% which compares with 9·676% in Jujuy and 10·145% in Salta over the same period. For some time the authorities have sought to transfer the greater part of the sugar industry to the latter two provinces where higher yields are obtained but until now there has been a strong resistance to such moves as the industry is the main employer of labour in the province of Tucumán. It is understood that jobs in government-sponsored building projects of roads and dams will be offered to those who lose their employment in sugar mills which have been taken over by the authorities."

* * *

U.S. sugar quotas, 1966.

The U.S. Dept. of Agriculture announced two further increases of 50,000 tons in the estimate of total sugar requirements, on the 19th and 31st August, respectively, bringing the total quota from 10,225,000 to 10,275,000 and then 10,325,000 short tons, raw value. At the time of the earlier increase, deficits were also announced in the Philippines, Panama and Nicaragua quotas, amounting to 105,430, 17,590, and 31,040 tons, respectively.

An unusual feature of the consequent reallocation is that, instead of being pro-rated with the Nicaragua deficit among other Central America areas, the Panama deficit was given to the Dominican Republic, along with the Philippines deficit; this was done in accordance with the President's determination of the

[1] *Willett & Gray*, 1966, **90**, 251.
[2] *The Times*, 25th August 1966.
[3] *Sugar Review*, 1966, (778), 161.
[4] *I.S.J.*, 1966, **68**, 130.

17th August under Section 204 of the Sugar Act that it would be in the national interest to increase the quota for the Dominican Republic.

According to the U.S.D.A. announcement, "The President's decision stems from a recognition of the special importance of a large sugar quota for the Dominican Republic at a time when President BALAGUER's government is undertaking steps to modernize the Dominican sugar industry and to improve its administrative organization so as to contribute to the progress of their country".

Quota changes as a result of the two increases in the total requirement, and the reallocations, are tabulated elsewhere in this issue.

* * *

Brazil 1966/67 crop plans.

After a protracted period of careful consideration, Brazil's National Monetary Council approved plans for the 1966/67 crop[1]. Production of sixty-five million bags[2] of sixty kg of sugar is authorized compared with the nearly seventy-six million bags produced during the 1965/66 crop year. Raw sugar for export will amount to seven million bags in the North and seven million bags in the South compared with actual output of about thirteen and seven million bags respectively during the previous twelve months. Illustrative of the authorities' cautious approach to the problem of oversupply was the fact that authorization of a further two million bags of raws was made dependent on market conditions later in the year. Should the production of the additional quantity of raw sugar be allowed, the output of whites is expected to be reduced to forty-nine million bags. With a normal increase in consumption from last year's forty-six-and-a-half million bags, this quantity is unlikely to cover domestic requirements and the currently high domestic prices would then be reduced to more manageable levels.

The Brazilian crop plan is regarded in sugar circles as constructive in view of the fact that considerably more cane is available than required to fulfil it. Despite the problems involved in arranging financing for the cane left in the field, the Brazilian authorities have apparently decided to deal with the root of the problem of low prices: overproduction. It is to be hoped that this attitude on the part of one of the major suppliers of sugar to the world market will serve as an example worth following by other producing countries.

* * *

Canada-Caribbean Commonwealth sugar duties.

At a three-day Canada-Caribbean Conference on trade Canada has agreed to eliminate the duty on sugar imports from British Commonwealth countries in the Caribbean. It is understood that the duty will be waived on some 270,000 metric tons, the average quantity imported during the past five years. The Commonwealth tariff amounts to 29 cents per 100 lb, compared with the full rate of $1·29 per 100 lb. Allocation between the various West Indian countries is to be left to the exporters to decide and the arrangements will be subject to the agreement of other Commonwealth countries supplying Canada as well as possibly South Africa which enjoys a preferential tariff, and GATT approval will also be necessary.

C. Czarnikow Ltd[3]. remind their readers that: "Canada has been playing a major rôle in international sugar affairs and in fact was one of the signatories to the importers' document published during the UNCTAD discussions in Geneva in October last year. It is understandable, therefore, that in any revision of the 1925 Trade Agreement Canada should endeavour to improve the situation in which her traditional suppliers find themselves, particularly in view of the current ruinously low prices and the continued ineffectiveness of the International Sugar Agreement."

* * *

Caroni Ltd. 1964/65 report.

The year under review was marked by a very dangerous period of strikes and disorders in February and March 1965, culminating in the declaration by the Trinidad Government of a State of Emergency in the sugar area. Despite this, a record crop of 226,000 tons of sugar was taken off. As about a quarter of Caroni's sugar was sold at prices related to the low 1965 world prices this has led to a most marked reduction in profits. It is fortunate that one-half of the sugar could be sold at the Negotiated Price under the Commonwealth Sugar Agreement.

Sugar production totalled 226,400 tons compared with 205,121 tons in 1964 and 196,225 tons as the average for 1962–64. Although a cane:sugar ratio better than normal for Trinidad should have resulted in a reduction in cost of production, costs were seriously affected by wage increases to which the Company had to accede during the period of high world prices in 1963 and 1964. Trinidad, in common with other West Indian countries, is now a high cost producer, with employment problems which discourage measures to increase mechanization and thereby decrease costs.

Work on the renewal of the older of the two mills at Ste. Madeleine and on increasing the factory capacity to take advantage of long term market requirements was progressing well and was to be substantially complete by the end of 1965. The total sum involved in this work is approximately £2,100,000 and this is an indication of the high capital cost of a modern sugar factory.

[1] *Czarnikow-Rionda*, 7th July 1966.
[2] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (22), 14.
[3] *Sugar Review*, 1966, (772), 134.

BEET RECEPTION & BEET COSTING

by N. H. BRINTON and J. F. WARRINER

Paper presented to the 18th Technical Conference of the British Sugar Corp., 1966

PART II. BEET COSTING

Before describing the beet accounting system of the British Sugar Corporation, it might help to trace the development of data processing within the Corporation since the setting up of the Mechanized Accounting Department fifteen years ago.

Prior to 1950, each factory was responsible for payment of beets delivered by its own growers. Details from weighbridges and tare-house were passed to the factory beet department, where temporary clerks, using ready-reckoners, calculated the load value. A copy weigh-ticket showing sample results, unwashed weight, clean weight, haulage charges, unloading allowance, and value of load was sent to the grower.

The relevant postings were made to the grower's statement of account, which was updated daily. At the end of the month, these statements were totalled and balanced, and a cheque was prepared, again by hand, for the payment to the grower.

This system had worked quite efficiently for many years, and usually the factory beet department could supply any required information about beet deliveries.

In 1950 the late F. W. Page, then Head of the Organization and Methods Department, was asked to investigate the preparation and settlement of growers' accounts using a punched card system. An experiment was carried out at Bury St. Edmunds factory under the direction of the late A. E. Preddy, then Accountant at that factory. On this system, the tare-house results were calculated to give average tares, and entered to the weigh ticket, which then contained all the information relating to the load. From this ticket a Hollerith card was hand-punched. Then all the necessary calculations, to give the value of the load, were completed using Unit-record machines supplied by British Tabulating Machine Co. (now I.C.T. Ltd.). This experiment was quite successful, and at the end of the 1950/51 campaign, a Mechanized Accounting Department was created.

Over a period of four years, this system was extended to cover payment for beets delivered to all factories. Though the payment of growers' accounts was the prime consideration, other problems, such as maintenance costing and analysis of agricultural records, were taken over during this period.

By 1961 the Mechanized Accounting Department was equipped with I.C.T. tabulators and calculating equipment, which, even though we had more than thirty machines, allowed very little scope for expansion. So it was necessary to undertake an investigation into the feasibility of using a computer, both to handle the existing routines and to extend and activities of the Department.

Three machines were considered: the I.C.T. 1301, the I.B.M. 1401, and the Ferranti "Pegasus". At the time of the investigation I.C.T. could not demonstrate a machine in actual operation with magnetic tapes attached. The "Pegasus", being a valve machine, as against the transistors of the other two, would have needed approximately ten hours per day to carry out the beet accounting system. We therefore ordered the I.B.M. 1401, which was delivered in May 1963. This machine has operated satisfactorily for three beet campaigns.

In April 1964, I.B.M. announced their System 360 range of computers and it was considered that this new machine would have an operating life of 12 to 15 years. It was felt that although the 1401 was sufficiently powerful to extend its activities to other applications, it had a very limited life. We therefore placed an order with I.B.M. to replace the 1401 with a 360 system of similar specification to be delivered in May 1966. We then considered exactly what configuration would suit the Corporation's requirements over the next five to ten years. It was certain that many new applications would be considered for computerization, and among those would be wages, stock control and sugar distribution. Then there were the specialist requirements of the Technical Department, Central Laboratory and the Statistical Department. All of these various applications called for some method of random access to stored information. So we changed the configuration of the machine ordered, to give us disc drives as well as magnetic tape units.

Beet Costing 1966/67

For the 1966/67 beet campaign the Data Processing Department will be receiving data from factory weighbridges and tare-houses as detailed in Part I of this paper.

Paper Tape Systems

Bardney

In Weighbridge		5 track telegraphic code
Out Weighbridge		
Tare-house	Dirty Scale	
	Clean Scale	5 track telegraphic code
	Saccharimeter	

Wissington

In Weighbridge		8 track—Sorensen code
Out Weighbridge		8 track—Sorensen code
Tare-house	Dirty Scale	
	Clean Scale	8 track—ASCII code
	Saccharimeter	

Allscott

In Weighbridge		8 track—Sorensen code
Out Weighbridge		8 track—Sorensen code
Tare-house	Dirty Scale	8 track—Sorensen code
	Clean Scale	8 track—Sorensen code
	Saccharimeter	8 track—Sorensen code

The tapes from these three factories will be transmitted daily via telephone lines to the Data Processing Department.

CARD SYSTEM

Brigg *Bury* *Cantley* *Ely* *Felsted* *Ipswich* *King's Lynn* *Newark* *Peterborough* *Selby* *Spalding* *York*	In Weighbridge Out Weighbridge	Punched Card No. 2
	Tare-house: Dirty Scale	Punched Card No. 3
	Clean Scale	Punched Card No. 4
	Saccharimeter	Punched Card No. 5

The cards from these factories, with the exception of Peterboroug, hare despatched by passenger train to be collected from Peterborough station at 8 a.m. each day.

HAND SYSTEM

Cupar *Kidderminster* *Nottingham*	In Weighbridge	
	Out Weighbridge	
	Tare-house Dirty Scale Clean Scale Saccharimeter	Tare and Test sheets

Weigh and tare sheets from three factories are mailed to Peterborough, where cards are punched, similar to those produced automatically at other factories.

Twelve main programmes are necessary to deal with the information received from factories, and to produce the daily advice notes and various tabulations and analyses required by factories. Sixteen programmes are required in the month-end routines to print growers' accounts, cheques and checking lists.

The weighbridge information, whether on paper tape or punched cards, is tabulated on the computer in the case of paper tape or on an off-line tabulator in the case of punched cards, to give totals of gross weight, tare weight and number of loads. These totals must agree with control figures prepared at factories.

Then all cards and paper tape are fed to the computer and each record is edited to ensure that the data it contains are acceptable before the details are written on to disc. This editing programme can be written to check any information for which limitations and standards can be laid down, e.g. sugar content must be within the range 11·0% to 22·9%. Records which are unacceptable are automatically rejected by the computer, to enable queries to be raised with the receiving factory. When all cards and paper-tape have been read, we have a disc filled with records in random sequence; for a normal day this would be 8,500 loads, 34,000 records. The computer next sorts these records so that all information for a load is together, in order that these details can be processed to evaluate individual deliveries.

This processing gives a list of tare-house results, and magnetic disc records of all cleared loads. During this operation the computer programme has to check that a complete set of valid results has been received for each load. Details of loads, which cannot be cleared for any reason, are listed to enable the receiving factory to settle the queries. After sorting to contract number sequence the records of cleared loads are matched against a master disc, containing the names and addresses for all growers, in order to print a Daily Beet Advice Note for each grower making a delivery on this day.

Daily during the campaign some 5000 advice notes are printed and these are automatically folded, inserted into envelopes and despatched to growers, usually on the day after the original information is received in the Data Processing Department. Tabulations giving analyses of beets received and beets contracted are sent to each factory, and it is endeavoured to return these on the day of receipt of data.

Details of other postings to growers' accounts are sent daily from factories, and a card is punched and verified for each entry.

Month-End Routine

The grower's contract stipulates that payment must be made twelve days after the end of each accounting period, and, with the equipment which was originally used in Mechanized Accounting Department, it was not possible to pay all growers in the limited time available. Therefore the eighteen factories of the Corporation were split into three groups for purposes of payment. Six factories are paid to the 10th of each month, six factories to the 20th and six factories to the end of the month. When the computer was installed, it would have been possible to settle all accounts in one payment, but we saw no reason for changing a system which had many practical advantages.

When all postings for an accounting period have been received from the six factories, statements of account are tabulated for every grower who has had any transaction during the period. A cheque is produced for each credit balance of more than £2.

Thus every ten days during the campaign, 15,000 statement forms and 8000 cheques are printed and despatched to growers. At this time a summary of all growers' total deliveries is prepared for fieldmen and factories. A monthly list of haulage charges, for beet deliveries and pulp collections, made to growers is tabulated to enable factories to check the accounts rendered by hauliers.

At the end of the campaign the Department is required to analyse the season's results as requested by various other departments of the Corporation. For example, deliveries are tabulated according to the method of unloading, and growers' results are summarized to give total weights and value, average root weight, average yield per acre, average sugar content and plants per acre.

EFFECT OF FILTER AID CONCENTRATION ON THE FILTRATION RATE OF RAW SUGAR SOLUTIONS

By PETER HIDI and D. N. SUTHERLAND

(C.S.R. Research Laboratories, Roseville, N.S.W., Australia)

PART I

INTRODUCTION

STUDY of slurry filtration and factors influencing slurry filtration rates[1, 2, 3] has helped the design of more efficient filter stations[4], but there is little theoretical knowledge of systems containing both filter aid and filter blocking impurities and of the evaluation of their influence on the filtration rate[5,6,7,8]. A more quantitative understanding of the principles involved concerning the effects of both filter aid and impeders on the rate of filtration may help in selecting the optimum conditions in sugar refining.

We now present some results which show the principles according to which filter aid concentration can be determined to obtain the maximum filtration rate of simple systems consisting of solution with various amounts and quality of suspended impurities and a rigid filter aid.

The filtration rate of a mixture of raw sugar solutions can be simply calculated, within certain limitations, by adding the filtration impeding activity of the components according to the percentage they contribute to the mixture[9]. Thus

$$Fia = p_1.Fia_1 + p_2.Fia_2 + \ldots p_n.Fia_n \quad \ldots\ldots\ldots (1)$$

when $p_1, p_2 \ldots p_n$ is the percentage/100 of first, second . . . n-th sugar in the mixture and Fia is the corresponding filtration-impeding activity, defined[9] as the negative logarithm of the filtrability (F), the latter expressed as a simple fraction and not a percentage, as is commonly used in the industry:

$$Fia = -\log F \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Filtrability (F) as defined and obtained according to NICHOLSON[10] is the rate of filtration of the 60·0°Bx sugar solution, measured in a special bomb type filter under strictly standardized conditions, divided by the rate of filtration of pure sucrose solution measured under identical conditions.

The filtration-impeding activities calculated according to equation (2) can be regarded as the hypothetical concentrations of the impurities interfering with filtration. The exponential correlation between rate of filtration and filtration-impeding impurity is the consequence of gradual blocking of the filter cake pores by the impurities[11]. While most of the earlier published filtration work from this laboratory[9, 10] was simplified by using strictly standardized conditions, this present work shows that the filtration-impeding activity concept is applicable in a wider field.

To limit the problems, the work described below was also carried out under standardized conditions similar in part to those of the NICHOLSON test. In contrast to earlier studies, however, the concentration and quality of filter aid, and in a few experimental series the filtering area and the sucrose concentration also, were altered systematically, but to secure sufficient control of the experimental conditions only rigid filter aids such as "Celite 505", "Supercel", and fiberized blue asbestos were used. The extension of the field to precipitated filter aids such as calcium carbonate brings in further problems due to the effect of impurities on the precipitation and is not dealt with at this stage.

EXPERIMENTAL CONDITIONS

It is known that as the amount of filter aid added to a sugar solution of poor filtering performance is increased, a maximum occurs in the graph of filtration rate *versus* filter aid concentration. In Fig. 1, the filtration rate of sugars of varying filtration performance is shown as the function of the applied filter aid concentration. The filter aid concentration (a) is expressed in units, one unit being the concentration of filter aid required in the NICHOLSON filtration test, i.e. 0·5 g "Celite 505" per 100 g of solids.

Variables which affect filtration rate such as pressure, time, filter area, temperature, sugar concentration, etc., are standardized in this work by fixing these parameters according to the requirements of the filtrability test[9,10], and the results are also expressed in standard sugar filtration rate units. The unit of filtrability (F) and, in this paper, the unit of filtration rate (f), is the filtrability of pure sucrose (standard sugar) with 1 unit (0·5 g/100 g solids) filter aid concentration under the standard conditions[9,10].

[1] CARMAN: *Trans. Inst. Chem. Eng.*, 1937, **15**, 150; *ibid.*, 1938, **16**, 168.

[2] TILLER and HUANG: *Ind. Eng. Chem.*, 1961, **53**, 529.

[3] HEERTJES: *Trans. Inst. Chem. Eng.*, 1964, **42**, 266.

[4] HERTZBERG and MOUNTFORT: *ibid.*, 1959, **37**, 5.

[5] LA FRENZ and BAUMANN: *J. Amer. Water Works Assoc.*, 1962, **54**, 847.

[6] SUBBA RAU: *J. Madras Univ.*, 1959, **B29**, 109.

[7] CARMAN: *Ind. Eng. Chem.*, 1938, **30**, 1163.

[8] SHIRATO, SAMBUICHI and OKAMURA: *Amer. Inst. Chem. Eng. J.*, 1963, **9**, 599.

[9] NICHOLSON, HIDI and MCINTYRE: *I.S.J.*, 1961, **63**, 173, 201.

[10] *Proc. 9th Congr. I.S.S.C.T.*, 1956, **2**, 271.

[11] SUTHERLAND and HIDI: *Trans. Inst. Chem. Eng.*, 1966, **44**, T.122.

Filtration rate (f) is then the rate of filtration of the tested sugar with the *applied unit* of filter aid concentration under standard conditions, divided by the rate of filtration of standard sugar under the same conditions (pressure, Brix, time, temperature and filter area) but with 1 *unit* of filter aid concentration. It follows that the filtration rate of the tested sugar with one unit of filter aid concentration is numerically equal to the filtrability.

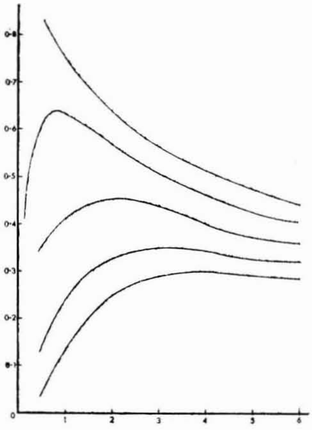

Fig. 1. Effect of filter aid concentration a on the filtration rate f of different sugars

Fig. 1 also shows that the concentration of filter aid required to obtain the fastest filtration rate varies considerably with the different sugars, as does the maximum attainable filtration rate.

It is supposed that these maxima are the result of two counteracting factors:—

(a) the increased amount of filter aid decreases the filtration rate by simply increasing the thickness of the filter cake formed on the filter.

(b) The addition of filter aid to a raw sugar increases the porosity of the cake which forms during the filtration process and hence increases the filtration rate.

In accordance with the model set up for describing the acting mechanism of filtration impeders, two hypotheses may be made for the relationship between filter aid concentration and filtration rate:

First, that the linear correlation between the log of filtrability (F), and filtration-impeding impurity concentration (Fii) or filtration-impeding activity (Fia):

$$-\log F = k\,(Fii) = (Fia) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2a)$$

is not only valid when applying the standard concentration of filter aid as was shown earlier[9], but a similar relationship exists for a wide range of filter aid concentrations.

Second, that the relative filtration rate of a sugar solution (see below), within reasonable limits, is independent of the concentrations of the harmful impurities and filter aid, depending only on the filtration-impeding activity/filter aid concentration ratio $\frac{(Fia)}{a}$. In other words, the relative filtration rate depends on the porosity of the filter cake which is influenced over a wide concentration range only by the filtration-impeding activity *versus* filter aid ratio.

The expression "relative filtration rate" is introduced here to distinguish it from the previously defined "filtration rate" (f). The relative filtration rate (f_{rel}) compares the rate of filtration of the tested sugar with that of the standard sugar under the same described conditions, and, in this case, the standard sugar is filtered with the same *filter aid concentration* as the tested sugar.

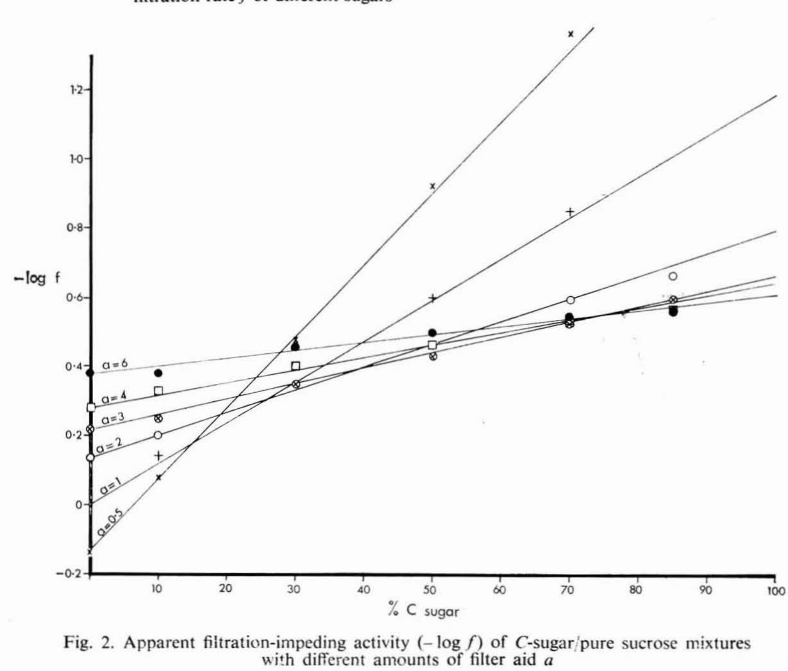

Fig. 2. Apparent filtration-impeding activity ($-\log f$) of C-sugar/pure sucrose mixtures with different amounts of filter aid a

To test these hypotheses, several series of standardized filtration rate measurements were made using the same *C*-sugar samples mixed with known amounts of pure sucrose. The concentration of filtration-impeding impurities was regarded as being proportional to the percentage of *C*-sugar in the mixtures. A rather wide range of filter aid concentrations (0·3—10 units) were tested with different values of *C*-sugar concentrations.

Results and Discussion

The results are collected in Table I. All the measurements are expressed as both filtration rate (f) and apparent filtration-impeding activity (Fia_{app}). The Fia_{app} values were calculated from measurements of filtration rate f, analogously to Equation 2.

$$-\log f = Fia_{app} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2b)}$$

The $-\log f$ results are recorded in graph form in Fig. 2 as the function of *C*-sugar concentration, in the presence of various filter aid concentrations.

Table I

The filtration rate (f) and apparent filtration-impeding activity ($-\log f$) of *C*-sugar/pure sucrose mixtures with various filter aid concentrations

Filter aid concn. (*a*) standard units		% *C*-sugar in the mixture 0	10	30	50	70	85
0·5	f	1·36	0·850	0·328	0·117	0·040	—
	$-\log f$	—0·134	+0·081	0·484	0·932	1·40	—
1	F*	1·003	0·735	0·445	0·247	0·137	—
	Fia	—0·001	+0·134	0·352	0·607	0·863	—
2	f	0·726	0·623	0·445	0·330	0·250	0·206
	$-\log f$	+0·140	0·205	0·352	0·481	0·602	0·686
3	f	0·590	0·565	0·439	0·356	0·291	0·239
	$-\log f$	+0·230	0·248	0·357	0·448	0·536	0·621
4	f	0·514	0·478	0·388	0·334	0·289	0·264
	$-\log f$	+0·289	0·320	0·411	0·469	0·539	0·578
6	f	0·418	0·427	0·375	0·309	0·288	0·266
	$-\log f$	+0·379	0·370	0·426	0·510	0·541	0·575

*As in this case the filter aid concentration = 1, we obtained filtrability (F) and *Fia*[9] instead of filtration rate (f) and Fia_{app} respectively.

The graphical representation of the results shows that the relationship of $-\log f$ *versus* *C*-sugar concentration seems to be linear, even when amounts other than the standard concentration of filter aid are used. This confirms the first hypothesis.

The relationships illustrated in Fig. 2 can be described by the following general equation:

$$Fia_{app} = -\log f = m.k.(C\text{-sugar}\%) + b$$
$$= m\,Fia + b \quad \ldots\ldots\ldots\ldots \text{(3)}$$

where k is a constant relating the filtration-impeding activity and % concentration of the particular *C*-sugar in the mixture[9].

$$k = \frac{Fia}{C\text{-sugar}\ \%} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(4)}$$

b is the intercept of the ordinate and is the apparent filtration-impeding activity (Fia_{app}) of standard sugar with that amount of filter aid applied, while m is the slope of the straight line graph of $-\log f$ *versus* $k.C$-sugar %. According to equation 2, with one unit concentration of filter aid, $b = 0$ and $m = 1$. As Fig. 2 shows, m decreases with increasing filter aid concentration. With the particular *C*-sugar used $k = 0{\cdot}0121$.

Determination of m

When seeking the correlation between m and the concentration of filter aid applied, a linear correlation between $1/m$ and the filter aid concentration was observed as is shown in Fig. 3. The data on which this graph was based appear in Table II.

Table II

m as the function of the applied filter aid concentration (a)

a	m	$\frac{1}{m}$
0·5	1·731	0·622
1·0	1·000	1·000
2·0	0·560	1·78
3·0	0·387	2·58
4·0	0·302	3·31
6·0	0·208	4·81

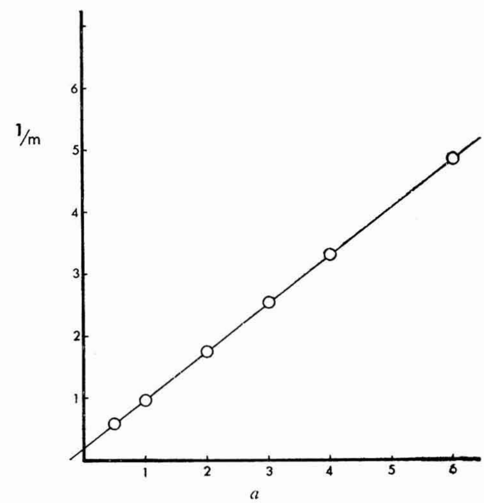

Fig. 3. Variation of $1/m$ as a function of filter aid concentration a

The equation of the straight line so obtained is:

$$a + n = \frac{1 + n}{m} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(5)}$$

where a is the filter aid concentration in standard units and n is a constant, apparently the filter aid equivalent of the filter paper used as a septum in the apparatus. According to Fig. 3, and from several similar experiments, involving rather different raw sugars, $n = 0{\cdot}3 \pm 0{\cdot}05$.

From equation 5:

$$m = \frac{1 + n}{a + n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

Substituting in equation 3, we obtain:

$$-\log f = \frac{1 + n}{a + n} (Fia) + b \quad \ldots\ldots\ldots\ldots(7)$$

Equation 7 shows that the slope of the lines in Fig. 2, i.e. the relative filtration rate (f_{rel}), is defined by the filtration-impeding activity:filter aid concentration ratio as was presumed in the second hypothesis. However, when calculating accurately the amount of filter aid involved, the filter paper used should not be neglected. Its filter aid equivalent (n) should be added to the filter aid concentration (a) applied.

Determination of b

Finally, to be able to convert the relative filtration rate to filtration rate (f), we should know more about b.

Fig. 2 shows that b is the apparent filtration-impeding activity of the pure sucrose calculated from filtration rate measurement and can have a positive or negative value.

To calculate the correlation between filtration rate f of standard sugar and the concentration of filter aid applied, the literature on slurry filtration can be applied[1,2,3]. For constant pressure filtration with negligible initial filter resistance CARMAN[1] gives an expression which can be simplified for our purposes by amalgamating the constants.

$$\frac{e}{f^2} = a \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

where f and a are the filtration rate and filter aid concentration defined earlier, and e is a constant involving all the parameters which are fixed by the standardization of the filtration process.

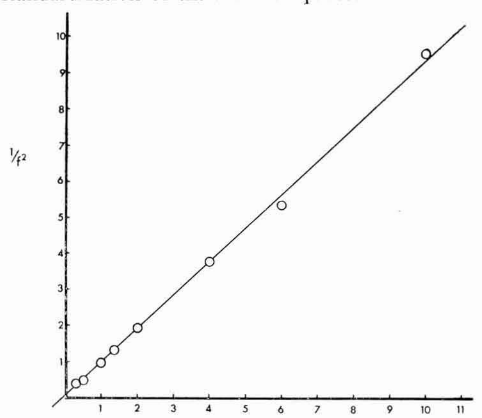

Fig. 4. Variation of $1/f^2$ as a function of filter aid concentration a

Checking this equation by measuring filtration rate f of pure sugar with different concentrations of filter aid and plotting $1/f^2$ against filter aid concentration (Table III and Fig. 4) we obtain the following equation:

$$\frac{1{\cdot}06}{f^2} = a + 0{\cdot}07 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

where 0·07 appears to be the filter aid equivalent of the filter paper for standard sugar filtration. This value is different from the filter aid equivalent of the filter paper (n) calculated by plotting $1/m$ against a. This is not surprising because it is expected that the filter paper should have a different filter aid equivalent value depending on whether its main effect is to bond the colloids of a raw sugar (0·3), or whether it acts mainly as a resistance to the flow of pure standard sugar (0·07).

Table III

Filtration rate (f) of pure sucrose with different concentrations of filter aid (a)

a	f measured	$\frac{1}{f^2}$
0·313	1·44	0·42
0·5	1·38	0·523
1·0	1·001	0·998
1·25	0·889	1·26
2·0	0·716	1·95
3·0	0·588	2·90
4·0	0·506	3·90
6·0	0·430	5·40
10·0	0·322	9·65

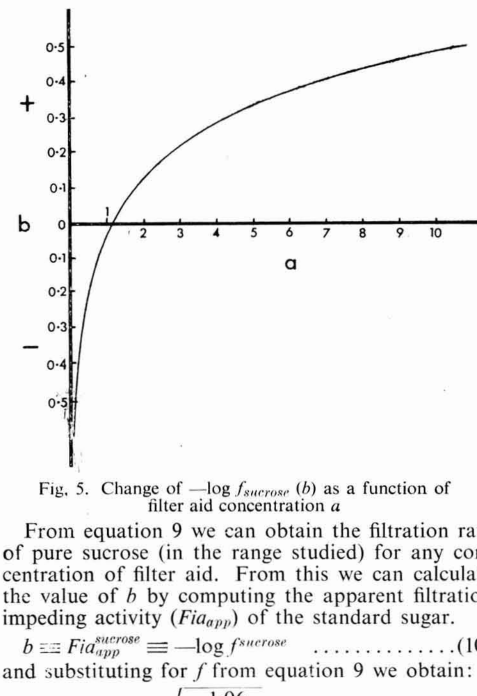

Fig. 5. Change of $-\log f_{sucrose}$ (b) as a function of filter aid concentration a

From equation 9 we can obtain the filtration rate of pure sucrose (in the range studied) for any concentration of filter aid. From this we can calculate the value of b by computing the apparent filtration impeding activity (Fia_{app}) of the standard sugar.

$$b = Fia_{app}^{sucrose} \equiv -\log f^{sucrose} \quad \ldots\ldots\ldots\ldots(10)$$

and substituting for f from equation 9 we obtain:

$$b = -\log \sqrt{\frac{1{\cdot}06}{a + 0{\cdot}07}} \quad \ldots\ldots\ldots\ldots\ldots(11)$$

Fig. 5 and Table IV give the b values, calculated in this way, for different filter aid concentrations.

Table IV

The "—log f standard sugar" (b) as a function of filter aid concentration (a)

a	0·0	0·2	0·4	0·6	0·8
0	—0·590	—0·297	—0·176	—0·100	—0·043
1	+0·002	0·039	0·071	0·098	0·123
2	0·145	0·165	0·183	0·200	0·216
3	0·231	0·244	0·257	0·269	0·281
4	0·292	0·302	0·312	0·322	0·331
5	0·340	0·348	0·356	0·364	0·372
6	0·379	0·386	0·392	0·399	0·405
7	0·412	0·418	0·424	0·430	0·435
8	0·441	0·446	0·451	0·456	0·461
9	0·466	0·471	0·475	0·480	0·484
10	0·488	0·493	0·497	0·501	0·505

We now have all the data necessary to calculate the filtration rate, under the test conditions, for any of our sugars, with any reasonable filter aid concentration.

The combined equation is:

$$-\log f = \frac{(1+n).Fia}{a+n} + b$$

$$= \frac{1{\cdot}3\, Fia}{a+0{\cdot}3} - \log \sqrt{\frac{1{\cdot}06}{a+0{\cdot}07}} \quad \ldots\ldots (12)$$

where $Fia = -\log F$ and is measured by applying the standard filtrability test with the standard filter aid concentration.

An example of such a calculation using equation (12) and the values of b obtained from Table IV is given below:

Let us calculate the filtration rate f of a sugar with triple concentration of filter aid which has a standard filtrability ($F\%$) of 22·4%.

$F = 0{\cdot}224$, $Fia = -\log F = 0{\cdot}650$, $a = 3$, $n = 0{\cdot}3$

$$-\log f = \frac{1{\cdot}3 \times Fia}{a+0{\cdot}3} + b \text{ (Equation 12)}$$

$$= \frac{1{\cdot}3 \times 0{\cdot}650}{3+0{\cdot}3} + b = 0{\cdot}256 + b$$

From Table IV, $b_{3{\cdot}0} = 0{\cdot}231$

$\therefore -\log f = 0{\cdot}256 + 0{\cdot}231$

$= 0{\cdot}487,$

Whence, $f = 0{\cdot}326 = 32{\cdot}6\%$.

(To be continued)

THE INFLUENCE OF CROWN REMOVAL ON BEET QUALITY

by A. CARRUTHERS, J. F. T. OLDFIELD and H. J. TEAGUE

Paper presented to the 18th Technical Conference of the British Sugar Corporation Ltd., 1966.

Introduction

An increasing proportion of the spring cultivation of the beet crop is now being handled mechanically and it is to be expected that this trend will be accelerated with the introduction of monogerm seed and with the rising cost of labour. Full mechanization of spring cultivation presents some additional difficulties in beet harvesting because the spacing of the beet along the row is likely to be less even than can be achieved by hand singling, so that the topping mechanism can less easily follow the variations in height from beet to beet. Unless special machines are developed to remove the tops from the unevenly spaced beet, there might be a tendency for an increasing amount of crown residue to be delivered to the factory. It has even been suggested that, with full spring mechanization, it might be necessary to abandon normal topping altogether and resort to a flail type mechanism to remove the leaf and stalk material but leave the crown intact.

It was therefore necessary to assess the effects of increasing amounts of crown residue on the quality of the beet delivered to the factory.

Background

An earlier investigation into the variations in quality between different sections of the sugar beet was undertaken at the B.S.C. Research Laboratories in 1957 and the results were reported in 1959[1]. As this report is now out of print, the results are reproduced below.

To investigate the composition of different sections of beet, eighteen samples each consisting of 5–7 beet were collected from different growing areas and each sample was sectioned and analysed independently.

The petioles were stripped from the beet by hand to remove all but a few short vascular strands which could not be forced off by hand. The crown was removed from the beet by a single cut, perpendicular to the axis, immediately below the lowest leaf bud. The vascular tissue at this cut curface did not form concentric rings but a series of irregular lines.

The outer ⅜-in was then removed from the sides and upper surface of the crown and these compacted stem-like residues will be referred to as *the bud* (Fig.1).

[1] CARRUTHERS *et al.*: *Paper presented to 12th Tech. Conf. British Sugar Corp.*, 1959.

The internal solid white irregular section is termed *the crown-core*.

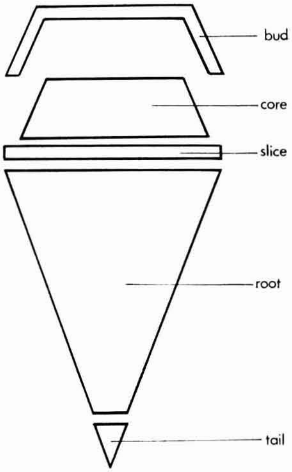

Fig. 1

A slice, ⅜-in thick, was then removed parallel to the cut surface of the beet to leave the root slightly overtopped. The surface of the root then consisted of circular rings of cell tissue.

The tap root and all fangs were cut from the beet at the position where these portions were 1-inch in diameter and were termed *the tail*, and the remaining body of the beet was called *the root*.

The sections for each sample were combined and diced, and 200 g of each was macerated in 250 ml water for analysis. The mean results are recorded in Table I.

It is apparent that the purity of the bud, crown-core and tail sections is lower than that of the main root section. This effect is very marked in the bud section which contained 10% invert on sucrose.

The ninhydrin method for estimation of amino acids had not been developed at the time of analysis but the noxious nitrogen value is recorded to give some indication of amino acid content. The noxious nitrogen content of the crown core section is notably higher than that of other sections, including the low purity bud. This increase was found in all the individual samples.

If all the tops could be removed while leaving the whole crown attached to the beet for processing, the values in part B of Table I show that the quantities of non-sugar sent to process would increase by a far greater extent than would the sucrose. In particular, while the sucrose per root in the samples would be increased by only 9% if the crowns were retained, the invert per root would be increased by 115%.

The results recorded in Table I indicated the serious reduction in processing quality which would arise if beet with intact crowns were delivered to the factory for processing. The additional invert sugar would have especially serious consequences, by increasing colour production and by increasing the amount of acid degradation products in the process juice.

These earlier results were obtained by analysis of beet harvested at the beginning of October. The possibility arose that the distribution of non-sugars might change during the later part of the growing season. Moreover, the ninhydrin procedure[2] now permits a more accurate estimation of amino nitrogen and the lime-phosphate procedure for clarifying press juice and beet extracts[3] has made obsolete the direct measurement of purity using raw beet material.

Accordingly, the effects of crown removal were reassessed during the 1965/66 campaign.

Effect of harvesting date

Random samples, each of 10 beet, were lifted at intervals during the growing period 4th October 1965 to 22nd November 1965 from a small plot of 150 sq. yards in a field of commercial beet.

After each sampling, the petioles were stripped by hand, leaving the crowns intact, and the beet were washed and weighed. The crowns were removed just below the lowest leaf scar, and lead acetate extracts were prepared by maceration of the separate roots and crowns of the individual beet. The extracts were analysed for sucrose, invert sugar, potassium and amino-nitrogen and the mean results for each sampling are recorded in Tables II and III.

[2] CARRUTHERS & OLDFIELD: *I.S.J.*, 1961, **63**, 103.
[3] *idem ibid.*, 72.

Table I. Composition of beet sections

A.

Section	Weight (g)	Purity	Sucrose %	Invert per 100 S	K %	Na %	Noxious N, mg/100 S
Bud	53	65·7	7·0	10·0	0·37	0·058	47
Crown-core	39	82·3	12·0	0·82	0·20	0·015	74
Slice	84	88·2	14·3	0·41	0·15	0·011	42
Root	505	89·1	15·4	0·34	0·18	0·011	23
Tail	50	83·5	13·5	0·63	0·24	0·010	21

B.

Section	Weight % total	Sucrose % total	Invert % total	K % total	Na % total	N.N. % total
Bud	7·2	3·5	48·2	14	29	12
Crown-core	5·3	4·5	4·9	5	5	13
Slice	11·5	11·5	6·5	9	9	16
Root	69·2	74·3	34·9	64	52	54
Tail	6·8	6·2	5·5	8	5	5

Table II

Analysis of roots and crowns, Oct.–Nov. 1965
(Each result is the mean from 10 individual beet)

	4.10.65	18.10.65	1.11.65	22.11.65	Mean
Weight, g					
Root	555	723	765	680	681
Crown	99	139	189	148	144
Crown %					
Total wt.	15	16	20	18	17
Sucrose %					
Root	15·0	15·9	16·8	17·0	16·2
Crown	9·7	10·4	11·8	12·5	11·1
Invert mg/100 g					
Root	38	31	44	57	43
Crown	286	237	286	294	276
K mg/100 g					
Root	196	193	190	186	191
Crown	289	320	300	309	304
Amino-N mg/100 g					
Root	42	38	37	41	40
Crown	80	86	78	81	81

Table III. Calculated increase in sucrose, invert, K and amino-N by processing whole beet

	4.10.65	18.10.65	1.11.65	22.11.65	Mean
Sucrose g/root					
Topped	83	115	129	116	111
Whole beet	93	129	151	135	127
Increase	11%	11%	12%	12%	12%
Invert mg/root					
Topped	211	224	337	388	290
Whole beet	494	553	878	823	687
Increase	134%	147%	161%	112%	137%
K mg/root					
Topped	1088	1395	1454	1265	1301
Whole beet	1374	1840	2021	1722	1739
Increase	26%	32%	39%	36%	34%
Amino-N mg/root					
Topped	233	275	283	279	272
Whole beet	312	395	430	399	388
Increase	34%	44%	52%	43%	43%

As the growing season progressed, there was no evidence of any systematic change in the relative qualities of the crown and root sections. As in the earlier analysis the crown was of substantially lower quality than the main root section; the reduction in quality was predominantly due to the excess invert sugar and amino-nitrogen in the crown while the potassium content increased to a smaller but still serious extent.

A slightly higher proportion of additional non-sugars was present in the crowns of these beet than in those examined earlier; this proportion will probably vary according to whether the beet have inherently small or large crowns but it is confirmed that the quality of the factory juice would be depressed if additional crown material were to be processed with the root, regardless of the time of harvesting.

Effect of crown material on clarified juice quality

Ten beet, which had all been grossly undertopped, were collected from the normal intake in the flumes at Nottingham factory in January 1966. The beets were topped as previously and press juices were prepared from the roots and crowns for each beet. Where the size of the beet was inadequate to provide sufficient juice, the six smallest beet were combined in two groups of three. The press juices were clarified by the lime/phosphoric acid procedure and purities measured. Sucrose and invert sugar were determined on lead acetate extracts of root and crown. The clarified juices were also analysed for potassium, sodium and amino-nitrogen.

The results of these analyses are recorded in Tables IV and V. The crowns of two of the beet, although of normal appearance before topping, were found to be discoloured and gummy internally, presumably owing to frost damage before harvesting. The results for these beets are shown with an asterisk.

Table IV. Sucrose and invert sugar content of roots and crowns of beets from Nottingham flume, Jan. 1966

Beet	*% crown on total wt.*	*Sugar %* Root	*Sugar %* Crown	*Invert mg/100 g* Root	*Invert mg/100 g* Crown
1	18	16·9	11·5	75	235
2	20	15·4	11·3	158	469
Composite 3 + 4 + 5	17	17·9	11·6	115	435
6*	18	14·4	7·6*	131	2308*
8*	16	13·8	7·0*	128	2550*
Composite 7 + 9 + 10	15	17·4	9·2	112	862

* Deteriorated crowns.

The analysis of clarified juices in Table V shows that the purity of extracts prepared from crowns was about 12 units lower than the root extracts, even when the beet with deteriorated crowns were excluded. The quality of the main root portions of these beet, 6 and 8, was not abnormal but purities of 51–54 were measured on extracts from their deteriorated crowns.

Table V. Analysis of clarified juices from beets from Nottingham flume, Jan. 1966

Beet	*Root* Purity	*Root* K mg/100S	*Root* Na mg/100S	*Root* Amino-N mg/100S	*Crown* Purity	*Crown* K mg/100S	*Crown* Na mg/100S	*Crown* mino-N mg/100S
1	92·2	1510	125	224	80·9	3570	720	582
2	92·7	1610	150	216	85·0	2740	350	403
Composite + 4 + 5	94·3	800	95	234	77·9	3080	520	858
6*	92·0	1350	65	161	53·4	8300	880	1250*
8*	91·8	1650	120	200	51·0	8500	900	1350*
Composite 7 + 9 + 10	94·1	920	140	153	78·8	2980	710	650
Mean	92·9				71·2			
Excluding tests 6 and 8	93·3		Deteriorated crowns.		80·7			

The invert content of the crowns was about 30% on sucrose and there can be little doubt that the processing of beets with deteriorated crowns would have a most serious adverse effect on juice quality even though the main root portions may be in good condition. It is therefore of particular importance to exclude crown material in processing frost-damaged beet.

Tarehouse sampling of beet with intact crowns

Two experiments were undertaken to assess whether the tarehouse sampling of beet with intact crowns would give brei containing the correct ratio of crown to root material and so adequately reflect the quality of the whole beet. The possibility arose that, owing to some difference in texture between the crown and root section, the multiple saw might throw an excess proportion of brei from either the crown or the root section. In fact, as shown below, the saw gave an adequate ratio of crown and root material when beet with intact healthy crowns were sampled by the normal tarehouse procedure.

100 grossly undertopped beet were collected from the flumes at Nottingham factory on 13th October 1965. After washing, the beet were subdivided into 10 random samples of 10 beet. Five of the samples were not topped. The ten root samples were put through the multiple saw at Nottingham tarehouse to yield 5 brei samples from topped beet and 5 samples from whole beet. The brei samples were analysed for sucrose and invert sugar.

From the separate weights and analysis of the crown and root of the topped samples, the sucrose and invert sugar concentration in the whole beet were calculated. These calculated values are compared with the concentrations measured in the brei from the intact beet samples in Tables VI and VII.

Table VI. Sucrose % beet

Topped Samples

Sample	*% Crown on total wt.*	*Crown*	*Root*	*Whole beet (calculated)*	*Whole beet: Sample*	
2	14	10·1	15·6	14·8	1	14·8
3	15	12·1	15·5	15·0	4	15·1
6	14	11·0	16·1	15·5	5	15·5
7	17	11·3	15·3	14·5	9	14·6
8	18	11·8	15·6	15·0	10	15·0
Mean	16	11·3	15·6	15·0		15·0

Table VII. Invert sugar, mg/100 g beet

Topped samples

Sample	*% crown on total wt.*	*Crown*	*Root*	*Whole beet (calculated)*	*Whole beet: Sample*	
2	14	454	94	143	1	120
3	15	230	84	106	4	99
6	14	500	116	168	5	146
7	17	270	91	120	9	117
8	18	254	93	120	10	157
Mean	16	340	94	132		128

The mean values both for sucrose and for invert sugar content as calculated from the separate crown and root samples closely correspond with the values obtained from the intact beet samples. The brei from the intact beet must therefore be derived from the root and crown portions of the intact root in proportions representative of the weight of these portions.

The experiment was repeated in January 1966 with similar results.

Effect of petiole residues

The crown material in the foregoing experiments had been stripped of all petiole residues as completely as possible. Unless special precautions are taken when harvesting unevenly spaced beet, short lengths of petiole may remain on the beet and so the effect of such residues on beet quality was assessed.

Thirty petiole samples were collected from different growing areas. The concentration of invert sugar in the samples ranged from 2·2% to 4·7% and the mean concentration was 3·2%.

A correctly topped healthy root, weighing say 700 g, contains about 300 mg of invert sugar and so the inclusion of only 10 g of petiole residue per root at the mean concentration of 3·2% would more than double the amount of invert sugar per root.

Even very small amounts of petiole residue in the beet sent to the cutting mills would therefore seriously lower the juice quality.

If the knife on the beet harvester removes the top by a cut which is not perpendicular to the axis of the root, it is possible for one or two intact petioles and blades to remain attached to the side of the cut surface of the root. This type of residue is visually very prominent in the beet as delivered to the factory but by far the greater part of this leaf material will be abraded from the beet during fluming and removed by the trash catchers before slicing. In contrast, the multiple petiole residues left when the harvester knife passes just through the top of the crown are less visually obvious and are less easily broken in fluming, so that this latter type petiole residue is the more detrimental to factory performance.

A harvesting procedure for beet which cannot be topped early

Until sufficient quantities of beet are grown under conditions of fully mechanized spring cultivation, it is necessary to deduce the effect of uneven spacing on beet harvester performance by examination of hand cultivated beet which present similar difficulties.

The beet in the Holmewood area are normally held only lightly in the ground and, in topping, some of the beet are pushed over so that accurate topping is not possible and petioles and leaves are left on a few of the beet. Consequently, the farmers tend either to overtop the beet or resort to hand picking to remove the leaves. It is believed that similar considerations would apply to beet grown on normal land without hand labour.

Mr. C. BRADFORD, at the B.S.C. Agricultural Development Department, had suggested a harvesting procedure to avoid petiole and leaf residues in the harvested crop without excessive overtopping or hand picking. The proposed procedure was first to remove the bulk of the leaves with a forage harvester, then to top the beet normally without excessive overtopping and, finally, to flail the topped beet in the ground to remove the few remaining petioles before lifting.

The effects of the proposed treatment were compared with the results which would have been obtained if the beet were topped normally without excessive overtopping or hand picking. In addition, the effect of omitting the normal topping operation and using only the forage harvester and the flail was examined.

Experimental procedures included three treatments:

(1) Beet were subjected to the full treatment as proposed by Mr. BRADFORD, i.e. forage harvester, normal topping and flailing;

(2) as treatment 1 but omitting the final flailing; and

(3) as treatment 1 but omitting the normal topping operation.

Successive rows were harvested employing the three different treatments and the harvested beet were piled separately in three heaps. The successive row harvesting was continued until about two tons of beet had been obtained from each treatment. The beet piles were sampled by collecting 100 bags of about 30 beet from each treatment.

From each set of 100 bags, 10 bags were selected at random and sent to Peterborough factory tarehouse for estimation of top tare. The remaining 90 bags from each set were analysed at Central Laboratory, either individually or after composting, to give 90 measures of average root weight, 60 measures of sugar content, 30 measures of purity, potassium, sodium and amino-nitrogen, and 6 measures of invert. These results were analysed statistically at the Research Laboratories.

The results are recorded in Table VIII.

Table VIII. Effect of harvesting treatment on beet quality

	(1) *Full Treatment*	(2) *No Flailing*	(3) *No Topping*	*Significant Difference*
Top Tare lb/cwt	6·2	6·8	14·0	1·1
Sugar content, %	14·97	14·88	14·20	0·08%
Purity	93·40	93·69	92·99	0·21
Invert, mg/100S	496	496	632	40
Amino N, mg/100S	227	214	236	8
Potassium, mg/100S	993	993	1005	Not significant
Sodium, mg/100S	221	228	248	9
Average root weight, g	859	876	891	Not significant

The full treatment (1) was successful in removing the petiole and leaf residues which were quite apparent when the flailing was omitted in treatment (2).

Treatment (3), omitting normal topping, left the crowns intact but removed all of the leaves and the fleshy tissue of the stems. Stem residues, consisting of vascular strands without fleshy tissue, up to 1 inch in length, remained attached to the crowns.

Small amounts of leaf residue remained on the beet harvested by treatment (2), but much of this material would probably be removed in the beet washer at the Central Laboratory and so would not contribute to the brei taken for analysis.

The top tare for the unflailed beet in treatment (2) was slightly higher than in treatment (1), but the difference was not statistically significant. The sugar content for treatment (1) was fractionally higher than for treatment (2) but the difference is barely significant. The purity for treatment (1) was $0{\cdot}29 \pm 0{\cdot}21$ units lower than for treatment (2) and the amino-nitrogen was 13 ± 8 mg higher. These differences are just significant, and are at present unexplained.

For treatment (3), in which the normal topping operation was omitted, the top tare was significantly higher by between 7 and 8 lb/cwt. The sugar content and purity were significantly lower than those found with the other two treatments and the invert sugar content, the amino-nitrogen and the sodium concentration were all significantly higher. All of these reductions in quality follow the trends reported above. As shown by the top tares, the beet from treatments (1) and (2) do still contain quite a lot of crown material and so their invert sugar concentration is not reduced below that of the beet with intact crowns to as great an extent as with the correctly topped beet reported earlier. The potassium concentration and average root weight were numerically higher for treatment (3) than for the other two treatments, as would be expected, but these differences were not statistically significant, being obscured by the variation from sample to sample.

As expected, the flailing procedure, omitting the normal topping operation, produced a serious reduction in beet quality. This procedure cannot be recommended.

The full treatment, as proposed by Mr. BRADFORD, permitted harvesting of beet from Holmewood with a normal knife setting, and yet free from petiole residues, without hand picking. Further development of this procedure may provide a satisfactory solution to the problem of avoiding a deterioration in quality when processing beet grown under conditions of fully mechanized spring cultivation.

Summary

The crown portion of the sugar beet is of substantially lower quality than the main root portion. This lower quality is predominantly due to excess invert sugar and amino-nitrogen in the crown; the potassium and sodium concentrations are also increased while the sucrose concentration is reduced.

There is no evidence of systematic changes in the relative qualities of the crown and root sections in the growing period from early October to late November.

It is particularly important to exclude crown material in processing frost-damaged beet because of the susceptibility of the crown to frost damage and consequent increase in invert sugar content.

Petiole residues are particularly high in invert sugar content. It is considered that multiple short petiole residues are more detrimental to factory performance than a few intact petioles and blades.

Flailing of beet to remove petioles without normal topping produces a serious reduction in juice quality. This procedure cannot be recommended.

A procedure to flail beet after normal topping provided beet suitable for processing under agricultural conditions such that normal topping alone was inadequate. Further development of this procedure may provide a suitable procedure for harvesting beet grown under conditions of full spring mechanization.

Acknowledgment

The assessment of the harvesting procedure, described above, was a joint operation undertaken by the Agricultural Development Department, the Central Laboratory, and the Research Laboratories of the British Sugar Corporation.

WATERLOGGING AND COLD TOLERANCE IN SUGAR CANE

THESE are subjects which have been attracting a good deal of attention in India, for there are considerable areas in that country where cane may be grown under conditions of waterlogging. In the northern cane areas of the subcontinent, notably the Punjab and Western Uttar Pradesh, cane may be subjected to quite severe cold as it matures, and this can cause severe damage.

Reference is made to these matters in a mimeographed booklet recently issued from Coimbatore[1] Sugar Cane Breeding Institute from which the following notes are taken.

There is a need for cane varieties that are resistant to waterlogging and which are at the same time satisfactory in regard to yield and quality of harvested cane. Such varieties should also be tolerant to red rot disease as this disease shows itself in a virulent form under waterlogging conditions. "The surest method of evolving suitable varieties for tolerance to waterlogging is to undertake 'location testing' of seedlings ,viz. growing a large population of seedlings under the actual waterlogged conditions and picking out tolerant genotypes. Later the seedlings are tested for other economic attributes, mainly yield and sucrose content. Based on the above idea, seedling trials have been in progress for the past three years in the waterlogged areas at Harinagar (Bihar) and Vadapathimangalam (Madras). Over 10,000 seedlings have been screened and suitable genotypes with built-in resistance isolated. Trial of these genotypes has resulted in the isolation of a clone combining in itself waterlogging tolerance and yield and quality. This clone (Co 6604) has been released this year to the State Research Stations for trial."

Three years ago damage from cold in northern India was so severe that there was even difficulty in obtaining seed material for planting. "Damage to the sugar cane crop can take place in three ways:

(*a*) damage to the mature stalk resulting in inversion of the sugar and drop in recovery percent;

(*b*) damage to the growing point resulting in complete stoppage of growth and development of lateral buds indirectly contributing to inversion of juice; and

(*c*) damage to the lateral buds and consequent loss of seed material.

The first two factors directly affect the production of sugar and gur while the third creates difficulties for the grower by way of non-availability of seed material.

One of the varieties evolved at the Institute, Co 1148, has shown a high degree of tolerance to low temperature and is now spreading into cultivation in the Punjab.

A laboratory technique for estimating the degree of cold tolerance has been perfected during the year by which it is possible to rate genotypes separately for each of the three characters mentioned above and assess the sum total of tolerance capacity. The technique consists in placing four-foot mature stalks of the genotype in a deep freeze, maintaining a temperature of —7°C with suitable controls. After 24 hours the stalks are taken out, some of them split open and the length of the frozen tissue assessed from the hardness of the tissue (indicating ice formation). The ratio of the frozen to the unfrozen length of the stalk is taken as a measure of tolerance to low temperature. The damage to the growing point is assessed in the split cane.

If damaged, the tissue becomes brown and powdery. For a surer test of damage to the growing point, tops of unsplit stalks given the treatment are planted and the growth of the tops with formation of new leaves gives an indication of the resistance of the growing point to cold. As regards lateral buds, unsplit one-budded setts are planted and the germinations recorded."

F.N.H.

[1] *Salient Research Achievements, 1965.* (Sugar Cane Breeding Institute, Coimbatore). 10 pp.

Study of red rot flora in Andhra Pradesh. P. PRAKASAM and P. APPALANARASAYYA. *Andhra Agric. J.*, 1964, **11,** 210–213; through *Plant Breeding Abs.*, 1966, **36,** 313.—Four varieties of sugar cane were inoculated with dark races of the red rot fungus (*Colletotrichum falcatum*) native to Andhra Pradesh and 3 light races found elsewhere. All varieties were similar in their reaction to the dark races but varied in their reaction to the light races.

* * *

Investigations with sugar beets at the Plains Branch Station, 1961-1963. N. R. MALM. *Res. Rpt. New Mex. Agric. Exp. Sta.*, 1964, (90), 9 pp.; through *Plant Breeding Abs.*, 1966, **36,** 314.—Performance trials of 8 varieties over 3 seasons are given. Holly Hybrid 1 showed most resistance to *Cercospora* leaf spot.

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Trials with monogerm seed for the mechanization of spring work in sugar beet. L. F. HANBURY and G. L. MAUGHAN. *J. Agric. Sci.*, 1966, **66,** 181–188. Trials spread over 3 seasons (1960–2) are reported; they were designed to compare the labour required to produce a weed-free stand from monogerm seed with labour needed for similar stands from quasi-monogerm and multigerm seed. The economy in labour with mechanical thinning or chemical weed control was also compared. Figures for yields are given, that from monogerm seed being inferior to that of popular multigerm types.

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Growth and quality of sugar beets at the Antelope Valley Field Station. F. J. HILLS *et al.* *Calif. Agr.*, 1964, **18,** (8), 6–7; through *Biol. Abs.*, 1966, **47,** 1578.—Lower autumn temperatures caused an abrupt slowing down of both root and top growth, but with increases in root sucrose levels. N-deficient roots had 2·7% more sucrose than did high N roots.

* * *

Machine thinning of sugar beet: field trials with chemical and mechanical weed control. L. F. HANBURY and G. L. MAUGHAN. *J. Agric. Sci.*, 1966, **66,** 189–195.—A series of large-scale field experiments (1961–1963) in raising crops from monogerm and ordinary or multigerm seed, without the use of hand labour as far as possible, are reported; 10% of the hand-thinned crop and 14% of that machine-thinned were lost. Mechanical weeders killed 35% of the weeds (41% in the case of "fat hen", *Chenopodium album*). The chemical herbicide used could kill over 90% of the weeds.

How to improve sugar cultivation in eastern Uttar Pradesh and Bihar. T. KANORIA. *Indian Sugar*, 1965, **15,** 261–262.—The difficulties associated with large numbers of indigent growers, averaging less than one acre per grower, are stressed. The need for improvements in irrigation, supply of fertilizers, disease-free planting material and drainage in low lying areas are discussed. Credit facilities for growers through scheduled banks or co-operative banks are recommended.

* * *

Development of the (Indian) sugar industry. V. D. JHUNJHUNWALA. *Indian Sugar*, 1965, **15,** 263–264. Sugar is the second largest industry of India and could be extended to increase exports. Ways and means are discussed under three headings: (i) making uneconomical units economical by merging or expanding; (ii) better utilization of by-products such as bagasse, molasses and filter press mud; and (iii) reduction in manufacturing costs by rehabilitation and modernization.

* * *

A progressive approach to payment for cane on the basis of quality. R. MAINPRICE. *Indian Sugar*, 1965, **15,** 271–273.—In India the sugar industry is second only to textiles in size and employs some two million people. The writer considers the main adverse factor with the industry is the payment for cane by weight and not sugar content, as in nearly all other cane growing countries. Possible methods of overcoming this are discussed.

* * *

Sugar is made in the fields. D. C. KOTHARI. *Indian Sugar*, 1965, **15,** 275–276.—The need for payment to growers for cane to be based on quality, i.e. sucrose content and not mere weight, is stressed. It is also urged that new mills or factories should be exempt from government taxes for the first six years.

* * *

Problems of the sugar industry in western Uttar Pradesh. L. B. DHAR. *Indian Sugar*, 1965, **15,** 277–281. Sugar production in this area, once responsible for 30% of India's total sugar crop, has gone down markedly in recent years. Reasons for this are discussed, e.g. heavy borer attack, unfavourable weather conditions, inadequate irrigation and waterlogging in some areas. Remedial measures are suggested.

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The sugar industry in Madhya Pradesh. P. S. DESAI. *Indian Sugar*, 1965, **15,** 283–286.—The sugar industry of Madhya Pradesh, in its present state, is reviewed. The five sugar factories are now getting less than 50%

of their actual cane requirements. Average cane yield is 10–11 tons/acre, as against an all-India average of 17 tons. Emphasis is placed on the need to improve irrigation by deepening wells and providing monsoon tanks and to increase fertilizer supplies, both organic and inorganic.

* * *

Progress of sugar cane breeding in India. J. T. RAO. *Indian Sugar*, 1965, **15**, 335–337.—Past achievements and the rôle of some well-known Indian varieties are referred to. The present breeding programme, or programmes, having regard to the seven distinct agro-climatic regions into which India is now divided by the cane breeder, is explained. With the northern states a major consideration is breeding for resistance to red rot disease, but a disturbing feature is the partial or total breakdown of varietal resistance under commercial cultivation.

* * *

How to multiply seed cane. R. R. PANJE. *Indian Sugar*, 1965, **15**, 339–342.—Normally the expected multiplication rate with sugar cane is 1:10, i.e. 1 acre of seed cane is needed to plant 10 acres. This means too slow a build-up with new varieties, especially under northern Indian conditions. How to increase this in practice is discussed, e.g. use of polyethylene sheeting over nursery beds to conserve moisture, encouragement of tillering, and reduction of stalk damage by borers. The aim must be to make every bud produce a plant.

* * *

Selection techniques for sugar cane improvement. C. N. BABU. *Indian Sugar*, 1965, **15**, 343–345.—A start has been made in transplanting seedlings at one of the sub-stations for screening for frost resistance. For surer selection much larger numbers of seedlings will need to be raised and decentralized selection practised within the State so that each area can select its material in its own environment from the beginning. This will involve more cross breeding work.

* * *

Major pests of sugar cane in North India. A. N. KALRA. *Indian Sugar*, 1965, **15**, 365–369, 373.—Brief descriptions are given of all the more important pests that attack cane in northern India. These include 7 or 8 borers, termites, leafhopper (pyrilla), whitefly, cockchafer beetles and black bug. Some notes on chemical control and the possibilities of biological control are included.

* * *

Latest results of sugar cane research in Punjab and future lines of work. S. S. SINGH and R. S. KANWAR. *Indian Sugar*, 1965, **15**, 371–373.—The successful introduction and cultivation of some new improved varieties of sugar cane is discussed, as well as proposals for future work. This includes special emphasis on evolving frost-, drought- and red rot-resistant varieties. For some areas, varieties resistant to waterlogging and lodging are especially needed.

Comparative investigations on mechanical singling and manual singling in sugar beets. H. W. STRICKER. *Zucker*, 1966, **19**, 33–38.—An account is given of field trials with mechanical and manual singling, both with and without second hand-hoeing, on a basis of labour costs and yields. Figures are given showing that mechanical singling gave greatly reduced labour costs but differences in yield were not significant. There was a greater proportion of small beets at harvesting in the case of mechanical singling without subsequent hand hoeing.

* * *

Colombia: sugar throughout the year. E. B. PETZALL. *Zucker*, 1966, **19**, 45.—Attention is drawn to the very favourable conditions that exist in parts of Colombia (Cauca Valley) for commercial sugar cultivation. There is good soil, an evenly distributed rainfall without the need for irrigation and flat terrain for easy transport.

* * *

The Mexican sugar cane pest "el salivazo". ANON. *Bol. Azuc. Mex.*, 1965, (198), 14–17.—This is the last of a series of articles on "el salivazo" (*Aeneolamia postica*)[1], which ranks second in importance among the sugar cane pests of Mexico. Methods of studying populations of the pest, eggs and pupae are discussed. A list of the known parasites or natural enemies of the insect is given.

* * *

Know the variety N:Co 310. B. A. ROJAS. *Bol. Azuc. Mex.*, 1965, (198), 18–20.—The good qualities of this variety of cane, raised in Natal, and its phenomenal rise in popularity in Mexico are emphasized. A full botanical description of the variety is given, with line drawings showing diagnostic characters.

* * *

Improving germination in sugar cane cuttings. G. N. MISRA. *Indian Sugar*, 1965, **15**, 599–612.—Results are reported of a wide series of experiments over three seasons at the Sugar Cane Research Station, Shahjahanpur. Setts from the tops of stalks, shallow planting (2–3 in) and adequate soil moisture, provided by irrigation soon after planting, gave the best results.

* * *

A new beetle pest of sugar cane. A. N. KALRA and N. C. SHARMA. *Indian Sugar*, 1965, **15**, 613.—This pest, the beetle *Heteronychus robustus* Arrow., caused up to 20% dead shoots in infested fields in Uttar Pradesh. It is a shining black beetle, 1·5–2 cm long and about 1·5 cm in breadth at the abdomen, which attacks young cane shoots about 1 cm below the soil surface, causing the shoot to wither and die. Further studies on biology and control are in progress.

[1] *See I.S.J.*, 1966, **68**, 112, 113, 210.

Co 527—an early cane of the Udaipur region. P. K. Dixit and N. Mukherji. *Indian Sugar*, 1965, **15,** 623–624.—The advantages of this cane in south east Rajasthan are discussed along with its performance record during the last three seasons. It germinates and tillers better than the standard variety. Spines on the leaf sheath are a drawback in harvesting and stripping.

* * *

Effects of tungsten and molybdenum on sucrose content and hydrolytic enzymes of immature sugar cane. A. G. Alexander. *J. Agric.* (Univ. Puerto Rico), 1965, **49,** 429–442.—Molybdenum has been shown to inhibit enzyme production in immature sugar cane, with increased sugar or sucrose formation as a side effect. Tungsten has similar effects. Details are given of experiments in which both tungsten and molybdenum were used as foliar sprays. Molybdenum was a more effective phosphatase inhibitor than tungsten but was less effective in promoting sucrose production.

* * *

Sucrose-enzyme relationships in immature sugar cane. A. G. Alexander. *J. Agric.* (Univ. Puerto Rico), 1965, **49,** 443–461.—This paper summarizes experiments in which molybdenum, calcium, iron, boron, lead, trichloracetic acid, beta-glycerophosphate and starch were supplied to cane in order to evaluate their effects upon enzymes and sucrose content.

* * *

Erosion and sugar cane soils in Mexico. D. Ontiveros H. *Bol. Azuc. Mex.*, 1966, (199), 16–21.—In common with other parts of Latin America, Mexico has suffered a certain amount of soil erosion from the earliest times, especially through shifting cultivation practised by the inhabitants to grow maize and other crops. It is pointed out that with increased cultivation of sugar cane, special care should be exercised on sloping terrain.

* * *

New gravity table installation for sugar beet seed. Anon. *Up and Down the Rows* (Canada and Dominion Sugar Co. Ltd.), 1966, (140), 2.—This new machine and its *modus operandi* are briefly described. Basically the machine consists of a flat surfaced table covered with a metal screen. Air is forced up through the deck surface which may be tilted at various angles and the table deck may be oscillated or vibrated. The lighter particles float on a film of compressed air and move across the surface of the deck. Several hundred pounds of seed per hour may be cleaned and separated in this fashion.

* * *

Chemical weed control in sugar beets. D. A. Dever. *Up and Down the Rows* (Canada and Dominion Sugar Co. Ltd.), 1966, (140), 2–4.—An account is given of the successful use of "Pyramin" and "Pyramin 80W" in controlling weeds in sugar beet in Ontario, success being dependent on adequate soil moisture. "Pyramin" is regarded as the most efficient broadleaf selective herbicide available for beet to date.

* * *

Nematodes of Puerto Rico. J. Román. *Tech. Paper Agric. Expt. Sta.* (Univ. Puerto Rico), 1965, (41), 23 pp.—In a 3-year soil and root survey of nematodes in Puerto Rico, largely concerned with sugar cane fields, one of the most common plant parasitic nematodes was the spiral nematode *Helicotylenchus*. This paper reports a critical taxonomic study of the species of this genus found in Puerto Rico. In all, 13 species, of which 10 are new, are described and illustrated.

* * *

Effects of amylase and invertase regulators upon sugar content, protein content, and enzyme activity of immature sugar cane. A. G. Alexander. *J. Agric.* (Univ. Puerto Rico), 1966, **50,** 18–35.—Both mercury and manganese were applied as foliar sprays and as nutrient solution additives. Plants receiving mercury and manganese as nutrient solution supplements experienced major sugar changes in meristem rather than leaves. Low manganese and both high and low mercury greatly suppressed sucrose content.

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Oxidizing enzymes of sugar cane: peroxidase. A. G. Alexander. *J. Agric.* (Univ. Puerto Rico), 1966, **50,** 36–52.—Further studies on enzymes in sugar cane are reported[1], notably the distribution and properties of peroxidase in sugar cane. Peroxidase was moderately inhibited by calcium, magnesium and zinc.

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Deterioration problem of chopped-up cane. Anon. *Australian Sugar J.*, 1966, **57,** 922–924.—An informative account is given of the sour cane problem resulting from the use of chopper harvesters and of the attempts made to overcome or alleviate the evil. As much as 14% of the sucrose present in the cane may be lost, apart from the milling difficulties that are caused.

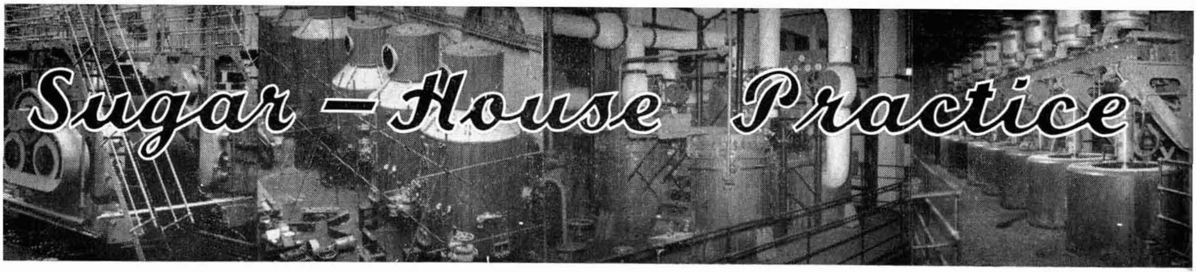
* * *

Irrigation lifts capacity. M. B. Hoare. *Producers' Review*, 1966, **56,** (2), 5.—Details are given of the phenomenal increase in irrigation that has taken place in some cane growing areas of Queensland in recent years. In one mill area over 90% of the cane is now irrigated, as against 43% in 1964.

* * *

New cane spreader for chopper harvesters. Anon. *Producers' Review*, 1966, **56,** (2), 61.—A description is given of a new type of chopped cane spreader invented by a Queensland cane farmer and known as the "Raigros binboy". It has been designed to do away completely with raking of chopped cane in bin-trucks. It is suitable for 3- or 4-ton bins. The chopped cane is packed horizontally to the corners and centre of the bin with no bruising or damage to the ends of cane.

[1] *See I.S.J.*, 1966, **68,** 16, this page.



Turbogenerators in the sugar industry. W. Siebe. *Bol. Azuc. Mex.*, 1965, (198), 22–28.—The characteristics of types of steam turbine suitable for sugar industry application are described with an account of their design rating and operating costs.

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Rapid deterioration of molasses in storage. R. H. Tseng and W. Chen. *Taiwan Sugar Quarterly*, 1965, **12**, (4), 13–23.—Descriptions are given of spontaneous deterioration of molasses stored at five Taiwan factories in 1963, 1964 and 1965. Losses varied from slight to complete destruction, depending on the extent of deterioration before it was discovered. Differences between the molasses itself and storage conditions are analysed to discover common factors and to account for the differences in behaviour, and factors which promote decomposition are listed, as well as steps which should be taken to reduce its possibility. Instances of spontaneous decomposition reported in the literature are discussed, with a mention of reactions thought to occur.

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Generation, distribution and utilization of steam in cane sugar factories. U. C. Upadhiaya. *Indian Sugar*, 1965, **15**, 407–418, 469–474, 527–540.—Aspects of steam production in sugar factories are discussed, including the boiler surface area needed and the quantity of steam required on cane weight for processing and for the prime movers. Steam conditions for use in turbines and engines and for process are discussed and the differences explained. Condensate removal and venting of incondensable gases are described and a flow diagram presented for an oil elimination plant, in connexion with an account of the advantages of condensate return but risks involved by sugar and oil contamination. Make-up water, its deionization and internal chemical treatment, blowdown and deaeration are reviewed, as are feed tank capacity and design, feed water regulation, economizers and air heaters. The literature on the calorific values of bagasse is briefly surveyed and calculations are made of the air required for combustion. Various types of bagasse furnaces are described and illustrated, and a list of measures presented for avoidance of the necessity for supplementary fuels. Oil burning is described as are the use of superheated steam, natural and forced draught, cleaning of boiler surfaces, and safety rules for boiler operation.

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Sugar from Sango Bay, Uganda. H. Bourzutschky. *Zeitsch. Zuckerind.*, 1966, **91**, 75–79.—Information is given on this 500 t.c.d. factory supplied by Gutehoffnungshütte Sterkrade A.G. for production of plantation white sugar. It is the third sugar factory to be erected in Uganda and started operations in August 1965. The milling train consists of three 24 × 48 inch 3-roller mills with self-setting floating rollers. The 1st and 2nd mills are driven by one 250 h.p. steam turbine, while the third mill has a 125 h.p. turbine drive. A 3-massecuite boiling scheme is used. Four fully-automatic centrifugals handle the massecuite, two being used for the *C*-massecuite. Each centrifugal has a maximum speed of 1470 r.p.m. and a charge capacity of 500 kg of massecuite, the *A*- and *B*-massecuites being handled at the rate of 30 charges/hr and the *C*-massecuite at 16 charges/hr.

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The Grande Anse sugar factory at Marie-Galante (Guadeloupe). Anon. *Ind. Alim. Agric.*, 1966, **83**, 23–26.—The three small sugar factories on Marie-Galante, a small island 50 km from Pointe-à-Pitre, capital of the large island of Guadeloupe, have been replaced by a new central sugar factory which now crushes all the island's cane. The new plant, erected on the site of one of the old factories, was given a capacity of 1200 tons/day in 1964 and 1500 tons in 1965, with the possibility of reaching 1900 tons at a future date. An illustrated account is given of the work involved in reconstruction and expansion, together with the new equipment, mostly supplied by Soc. Fives Lille-Cail, which has been installed.

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Studies on the use of flocculating agents during sugar cane juice clarification. VI. Trial of "Separan AP-30" in sugar factories. S. Bose, K. C. Gupta, S. Mukherjee and A. N. Shrivastava. *Proc. 33rd Conv. Sugar Tech. Assoc. India*, 1965, 11–19.—"Separan" was used as an aid to clarification at three factories producing sulphitation white sugar. In each case the clarifier capacity was increased so that the crushing rate could be increased. Oliver filtrate was reduced and could be returned to the clarifier without treatment, so saving the cost of chemicals. The juice was clearer and mud thicker, and juice retention in the filter was shorter, so decreasing degradation losses.

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Studies on the use of flocculating agents during sugar cane juice purification. VII. A process for the clarification of vacuum filter filtrate by the use of "Separan AP-30". S. Bose, K. C. Gupta, S. Mukherjee and S. B. Pendse. *Proc. 33rd Conv. Sugar Tech. Assoc. India*, 1965, 27–33.—Laboratory and factory-scale trials showed that Oliver filtrate after liming to pH 8·2–8·3 (from 6·5) followed by bringing to pH 7·5 by sulphitation or addition of superphosphate and addition of 10–15 p.p.m. of "Separan" yielded a clear juice, which could be sent to the evaporators, and a thick mud which could be returned to the filter.

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Modified "sweetening-off" technique of carbonatation filter cake. K. K. SHARMA. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 49–55.—Although increasing wash water recovered more sugar from filter cake, the non-sugars were also re-dissolved to an increasing extent, so that the washings should be returned to the raw juice for further clarification.

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Studies on the use of flocculating agents during sugar cane juice clarification. VIII. Settling studies with "Flocbel FC-160, FC-170 and FC-18". S. BOSE, K. C. GUPTA, P. A. A. MENON and S. MUKHERJEE. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 57–60.—A new series of flocculants, "Flocbel FC-160, FC-170 and FC-180"[1], were tested in laboratory trials on settling of limed and sulphited juice. Tabulated data give volumes of mud at intervals using 1, 2, 4, 6 and 10 p.p.m. of "Flocbel", with comparative data for settling after addition of "Separan AP-30". Optimum rates for the three "Flocbels" were 4, 2 and 2 p.p.m., respectively, and "Flocbel FC-160" was found to produce more rapid settling and smaller mud volume than the "Separan".

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Advantages of (the) middle juice carbonatation process. J. D. TANEJA, R. N. DASS and R. P. AGARWAL. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 61–67.—Raza and Buland sugar factories are less than 1 km apart and crush cane of the same variety from the same area. Middle juice carbonatation was introduced at Buland in 1962/63, and 1964/65 data from the two factories are tabulated for comparison. Limestone and coke usage are lower at Buland, as is sulphur consumption, while the purity rise from mixed juice to clear juice is 4·28–4·80 at Raza and 4·30–4·44 at Buland. Invert destruction is somewhat higher with middle juice carbonatation, while lime in juice is lower and molasses production and purity are slightly reduced.

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Continuous syrup sulphitation vessel. B. L. MITTAL and S. S. ANAND. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 81–84.—A continuous sulphitation vessel designed by the National Sugar Institute was tested at Dhampur Sugar Mills Ltd.; in the 1963/64 season, sucrose inversion was found to occur in dead pockets, and the spray water pH fell considerably, causing corrosion; the latter was found to be due to release of SO_2 from the syrup during boiling to dissolve in the condenser water. Re-design of the trays in 1964/65 eliminated this trouble, which had previously required addition of lime to the spray water.

Improvement in automatic feed control equipment and technique. R. P. JOHRI, S. K. D. AGARWAL and P. N. SAXENA. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 89–95.—An account is given of the application of a simple conductivity control to boiling of *A*-massecuite. A normal boiling is discussed and recorded in tabular form, the conductivity being recorded at intervals, and a similar table prepared for a boiling in which feed was admitted by a pneumatic valve in response to a signal from the cuitometer. The improvements in boiling procedure are discussed.

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Horse shoe-type furnace for burning wet bagasse and other fuels for use in (the) khandsari industry. S. C. GUPTA, S. L. PHANSALKAR, S. L. SAXENA and S. K. D. AGARWAL. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 99–107.—A horse shoe-type furnace has been designed by the National Sugar Institute for use in burning bagasse from a khandsari mill; such bagasse contains 48–52% moisture and usually has to be sun-dried. The design has given excellent results with wet bagasse and is to be further developed.

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Fuel and steam economy in Indian sugar factories. IV. S. C. GUPTA, S. L. SAXENA, S. K. GHOSH and P. N. R. RAO. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 137–147.—The heat content of condensates is pointed out and the need for condensate recovery for maximum thermal efficiency is emphasized. Two such schemes are illustrated in diagram form. A further scource of heat loss is the blowing-off of exhaust steam, and this should be avoided by achieving a proper working ratio between process steam demand and exhaust steam production; means for reducing the latter are briefly described. The reduction of heat radiation by lagging of steam pipes is discussed, and calculations indicate how the return in value of steam becomes less above an optimum thickness (and thus efficiency) of lagging. Attention is drawn to the losses of steam possible through even small leaks, and the amount of superheat suitable for certain applications is discussed.

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Middle juice sulphitation process. S. C. GUPTA, N. A. RAMAIAH, K. KUMAR and C. N. JAYARAM. *Proc.* 33*rd Conv. Sugar Tech. Assoc. India*, 1965, 181–192.—The middle juice sulphitation process, in which juice was limed to pH 7, concentrated to 30°, 35° or 40°Bx and limed and sulphited simultaneously to pH 7·1 before boiling, was compared with the conventional sulphitation process, both being carried out on a laboratory scale. The middle juice sulphitation proved to have the following advantages over conventional sulphitation: the colour content of the treated juice was lower (even more so with lower lime usage); the CaO content of the juice was lower; and the purity rise was 1–1½ units greater.

[1] Float-Ore Ltd., Apex Works, Willowbank, Uxbridge, Middx., England.

BEET FACTORY NOTES

Treatment of low-grade massecuite. F. PITTALUGA. *Ind. Sacc. Ital.*, 1965, **58**, 348–357.—From a study of crystallization rates of massecuites at various supersaturations and temperatures, the author postulates two opposing factors: an activating factor proportional to the ratio of sugar to water, and an inhibiting factor proportional to the ratio of non-sugar to water. The purity and concentration of the sugar syrup will therefore determine the optimum supersaturation for crystal growth. Lowering of the temperature will maintain a supersaturation at which crystallization continues, and the Werkspoor-ASG crystallizer for such cooling is described. It is suggested that cooling should be such as to bring the massecuite to 32–33°C, after which it can be reheated to 48–50°C before centrifugalling.

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Modern vacuum pan designs. D. WAGNER. *Zucker*, 1966, **19**, 55–62.—Requirements of modern vacuum pans are listed and descriptions given of various pan designs, including one developed by A. L. WEBRE in which the large downtake is provided with a deflector. The use of mechanical stirrers in pans is discussed with particular reference to the work being carried out in British Sugar Corporation factories[1]. Brief mention is made of incondensable gas removal and entrainment separators, and experimental work on the development of a continuous pan is touched on.

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Chemical control of steam circulation in a boiler plant. H. ANDERS. *Zucker*, 1966, **19**, 63–66.—A table is given of the required ranges of values of the various contents and factors concerning steam circulation. These ranges are offered as an approximate guide only, and are applicable to various components of the steam and to different sampling points. Each factor is discussed individually.

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Polar storage of beets at Sucrerie Central de Cambrai. A. ROBACHE. *Sucr. Franç.*, 1966, **107**, 31–34.—An illustrated description is given of the Fives Lille-Cail system of beet storage installed at Cambrai, in which beets received at a weighing station are brought by a conveyor of 700 tons/hr capacity to the centre of a rotary conveyor, which deposits them in a circular area, of 67·5 metres diameter, provided with two covered concentric flumes feeding a common outflow flume to the factory. The storage capacity is 10,000–12,000 tons of beet.

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Membranes spur ultrafiltration study. ANON. *Chem. Eng. News*, 1965, **43**, (40), 46–48; through *S.I.A.*, 1965, **27**, Abs. 1049.—"Diaplex" polyelectrolyte membranes, developed by Amicon Corp., Mass., U.S.A., are to be tested by Dorr-Oliver in prototype devices for beet sugar purification. It is thought that this filtration process might replace carbonatation. Such membranes can be made which are almost impermeable to solutes with molecular weights of 500, and which have water permeabilities of 2–5 ml/hr/sq.cm. The hydrated membranes are based on Amicon's "Ioples" polyion complex resins, which are made by reacting cationic and anionic polyelectrolytes to produce an ionic cross-linked structure. Since the membranes are non-porous, filtration is by diffusive transport. Other uses of the membranes are discussed.

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Massecuite circulation in vacuum pans. V. N. SHCHEGOLEV and M. N. MAKSIMENYUK. *Sakhar. Prom.*, 1966, **40**, (2), 8–10.—With the aid of mathematical expressions it is shown that to shorten the time of a strike by accelerating massecuite circulation it is necessary to: reduce hydraulic resistances, raise the massecuite level to an optimum (found experimentally) and increase the difference between massecuite density in the downward currents and the average density in the massecuite layer above the bottom tube plate ($\rho_1 - \rho_2$). The hydraulic resistance in a Soviet experimental calandria pan in which the ends of the tubes are widened and hexagonal, so presenting a honeycomb pattern in plan view, was lower than in other Soviet pans. The pan diameter is greater above the calandria to permit an optimum massecuite level. An increase in the difference ($\rho_1 - \rho_2$), brought about by lowering the value of ρ_2, is possible by increasing the vapour bubble volume. This requires as high a vacuum in the final phase as is feasible. However, boiling under high vacuum also necessitates enlarging the condensers and pipelines. After modifications had been made to the pipelines and the air pump unit at Smelyanskii sugar factory, a vacuum of 66 cm Hg was obtained in the pans.

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Effect of purified juice quality on variation in technological factors during evaporation under different temperature conditions. L. P. REVA, N. YU. TOBILEVICH and V. T. GARYAZHA. *Sakhar. Prom.*, 1966, **40**, (2), 16–21.—Tests in an experimental evaporator showed that over the range 115–125°C juice colour increased only slightly, the temperature-colour relationship being linear. At 125°C there was an upward inflexion in the curve, after which linearity was maintained up to 135°C. Over the range 125–135°C colour increased markedly, the more so with higher initial invert content. At low initial invert content (0·1% on 100°Bx) heating to 130°C was possible without any appreciable colour increase, and only at 135°C was there any appreciable increase in the invert content. At an initial invert content of 0·7% on 100°Bx there was an initial fall in the invert content to $\sim$0·1%, after which it rose until at 135°C the net content exceeded that initially present. The rate of invert formation in juices of high pH was lower than its decomposition rate. With a fall in pH the invert formation rate increased and the decomposition rate fell. At 115–125°C the level of the juice in the evaporator tubes did not affect the colour, but

[1] *See* RODGERS & LEWIS: *I.S.J.*, 1965, **67**, 9–12, 42–45, 76–79.

above 125°C the increase in colour was greater the higher was the level of the juice; increase in the level was also accompanied by greater invert formation and reduction in pH. Reasons are suggested for the higher concentrations of ionic calcium in the evaporated juice than in the original carbonatation juice.

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Results of using sodium triphosphate for beet juice purification. L. I. ONANCHENKO. *Sakhar. Prom.*, 1966, **40,** (2), 11–14.—Investigations at a number of Soviet sugar factories have shown that the anions from sodium triphosphate added to 2nd carbonatation juice are not completely precipitated in the form of calcium phosphate, some forming organophosphorus compounds, all or some of which enter the evaporators and then pass to the boiling house. These compounds decompose on the heating surfaces and can cause pitting of steel tubes. It is claimed that sodium triphosphate does not reduce the molasses sugar content nor increase the time between boiling-out of evaporators, and because of the adverse effects mentioned above its use is not recommended.

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Improving heat economy. Z. O. ZINGEL'. *Sakhar. Prom.*, 1966, **40,** (2), 25–28.—Reasons for excessive fuel consumption in Soviet sugar factories are given and means of raising the efficiency of the heat economy are suggested, covering evaporators and vacuum pans. Particular emphasis is laid on the need to reduce the extent of dilution of juice before evaporation and on more efficient use of condensate.

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Incondensable gases in evaporator steam chests. F. N. FILIPPOVA. *Sakhar Prom.*, 1966, **40,** (2), 28–29.—Tests showed that the quantity of incondensable gas in the vapour of a 2nd and 3rd evaporator effect fluctuated (between 0·2 and 1·5% by weight), as did its composition: CO_2 35–85%, NH_3 5–21%, O_2 3–18%, N_2 7–26% and CO 0·05–0·562%. Almost without exception the gas concentration increased from top to bottom of the steam chest, especially with reduced gas withdrawal. There were no differences in gas concentration across the steam chest, while that in the 3rd effect was greater than in the 2nd effect.

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Means of washing vacuum filter mud. P. S. MAKSIMUK. *Sakhar. Prom.*, 1966, **40,** (2), 36–37.—Water is fed through a perforated pipe housed in an outer tube provided with a 2-mm slot over its whole length. It falls from the slot in a uniform curtain onto a slightly sloping plate whence it cascades onto the cake on the filter drum. Replacing the conventional spray washing, this device has given sugar losses in the cake averaging 0·59% by weight at a water consumption of 11·5–15% on weight of beet.

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Some data on storage and processing of mechanically-harvested beet at Alma-Ata sugar factory. G. V. ERESHCHENKO and I. K. STOYANOVSKAYA. *Sakhar. Prom.*, 1966, **40,** (2), 43–46.—Daily sugar losses in mechanically-harvested beet stored for 86 days were 0·016% on weight of beet compared with 0·011% in manually-harvested beet stored for 92 days. The weight losses were 6·60% by weight compared with 5·88% in the control. Despite certain difficulties in processing, including an increase in 2nd product massecuite viscosity (it could be cured at 45–46°C, but centrifugalling took 4 min longer than usual on average), the brown sugar quality was good and the white sugar quality was unchanged. Molasses purity rose by 0·7 units. Diffusion and filter-cake losses were unchanged.

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Operation of a beet feeder (grab crane) at Zolochevskii sugar factory. P. A. GUMENCHUK. *Sakhar. Prom.*, 1966, **40,** (2), 46–48.—Difficulties in using bulldozers to transfer beet from the pile to the flume are discussed. A Polish grab crane with a 14-m long jib (subsequently lengthened to 21 m) is used instead. The special rake travels to the required point in the pile and on its return pushes the beets into the flume which is at right angles to the crane jib. In one pass an average of 2–2½ tons of beet are pushed into the flume. Modifications to the crane are described and its advantages discussed.

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Beet juice purification with lime and carbon dioxide gas with repeated use of lime in defecation. A. I. VOSTOKOV. *Sakhar. Prom.*, 1966, **40,** (3), 12–19. Details are given of the author's scheme, in which the raw juice at 40–45°C is mixed with milk-of-lime equivalent to 0·25% CaO on weight of beet and with all the mud suspension obtained after carbonatation juice settling. The pre-limed juice is settled, giving a mud suspension which is vacuum filtered and the filtrate mixed with the clear supernatant. This is limed to 2·75% CaO on weight of beet by adding recycled mud suspension plus fresh milk-of-lime. The limed juice is cooled to 10–15°C (or preferably lower) and then re-heated in two stages to 85–90°C. After settling, the mud suspension (25% by volume) is returned partly to pre- and partly to main liming, while the clear juice is saturated with CO_2 to 0·015–0·020% CaO, heated to 85°C and settled. The 10% mud suspension is returned to pre-liming and the juice is filtered and sent to the evaporators. The purities of the juice from this and the standard scheme were practically the same. Advantages of the new scheme are claimed to be faster filtration of the pre-limed juice (5·3 litres/sq.m./min compared with 2·8 litres/sq.m./min with the conventional scheme) and lower consumption of lime (1·0% CaO compared with 3·0% CaO on weight of beet).

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Washing, drying and repairing sugar bags. V. M. CHERNIKOV. *Sakhar. Prom.*, 1966, **40,** (3), 19–23. Information is given on a standard Soviet scheme used in a number of factories for removing residual sugar from bags, washing them, drying them in a spin-dryer followed by hot-air drying in a drum dryer. The final stage is sorting into usable bags and those needing repairs.

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Comparative durability of floors with cement, polymer cement and cementless plastic concrete bases. A. V. CHUIKO, YU. V. LISITSIN and A. A. KOSTROMINA. *Sakhar. Prom.*, 1966, **40**, (3), 35–40.—Comparative tests on floors of various compositions are reported. The compositions included: normal cement-sand mixture (1:3); a mixture of 18·4% liquid glass, 3% sodium fluosilicate and 78·6% sand; a mixture of Portland cement and synthetic latex, with a 20% aqueous casein solution as stabilizer (so-called polymer cement concrete); and a mixture of 80% quartz sand, 16% furfural-acetone monomer and 4% benzene sulphonic acid (so-called cementless plastic concrete). The samples were exposed to the action of 20% brown sugar solution, 30% molasses solution and raw juice. The least resistance was exhibited by an alumina cement-sand mixture, while the plastic concrete containing furfural-acetone monomer had greatest resistance. Changes in the composition of molasses were due to inversion of sucrose and its reaction with decomposing constituents in the concrete. Bacterial activity also caused slime formation, making the floor very slippery. Recommendations are given regarding the making of plastic concrete flooring.

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Molasses obtained from deionized 2nd product run-off. R. VANDEWYER. *Sucr. Belge*, 1966, **85**, 221–223. Run-off from a 2nd product was diluted to 20°Bx, cooled to 10–12°C and passed successively through cation and anion exchange resin beds, after which it was boiled to a 3rd strike in a flask. This massecuite was cooled to 45°C at a rate of 10°/24 hr, reheated to 55°C and spun in a centrifuge, without washing. Comparative data are given for the final molasses produced and for factory molasses from the same period; the "deionized" molasses was of 55 apparent purity against 60, 49·8 Clerget (HCl) purity against 59·1 and contained about 3% ash as against 15%. Viscosity (at 75°Bx and 50°C) was appreciably higher at 194 cp as compared with 148 cp. The mole ratio of sucrose: (K + Na + Ca) was 4·1 as against the figure of 1, held to be the theoretical minimum, and even after exhaustion by the Grut technique the ratio was still 2·954:1. This indicates the importance of the organic constituents of the non-sugars in retaining sucrose in solution.

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Sugar house calculations by means of the purity nomogram. J. MANINA. *Zucker*, 1966, **19**, 116–124. A nomogram is presented for sugar house calculations in terms of Brix. Based on the mathematical relationship between Brix and purity, the nomogram consists essentially of two superimposed systems of curves divided into Brix values at unit intervals in the range 2–31°. The left- and right-hand sides of the nomogram represent purity values in the range 44–100. By drawing a straight line linking two known purities, it is possible to use other known factors to find the required values. A number of examples are given together with diagrams illustrating the schemes, which include a complex system starting from thick juice. The accuracy of the nomogram is claimed to be equal to that of a slide-rule.

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The storage of sugar beet. S. VAJNA. *Zeitsch. Zuckerind.*, 1966, **91**, 71–75.—A survey of the principal processes occurring in stored beet is presented, covering respiration, withering, freezing and the effects of bacteria. Requisites for ideal storage are listed. The article concludes with a discussion of natural and forced ventilation, in which the author emphasizes the fact that forced ventilation is of advantage only when the beet are stored clean, which is not the case with mechanically-harvested beet unless the beet are washed before storage. A description is given of the storage system advocated by the author in which the pile is completely covered and air circulated continuously inside the pile by means of a mechanically-cooled heat exchanger. This enables temperatures of approx. 0°C to be obtained. This method was used for two campaigns in the storage of 60 tons of beet in each case. Satisfactory results were obtained, with sugar losses approximately equal to the theoretical values. It is claimed that by this means the campaign could be extended and beet stored until January.

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Dymokury sugar factory (Czechoslovakia). S. GAWRYCH. *Gaz. Cukr.*, 1966, **74**, 6–7.—At this raw sugar factory, the raw juice is limed in three stages (0·25%, 0·70% and 0·70% CaO on beet), the third dose being given between 1a and 1b carbonatation, in which the juice is saturated to 0·020% and 0·080% CaO respectively. Pre-liming is carried out in a continuous counter-current 5-chamber tower of the Vašátko, Kohn & Tibensky system. Retention time is 12 min, and the mixer rotates at 16 r.p.m. Main liming is also carried out in a tower, retention time being 10 min, while the 2nd carbonatation process is standard. Juice de-liming by cation exchange resin is planned.

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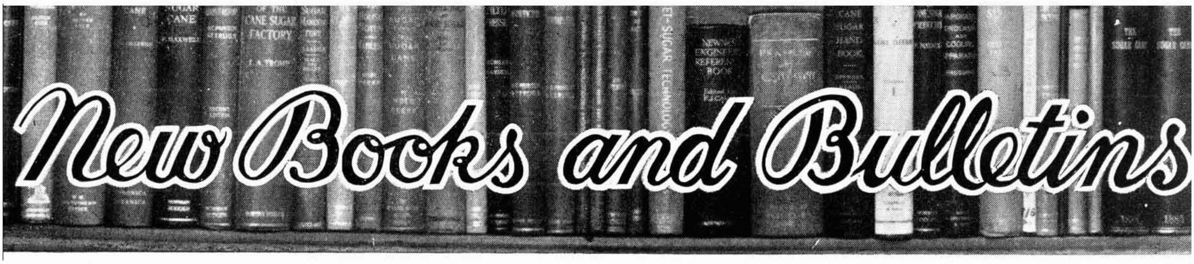
Recent developments at Holly Sugar Corporation. ANON. *Sugar y Azúcar*, 1966, **61**, (2), 51.—A brief report is made on operation of the Hereford, Texas, plant of Holly Sugar Corporation. This slices over 6000 tons/day, employing a single RT diffuser which is claimed to be the largest in the world.



Introduction to Cane Sugar Technology. G. H. JENKINS. 478 pp.; 6 × 9 in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex.) 1966. Price: 115s 0d.

The author of this book, recently Senior Lecturer in Sugar Technology, originally planned it as a textbook for use in the post-graduate course held at the University of Queensland. It summarizes for the first time in book form information accumulated by workers of the Sugar Research Institute and at the University's Mechanical Engineering Dept., and presents a concise account of cane sugar manufacture, from both chemical and engineering aspects, in a single volume of convenient size.

More than a quarter of the book is devoted to cane milling, three out of eleven chapters being concerned with the machinery employed and the remainder on more detailed studies of milling performance, settings, feeding, capacity and power requirements, etc. By contrast, a final chapter in this section gives a surprisingly brief survey of cane "diffusion", which is rather incomplete and inadequate in view of the undoubted future growth of this form of sugar extraction.

Crystallization of sugar is treated in great detail with accounts of vacuum pan, centrifugal and crystallizer designs and the boiling, crystallization and curing of massecuites, with a separate chapter devoted to low-grade work.

Clarification, evaporation and raw sugar drying, storage and refining are treated separately, but in less detail, while another section on steam generation and usage reviews furnace design and boiler efficiency determination, the steam cycle and heat balance calculations. The book is provided with references at the end of each chapter and with author and subject indexes at the end of the book. The text naturally contains many allusions to Queensland practice but is not aggressively Australian, special conditions and practices in other parts of the world being given due attention.

The author writes in his preface that his book "while introductory, is designed to be more than elementary". In this aim he has succeeded admirably; he provides a thoroughly-treated basis in general terms from which the reader can go on to the specialist literature on individual parts of the sugar manufacturing process.

There is no doubt that JENKINS' "Introduction" will find an honoured place on many a technologist's bookshelf.

La Producción Azucarera Argentina; Necesidad de su Regulación. R. FERNÁNDEZ DE ULLIVARI and G. KENNING VOSS. 55 pp.; 8½ × 11 in. (Centro Regional Nordeste, Instituto Nacional de Tecnología Agropecuaria, San Miguel de Tucumán, Argentina.) 1966.

This duplicated bulletin reviews the current (March 1966) position as regards world sugar supplies, markets and prices as they affect Argentina. With a surplus production of 450,000 tons and an annual consumption increase of only 15,000 tons, it is recommended that the country's sugar production should be controlled and a scheme for this is presented. Cane producing zones should be given quotas based on the previous 10-, 5-, 3-year and 1965 crop averages, and the cane crushed by the factories in the zone. Taxes on sugar should be abolished and a fund built up to aid exporting. No credit should be provided for new factories and cane payment should be based on sugar yield.

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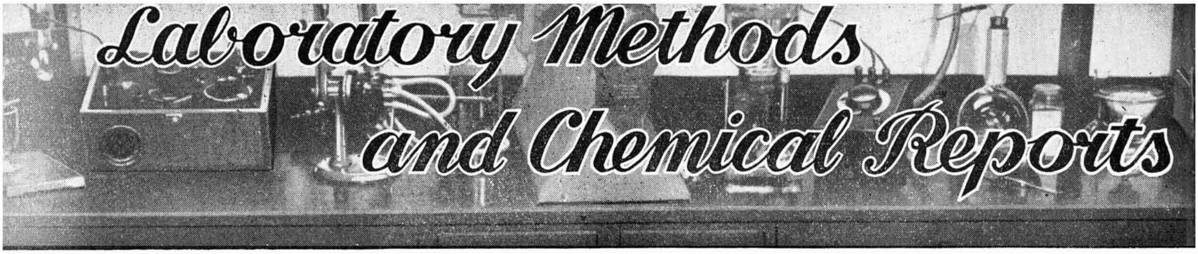
Las Razones de Vicente. (The discourses of Vicente.) N. M. GÁNEM. 43 pp.; 5¼ × 8¼ in. (José Ch. Ramírez, Eugenio Sue No. 316, México, D.F.) 1966.

This is the third in a series of booklets featuring Vicente, an iconoclastic character, whose uninhibited examination of the Mexican sugar industry from fresh angles provides a criticism of its organization and operation of the Mexican sugar producers' association UNPASA and the thinking of member producers. The actions and functions of the workers' *sindicato* or trade union are also discussed, as by Vicente, with several quotations from its Secretary-General. The position of the cane growers is examined, and it is proposed that all three sectors should meet to provide discussions on the problems of the Mexican sugar industry in the hope of finding solutions which could be forwarded to the Government.

U.S. beet factory conversion for refining.—Construction of the Easton, Maine, factory was started in 1965 with the intention of its processing 3000 tons of beet per day from the local beet area allotted by the U.S.D.A.[1] An application has now been made, however, for a loan to enable additional equipment to be installed to permit the plant to refine cane raw sugar, since farmers in the area are reported to be receiving a higher return from potatoes.

[1] *I.S.J.*, 1965, **67**, 256.
[2] C. Czarnikow Ltd., *Sugar Review*, 1966, (776), 154.



Influence of the decolorization of juices and sugar products on the crystallization rate of sucrose in impure solutions. S. ZAGRODZKI and H. ZAORSKA. *Ind. Sacc. Ital.*, 1965, **58**, 315–323.—See *I.S.J.*, 1965, **67**, 300–303, 337–338.

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Hydrolysis of sucrose and breakdown of the hydrolysis products, especially under the conditions of beet sugar manufacture. II. Degradation of invert sugar. K. VUKOV. *Cukoripari Kutatóintézet Kozleményei*, 1964, **9**, 1–52; through *S.I.A.*, 1965, **27**, Abs. 1024.—The review is continued[1] to determine rate equations for the decomposition of invert sugar under alkaline conditions and the resulting colour formation. The kinetics of alkaline degradation are analysed in detail[2] and summarized in the following equation for k_e, the basic 1st order rate constant (min^{-1}): $\log k_e = 16{\cdot}88 - (5620/T) - \text{pOH}$. The value of k_e is additively increased by an amount k_d in beet factory juices. The amount of anions formed per g of decomposed invert sugar is given by A_g, the "total anion ratio", which is nearly constant at pOH 1·5—2·4 and is equal to 7·5 meq/g. Under less alkaline conditions (pOH 2·4–5·0), $A_g = 9{\cdot}2 - 0{\cdot}68$ pOH, and the ratio of lactic acid to volatile acids decreases. Aci-reductones amount to 7–8% of the decomposed invert sugar at pOH 2–4·9; at pOH $< 1{\cdot}9$, and after degradation of $> 75\%$ of the invert sugar at pOH $> 2{\cdot}0$, the ratio of aci-reductones falls to 3%. The rate of formation of colouring matter[3] is expressed by B_λ, the extinction coefficient (at λ mμ) of the substances formed from 1 g of decomposed invert sugar per ml. At pOH 1·5–3, B_λ is independent of the solution composition: $B_{436} = 310$ pOH — 310, $B_{465} = 195$ pOH — 195, $B_{550} = 50$ pOH — 50. At pOH > 3, B_λ depends on the solution composition: in normal Hungarian juices under anaerobic conditions, $B_{465} \simeq 150$, and $B_{550} \simeq 50$; in the presence of air, these values are increased by approx. 200% and 300% respectively.

From the above study of quantitative sugar losses and the resulting degradation products, general recommendations are made on the conduct of the various stages of beet sugar manufacture. Losses by invertase action in diffusion can be eliminated by correct automatically-controlled scalding. The importance of salt-catalysed inversion is emphasized, particularly at high temperatures. Once invert sugar is formed, it is degraded more rapidly than in cane sugar manufacture, owing to the high value of k_d due to the amino compounds present; it is therefore impracticable to preserve the invert sugar (e.g. by "mild" defeco-saturation). It is recommended to carry out defecation at a high pH so that mainly colourless degradation products are formed; the latter, together with the salts, are largely adsorbed by the $CaCO_3$ precipitate, especially at high lime doses.

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Indian raw sugar quality control. M. ANAND. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 80–82.—Specifications for export raw sugar from India include a pol range of 96·5–97·5. This was taken by factories to indicate that sugars of pol high than 97·5 would not be acceptable and steps have been taken—boiling back, etc.—to ensure that the sugar produced was near the lower acceptable pol. This has resulted in poorer quality than necessary in respect of colour, moisture, reducing sugars, etc., and it is considered that the pol range should be extended upwards.

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Pol balancing under raw sugar manufacture. M. ANAND. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 83–86.—Pol balances were drawn up easily when making white sugar but there is a high apparently unknown loss when drawing up a corresponding balance for raw sugar manufacture. This is partly attributed to the inherent inaccuracies in using direct pol but the large balance requires investigation.

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Unknown loss. M. Y. LONKAR and V. P. YAWALE. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 87–91.—Unknown loss may be unreal or real; the causes for the former type include errors in weighing, sampling and analysis, including the effects of optically-active non-sugars in juice, while real losses may arise through inversion, entrainment, leakages, caramelization and thermal decomposition through local overheating.

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Calcium content of clarified juices and possible improvements in sulphitation factories. S. C. GUPTA and N. A. RAMAIAH. *Proc. 20th Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 119–127.—The higher CaO content in sulphitation juices than in carbonatation juices is attributed to the formation of calcium sulphate by oxidation of calcium sulphite. Prevention of such oxidation by, e.g., use of liquid SO_2, operation under vacuum, use of an oil seal in the clarifier to exclude air, would result, it is suggested, in lower CaO contents.

[1] *I.S.J.*, 1965, **67**, 155.
[2] *ibid.*, 172–175, 348.
[3] *ibid.*, 346.

Moisture determination in molasses. S. K. D. AGARWAL and R. C. GUPTA. *Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 115–118.—A technique is described in which molasses is carried by a glass wool base for drying under vacuum at 70°C. Results obtained are slightly higher than when sand is used as a carrier; this is attributed to better exposure of the molasses to the dehydrating atmosphere.

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Cyclone molasses pot. D. V. GHATE *et al. Proc. 20th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 158–160.—A cyclone pot is described for use in separating a sample of molasses from a massecuite immediately after dropping a strike. It is provided with a "cup sieve" made from centrifugal liner material which fits inside a holder-funnel with a flange forming a seal on the corresponding flange of a receiver in which the funnel fits. The funnel has ports so that vacuum applied to the receiver is transmitted to the massecuite in the cup sieve, drawing molasses into the receiver.

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One criterion of sugar solutions. I. N. KAGANOV and V. I. TUZHILKIN. *Sakhar. Prom.*, 1966, **40**, (3), 10–12. The Einstein-Stokes equation for the diffusion coefficient D, which assumes D to be inversely proportional to the viscosity coefficient at constant temperature, is found to be valid only for very dilute sugar solutions. Linear semi-log graphs of fluidity (reciprocal of viscosity) and diffusion coefficient *vs.* concentration correspond to $\phi = A_1 \times 10^{-B_1N}$ and $D = A_2 \times 10^{-B_2N}$, where N = concentration in moles and A_1 and B_1 are fluidity (viscosity) constants and A_2 and B_2 diffusion constants. With increase in concentration, the value of D falls at a lower rate than does ϕ. The Prandtl-Schmidt similarity criterion (Sc) is a dimensionless factor relating kinematic viscosity to the diffusion coefficient. A graph of Sc *vs.* concentration and temperature is also linear. Disregarding the very small change in density occurring over the range covered, $Sc \simeq A_3 \times 10^{B_3N}$, where $A_3 \simeq \frac{1}{A_1 A_2}$ and $B_3 = B_1 + B_2$. Hence, Sc is not proportional to η^2, where η is the dynamic viscosity, as would be expected from the Einstein-Stokes equation.

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Determination of the colour of sugar factory products in physical units. A. YA. ZAGORUL'KO, L. K. IVANOVA, Z. O. IGNAT'EVA, L. A. KOROBEINIKOVA and Z. A. PIVOVAR. *Sakhar. Prom.*, 1966, **40**, (3), 27–33. Removal of turbidity before determination of sugar solution colour is discussed. A description is given of a laboratory filter which has been adapted from a thistle funnel for white sugar solution filtration. The inner surface is covered with cotton cloth and the bulb filled with cotton wadding, while in the conical section above this two filter papers are so arranged that there are four layers all round. A 50°Bx solution had zero optical density at 720 mμ after filtration, indicating complete absence of turbidity. For dark solutions the cotton wadding should be removed and the solution first treated with 2% kieselguhr (on Brix) and the solution brought to pH 7. Since air absorbed by solutions will affect light absorption, it should be evacuated for precise analysis. While a wavelength of 506 mμ for monochromatic light corresponds to the mean integral optical density of sugar products and would therefore be useful in comparing the colour of all factory products, it is considered preferable to use the ICUMSA-recommended wavelengths until sufficient data have been accumulated. Distilled water may be used as standard, since it has the same optical density as 50% sugar solution in the range 400–560 mμ. Details are given of the procedures to be used in the determination of the colour of white sugar and dark solutions. Graphs are presented showing the relationship between °St and the colour index, which is given by $\frac{100{,}000\ D_{420}}{Bx.d.b.}$ and $\frac{100{,}000\ D_{560}}{Bx.d.b}$, for white sugar and dark solutions respectively, where d = solution density and b = length of colorimeter cell (cm). Generally, the colour index = 89·3 × °St for white sugar and 15·3 × °St for dark solutions.

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Properties of colouring substances occurring in sugar production. V. VALTER. *Listy Cukr.*, 1966, **82**, 13–23. A summary of information on the properties of the colouring substances encountered in sugar production is presented, with 92 references to the literature.

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A new approach to the saccharate cake purity determination. K. SCHOENROCK. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 425–431.—A technique is described for determining the purity of saccharate cake produced in the Steffen process, whereby the amount of non-sugars returned to process can be calculated. Into a Waring blender is charged 300 g of cake (40% solids) and this agitated while 100 g powdered ammonium carbonate is added. The temperature rises to 65°C during the reaction. The blender is operated for 3 min and the mixture filtered under vacuum and the cake washed. Ammonia is expelled from the filtrate by steam distillation to an end pH of about 7 (between 5·5 and 8·5), when the purity is determined from the sucrose content and refractometric Brix. The method is simple, accurate, and requires only 15–20 min with unskilled personnel and no special equipment.

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The chemical destruction of sucrose, fructose and glucose in hot alkaline process juices and liquors. S. E. BICHSEL. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 406–414.—Concentrations and reaction rates in an alkaline process juice, where sucrose is being inverted and the reducing sugars converted to acidic end-products, are such that the sucrose and invert contents are approximately constant and only the acidic material formation can be considered in terms of reaction kinetics. The "steady state" invert concentration (at which formation is balanced by further conversion) rises with juice temperature at constant pH, while from determination of glucose and fructose reaction constants it is found that the fructose proportion of any steady state invert concentration will be only 36·5% since it reacts faster. The sucrose loss rate is only slightly affected by temperature at pH 9·7, the loss in a clarifier being calculated at only 0·022% after 30 min at 85°C. Losses through sucrose destruction in the high green storage tank at 100°C and under various pH conditions are indicated in graph form.

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Determination of sucrose and non-sugars balance in refining from analytical data. J. BURIÁNEK. *Listy Cukr.*, 1966, **82**, 29–37.—Determination of the sucrose, non-sugar and water contents in intermediate products is discussed. Values of α, the proportion of sucrose in one of two products combined to give another single product, are calculated for mixtures of a molasses solution of known composition with a pure sucrose solution. The values were determined from conductivity ash measurement, measurement of the Cl^- concentrations and from the purities. It is emphasized that where two products have been mixed, the electrical conductivity is valid as a measure of the ash content only if it is a linear function of the weight ratio between the two original products, a condition that does not obtain in practice. The most accurate method is considered to be polarographic determination of the Cl^- concentration. A similar proportion, α_k, is the amount of sucrose present in one of two products (e.g. as solid crystal in a massecuite) as a proportion of the total sucrose in both products. Polarograms are given for various massecuites. The procedure involves the addition to a 5-g sample of 10 ml of 1M H_2SO_4 and water to 200 ml.

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Deionization of sugar solutions by electrolysis on ion exchange columns. II. Isolation of nitrogen compounds. P. KADLEC. *Listy Cukr.*, 1966, **82**, 37–43.—Tests were conducted with a continuous laboratory apparatus, consisting of resin columns arranged in a closed system for cation-anion-cation-anion exchange. The cation exchange columns were of "Lewatit S 100" resin (with a capacity of 1·8—2·0 meq/ml) surrounded by a "Permaplex C 20" cation exchange membrane, while the anion exchange columns were of "S 8-TM" resin (with a capacity of 1·4–1·5 meq/ml) surrounded by a "Permaplex A 20" anion exchange membrane. Test deionization of a 0·01N K_2SO_4 solution gave satisfactory results, and approx. 60% of the inorganic salt cations in a 4°Bx molasses solution were removed. Sucrose inversion was not measured. Most, but not all, of the N compounds adsorbed on the cation exchanger (approx. 55% of the quantity in the molasses) could be removed with 2N NH_4OH. Details are given of a system advocated for recovery of N compounds. These are concentrated by treatment of 4°Bx molasses which is added to the centre cell of a three-cell unit, the partitions being cation-permeable membranes. Also in the centre cell is added a cation-exchange resin ("Amberlite IR 120"). The two outside cells contain 0·1N K_2SO_4 solution and a cathode and anode, respectively, to which a direct current is supplied. H^+ ions generated at the anode pass through the membrane into the centre cell and displace inorganic and organic cations from the molasses; the inorganic cations pass readily through the second membrane and enter the cathode chamber where they combine with the hydroxyl ions generated to produce alkali hydroxide. The solution is eventually treated with CO_2, and $CaCO_3$ produced is filtered off, giving a relatively pure solution of K_2CO_3, partly contaminated with Na_2CO_3. The concentrated cationic nitrogenous material is recovered from the resin by eluting with ammonia.

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Cell breakage determination in prepared cane and bagasse and the rôle of diffusion during maceration in juice extraction from sugar cane. S. C. GUPTA, S. K. D. AGARWAL and V. M. BHALWAR. *Proc. 33rd Conv. Sugar Tech. Assoc. India*, 1965, 1–10.—Cane and bagasse samples subjected to various preparation techniques were contacted with water and the rate of diffusion measured in terms of the rise in sugar concentration in the water. The sugar concentration rose more quickly when the preparation was such as to open more cells.

* * *

A new method for measurement of colour or raw sugar in Stammer units. S. C. GUPTA, S. K. D. AGARWAL, R. P. JOHRI and V. M. BHALWAR. *Proc. 33rd Conv. Sugar Tech. Assoc. India*, 1965, 21–26.—A system is described in which colour is measured by adding sugar solution to a glass cylinder on the bottom of which is a disc carrying a black cross visible from above. The height of the liquid column is measured at which the cross becomes no longer visible. The device can be calibrated in terms of the measurements recorded with the same solutions using a Stammer colorimeter.

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Clarification factor. B. L. MITTAL. *Proc. 33rd Conv. Sugar Tech. Assoc. India*, 1965, 35–37.—An equation is derived for removal of non-sugars in clarification, viz. $K \text{ (clarification factor)} = \frac{100\ P_{mj}\ (100 - P_{cj})}{P_{cj}\ (100 - P_{mj})}$, where P_{cj} and P_{mj} are the purities of clear and mixed juice, respectively. This eliminates the effect of variations in filter performance which affect the value of the factor used by the Sugar Technologists' Association of India[1].

[1] HONIG: Principles of Sugar Technology, Vol. I. (Elsevier, Amsterdam.) 1953, p. 614.

BY-PRODUCTS

Methods for depithing sugar cane bagasse. A. G. KELLER. *Sugar J.* (La.), 1966, **28,** (11), 26–33.—A review is presented of wet and dry depithing methods with 12 references to the literature.

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Manufacture and uses of fatty acid esters of sugars. Survey and assessment. H. BERTSCH, F. PÜSCHEL and E. ULSPERGER. *Tenside*, 1965, **2**, 397–404; through *J. Appl. Chem. Abs.*, 1966, **16**, i–359.—The review (with 43 references to the literature) covers a general consideration of surface-active polyhydroxy compounds, the processes for the manufacture of mono- and di-esters of fatty acids of sugar, particularly sucrose, and an evaluation of the reaction conditions such as solvent, catalyst, temperature and time. The properties of the products are discussed, especially detergency, surface tension, emulsifying power, froth formation and biological degradability. Applications of the esters as detergents, emulsifiers, to the cosmetic and foodstuff industries and other special uses are surveyed.

* * *

Sugar esters and pastry products. ANON. *Prumysl Potrav.*, 1966, **17**, (2), 80; through *Lebensmittelind.*, 1966, **13**, 192.—The Fat Research Institute at Rakovnik (Czechoslovakia) and the Research Centre for Pastry Products in Prague have conducted research on the use of sugar esters (fatty acid esters with 12–18 C atoms) in the production of biscuits. These surface-active derivatives are non-toxic, tasteless, highly soluble in ethanol and partially water-soluble, and have a hydrophilic-lipophilic equilibrium between 7 and 12. A 15–25% sugar ester gel was added to the egg mixture and results of the tests were very good. The advantages lie in the reduction of time spent in mixing and beating, while the foam mass was stabler and firmer. Details of the esters used (in percentages) are available.

* * *

Performance characteristics of sucrose ester detergents. A. M. SCHWARTZ and C. A. RADER. *J. Amer. Oil Chem. Soc.*, 1965, **42,** 800–804; through *S.I.A.*, 1966, **28,** Abs. 131.—Standard household laundering formulations were prepared, using commercial sucrose esters of coco(nut oil), tallow, tall oil, stearate or laurate as the active ingredient (20–25% of the total). The washing performances were determined and compared with those of commercial anionic detergents, LAS anionics, non-ionics and soap. The detergent power of the sucrose esters was as good as that of the commercial anionics, and was effective at relatively lower concentrations. The anti-redeposition and lime soap dispersing powers of the sucrose esters were superior to those of the other detergents, indicating a superior performance under domestic conditions. Within the sucrose esters, the best performances were given by the saturated C_{18} esters; these, however, tended to contain a higher proportion of monoester than did the other commercial sucrose esters.

Sucrose esters as raw materials for paints. A. KRAUS. *Fette-Seifen-Anstrichmittel*, 1965, **67,** 16–19; through *S.I.A.*, 1966, **28,** Abs. 133.—Tests with sucrose acetate isobutyrate (SAIB) and sucrose (octa)benzoate as paint constituents are reported. They are particulary suitable for incorporation in nitrocellulose paints. SAIB and sucrose benzoate respectively behave in a similar manner to a soft resin and a ketonic-type hard resin.

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Sucrose derivatives. I. Preparation and properties of oxyethylated sucroses. W. GERHARDT *J. Prakt. Chem.*, 1965, **29,** 300–308; through *S.I.A.*, 1966, **28,** Abs. 134.—The reaction of sucrose with ethylene oxide in the presence of basic catalysts in homogeneous solution yielded oxyethylated sucroses containing up to 80 or more moles of ethylene oxide/mole of sucrose. The reaction proceeded in water, dimethyl formamide, dimethyl sulphoxide or formylmorpholine, provided that a soluble catalyst was used, e.g. KOH in the case of water, or basic organic substances in the other cases. The reaction in water was exothermic above 60°C. No free sucrose remained after the absorption of 8 moles of ethylene oxide/mole. The products were viscous, hygroscopic, freely miscible with water, and soluble in methanol or acetone. The viscosity and density of the products decreased with increasing degree of oxyethylation. Freezing point depressions were measured at various concentrations of a 30 mole/mole product.

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Utilizing bagasse for paper making in India: Mandya mill is significant. D. K. MISRA. *Tappi*, 1965, **48,** (7), 88A–92A; through *S.I.A.*, 1966, **28,** Abs. 137. Experience with the Pandia continuous digestion system[1] at a Mysore paper mill is reported. The bagasse is treated with Hörkel depithers at Mandya sugar factory, removing two-thirds of the pith before dispatch to the paper mill. Paper has been successfully produced from 100% bagasse pulp, but the incorporation of 10–20% of long-fibre pulp greatly improves the draining of paper stock, machine speed and paper quality.

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Carbon dioxide from industrial alcohol fermentations. B. G. KRISHNAMURTI. *Indian Sugar*, 1966, **15,** 679–683. The harnessing and utilization of CO_2 produced during alcohol fermentation (theoretically amounting to nearly 49% of the fermented sugar, as glucose) is discussed and the requisite procedures and plant are considered. Possible applications are briefly mentioned.

[1] *I.S.J.*, 1966, **68**, 281.

UNITED KINGDOM

Preparation of water-soluble and water-insoluble sucrose esters. LEDOGA S.p.A., of Milan, Italy. **1,021,694.** 31st October 1962; 9th March 1966.—One mole of a natural triglyceride (coconut oil and/or palm oil, lard, or ox tallow) is reacted with at least 2 (4·4) moles of sucrose in dimethyl formamide, in the presence of K_2CO_3 as catalyst, at 90°–95°C for 3–9 hr, adding natural glyceride in the amount of at least $\frac{1}{2}$ (2) mole per mole of unreacted sucrose, heating to 90°–95°C for a further 3–9 hr and evaporating off the dimethyl formamide. The product is a mixture of esters of C_8–C_{30} acids which is readily separated into the water-insoluble fraction in which the combined sucrose is between 10 and 30%, and the water-soluble fraction in which the sucrose content is greater than 30%.

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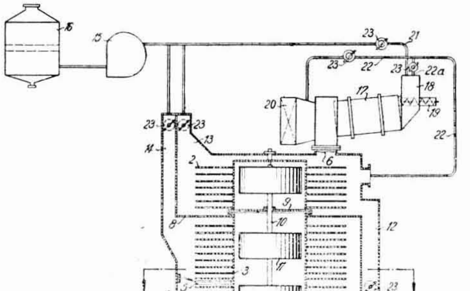
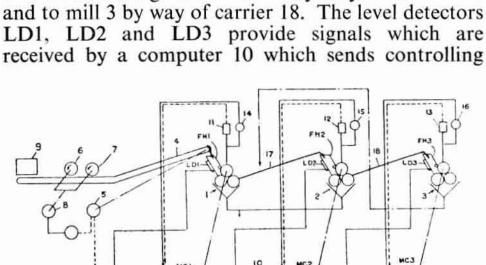
Sugar dryer and cooler. BÜTTNER-WERKE A.G., of Krefeld-Uerdingen, Germany. **1,023,700.** 11th January 1963; 23rd March 1966.—The annular disc dryer 1 is provided with discs 2 mounted on a rotary frame 3 and provided with radial slots through which sugar is pushed by stripper devices 5 onto the disc below, so that sugar admitted through inlet 6 falls through the dryer and is eventually discharged at outlet 7. An annular plate 8 separates the housing into two zones, the upper one for drying and the lower one for cooling of the sugar, a suitable stripper and slot allowing transfer of sugar from the one to the other. In the centre of the housing is a plate 9 which separates this part into two corresponding zones. Within this space is a driven shaft 10 carrying fans 11 which circulate the heating and cooling air through the layers of sugar.



Sugar from a centrifugal is passed through a drum dryer 17, the discharge point being connected to the inlet 6 of the disc dryer. Hot air used in the drum dryer is supplied by an air heater 20 which may provide hot air for the disc dryer through duct 22. Cool air may be supplied to the drying zone through duct 12 from port 24, through which it is admitted to the cooling zone, the amount in duct 12 being regulated by valve 23. Air leaving the drum dryer through pipe 21 and the drying and cooling zones of the disc dryer through ducts 13 and 14 is drawn by fan 15 to a wet dust extractor 16.

* * *

Cane mills. DUNCAN STEWART & CO. LTD., of Glasgow C.3. **1,024,236.** 19th February 1965; 30th March 1966.—The crushing units 1,2,3 of a three-mill tandem are provided with feed hoppers FH1, FH2 and FH3 having high- and low-level detectors LD1, LD2 and LD3. Cane is fed by a suitable device 9 to a conveyor 4 driven by a variable-speed motor 5 which takes it by way of levelling knives 6 and cutting knives 7, driven by motor 8, to hopper FH1. From mill 1 the cane goes to mill 2 by way of carrier 17 and to mill 3 by way of carrier 18. The level detectors LD1, LD2 and LD3 provide signals which are received by a computer 10 which sends controlling



signals to devices MC1, MC2 and MC3 which control the operation of hydraulic cylinders 11, 12, 13 coupled to the top rollers of the mills, so adjusting the angle of nip. The positions of the top rollers are shown by indicators 14, 15, 16 which also send signals to the devices MC1, MC2, MC3 when the rollers have taken up their regulated position. The computer also governs the speed of the motor 5 for conveyor 4, and sends signals to speed controllers SC1, SC2 and SC3 which govern the turbines ST1, ST2 and ST3 driving the mills. The computer is so programmed that if the level in any hopper rises above a certain value, the speed of the unit will be increased and the

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 U.S.A. (price 50 cents each).

angle of nip varied appropriately by the control device until the level has fallen or until maximum throughput is achieved; in the latter case the speed of the preceding mill will be reduced.

If the earlier mill cannot, at the reduced speed, deal with the cane supplied, its hopper will fill and the level detector will send an appropriate signal to the computer. The preceding mill (or conveyor 4) will then be slowed. When the hopper contents drop below the set levels, the speed of the mill is similarly reduced by the computer and its angle of nip adjusted. In this way the tandem is operated with automatic adjustment to give maximum efficiency for all rates of cane supply.

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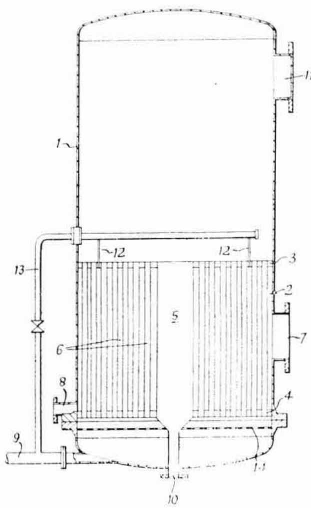
Evaporator. SOC. FIVES LILLE-CAIL, of Paris 8e, France. **1,024,191.** 11th December 1962; 30th March 1966.—The sealed-downtake design of evaporator is provided with bleed pipes 12 through which the incondensable gases and some steam are withdrawn from the steam side of the calandria, under the control of a valve in pipe 13, and admitted to the feed pipe 9, thereby increasing the flow rate through the tubes. Homogeneous mixing of the gases in the feed is ensured by providing a porous partition 14 of sintered metal which serves as a distributor.



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Production of mannitol and sorbitol. ATLAS CHEMICAL INDUSTRIES INC., of Wilmington, Del., U.S.A. (A) **1,022,480.** 30th December 1963; 16th March 1966. (B) **1,025,813.** 30th December 1963; 14th April 1966.

(A) The pH of an (20–80%) invert sugar solution is adjusted to neutral (6–8) and it is catalytically hydrogenated at 50°–80°C under a pressure of 500–3000 p.s.i.g., for 0·25–2 hr, until almost all the fructose is reduced to mannitol and sorbitol, the pH adjusted to 8–11 by addition of an alkaline material (0·25–1·5% of lime), and hydrogenation continued (for 1·5–6·0 hr) until all the reducible sugars are hydrogenated. The pH is then lowered with a (mineral) acid (to hydrolyse any sucrose present) to below 6·5 and the solution hydrogenated until hydrogenation is complete.

(B) An aqueous (20–80%) solution of glucose and/or invert sugar is catalytically hydrogenated in the presence of lime (0·25–1·5% by weight of sugar) and a supported nickel catalyst (0·2–2% by weight of sugar) (and 0·02–0·08% $CaCO_3$ by weight of sugar) at a temperature of 60°–100°C and hydrogen pressure of 500–3000 p.s.i. When hydrogenation is complete the catalyst is filtered off and mannitol and sorbitol recovered from the filtrate.

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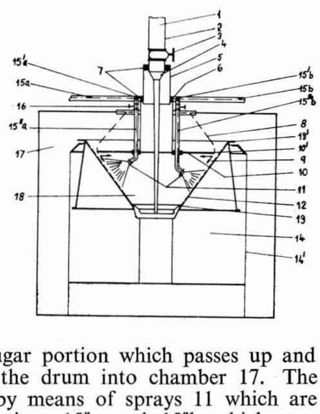
Sugar centrifugal. HEIN, LEHMANN & CO. A.G., of Düsseldorf, Germany. **1,028,831.** 8th April 1964; 11th May 1966.—Massecuite 1 is supplied through pipe 2 and valve 3 to nozzle 4 which is surrounded by a transparent pipe 5 connected with packing rings 7 to pipe 6. This last is secured at its lower end with an annular cover disc 10, preferably of transparent material, which almost reaches the screen 12 of the tapered drum 13, but leaves a space 9 for discharge of sugar. Except for this gap, the drum 13 is hermetically sealed by the packing rings. Massecuite supplied is separated in the drum into a molasses portion which passes through the screen 12 into chamber 14,



and a sugar portion which passes up and over the edge of the drum into chamber 17. The sugar is washed by means of sprays 11 which are supplied through pipes 15″a and 15″b which pass through disc 10 from pipes 15a, 15b and may contain the same wash fluid or different fluids to be used at different levels. Because of the air-tight seals, air flow into the drum is only by way of the path indicated at 8 and this ensures that no wash liquid in spray form is carried over into chamber 17 with the discharged sugar.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

"Pan-Aid Concentrate". Fabcon Inc., 314 Public Square Bldg., Cleveland, 44101 U.S.A.

"Pan-Aid Concentrate" contains 55% more active surfactant than the original "Pan-Aid"[1]. Viscosity and film tensions of massecuites are sharply reduced. Most important, the excellent performance of "Pan-Aid Concentrate" is little if at all diminished by increasing concentrations of calcium in the molasses. Results with the original "Pan-Aid" from more than 90 cane and beet sugar factories throughout the world show: a 10–20% reduction in boiling time for low-grade strikes, and a 1·5–3% reduction in apparent purity of final molasses, using 1 lb "Pan-Aid" per 400 cu.ft. of low-grade massecuite. "Pan-Aid Concentrate", at a rate of 1 lb per 600 cu.ft. of massecuite, is producing similar results with more consistent performance as the salt content, particularly calcium, in the molasses increases. To reduce final molasses purity, "Pan-Aid Concentrate" must be used to boil to higher Brix or preferably to boil with lower massecuite purity. With "Pan-Aid Concentrate" these changes can be made safely with consistently reduced molasses purity.

Independent evaluation by Rumsu Technical Services Ltd., of Kingston, Jamaica, has shown that in Jamaican factories use of the recommended dosage of 1 lb of "Pan-Aid" per 400 cu.ft. of *C*-massecuite boiled at the normal concentration and purity levels has resulted in boiling cycles of the order of 12% shorter. While the massecuite boiled more freely and purged easily with a resulting sugar purity of about 91%, no significant reduction of final molasses purity was observed.

However, the time saved in the boiling cycle and the easier purging of the massecuite become very important factors with the factories in question, which have to process highly variable quality juices with limited capacities in the low-grade stations. The significance of such factors can be gauged when it is considered that the molasses production in a factory can vary from 4·50 gallons to 6·25 gal per ton of cane, or a variation of about 39%.

In one factory, using the same dosage but dropping the *C*-massecuite purity from 57·32 to 55·47, the average *C*-molasses apparent purity was reduced from 31·53 to 29·98, while the average total boiling time was also reduced from 4·50 to 4·30 hours.

For the efficient and full capacity operations of both batch and continuous *C*-centrifugals, the massecuite has to be re-heated to a temperature as high as 130°F before entering the centrifugals, in order to reduce its viscosity. Except with the use of the most expensive type of re-heater, there is always risk of local over-heating with dissolution of recoverable sugar. By introducing ¼ lb of "Pan-Aid" into the crystallizers with 1000 cu.ft. of massecuite, so as to reduce its viscosity, continuous centrifugals may be operated at top capacity with purging temperatures of 115–120°F.

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PUBLICATIONS RECEIVED

LEVEL SWITCHES. Dukes & Briggs Engineering Co. Ltd., Approach Road, Urmston, Manchester.

Leaflet LS1/3/65 gives details of the company's level switches, which are of the float type and operate at temperatures up to 200°F and pressures up to 150 p.s.i.

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TANK GAUGES. Eurogauge Co. Ltd., Queen's Road, East Grinstead, Sussex.

Details are contained in a recently published catalogue of pneumatic, mechanical and electronic tank contents gauges, as well as tank filling alarms.

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THERMOSTATS. K.D.G. Instruments Ltd., Manor Royal, Crawley, Sussex; Sopac-Régulation, 8–16 rue du Parc, 92 Levallois-Perret, France.

Information is given on the various types of thermostats, pressure switches, and remote recorders suitable for a number of applications.

Brevities

Polish sugar factory equipment.—CEKOP has recently signed a contract to provide Shirvan Qhchan sugar factory in Iran with $2,000,000 worth of new equipment and spare parts. The new equipment is intended to enlarge the factory, which was built by CEKOP in 1959–61, and increase its capacity to above the present slicing rate of 1000 tons of beet per day.

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Kestner glandless pumps in refining.—A total of 14 glandless pumps have been supplied by Kestner Evaporator & Engineering Co., of Greenhithe, Kent, to the Tate & Lyle refinery in Liverpool after satisfactory tests in handling sugar solution and milk-of-lime. The pumps will overcome the problem of leakages from horizontally-mounted centrifugal pumps and of the considerable maintenance costs in servicing and repacking pumps, glands and seals.

* * *

Satellite computer centre.—Recently a satellite computer centre was opened in London, designed to provide clients with swift and easy access, by means of a telephone data link, to a giant "Univac 1107" computer in Birmingham. Programmes are fed into the satellite computer in London and transmitted to the central computer, which gives an immediate response to the problems. The "Univac" has a thin magnetic-film control memory with an access time of 0·167 microseconds, a 65,536-word core memory in two overlapping core banks providing an effective access time of 2 microseconds, and a 786,432-word mass memory drum store which has an average access time of 17 milliseconds. Seven magnetic-tape units transfer characters at the rate of 120,000/sec. Linear programming packages and a large-scale matrix scheme help solve a variety of problems, maximum utilization of the system being achieved when a series of independent problems is being tackled while a number of relatively simple input/output programmes are being processed in parallel. Tate & Lyle Ltd. have applied the system to solving the problem of minimizing the cost of storage of different types of refined sugar in the face of fluctuating demand throughout the year.

[1] *I.S.J.*, 1965, **67**, 220.

U.S. SUGAR QUOTAS, 1966

	Quota as at end-July	*Quota increases of 19th August*	*Shortfalls/ redistribution*	*Quota increases of 31st August*	*Revised quotas*
			(short tons, raw value)		
Domestic beet	3,025,000	—	—	—	3,025,000
Mainland cane	1,100,000	—	—	—	1,100,000
Hawaii	1,200,227	—	—	—	1,200,227
Puerto Rico	730,000	—	—	—	730,000
Virgin Islands	10,000	—	—	—	10,000
Philippines	1,302,978	5,430	—105,430	—	1,202,978
Argentina	54,871	1,149	—	1,122	57,142
Australia	182,313	1,604	—	1,605	185,522
Bolivia	5,310	112	—	1 8	5,530
Brazil	446,046	9,345	—	9,120	464,511
British Honduras	12,309	198	—	128	12,635
British West Indies	168,973	2,722	—	1,761	173,456
Colombia	47,201	989	—	965	49,155
Costa Rica	54,045	1,134	12,614	1,528	69,321
Dominican Republic	446,046	9,345	123,020	9,418	587,829
Ecuador	64,901	1,359	—	1,327	67,587
Fiji	40,008	352	—	352	40,712
French West Indies	53,153	857	—	555	54,565
Guatemala	45,543	954	10,630	1,290	58,417
Haiti	24,781	518	—	507	25,806
India	72,926	642	—	641	74,209
Ireland	5,351	—	—	—	5,351
Malagasy	8,609	76	—	76	8,761
Mauritius	16,712	147	—	147	17,006
Mexico	456,077	9,553	—	9,327	474,957
Nicaragua	54,045	—4,005	—31,040	—	19,000
Panama	33,041	—2,451	—17,590	—	13,000
Peru	355,775	7,453	—	7,274	370,502
El Salvador	33,400	698	7,796	947	42,841
South Africa	53,681	473	—	472	54,626
Swaziland	6,583	58	—	58	6,699
Taiwan	75,964	669	—	668	77,301
Thailand	16,712	147	—	147	17,006
Vietnam	22,419	472	—	457	23,348
	10,225,000	50,000	—	50,000	10,352,000

BREVITIES

New U.S. raw sugar futures contract.—Futures contract No. 10 will probably replace the current No. 7 contract on the New York Coffee & Sugar Exchange, according to B. W. Dyer & Co., Sugar Economists & Brokers. The reason for the new contract is the likelihood that U.S. refiners will alter substantially the present contract under which they purchase actual raw sugar. American Sugar Company, for example, recently notified the raw sugar trade that from 12th September it intended to buy sugar with discounts and premiums for quality below and above certain standards. The historic single standard of polarization is considered insufficient because other factors such as moisture, ash, osmophilic yeasts, grain size, filtrability and colour also affect refiners' processing costs.

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Rhodesia factory closures[1].—The Nandi sugar project in Rhodesia, which was due to commence operations this year, has recently been abandoned, and, as a result of sanctions and the loss of guaranteed quotas for sugar exports, the sugar estate at Chirundu on the Zambezi will cease production at the end of the current season. Sugar can apparently be produced more economically in the Lowveld, where production continued during 1965.

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Corrigendum—In the table of Cuban sugar statistics published in our August issue[2], a figure of 31,556 tons was given for 1965 exports to Venezuela. This figure, in fact, represents Cuban exports to the Sudan in 1965.

Argentina frost damage[3].—A series of frosts in recent weeks is stated to have severely affected crop prospects in Argentina and losses are reported to have been the the worst since 1955 when production amounted to no more than 574,518 tons compared with 778,000 tons in the previous year. In order to avoid expanding the already very substantial tonnage of stocks, the Argentina authorities had already decided to limit deliveries of cane to 75% of the level of 1965[4] and it has now been announced that the quota for Tucumán province—the province producing by far the largest quantity of cane—had been reduced to 70% of the 1965 level. It would seem likely that stocks will have to be drawn upon to meet local comsumption as well as the U.S. quota and earlier talk of subsidized exports to the world market will be dropped.

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Dominican Republic sugar industry re-organization[5].—Private sources indicate that President BALAGUER has submitted to Congress a measure that would dissolve the Dominican Sugar Corporation and organize its twelve mills as independent units. Unprofitable mills would be closed down and the land used for other crops. All mills would, however, be under the supervision of a governing Council which would centralize sales and exports.

[1] *Standard Bank Review*, August 1966, p. 18.
[2] *I.S.J.*, 1966, **68**, 255.
[3] C. Czarnikow Ltd., *Sugar Review*, 1966, (776), 153.
[4] *I.S.J.*, 1966, **68**, 192.
[5] *Woodhouse, Drake & Carey Ltd.*, 26th July 1966.

BREVITIES

U.K. sugar surcharge.—Since the last change in surcharge sugar prices on the world market have continued to fall, and the Minister of Agriculture, Fisheries & Food therefore made Orders under the Sugar Act, 1956, adjusting the surcharge from 3¾d per lb (35s 0d per cwt) to 4d per lb (37s 4d per cwt) from the 1st September 1966.

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Malaysia sugar trials[1].—Brunei will soon have its first sugar mill as an experiment to see whether sugar can be manufactured commercially in the state. The state's Agricultural Department recently tendered for a small mill to be built in Brunei town. Government sources said that a variety of sugar cane from Indonesia had grown well on the outskirts of the capital and would be ready for cutting in about eight months' time.

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New sugar factory for Spain[2].—The Spanish Minister of Information recently announced that a new sugar factory with an annual slicing capacity of 50,000 tons of beets is to be erected in the Badajoz province. The factory will be built by a newly-established company, Azucarera del Guadiana, and will probably be put into operation in 1968.

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Puerto Rico sugar crop.[3]—Operations for the 1965/66 crop in Puerto Rico have been completed and final production for the season amounted to 873,408 short tons, the lowest figure since the war. This compares with an output of 886,676 tons in 1964/65.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 19th September*, 1966)	s d
Anglo-Ceylon (5s)	4/10½
Antigua Sugar Factory (£1)	8/9
Booker Bros. (10s)	18/3
British Sugar Corp. Ltd. (£1)	21/3
Caroni Ord. (2s)	1/6
Caroni 6% Cum. Pref. (£1)	14/–
Demerara Co. (Holdings) Ltd.	3/3
Distillers Co. Ltd. (10s units)	19/3 (x.d.)
Gledhow Chaka's Kraal (R1)	13/9
Hulett & Sons (R1)	11/3
Jamaica Sugar Estates Ltd. (5s units)	3/6
Leach's Argentine (10s units)	11/6 (x.d.)
Manbré & Garton Ltd. (10s)	28/1½
Reynolds Bros. (R1)	14/4½
St. Kitts (London) Ltd. (£1)	15/–
Sena Sugar Estates Ltd. (5s)	10/–
Tate & Lyle Ltd. (£1)	26/–
Trinidad Sugar (5s stock units)	1/9
West Indies Sugar Co. Ltd. (£1)	6/10½

CLOSING MIDDLE

New York Stocks (*at 17th September*, 1966)	$
American Crystal ($5)	15⅜
Amer. Sugar Ref. Co. ($12.50)	23¾
Central Aguirre ($5)	31½
Great Western Sugar Co.	40¼
North American Sugar ($10)	10⅝
South P.R. Sugar Co.	20⅜
United Fruit Co.	32⅝

Pakistan export surplus possibility[4].—Pakistan is likely to begin exporting sugar next year, with an initial surplus of about 100,000 tons, according to official sources in Lahore. Production in West Pakistan in 1965/66 was 400,000 tons, of which 300,000 tons was used locally, 28,000 tons sent to East Pakistan and the remainder either put to reserve or surplus. Next year's production is estimated at 500,000 tons, while present output is expected to be doubled by 1970.

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Sugar project for Sierra Leone[5].—During July the Ministry of Agriculture reported that the pilot sugar cane project, established with the help of the British Government, was progressing favourably. It is hoped that in the not too distant future Sierra Leone will be able to commence a sugar manufacturing industry.

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Danish loan for Brazilian sugar factory[6].—An agreement has been signed between the Governments of Denmark and Brazil covering the loan of 21,000,000 Danish crowns to Brazil, to be used mainly for the purchase of machinery for a Brazilian sugar factory.

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Norway-Czechoslovakia trade agreement[7].—The Board of Trade announced recently that a three-year agreement has been signed in Oslo between the governments of Norway and Czechoslovakia under which Czechoslovakia is to export 37,000 metric tons of sugar to Norway during 1966.

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Yugoslavia sugar crop, 1965/66[8].—Official statistics for the 1965/66 sugar crop in Yugoslavia show that sugar production totalled 333,566 metric tons, white value, compared with 331,113 tons in 1964/65 and 308,651 tons in 1963/64. This was made from 2,620,000 tons of beets (2,830,000 and 2,670,000, respectively, in 1964/65 and 1963/64), harvested from 80,000 hectares (88,500 ha and 96,300 ha). For 1966 the beet area has been expanded to 103,000 hectares and, since weather conditions have been good up to now, a good crop is expected with a production of about 400,000 tons, raw value, only slightly less than domestic requirements. Thus only a small quantity of sugar is likely to be required in 1966, compared with 94,203 tons of refined sugar imported in 1964 and net imports of 94,030 tons in 1964.

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Mainland China sugar industry[9].—The largest harvest of sugar cane and sugar beet in the history of China was in progress in 1966, and all the factories from Jeilongchiang in the extreme north to Guangdong in the south were working at maximum capacity. Many of these factories have been expanded and the State has financed the construction of 24 new ones, 17 of which had started operation before the end of 1965. When the 1965/66 season ended in May last the production of sugar was hoped to have exceeded by 30% the 1964/65 outturn, which was itself 59% greater than that of 1963/64 and was the best in the history of China. Sugar factories were built in China 1200 years ago, and sugar was exported in the southern Song dynasty (1127–1279 A.D.). The first modern sugar factory was built near Canton in 1934, but in 1949 only two or three were working. By 1952 sugar production had doubled that of 1949 and exceeded the previous record crop of 410,000 tons produced in 1936. The first Five-Year Plan (1953–57) provided for construction of 20 large factories and small and medium-sized plants, machinery being imported. Since 1956, however, China has stood on her own feet and all plants built since 1957 have been designed and equipped locally. Furthermore, complete plants have been exported.

[1] *Reuters Sugar Rpt.*, 29th August 1966.
[2] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (21), 13.
[3] C. Czarnikow Ltd., *Sugar Review*, 1966, (775), 151.
[4] *Public Ledger*, 30th July 1966.
[5] *Overseas Review* (Barclays D.C.O.), August 1966, p. 62.
[6] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (22), 8.
[7] C. Czarnikow Ltd., *Sugar Review*, 1966, (776), 154.
[8] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (22), 8–9.
[9] *Bol. Azuc. Mex.*, 1966, (200), 22–23.