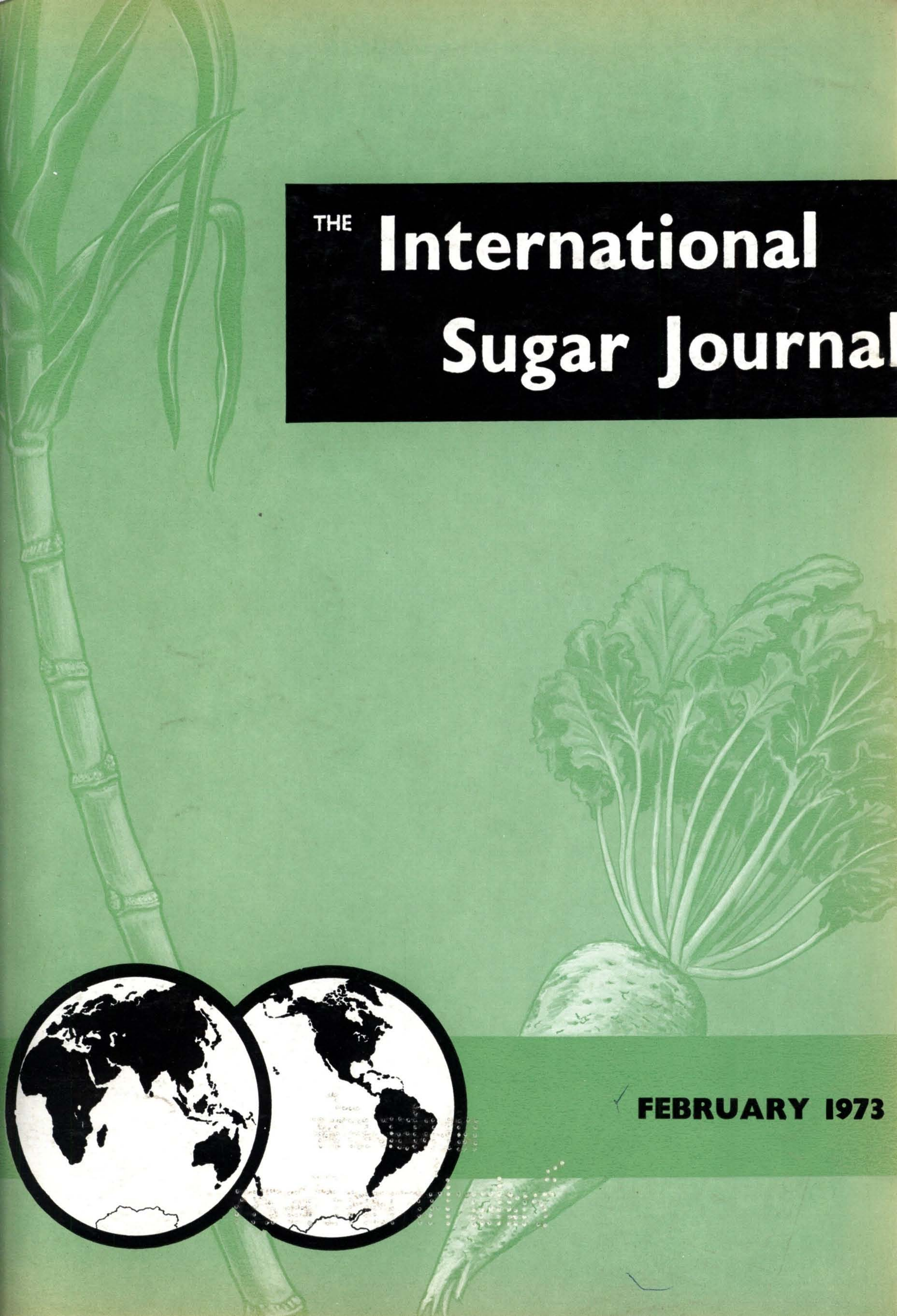
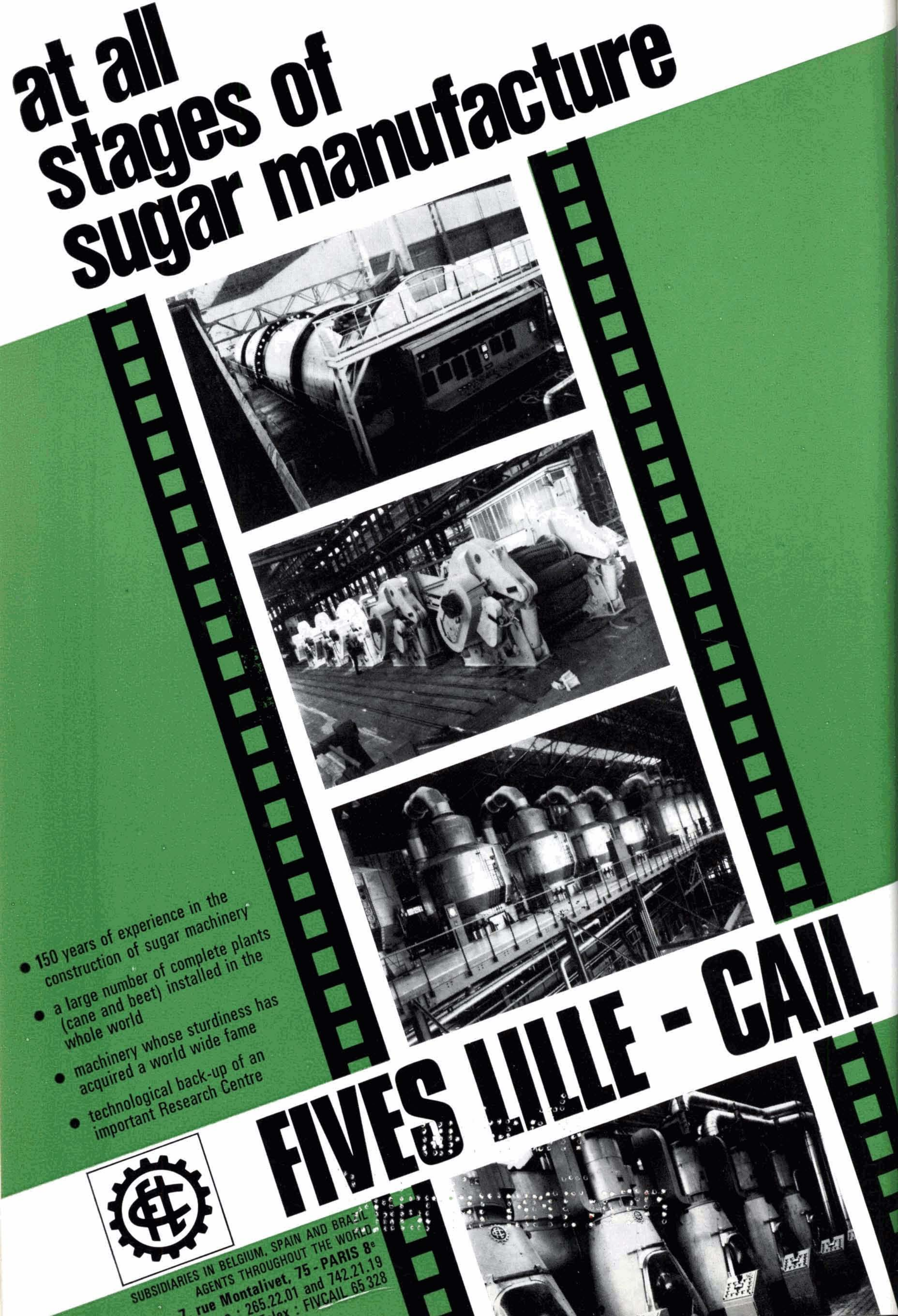


THE

International Sugar Journal

FEBRUARY 1973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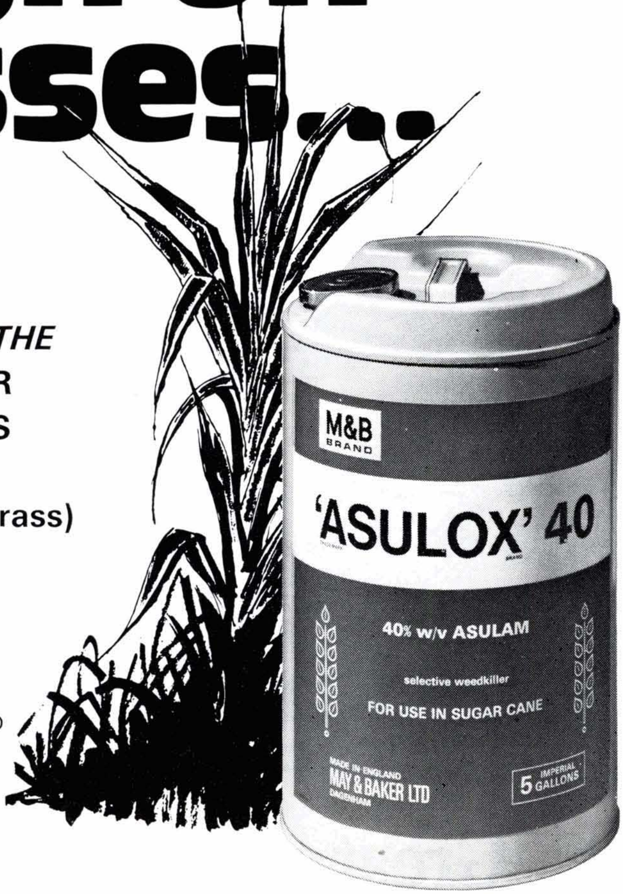

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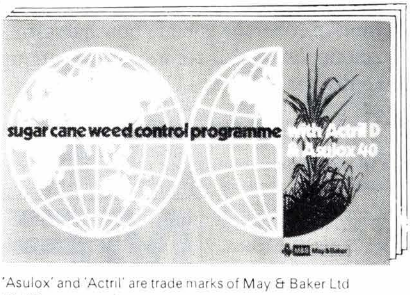

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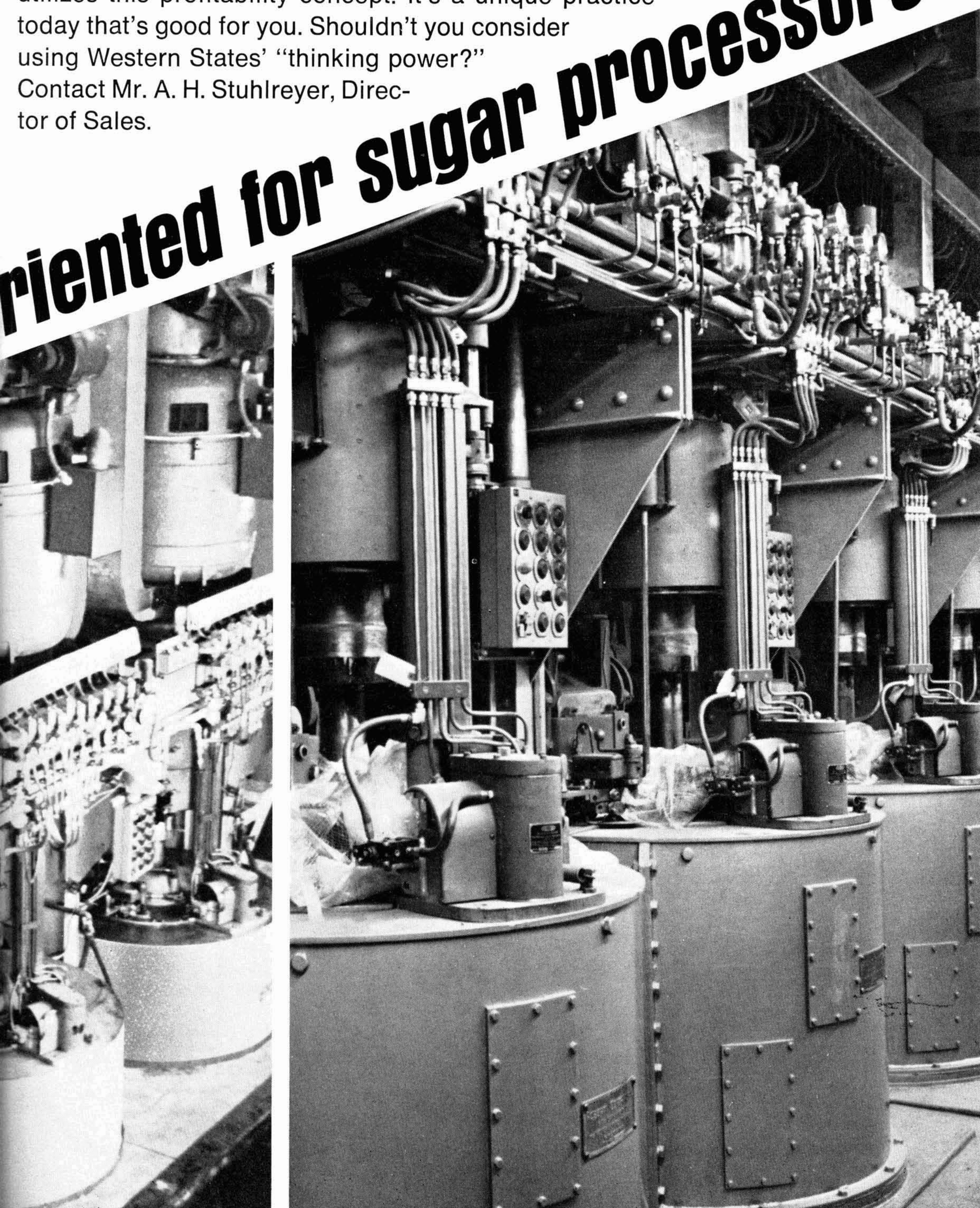

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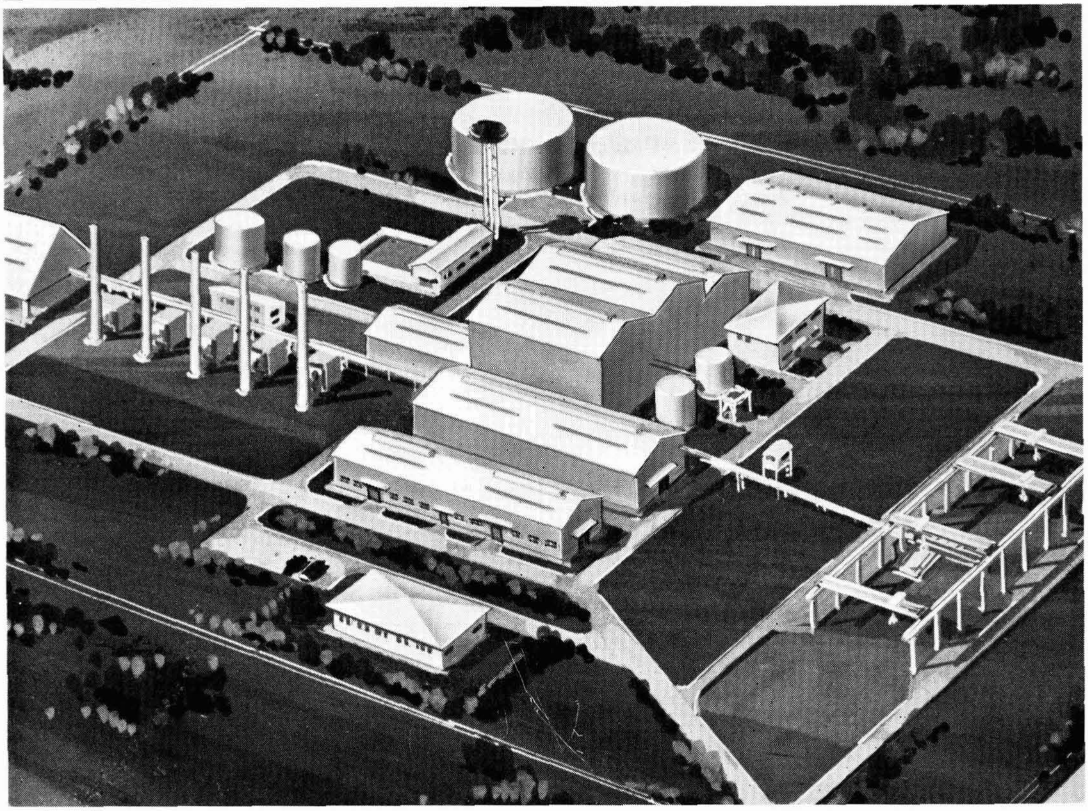

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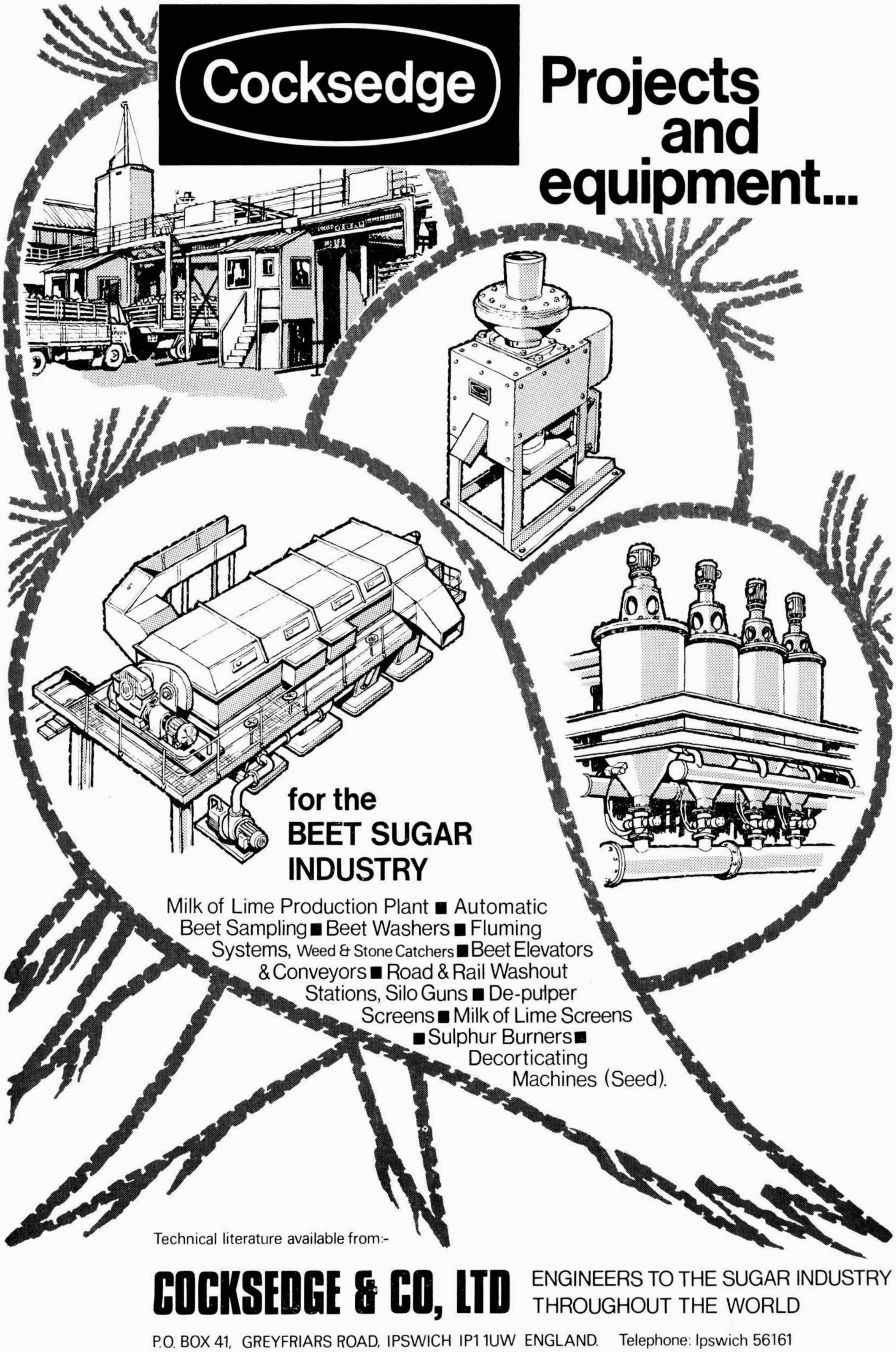
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Temps de retention dans les diffuseurs de betteraves et de canne. N. MARIGNETTI et G. MANTOVANI. *p.* 35–40

La durée de diffusion est définie et on montre que, sur le plan de l'usine, elle est constituée par la combinaison du temps pour le chauffage de la matière solide (et/ou l'echaudage) et du temps pour l'extraction du sucre. Ces deux durées peuvent être calculées, ainsi qu'on le montre à l'aide de deux exemples pratiques. Le comportement du tissus de betteraves et de canne est examiné et on considère la mort des cellules résultant de la préparation mécanique et de l'action de la chaleur. Le pourcentage de cellules cassées a été calculé pour différentes valeurs du quotient Silin. On met également en tableau la performance de différents diffuseurs pour la betterave et la canne.

* * *

Le chauffage électrique des masses cuites. IIe Partie. R. J. BASS, N. W. BROUGHTON et J. S. HOGG. *p.* 40–44

On discute des conductivités électriques de mélasses et de masses cuites finales, de la variation de la conductivité de la mélasse au cours de la campagne et de l'effet de l'addition d'eau sur la valeur de la conductivité. On examine l'influence de la température sur la conductivité de la mélasse. On décrit des méthodes pour mesurer la chaleur spécifique des masses cuites. A l'aide d'équations de régression on établit des valeurs qui sont en accord avec les données mesurées et qui tiennent compte de l'effet de l'eau de lavage et de l'incidence du Brix et de la pureté sur la chaleur spécifique. En annexe on donne une description de la mesure de la chaleur spécifique par la méthode des mélanges et du chauffage électrique.

* * *

Détermination simultanée d'acide phosphorique et d'acides organiques dans les jus et mélasses de betteraves. IIe Partie. J. F. T. OLDFIELD, R. PARSLOW et M. SHORE. *p.* 44–46

On a déterminé la capacité des résines échangeuses anioniques en utilisant des mélanges d'acides semblables à la composition des jus. La réponse des acides individuels fut rapportée à celle de l'acide tartarique. On donne également des détails sur la procédure d'élution de la résine et sur la méthode utilisée pour la standardisation analytique. On discute en détail la silylation et le procédé de chromatographie gaz-liquide. On cite en outre les résultats obtenus pour des jus et mélasses de betteraves. On a retrouvé environ 95 à 103% des acides.

Ueber die Verweilzeit in Extraktionsanlagen für Zuckerrüben und Zuckerrohr. N. MARIGNETTI und G. MANTOVANI. *S.* 35–40

Nach einer Definition der Verweilzeit in Extraktionsanlagen (Diffuseuren) wird gezeigt, dass sich für die Zuckerfabrikspraxis die Verweilzeit aus der für das Erwärmen und/oder Vorbrühen der festen Phase sowie für die Zuckerextraktion erforderlichen Zeit zusammensetzt. Beide Zeitfaktoren lassen sich rechnerisch ermitteln, wie an zwei auf Werten aus der Praxis basierenden Beispielen gezeigt wird. Das Verhalten des Rüben- und Rohrgewebes wird untersucht, und der Zelltod wird als ein Ergebnis der mechanischen Aufbereitung und der Wärmeeinwirkung angesehen. Der Anteil der bei verschiedenen Silinzahlen freigelegten Zellen wurde berechnet. Die Leistung von Rüben- und Rohr-Extraktionsanlagen verschiedener Typen ist tabellarisch zusammengestellt.

* * *

Die elektrische Anwärmung von Füllmassen. Teil II. R. J. BASS, N. W. BROUGHTON und J. S. HOGG. *S.* 40–44

Die Autoren berichten über die elektrische Leitfähigkeit von Melassen und Nachproduktfüllmassen, über die Aenderung der Leitfähigkeit von Melassen während der Kampagne und über den Einfluss der Wasserzugabe auf die Leitfähigkeitswerte. Sie untersuchten ferner den Einfluss der Temperatur auf die Leitfähigkeit von Füllmassen und beschreiben Methoden zur Messung der spezifischen Wärme der Füllmassen. Es wird gezeigt, dass die nach Regressionsgleichungen berechneten Werte gut mit den gemessenen übereinstimmen, wenn man die Wirkung des Deckwassers und den Einfluss von Trockensubstanzgehalt und Reinheit auf die spezifische Wärme berücksichtigt. In einem Anhang ist die Messung der spezifischen Wärme mit Hilfe der Methode der Mischungen und durch elektrische Anwärmung beschrieben.

* * *

Gleichzeitige Bestimmung von Phosphorsäure und organischen Säuren in Zuckersäften und Melassen. Teil II. J. F. T. OLDFIELD, R. PARSLOW und M. SHORE. *S.* 44–46

Die Autoren haben die Kapazität des Anionenaustauschers für der Saftzusammensetzung entsprechende Säuregemische bestimmt und die Empfindlichkeit für die einzelnen Säurekomponenten der für Weinsäure gegenübergestellt. Ausserdem geben sie Einzelheiten über die Eluierungsmethode und die Eichvorschrift für die analytische Bestimmung an. Die Genauigkeit der Umsetzung zu Silylderivaten, der Gaschromatographie und der analytischen Bestimmung wird diskutiert. Aus Ergebnissen bei der Isolierung der Säuren aus Rübensäften und Melassen, die in Tabellen zusammengestellt sind, ergibt sich ein Bereich von 95 bis 103%.

Tiempo de retención en difusores de remolacha y de caña. N. MARIGNETTI y G. MANTOVANI. *Pág.* 35–40

Se define el tiempo de retención y se demuestra, para consideraciones del proceso, que es una combinación del tiempo necesario para calefacción de los sólidos y/o escaldadura y el tiempo necesario para extracción del azúcar; ambos de estos factores pueden calcularse, como demuestran dos ejemplos que se basan en dados prácticos. El comportamiento de tejido de remolacha y de caña se examina y los autores consideran el muerto de la celula como resulta de preparación mecánica y acción térmica. El porcentaje de celulas sujeto a rotura en diferente números Silin se ha calculado, y el cumplimiento de difusores de varias tipas para remolacha y caña se presenta en forma tabular.

* * *

Calefacción eléctrica de masa cocida. Parte II. R. J. BASS, N. W. BROUGHTON y J. S. HOGG. *Pág.* 40–44

Se discuten las conductividades eléctricas de melaza y masa cocida final, la variación en conductividad de melaza mientras la campaña, y los efectos del adición de agua sobre los valores de la conductividad. Se examina la influencia de la temperatura sobre la conductividad de masa cocida, y se describen métodos para determinar el calor específico de masa cocida. Valores calculado de ecuaciones de regresión se demuestran en buen acuerdo con valores de medición, tomando en consideración el efecto de agua de lavado y las influencias de densidad Brix y pureza sobre calor específico. En un apendice se describe la medición de calor específico por el método de mezclas y por calefacción eléctrica.

* * *

Determinación simultánea de ácido fosfórico y ácidos orgánicos en jugos y melazas de la fabricación de azúcar de remolacha. Parte II. J. F. T. OLDFIELD, R. PARSLOW y M. SHORE. *Pág.* 44–46

Se determinó la capacidad de la resina de cambio aniónico para mezclas de ácidos que aproximan a la composición de jugo, y las respuestas de componentes ácidos individuales se relataron a élla de ácido tartárico. Se describen también detalles del procedimiento para elución de los ácidos de la resina y del método de calibración del analisis. Los grados de precisión de los procedimientos de sililación y cromatografía gas-líquido y de la técnica analítica se discuten y las resultas de ensayos de recuperación para jugos y melazas de remolacha se presentan en forma tabular; tienen una gama entre 95% y 103%.

THE

INTERNATIONAL SUGAR JOURNAL

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Notes & Comments

World raw sugar price

The rumours of purchases by the USSR were confirmed during the second half of December and the London Terminal Market Daily Price rose to £100 per ton by the 27th December. Subsequently it remained steady at £99 for a time and, after a short dip to £97, recovered and stands at £105 per ton at the time of writing, a value equalled only during 31st October–18th November 1963.

E. D. & F. Man, writing on the 29th December, indicate that the USSR's purchases will leave an acute shortage of sugar for the world which will last, they believe, until the beet crops of next Autumn. They estimate a world market shortage of a little over 1¼ million tons for the year ending 30th September 1973 and believe that cane sugar crops of the intervening period will not be adequate to meet consumption.

"With world stocks at an acknowledged extremely low level, we cannot expect world buyers to draw on stocks in 1973 to the same extent that they were able to in 1972. Neither are there many producers with the ability to find further quantities, though exporters to the USA will be tempted to deliver their quota late in 1973 and sell to the world in the earlier months. Prices will surely be the main arbiter in bridging the gap between current estimates of supply and demand and higher levels than those ruling today seem probable."

* * *

World sugar production estimates, 1972/73

F. O. Licht K.G. recently published their first estimates of world sugar production for the crop year September 1972–August 1973 and details are tabulated elsewhere in this issue[1]. Sugar production in Europe is expected to remain almost the same as in 1971/72, as has been indicated in previous estimates for this area, but a considerable increase is expected in the cane sugar sector, bringing total world production from 72·5 million tons to 77·1 million tons in 1972/73. This involves an increase of 4·428 million tons or 10·9% of total cane sugar production, of which 1·35 million tons is represented by the higher crop expected in Cuba.

Other major increases expected include 800,000 tons more in Brazil, 300,000 tons more in Mexico and increases of 245,000 tons in India, 235,000 tons in Argentina, 202,000 tons in the Philippines, 175,000 tons in Pakistan, 156,000 tons in the US mainland cane sugar industry, and 100,000 tons in Thailand.

Assuming that the same low rate of consumption increase occurs in 1972/73 as occurred in 1971/72 (about 1·7% compared with the usual 3½–4%), this production increase should just match consumption in the period. Stocks, under these circumstances, would remain at the same low absolute level but would have declined as a proportion of annual world consumption.

* * *

US sugar supply quotas 1972

On the 12th December, the US Department of Agriculture announced shortfalls in the 1972 quotas of Hawaii, Puerto Rico and Panama totalling 129,167 short tons, raw value. At the same time it announced that the Domestic Beet area would be able to supply 50,000 tons more than previously expected and its quota was raised accordingly while, of the balance, 30,000 tons was allocated to the Philippines and the remainder pro-rated among 15 Western Hemisphere suppliers.

On the last trading day of the year the Department announced that deficits amounting in total to 5155 tons were to be reallocated. These included 4240 tons from the quota for Peru, 461 tons from Venezuela, 219 tons from Guatemala, and 235 tons from the Indian quota; the last was shared among non-Western Hemisphere suppliers and the rest among eligible Western Hemisphere quota holders. As C. Czarnikow commented[2]: "This makes only marginal adjustments in final 1972 quota levels and most suppliers already have sugar in bond to meet these changes, but it illustrates the readiness of the USDA to maximize current availability even to this small extent."

Details of the net changes and final quotas appear elsewhere in this issue.

[1] *International Sugar Rpt.*, 1972, **104**, (33), 1–6.
[2] *Sugar Review*, 1973, (1108), 2.

Sugar prospects for 1973

In their *Sugar Review* dated at the end of the past year, C. Czarnikow Ltd. summarize developments during the previous twelve months and conclude with an analysis of prospects for this year. Their views, somewhat condensed, are given below:

"For at least the past two years world consumption has considerably exceeded production and consequently the heavy stocks which had been built up and had been carried forward from year to year were quickly eroded. The failure of the crops in many of the socialist countries in 1971/72 led to widespread purchases of world market sugar and suddenly brought home to the market how serious the shortage had become. One year later Russia has again found it necessary to have recourse to purchases of world market supplies and this, of course, has inspired the latest increase in values. The course of prices in 1973 will greatly depend upon whether it is expected that this is to be an annual event or whether it is believed that Russia will be able to revert to securing supplies from her traditional sources.

"It must be expected that the Soviet Union will endeavour to expand her production so as to become less reliant upon deliveries from overseas, but she will still need to effect substantial imports. Whether the world market will again be called upon to make up this deficit will depend on the level of production in Cuba.

"It can be expected that several countries and groups of countries will endeavour to expand their production. Brazil has already shown her ability to increase her output to take advantage of current prices and ready outlets and it can be expected that further growth will take place. Other countries in Latin America can also be expected to endeavour to produce more sugar, but in the face of expanding consumption it is not at all sure that this will lead to greatly increased exports. The most significant growth, however, will probably take place in Europe. Beet sugar producers are best placed to take advantage of temporary situations of shortage and several countries can be expected to take appropriate action.

"For many years it has been recognised that developing countries should be encouraged to expand their production of sugar. This is clearly in accordance with the principles of UNCTAD and is one of the tenets of the International Sugar Agreement. However, few developing countries have adequate resources of their own to set up or expand their industries while the treatment afforded to foreign investors has in many cases discouraged the flow of private capital. Money must therefore be provided by international agencies, the foremost of which is, of course, the World Bank, where recent developments have been most encouraging. Although it is hoped this will lead to an expansion in developing countries' production in future years it is unlikely to bring any benefits in the shape of expanded output during 1973.

"In general it can be expected that both importers and exporters are reasonably satisfied with the operation of the International Sugar Agreement, though reservations are no doubt held as to the way in which some of its provisions have operated. There are, of course, various difficulties which will need to be surmounted before a new Agreement can be inaugurated, the most important of which have to do with prices and quotas. There is a general acceptance that some adjustments need to be made in the ISA reference prices. Since it was signed in 1968 both currencies—British and US—mentioned in the Agreement have been reduced in value in terms of other currencies, while throughout the world inflation has been reducing the value of money.

"Certainly exporters will require these factors to be taken into consideration, but there is one other which, while it may be psychological, is none the less real. When the 1968 Agreement was signed exporters had experienced the effects of four consecutive years of low prices and were willing to accept a scale of values which at that time appeared realistic. In 1973, having experienced a situation whereby their returns have actually been reduced by the operation of the supply commitment provisions, they are likely to be in a far different frame of mind. Indeed, it may well be the importers who are the more keen for negotiations to be concluded successfully in order to ensure the guaranteed continuity of supplies.

"It may be assumed that those countries which have shown themselves capable of expanding exports when called upon will insist that this situation is regularized in the form of increased quotas. But in deciding the total level of quotas it will be necessary to bear in mind the actual and the projected outlet. Accordingly, if some quotas are raised it is probable that others will need to be reduced. This may well be a crisis point for the negotiations and if the Agreement were less well based it could lead to a breaking point.

"Wherever prices may go in 1973, one thing is certain. There is a great need to expand the output of sugar. High prices can, in the long run, bring no lasting benefit to producers and assuredly not to final consumers. Rationing only leads to a slowing in the growth rate of consumption and there can be no satisfaction in the knowledge that sugar is being priced out of the hands of consumers and would-be consumers.

"In these circumstances the increase in the area in the EEC is to be welcomed while the interest now shown by the World Bank is especially desirable. More sugar is needed by the world if demand is to be satisfied. It may be that the current level of world market prices will encourage the expansion of existing industries and the installation of new ones in other parts of the world. If this proves to be the case then, at least in this respect, present price levels are to be welcomed."

Retention time in beet and cane diffusers

By N. MARIGNETTI and G. MANTOVANI
(University of Ferrara, Italy)

Introduction

THE "retention time" for the extraction process undergone in continuous beet and cane diffusers may be defined as the sum of the partial times for the completion of the solvent extraction operation up to the limit set by industrial economics. These individual partial times will be governed by the following main factors:

(i) behaviour of the beet and cane tissue, and

(ii) transfer rate of the sugar solution at various concentrations from the solid to the solvent,

as well as the following concomitant factors:

(iii) the mixing effect of the solid-liquid system, and

(iv) the counter-current effect of the extraction conditions.

The first two factors above can therefore be referred to in practice as "extraction technology" factors, while the second two are "diffuser-design" factors. By its definition, the retention time is different from the diffusion or extraction time—the period during which the solid, after heating, is in contact with the extraction liquid—and also from both the solids passage time through the diffuser—the period between solids entry and discharge from the diffuser—and the solvent passage time through the diffuser—the period between solvent entry and discharge from the diffuser.

From the practical point of view, for the so-called solids forced-drive diffusers, it is quite easy to calculate the passage time of the solid through the diffuser from the length of the conveying system and its speed. For other types of diffuser, and particularly for beet diffusers not provided with cossettes forced-drive[1,2], the passage time may be determined by means of experiments in which the solid is coloured (using methylene blue for beet cossettes[3]) and calculating the statistical average of the experimental times obtained in this way.

Behaviour of beet and cane tissues

Industrial operations for the extraction of the sugar solution contained in beet or cane vegetable cells are substantially different, depending on whether the cells are living or dead. Extraction from living cells is based on the possibility of reproducing the cellular pulsation by artificial means in conformity with the periodic cycle of expansion and contraction of protoplasm[4,5].

For beet, several means of killing the cells have been studied[6], including the use of such chemicals as formaldehyde, carbon tetrachloride, chloroform, alcohols[7], acetic and lactic acids[8], or the use of electric current[9]. Present continuous beet[1,2] and cane diffusers[10] operate with dead cells.

Killing of the cells takes place as a result of mechical and thermal action; during preparation of raw material, mechanical destruction of the cells takes place when the beet and cane are cut to produce solids having proper dimensions for operation of the diffuser, while cells are killed during scalding by contact of the solid with the solvent at high temperature as well as at the diffuser operating temperature.

Present-day beet preparation, i.e. the cutting into cossettes, involves the mechanical breakage, and so the killing, of 30–40% of cells[11]. Taking the average diameter of a beet cell to be 0·05 mm[11], the volume of a cell can be considered as equal to $(0{\cdot}05\text{ mm})^3 = 125 \times 10^{-6}\text{ mm}^3$ so that the number of cells per mm^3 is $1/(125 \times 10^{-6}) = 8000$.

If the mean specific weight of beet cossettes is taken as 1·05 g/cm³, we may calculate the volume of 100 g of cossettes to be

$$\frac{100}{1{\cdot}05}\text{cm}^3 = 95{\cdot}2 \times 10^3\text{ mm}^3$$

and consequently the number of cells in 100 g of cossettes is

$$8000 \times 95{\cdot}2 \times 10^3 = 761{\cdot}6 \times 10^6\text{ cells.}$$

If we indicate the length in metres of 100 grams of cossettes by L and assume the cossettes to have square cross-sections of thickness t mm,

$$L \times 10^3 \times t^2 = 95{\cdot}2 \times 10^3\text{, whence } t^2 = \frac{95{\cdot}2}{L}$$

$$\text{and thickness } t = \sqrt{\frac{95{\cdot}2}{L}}\text{ mm} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

The total surface S, in mm², of 100 g of cossettes can therefore be calculated as follows:

$$S = 4\left[\sqrt{\frac{95{\cdot}2}{L}} \times L \times 10^3\right] + 2\left[\frac{95{\cdot}2}{L}\right] \times \frac{L \times 10^3}{l}$$

$$= 4\left[\sqrt{\frac{95{\cdot}2}{L}} \times L \times 10^3\right] + \frac{190{\cdot}4 \times 10^3}{l} \quad \ldots\ldots (2)$$

where l is the average length of the cossettes in mm.

It we set the value of l at 100 mm, the second term of the above sum becomes 1904 mm² and is negligible by comparison with the first term and so may be disregarded, when

[1] SCHNEIDER and REINEFELD: *Zucker*, 1960, **13**, 460–471.
[2] MANTOVANI: *Ind. Sacc. Ital.*, 1963, **56**, 101–122.
[3] SCHNEIDER *et al.*: *Zucker-Beihefte*, 1951, 25–39.
[4] TEATINI: *9th Int. Congr. Agr. Ind.* (Rome), 1952, Sect. C.S. to C.P.5.
[5] SORGATO: *Proc. 5th Tech. and Chem. Int. Congr. Agr. Ind.* (Schéveningue), 1937, 526–633.
[6] TULLIN: *Zucker*, 1952, **5**, 433–441.
[7] WATERMAN and VAN VLODROP: *I.S.J.*, 1937, **39**, 271–272.
[8] BRÜNICHE-OLSEN: "Solid-Liquid Extraction" (NYT Nordisk Forlag, Copenhagen). 1962.
[9] DEDEK: *Socker*, 1946, **2**, 357–362.
[10] BAIKOW: "Manufacture and Refining of Raw Cane Sugar" (Elsevier, Amsterdam). 1967, 70–84.
[11] MCGINNIS: "Beet Sugar Technology", 2nd End. (Beet Sugar Dev. Foundn., Fort Collins).

$$S = 4000 \sqrt{95{\cdot}2L}\ \text{mm}^2$$

If the cell diameter is 0·05 mm there are $(1/0{\cdot}05)^2 =$ 400 cells per mm² and the number of cells on the surface of 100 g of cossettes

$$= 400S = 400 \times 4000\sqrt{95{\cdot}2L} = 16 \times 10^5 \times \sqrt{95{\cdot}2L} \quad \ldots\ldots(3)$$

The percentage of cells subject to breakage (R) can be calculated as a function of the Silin number by the relation

$$R = \frac{100 \times 400S \times s}{761{\cdot}6 \times 10^6} \quad \ldots\ldots\ldots\ldots(4)$$

where s is the number of cell layers affected by the superficial breakage e.g. $= 5$ in the case where the thickness of the cutting operation is 0·5 mm. For a Silin number $L = 15$ m/100 g we obtain, for instance, $R = 42{\cdot}7\%$, which is in accordance with the values stated by various authors[11]. Repeating the above calculation for various Silin numbers and specifying the type of cossette shown in Fig. 1, we may obtain the percentage R of cells subjected to breakage as a consequence of the cutting operation; such calculated values are indicated in Table I.

Table I. Calculated percentage of cell breakage corresponding to various Silin numbers

Silin Number, *m/100 g*	*R* %
6	27·3
8	31·4
10	35·0
12	38·4
14	41·3
15	42·7
16	44·0
18	46·7
20	49·2
22	51·6
24	55·2
26	56·0
28	58·2
30	58·8
50	77·5
70	91·5
80	97·0

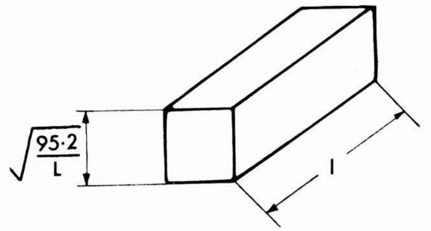

Fig. 1. Dimensions of beet cossette

It is now known from industrial practice that the best figures for sugar extraction from cane have been achieved with mechanical preparation such as to involve the breakage of about 95% of cells[12]. Such high degrees of breakage[13,14,15] allow the circulation of the solvent in the extraction zone of the cane diffuser[10].

The cellulose structure of beet and cane may be considered as a fundamental element in the influence of solvent circulation in relation to the dimensions of the solid pieces. Comparison, even if qualitative, between the fibre content of cane and the marc of beets shows that the latter is only about 40% of the cane cellulose structure. In other words, the need to obtain cossettes having such dimensions as not to prevent the solvent from circulating is explained, in the case of beets, by the features of its vegetable structure as well as by the design characteristics of beet diffusers[1,2].

On a non-industrial scale, the possibility has been studied of carrying out the extraction even with beets reduced to similar dimensions as those of cane[16,17]. The extraction was performed with beets and cane reduced to 2 mm. In this case, the Silin number, calculated from equation (1) is $L = 95{\cdot}2/4$ or approximately 24 and, according to Table I, about 55% of the cells were broken mechanically.

In cases where breakage of cane cells reached 95% there would be an "equivalent Silin number" of about 75 m/100 g, corresponding to a solid "cane cossette" thickness of about 1·1 mm for a mean length of about 100 mm[18].

It is evident that, for the extraction of sugar contained in the solid parts of beet or cane, the effect of the mechanical preparation before the solid-liquid extraction operation is particularly important because the juice contained in the broken cells can be extracted by simple lixiviation and osmosis is restricted to unopened tissues, i.e. non-broken cells.

From the point of view of sugar industry practice, the different processes involved in the extraction of sugar contained in the juice of broken and whole beet and cane cells, as indicated in Fig. 2, are such as to affect the retention time as a technical-practical parameter.

Furthermore, some concomitant factors must be taken into account, such as the condition of the raw material, i.e. whether fresh or deteriorated beets or cane are to be processed. In the present paper we shall suppose that fresh material is to be treated because conditions causing deterioration, for instance by frost, by long storage or as the result of local climate, must of course be studied case by case and not in a general manner.

Heating of beet and cane solids

In industrial practice there are two different heating requirements: scalding, i.e. the practice of heating solids before extraction in order to kill the cells, and for extraction, i.e. the use of heat to achieve the most suitable temperature for reducing the extraction time and for limiting sugar losses and the dissolving of non-sugars.

[12] PAYNE: *Proc. 13th Congr. I.S.S.C.T.*, 1968, 103–121.
[13] FOSTER and SHANN: *ibid.*, 142–150.
[14] FREUND: *ibid.*, 133–141.
[15] TANTAWI: *Sugar J.*, 1964, **27**, (1), 27–32, 44.
[16] GULBARAN: US Patent 3,135,631; *I.S.J.*, 1964, **66**, 335.
[17] *idem*: *Proc. 12th Congr. I.S.S.C.T.*, 1965, 1712–1724.
[18] TANTAWI: *ibid.*, 1496–1504.

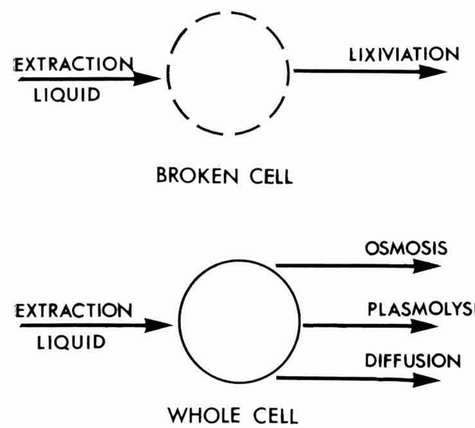

Fig. 2. Representation of the behaviour of broken and whole cells in relation to extraction

Scalding is usual in the case of beet cossettes, while heating for extraction is normal both for beet and cane. The required temperatures are usually achieved by counter-current exchange between the solids to be heated and the liquid which supplies heat. The time required for this heating is the first partial time contributing to the retention time.

With certain approximations, this partial time can be calculated in relation to heat supplied to the solid so as to reach the scalding or extraction temperature. With reference to 100 grams of solid we may write:

$$Q = c\,\theta \,\frac{S}{\sqrt{\dfrac{95{\cdot}2}{L}}}\,(T_1 - T_2)$$

and therefore the partial time θ for heating is given by

$$\theta = \frac{Q\,\sqrt{95{\cdot}2/L}}{cS\,(T_1 - T_2)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where Q is the quantity of heat, c the thermal conductivity of the solid, T_1 and T_2 the temperatures of the heating liquid and heated solid, and other symbols have the meanings ascribed to them above.

The thermal conductivity c which is different for beet and cane owing to the different chemical composition and morphological structure, may be calculated empirically[19] in relation to fibre or marc content and water content of the solid. From the relation (5) it is apparent that the partial time θ depends on the dimensions of the solid, the heat quantity and the thermal conductivity.

Qualitative considerations on the presence of intercellular gases and superficial gas—air in contact with the solid—could help to improve the calculation of the thermal conductivity and in a similar way the effect of porosity of the solid[19] could be taken into account. Such considerations should also include the different behaviour, as far as heat transfer is concerned, of structures formed by whole cells and of those formed by broken cells; the limits of "industrial practice" do not allow expatiation on this aspect of the problem, while the matter will be discussed later in relation to the extraction of the sugar solution from the solid by the solvent.

In practice, time θ is governed by the volume of the diffuser and/or scalding device in which the required heating takes place.

Extraction of the sugar solution from solid to solvent

The application of extraction and diffusion theory in industrial practice is not always easy. The various mathematical theories[8,11,20], the applicability of some of them to modern extraction systems[21,22,23], the different characteristics of beet and cane diffusers and careful investigations of sugar extraction from beet[22,24] and from cane[15,22,25], prove that in the practical definition of the retention time, the following can be considered as fundamental: in mechanical breakage of the cells the passage of sugar solution from solid to solvent takes place by an extracting process consisting basically of exchange of liquid and lixiviation, while in whole cells which have not been broken during the preparation, the passage of the sugar solution from solid to solvent occurs by the following phases in succession: (*a*) osmosis of water into the cell, (*b*) cell death or modification owing to temperature, and (*c*) diffusion of the sugar into the solvent.

If we suppose that the extraction of the sugar solution from solid to solvent takes place in a manner similar to that of first-order processes[26], that is to say, according to the general laws of statistical mechanics applicable to modern chemical kinetics[27], we may use the relationship:

$$X_n = 100\, e^{-KT_m LDt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

from which we obtain

$$t = \frac{\log_{10}(100/X_m)}{0{\cdot}434KT_mLD} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

where t is the time of extraction of the sugar solution from solid to solvent, X_m = losses % sugar originally in the solution contained in the solid, T_m is the mean temperature at which extraction takes place $= \frac{T}{\mu}$, where T is the absolute temperature and μ the corresponding viscosity of water in poises, L is the Silin number or length in metres of 100 grams of solid, D = parts of juice extracted per part of juice contained in the solid, and K is an operative constant dependent on the design and features of the extractor or diffuser.

[19] JAKOB: "Heat Transfer", Vol. I. (Chapman & Hall Ltd., London). 1949.
[20] SCHNEIDER: "Technologie des Zuckers" (Schaper Verlag, Hannover). 1968.
[21] SMET: *Sucr. Belge*, 1952, **71**, 481–487.
[22] BRÜNICHE-OLSEN: *Sugar Technology Reviews*, 1969, **1**, 3–42.
[23] RATHJE: *Zeitsch. Zuckerind.*, 1970, **95**, 410–413.
[24] SCHLIEPHAKE and WOLF: *Zucker*, 1968, **18**, 489–493.
[25] JENKINS: "Introduction to Cane Sugar Technology" (Elsevier, Amsterdam). 1966, 159–164.
[26] D'ORAZI: *Ind. Sacc. Ital.*, 1971, **64**, 31–35.
[27] GRAHAM *et al.*: *Proc. 13th Congr. I.S.S.C.T.*, 1968, 122–132.

Table II. Operating results of beet diffusers*

Type of diffuser	Draft % beet	Cossettes Pol %	Cossettes m/100 g	Losses % beet	Temp., °C	Retention time, minutes
RT	112	16·5	—	0·19	—	—
	112	17·3	—	0·43	67	—
	—	—	14–16	—	70–75	100
BMA	125	14·98	13·6	0·19	—	77
	125	16·50	—	0·25	—	—
	118	14·32	—	0·18	72	—
	120	—	—	0·20	70	80
	125	16·50	—	0·25	—	—
	—	—	12–14	—	78	77
BUCKAU-WOLF	124	19·42	11·8	0·49	66	—
	117	—	—	0·24	—	75
	115–120	15–16	11–13	—	71–73	78
DE SMET	114	—	—	0·18	—	103
	105	16–17	16·5	0·15–0·20	78	100
DDS	110–115	—	—	0·27	72–74	90
	115	15·5	7–9	0·23–0·32	—	80–85
	120	—	6–8	0·15	—	—
	110	—	9	0·30	74	90
	105	—	6·5	0·40	—	—
	117	16·8	8·7	0·55	—	98–100
DDS-Silver	118–120	—	22–24	0·29	—	50
	124	16·65	21	0·23	76–78	53
	116	15·80	20	0·19	74	56

NOTE: Scalding time: RT — 8–14 min; BMA — 3–7 min; Buckau Wolf — 8–10 min; De Smet — 10–14 min; DDS — 14–16 min; DDS-Silver — 7–10 min.

* Figures quoted have been obtained from published literature and gaps indicate that the values for the parameters concerned were not included in the original source.

Table III. Operating results of cane diffusers*

Type of diffuser	Draft % cane	Cane Pol %	Cane Fibre %	Losses % cane	Temp. °C	Retention time minutes
DDS	95	12·85	13·50	0·46	65–70	30
	99	13·21	13·80	0·41	—	—
	95	12·36	14·57	0·40	—	—
	96	12·17	14·58	0·42	70	33
Silver Ring	102	12·84	14·06	0·38	70	37–55
	95	12·40	13·50	0·44	—	—
De Smet	106	12–13	12–15	0·40	76–79	50–60
	100	—	—	0·42	78	—
BMA-Egyptian	88	11–12	13–15	0·48	76–78	40–47
	105	11–13	11–12	0·41	—	45
Buckau-Wolf-Burnett	96	15·22	13·85	0·48	80–90	30–40
Suchem	100	—	—	0·40	74	40–60
Diaz-Compain	93	—	—	0·40	74	45
Saturne	100	12·5	—	0·32	75	30

NOTE: All retention times include the heating time, which we calculated to be approximately 5–8 minutes.

* Figures quoted have been obtained from published literature and gaps indicate that the values for the parameters concerned were not included in the original source.

In merely theoretical conditions, and therefore not needing to meet the requirements of industrial conditions, the above-mentioned constant K could be identified with the diffusibility of the sugar from the solid to the solvent. In practice, however, many other factors may exert an influence, sometimes dominant, on the whole process of extraction.

From the industrial viewpoint, therefore, the applicability of equation (7) to calculation of the partial time t must be preceded by evaluation of the constant K for each type of extractor, selecting values for the different parameters of the equation according to the optimum or design conditions of the extractor's operation. In this way we obtain a typical and characteristic value of K for the extractor in the circumstances of typical parameters which may apply

Table IV. Calculated values of constant K for beet diffusers

Type of diffuser	*RT*	*BMA*	*Buckau-Wolf*	*De Smet*	*DDS*	*DDS-Silver*
(*a*) Draft % beet	112	125	120	105	115	124
(*b*) $D = (a)/100$	1·12	1·25	1·20	1·05	1·15	1·24
(*c*) Pol % cossettes	16·50	14·98	15·50	16·50	15·50	15·50
(*d*) Losses % beet	0·20	0·19	0·24	0·15	0·24	0·24
(*e*) $X_m = (d) \times 100/(c)$	1·22	1·27	1·55	0·91	1·55	1·55
(*f*) $t = \tau - \theta$ min	86	77	70	78	82	49
(*g*) Extract. Temp., °C	73	78	78	78	74	74
(*h*) $T_m = (g) + 273/\mu$	88·71	94·86	94·86	94·86	91·31	91·31
(*i*) L = m/100 g	15·00	13·60	12·00	17·00	9·00	22·00
(*l*) K	$3{\cdot}43 \times 10^{-5}$	$3{\cdot}52 \times 10^{-5}$	$4{\cdot}36 \times 10^{-5}$	$3{\cdot}22 \times 10^{-5}$	$5{\cdot}38 \times 10^{-5}$	$3{\cdot}41 \times 10^{-5}$

Table V. Calculated values of constant K for cane diffusers

Type of diffuser	*DDS*	*Silver Ring*	*De Smet*	*BMA-Egyptian*	*Buckau-Wolf-Burnett*	*Suchem*	*Diaz-Compain*	*Saturne*
(*a*) Draft % cane..	96	100	106	105	96	100	93	100
(*b*) $D = (a)/100$	0·96	1·00	1·06	1·05	0·96	10··	0·93	1·00
(*c*) Pol % cane	12·17	12·66	12·50	12·00	15·22	12·50	12·50	12·50
(*d*) Losses % cane	0·42	0·34	0·40	0·41	0·48	0·40	0·40	0·33
(*e*) $X_m = (d) \times 100/(c)$ ..	3·45	2·68	3·20	3·41	3·15	3·20	3·20	2·64
(*f*) $t = \tau - \theta$ min	25	50	55	42	35	55	40	17
(*g*) Extract. Temp., °C ..	70	70	78	78	85	74	74	70
(*h*) $T_m = (g) + 273/\mu$.. ..	83·65	83·65	94·86	94·86	105·29	91·31	91·31	83·65
(*i*) L = m/100 g (*)	75	75	75	75	75	75	75	75
(*l*) K	$2{\cdot}24 \times 10^{-5}$	$1{\cdot}15 \times 10^{-5}$	$0{\cdot}79 \times 10^{-5}$	$1{\cdot}08 \times 10^{-5}$	$1{\cdot}30 \times 10^{-5}$	$0{\cdot}91 \times 10^{-5}$	$1{\cdot}35 \times 10^{-5}$	$3{\cdot}41 \times 10^{-5}$

* pre-determined value appropriate to a cells breakage of about 94%.

in the relevant optimum conditions. In the calculation of the time t the typically operative parameters such as X_m, T_m, L and D will therefore act as variables.

In Tables II and III are given operating conditions recorded in the literature[1,2,10,28–36] for different types of beet and cane extractors, respectively, while in Tables IV and V are indicated the corresponding calculated K values.

Retention time

From the above considerations of industrial practice we can conclude that the retention time τ may be calculated by the relation

$$\tau = \theta + t \qquad \text{.............................(8)}$$

in which the two partial time components appear; θ may be calculated from equation (5) or from

$$\theta = \frac{\psi V}{W} \qquad \text{..............................(9)}$$

where ψ is the weight of solid per unit extractor volume, V is the volume of the extractor involved in scalding and/or heating, and W is the weight of solid treated per unit of time. The partial time t is calculated by the equation (7). Two practical examples are given below.

Example 1.

The operating conditions of a Buckau-Wolf beet diffuser are:

Pol % cossettes	14·65
Silin number L	14·50 m/100 g
Draft	118% on beet
Losses	0·18% on beet
Temperature	74°C

Calculations: $X_m = 1{\cdot}24$
$T_m = 91{\cdot}31$
$D = 1{\cdot}18$

whence $t =$

$$\frac{1{\cdot}9018}{0{\cdot}434 \times 4{\cdot}36 \times 10^{-5} \times 91{\cdot}31 \times 14{\cdot}50 \times 1{\cdot}18} = 64 \text{ minutes}$$

Therefore retention time $\tau = \theta + t = 5 + 64 = 69$ minutes.

Example 2.

The operating conditions for a DDS cane diffuser are:

Pol % cane	11·50
Draft	98% on cane
Losses	0·46% on cane
Temperature	70°C

Calculations: $X_m = 4{\cdot}00$
$T_m = 83{\cdot}65$
$D = 0{\cdot}98$
$L = 75$ (assuming a cell breakage of almost 94%)

whence $t =$

$$\frac{1{\cdot}3979}{0{\cdot}434 \times 2{\cdot}24 \times 10^{-5} \times 83{\cdot}65 \times 75 \times 0{\cdot}98} = 24 \text{ minutes}$$

Therefore retention time $\tau = \theta + t = 6 + 24 = 30$ minutes.

[28] WENG and BRÜNICHE-OLSEN: *Proc. 12th Congr. I.S.S.C.T.*, 1965, 1481–1495.
[29] TOWNSLEY and CHEATHAM: *ibid.*, 1505–1521.
[30] DIAZ-COMPAIN: *ibid.*, 1474–1480.
[31] ADAM: *Rpts.* 1967 *Meeting Hawaiian Sugar Tech.*, 30–34.
[32] FREUND and DANNEIL: *ibid.*, 95–99.
[33] ANON.: *Sugar y Azúcar*, 1968, **63**, (9), 54–57.
[34] PALACI: *ibid.*, 1970 **65**, (3), 31–36.
[35] STRICH: *I.S.J.*, 1968, **70**, 203–205.
[36] SOC. SUCRIERE DE L'ATLANTIQUE (ENGINEERING): UK Patent 1,218,870; *I.S.J.*, 1971, **73**, 284.

Summary

A definition of the retention time is given. The behaviour of beet and cane tissues is examined and cell death considered as a result of mechanical preparation and thermal action. Beet cossette preparation involves mechanical breakage; calculations give the percentage of cells subject to breakage at various Silin numbers. In the case of 95% of cane cells, the equivalent "Silin number" is about 75 metres /100 g . Calculations are given for θ, the times required for solid heating and/or scalding, and for t, the time required for the extraction of the sugar solution from solid to solvent. For considerations of industrial practice, the retention time is given by the equation $\tau = \theta + t$ and this may be calculated. From tabulated practical data for different types of beet and cane diffuser two examples of such calculations are given.

The electrical heating of massecuite

By R. J. BASS, N. W. BROUGHTON and J. S. HOGG

Paper presented to the 21st Technical Conference, British Sugar Corporation Ltd., 1972

PART II

The conductivities of molasses and final massecuite

The conductivities of molasses and final massecuites were determined using, as the conductivity cell, a 3 × 2 × 5 cm "Paxolin" box fitted with 2 × 2 cm copper foil electrodes cemented to the opposing inside end walls. Sufficient molasses or massecuite to just cover the electrodes was placed in the cell and then heated uniformly to the required temperature by application of the 240V 50Hz mains electricity supply, via a 240V 100W light bulb in series as a current limiter, to the cell electrodes. A temperature rise from 25°C to 100°C was achieved in less than 5 minutes with molasses and less than 20 minutes with massecuite.

Using Ohm's law the conductivities were calculated from the current produced when 17V at 50Hz from a separate low voltage transformer was applied to the electrodes.

The molasses conductivities measured at the higher temperatures were somewhat lower than the absolute values as they were subject to a small error owing to the formation of a black deposit on the electrodes during the determination. There was a similar but much smaller error with massecuite.

It was found that the conductivity of molasses increased dramatically as the temperature increased over the range 40—70°C. A typical pattern is recorded in Table III; the conductivity at 70° was four times the value at 40°C.

Table III. Change in molasses conductivity with temperature

Temperature (°C)	40	45	50	55	60	65	70
Molasses conductivity (mmhos cm^{-1})	0·90	1·25	1·62	2·00	2·50	2·98	3·57

Variation of conductivity during the campaign

Several changes, which may affect the conductivity, occur in massecuite in storage. There is a gradual crystallization of sucrose and also a reduction in volume owing to the separation of air bubbles from the massecuite; moreover composite samples are not available from the factories.

It was thought possible that the average massecuite conductivity could possibly be deduced from the molasses conductivity. The conductivities of weekly composite samples of molasses from Cantley and Bardney were determined to find the variation over the campaign.

Comparison of the results showed no practical difference between the average conductivities for the two factories, but, while the variation from week to week was small over the course of the campaign, the variation overall was 300% for Cantley and 400% for Bardney at 50°C.

Effect of water addition on molasses conductivity

It is unlikely that the relative amounts of the various non-sugars in Cantley and Bardney molasses would change sufficiently over the campaign to explain the large variation in molasses conductivity during the course of the campaign.

Over the campaign variations occur in the ratio of wash water to mother liquor spun from the massecuite and the effect of this variation on molasses conductivity was studied.

A sample of Cantley final massecuite was uniformly and rapidly heated to 70°C and the mother liquor separated by centrifugation. The conductivities of samples of mother liquor, to which had been added increasing amounts of water, were determined over the temperature range 50°C to 70°C and the results are recorded in Table IV.

Table IV. Variation of molasses conductivity with increasing water addition

Water % on mother liquor	*Conductivities, mmho cm^{-1}*				
	50°C	*55°C*	*60°C*	*65°C*	*70°C*
0	0·07	0·14	0·22	0·33	0·52
2·5	0·26	0·37	0·51	0·69	0·95
5·0	0·49	0·67	0·87	1·16	1·43
7·5	0·87	1·17	1·47	1·81	2·17
10·0	1·24	1·60	1·95	2·35	2·82
12·5	1·82	2·20	2·66	3·05	3·54

The results at 50°C show that by the addition of 12·5% water on mother liquor the conductivity was increased by 2600% and most of the variation between samples from Cantley and Bardney may be due to this effect.

As quite small variations in the amount of wash on after-product sugar will cause large variations in molasses conductivity, calculation of final massecuite conductivities from the corresponding molasses conductivities would not be possible.

Variation of massecuite conductivity with temperature

The relative change in conductivity with increasing temperature represents a higher percentage increase when the quantity of water in the mother liquor is smallest. It would be expected that this effect would be particularly apparent in the saturated massecuite from the crystallizer. The conductivity of a Cantley final massecuite was determined at 5°C intervals over the temperature range 30°C to 100°C and the results are recorded in Table V.

Table V. Variation of massecuite conductivity with temperature (Cantley final massecuite)

Temperature, °C	*Mean apparent conductivity, mmho cm^{-1}*
30	0·055
35	0·074
40	0·110
45	0·150
50	0·190
55	0·240
60	0·300
65	0·370
70	0·440
75	0·510
80	0·600
85	0·670
90	0·780
95	0·870
100	0·970

There is a rapid increase in conductivity with increasing temperature and the increase for a 5°C rise in temperature is about five times greater at 95°C than at 30°C.

The conductivity of massecuites used in the experiments at Cantley factory at the end of the 1971/72 campaign were calculated from the dimensions of the factory heater and the voltage and current records. The results are given in Table VI.

Table VI. Calculated conductivities of Cantley massecuite

Output temperature, °C	*Calculated conductivity, mmho cm^{-1}*
55	0·126
58	0·145
71	0·187

Measurement of the specific heat of final massecuite

The design of a resistance heater depends, in part, on the specific heat of final massecuite because the electrical power required is proportional to the product of the flow rate, the specific heat of the massecuite and the temperature rise required. Few values have been recorded for the specific heats of beet massecuites[7,8]. Accordingly, two methods have been devised and used to obtain values for the specific heat of final massecuite and its variation with temperature.

Measurement using the method of mixtures.—Experimental work was carried out using molasses, which is a composite of the mother liquor from the final massecuite and wash syrup from the centrifugal, as the high viscosity of massecuite made it unsuitable for the necessary intimate mixing. The use of molasses also eliminated the possibility that temperature changes during the experiment might have caused sugar in massecuite to dissolve or crystallize, processes that both involve heat energy transfer.

The method of mixtures was used, as described in the Appendix, to obtain an average value of the specific heat of molasses over the temperature range through which it cooled during the determination. Thus, for a cooling range from 70° to 40°C and linear variation of specific heat with temperature, the observed specific heat corresponded to the value at 55°C.

The specific heat of massecuite was calculated from the observed specific heat of molasses. For four factories for which sufficient data was available from the 1970/71 campaign, the calculated average yield of after-product sugar was 47% on final massecuite. A different calculation from figures quoted by R. A. McGinnis[9] gave 48%. The specific heat of after-product sugar was taken to be that of sucrose as tabulated in the literature[10].

In each determination about 300 g of molasses at 70°C was mixed with about 1000 g of carbon tetrachloride at 20°C. The 1970/71 campaign composites of beet molasses were used. The observed specific heats are recorded in Table VII with the calculated Brix and apparent purity of the molasses by spindle Brix, these terms thus being the same as those used by Corporation factories.

Table VII. Observed specific heat of beet molasses at 55°C

Factory	*Initial molasses temp., °C*	*Equilibrium temp., °C*	*Specfic heat, cal/g/°C*	*Calculated Brix*	*Apparent purity*
Bardney	70·0	41·2	0·616	82·77	60·82
Brigg	70·0	40·8	0·593	82·38	62·20
Bury	70·0	43·1	0·611	85·33	60·84
Cantley	70 0	40·4	0·580	82·88	62·69
Ely	70·0	40·2	0·598	82·28	63·50
Ipswich	70·0	40·1	0·571	88·83	63·22
King's Lynn	70·0	39·9	0·586	83·42	63·36
Newark	70·0	43·0	0·618	81·35	60·82
Nottingham	70·0	41·7	0·622	78·72	62·17
Peterborough	70·0	40·4	0·568	83·52	64·08
Selby	70·0	42·9	0·590	83·17	60·84
Spalding	70·0	45·2	0·598	88·50	61·20
York	70·0	42·9	0·567	87·18	62·65

[7] Spoelstra and Hoks: *I.S.J.*, 1968, **70**, 103–107.
[8] Terent'ev and Popov: *Sbornik Pishchev. Prom.*, 1965, **2**, 61–68.
[9] McGinnis: "Beet Sugar Technology" 2nd Ed. (Beet Sugar Development Foundation, Fort Collins). 1971. Table 12-2b.
[10] Honig: "Principles of Sugar Technology" Vol. I. (Elsevier, Amsterdam). 1953. p. 20.

The average specific heat of the 13 composites was 0·594 cal/g/°C and the standard deviation of the data was 0·019 cal/g/°C at an average temperature over the cooling range of about 55°C.

The average specific heat of final massecuite was calculated from this to be 0·460 cal/g/°C at 55°C with a range of 0·44–0·48 cal/g/°C corresponding to the observed range of specific heats, 0·567 to 0·622 cal/g/°C, measured for B.S.C. beet molasses.

Measurement using the method of electrical heating.—Because the specific heat measured by the method of mixtures was an average value over a large temperature interval, the method of electrical heating using small temperature changes was employed. A 1-kg test sample was heated by 80 W flowing through a coil of resistance wire in the sample, a cooling correction subsequently being made for heat lost to the surroundings during heating.

This method, which was carried out on molasses in order to achieve more efficient stirring than would have been possible for massecuite, was used to measure a succession of values of the specific heat of two samples of beet molasses over the range 60–80°C at 1°C intervals, so showing the variation of specific heat with temperature. Of the large number of values so obtained, the measured values at 5°C intervals are recorded in Table VIII.

Table VIII. Observed variation of the specific heat of beet molasses with temperature

Temp., °C	*Specific heat, cal/g/°C* — *Cantley 1971/72 composite*	*Bury 23.1.72*
61·5	0·561	0·604
66·5	0·579	0·617
71·5	0·584	0·622
76·5	0·593	0·627

Using all the measured values, the following linear regression equations were derived:

Specific Heat = 0·000853 × Temperature (°C) + 0·5208 (Cantley)

Specific Heat = 0·00129 × Temperature (°C) + 0·5280 (Bury)

Values of the specific heats obtained using these equations are shown in Table IX.

Table IX. Calculated variation of the specific heat of beet molasses with temperature

Temp., °C	*Calculated specific heat, cal/g/°C* — *Cantley*	*Bury*
45	0·559	0·586
55	0·568	0·599
65	0·576	0·612
75	0·585	0·624

The values calculated for 55°C are in good agreement with those obtained by the method of mixtures for molasses samples from Cantley and Bury (Table VII).

The use of these equations, in particular to extrapolate to temperatures below 60°C, as in the derivation of Table IX, was shown to be valid by two further experiments in which the observed specific heats of the Bury molasses were 0·582 cal/g/°C at 44·75°C and 0·626 cal/g/°C at 74·75°C, extremely close to the values given in Table IX for 45° and 75°C respectively.

From the regression equations, the specific heat of beet molasses increased by about 0·001 cal/g/°C for each 1°C rise in temperature. The specific heats at 40° and 70°C would thus be 0·015 cal/g/°C lower and higher respectively than the value at 55°C. The average specific heat at 55°C of beet molasses obtained by the method of mixtures would thus become 0·579 cal/g/°C at 40°C and 0·609 cal/g/°C at 70°C.

The corresponding average specific heats of final massecuite were calculated to be 0·444 cal/g/°C at 40° and 0·472 cal/g/°C at 70°C. The temperature coefficient of the specific heat of final massecuite is thus about 0·001 cal/g/°C for each 1°C rise between 40° and 70°C.

The effect of wash water on the calculated values

Between 1·7 and 3·2% wash water on massecuite was used in the Cantley trials. In calculating the above specific heats of massecuite an allowance was made for the contribution to the specific heat of molasses of 5% wash water on molasses, a convenient average value. For an actual value 1% less, the calculated specific heats of massecuite would have to be increased by 0·002 cal/g/°C. This effect is very small and no allowance was made, therefore, for sugar dissolved in the wash water.

The effect of Brix and purity on specific heat

The results in Table VII were examined by multiple regression analysis and the best fit was obtained by the equation:

Specific heat of molasses at 55°C =

$$1{\cdot}5084 - 0{\cdot}331\,\frac{\text{Calc. Bx.}}{100} - 1{\cdot}024\,\frac{\text{App. Purity}}{100}$$

for 78–88°Bx and 60–65 apparent purity.

Molasses specific heats, calculated from this equation by substituting factory measurements for calculated Brix and apparent purity of molasses, can be appropriately combined with the specific heats of water and sucrose at 55°C to give the specific heats of the corresponding massecuites at 55°C. Brix has a far greater effect than purity on the specific heat and the simpler equation:

Specific heat of molasses at 55°C =

$$0{\cdot}9043 - 0{\cdot}370\,\frac{\text{Calc. Bx.}}{100}$$

was also a satisfactory fit to the observations.

Specific heat decreases as the Brix increases, because there is then less contribution to the specific heat from water, which has a high specific heat compared with that typical for the organic and inorganic constituents of molasses.

Measurement in factory operation

An average specific heat for final massecuite of 0·41 cal/g/°C over the heating range 47° to 55°C was calculated from the results of an experiment at Cantley in which a mean temperature rise of 8·06°C was obtained for massecuite flowing at 205 lb/min through a prototype resistance heater with a mean power input of 21·68 kW.

The observed temperature rise corresponded to heat distribution to both mother liquor and sugar, because, if the heat energy had been supplied only to the mother liquor, to achieve the same temperature rise the specific heat of this would have had to have been about 0·78 cal/g/°C, which the laboratory results for molasses indicate is an extremely unlikely value.

Because insufficient data were available from other trials at Cantley, more factory experiments are needed to prove that the heat energy is distributed between the mother liquor and the sugar and to check the factory measurement of the specific heat of massecuite.

Conclusions

Electric resistance heating of beet massecuites is a feasible proposition; it is fast in response, and heaters of adequate capacity to give temperature rises of the order of 10°C at starting temperatures in the range 48°C to 58°C can be constructed.

The tests at Cantley were subject to the limitations:
(a) that the heaters had been designed for 6 tons per hour throughput although the centrifugal is now reputed to have throughputs in the region of nine tons per hours, and
(b) that the Cantley plant normally gave a temperature for feed massecuite starting temperature of at least 58°C. However, under rather special circumstances, the massecuite temperature fell to 47°C thus proving the suitability of the design at a lower temperature.

Under no circumstances was there a detectable change in molasses purity, even at the highest temperatures reached. There was no detectable change in 3rd product sugar quality that could be attributed to the heaters.

The most easily observed change in sugar quality was caused by small changes in wash water quantity. The characteristics of a continuous machine mean that the wash water, at 98–100°C, is much more effective in purging the sugar of molasses than any massecuite heating. This is in contrast to a batch machine where the water has to pass through a thick wall of sugar.

While further work on evaluating continuous centrifugal operation is necessary, it would appear that a combination of electrical heating of very low temperature massecuites and centrifugal wash water flow control would produce the best results.

The specific heat and electrical conductivity of massecuites has been determined over a temperature range in which resistance heaters would be expected to work.

Acknowledgements

Our thanks are due to members of the staff at Brigg and Cantley factories and at the Research Laboratory who helped with the tests and carried out the analysis of the large number of samples.

In particular we acknowledge the work of Mr. D. Sargent at the Research Laboratory in determining the electrical conductivity of massecuite. We also thank Mr. F. Robson and Mr. R. Rogers at Cantley factory for the assistance and encouragement they gave during the tests.

Appendix

The method of mixtures

By following the thermal equilibrium of an intimate mixture of a hot substance of unknown specific heat with a cold one of known specific heat contained in a suitably insulated calorimeter, the unknown specific heat can be found by equating the heat lost by the hot substance with that gained by the cold substance and the calorimeter. Thus:

Heat lost = Mass of hot substance × Specific heat × Temperature fall.

$$\text{Heat gained} = \left(\text{Mass of cold substance} \times \text{Specific heat} + \text{Water equivalent of calorimeter}\right) \times \text{Temperature rise.}$$

The water equivalent of the calorimeter, a 2-pint Thermos flask, was determined by adding to the flask, equilibrated at room temperature, a known weight of carbon tetrachloride at 70°C such that the volume filled corresponded to that used in the second part of the experiment.

In order to measure the specific heat of molasses, about 300 g of molasses at 70°C were mixed thoroughly with 1000 g of carbon tetrachloride equilibrated at room temperature in the calorimeter. The use of carbon tetrachloride eliminated both heat of dilution and heat of reaction from the thermal equilibrium. Corrections for heat losses by transfer to the surroundings or by evaporation of carbon tetrachloride were not significant nor was the temperature variation of the specific heat of carbon tetrachloride. Temperatures were measured to 0·1°C with mercury-in-glass thermometers after thorough mixing. Measured specific heats were reproducible to better than ± 5%.

The method of electrical heating

Electrical energy flowing through a coil of resistance wire in the sample contained in a calorimeter provides the heat source.

The copper calorimeter used was fitted with a stirrer, a mercury-in-glass thermometer and a resistance coil connected to a stabilized 24 volt D.C. power supply and was suspended centrally in a sealed tin box, which acted as an isothermal air jacket, being itself submerged in a water bath maintained at 30·0 ± 0·2°C. During heating of the calorimeter and contents, the time was noted at convenient temperature intervals, e.g. 0·5 or 1°C. There was no significant heating by the stirrer. After disconnecting the power supply, a cooling curve was plotted as the temperature fell by 0·5 or 1°C intervals through the heating range. All time intervals were measured to an accuracy of at least 0·1% by calibrating the stopwatches used against the G.P.O. Speaking Clock.

The cooling curve was necessary to correct for heat lost from the calorimeter and contents during heating, the equation of cooling at an excess temperature, θ, over that of the surroundings being taken to be:

$$\frac{d\theta}{dt} = -K\theta^n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

after FERGUSON & MILLER[11]. The value of $\frac{d\theta}{dt}$ at the point $\theta = \frac{1}{2}(\theta_1 + \theta_2)$ midway between two close observations (t_1, θ_1) and (t_2, θ_2) on the cooling curve was taken to be $\left(\frac{\theta_1 - \theta_2}{t_2 - t_1}\right)$ which was not significantly different from the true slope. Substituting into (1) and taking logarithms,

$$\log\left(\frac{\theta_1 - \theta_2}{t_2 - t_1}\right) = \log(-K) + n\log\left(\frac{\theta_1 + \theta_2}{2}\right) \quad ..(2)$$

Several corresponding values of $\log\left(\frac{\theta_1 - \theta_2}{t_2 - t_1}\right)$ and $\log\left(\frac{\theta_1 + \theta_2}{2}\right)$ were obtained from the cooling curve and, from the line of best fit for these values in equation (2), the values of n and K were found for each experiment.

When heat was being supplied to the calorimeter, of water equivalent E, and contents, of mass m and specific heat s, the rate of loss of heat at an excess temperature θ was given by:

$$-\frac{dH}{dt} = (ms + E)\left(-\frac{d\theta}{dt}\right)$$

The heat lost in raising the temperature from θ_2 to θ_1 in time t was therefore:

$$-H = (ms + E)\int_o^t \left(-\frac{d\theta}{dt}\right) dt$$

$$= (ms + E)\int_o^t K\theta^n . dt \text{ from (1)}$$

or, to a good approximation,

$$= (ms + E)\int_o^t K\left(\frac{\theta_1 + \theta_2}{2}\right)^n dt$$

$$\text{i.e. heat lost} = (ms + E)K\left(\frac{\theta_1 + \theta_2}{2}\right)^n t \ldots\ldots (3)$$

$$\text{Now, heat gained} = (ms + E)(\theta_1 - \theta_2) \ldots\ldots\ldots (4)$$

and heat supplied =

$$\frac{\text{Average volts} \times \text{Average amps} \times t}{J} \ldots\ldots\ldots (5)$$

so that, since (5) = (3) + (4)

$$\frac{\bar{V}\bar{I}t}{J} = (ms + E)\left\{(\theta_1 - \theta_2) + K\left(\frac{\theta_1 + \theta_2}{2}\right)^n t\right\} \quad (6)$$

From measurements made using water, the water equivalent, E, was found by averaging the values calculated for several excess temperatures $\frac{1}{2}(\theta_1 + \theta_2)$ for which the corresponding specific heat of water was substituted in (6).

For glycerine, a liquid of similar viscosity, density and specific heat to molasses, the measured specific heats at 1°C intervals from 55° to 80°C were, on average, 3·2 ± 0·6% below those published. The measured specific heats of molasses were, therefore, considered to be within 5% of the true values.

[11] *Proc. Phys. Soc.*, 1933, **45**, 194–207.

Simultaneous determination of phosphoric acid and organic acids in beet process juices and molasses

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PART II

DISCUSSION

Specification of anion exchanger capacity

To avoid losses of acids it was arranged that the capacity of the anion exchanger would be about twice the total equivalent of the acids present in the sample aliquot. Losses could not be corrected by reference to recovery of an internal standard because the weaker acids were displaced preferentially by the stronger acids if the column capacity was exceeded.

To determine the capacity of the anion resin for acid mixtures approximating to juice composition, increasing aliquots of diluted molasses at 15°Bx, to which had been added a mixture of standard acids, were diluted to 200 cm³ with deionized water and then applied, together with 25 mg lots of tartaric acid, as internal standard, to sets of paired cation and anion exchangers each containing 5 cm³ of resin.

The ammonium salts of the acids were isolated as described and the TMS esters prepared and analysed by GLC. The peak height obtained for each acid relative to that for tartaric acid was plotted against the concentration of acid and the results are shown in Fig. 5.

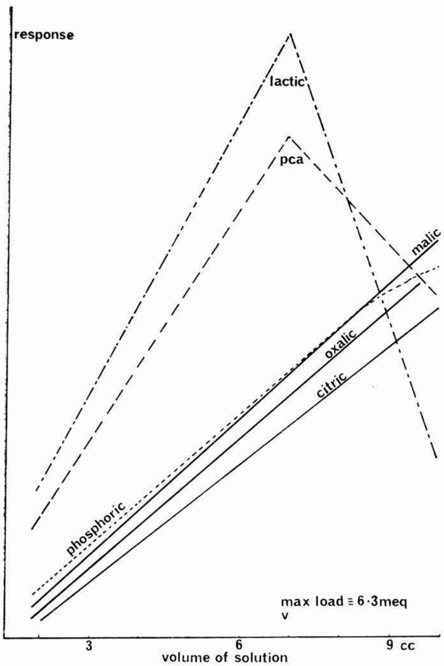

Fig. 5. Effective capacity of 5 cm³ anion exchanger; normal capacity 7 meq

The response for each acid was linear up to an application of a 7 cm³ aliquot of the molasses/standard acids mixture, which represents a total of 6·3 meq acid, and thereafter decreasing responses were obtained for lactic, pyrrolidone carboxylic and phosphoric acids showing leakage of these weaker acids.

To allow for the determination of juices containing unusually high amounts of acids and to allow for the occasional need to increase the sensitivity to citric, malic and oxalic acids in clarified juices by increasing the volume of the juice sample, the use of 10 cm³ resin column is advocated with a maximum application of 6·5 meq of acids.

Elution of anion exchanger

Concentration of the ammonium carbonate eluate from the anion exchanger is time-consuming and the minimum volume of 5% ammonium carbonate eluant solution, consistent with the quantitative recovery of the acids under determination, should be applied to the anion exchanger.

7 cm³ aliquots of 15°Bx diluted molasses with added standard acids containing 6·3 meq of total acids were diluted to 200 cm³ with deionized water and applied to four pairs of ion exchange columns. After washing free of sugar, the anion exchangers were eluted with different amounts of 5% ammonium carbonate solution. TMS derivatives were prepared and analysed by GLC and the relative response for each acid (tartaric acid = 1·0) obtained for different eluant volumes is recorded in Table I.

Table I. Volume of eluant required for constant relative response

Eluant volume (cm³)	*Relative response (tartaric acid = 1·0)*					
	Lactic	*Oxalic*	*Phosphoric*	*Malic*	*PCA*	*Citric*
75	1·98	0·96	1·12	1·13	1·50	0·96
125	2·75	1·08	1·36	1·42	2·31	1·13
175	2·55	1·23	1·34	1·37	2·14	1·10
250	2·55	1·37	1·40	1·43	2·01	1·12

While most of the acids were recovered using 175 cm³ of ammonium carbonate eluant the recovery of oxalic acid is not complete and 250 cm³ eluant was required before a constant relative response was obtained.

There was an increased relative response for lactic acid and PCA with 125 cm³ eluant and this was due to the recoveries of these acids being more complete than the recovery of the internal standard at this low volume.

Calibration of the analytical procedure

TMS derivatives of a mixture of standard acids were prepared and then analysed by GLC. The peak area on the elution chromatogram for each ester was measured and the results, expressed in terms of area obtained per unit weight of derivative, are recorded in Table II. The weights of the derivatives were calculated assuming that all possible reactive functional groups had reacted completely.

Table II. Variations in the GLC response of TMS derivatives of acids

Acid	*Number of TMS groups*	*Calculated weight of derivative, µg*	*Response mm²/µg*
lactic	2	3·12	280
oxalic	2	3·12	248
phosphoric	3	3·85	202
malic	3	3·13	224
PCA	2	2·54	189
tartaric	4	2·92	220
citric	4	3·00	225

The variation in response of the flame ionization detector with the structure of the TMS derivatives, the uncertainty in the extent of derivative formation and possible decomposition or absorption taking place on the GLC column, confirmed by the values recorded in Table II, shows that it is not possible to predict the GLC response for the TMS derivatives of the acids. Quantitative work requires the preparation of a standard curve for each acid recording the change in response with increasing concentration relative to the response obtained for a constant addition of an internal standard.

Tartaric acid, a hydroxy acid which is not present in detectable amounts in raw juice prepared from sugar beet grown in the United Kingdom as shown in Fig. 3, was used as an internal standard. The TMS derivative of tartaric acid has a convenient retention volume relative to those of the TMS derivatives of the acids contained in sugar beet process juices.

To avoid the possible introduction of errors due to small differences in the recoveries of the individual acids from the ion exchange procedure, standard curves were plotted from the results obtained by taking the mixtures of standard acids and tartaric acid through the complete analytical procedure in the same manner as the juice samples.

A plot of the relative response for each acid (tartaric = 1·0) against acid concentration was linear in the range equivalent to between 20 mg and 1000 mg per litre of juice (juice aliquot = 50 cm^3) and linearity was maintained up to the equivalent of 2000 mg per litre for citric acid and PCA.

Experimental Results

Precision of silylation and GLC procedure

A series of equal aliquots of a standard solution containing 15 mg of each standard acid were dried as their ammonium salts, reacted with BSA and analysed by GLC. The relative responses for each acid derivative (tartaric acid = 1·0) were measured and the results are recorded in Table III.

Table III. Precision of silylation and GLC procedure

Acid	*lactic*	*oxalic*	*phosphoric*	*malic*	*PCA*	*citric*
Mean relative response	2·04	1·62	2·06	1·88	1·04	1·50
Standard deviation % mean response	0·6	1·9	2·3	1·0	4·4	2·0

The results show good precision for all the acids except PCA. The silylation reaction with PCA is more sensitive to traces of water than with the other acids which possibly accounts for the lower precision obtained for PCA.

Precision of the analytical procedure

The precision of the analytical procedure was determined using raw juice produced in the laboratory to which had been added 500 mg tartaric acid/litre. Laboratory raw juice contains very little lactic acid or PCA and amounts of 118 mg lactic acid/litre and 284 mg PCA/litre were also added. The relative responses for each acid were measured and the results are recorded in Table IV.

Recovery experiments

The results of recovery experiments for beet process juices and molasses ranged from 95 to 103% as shown in Table V.

Table IV. Precision of analytical procedure with raw juice

Acid	*lactic*	*oxalic*	*phosphoric*	*malic*	*PCA*	*citric*
Mean relative response	0·36	1·05	2·17	0·57	0·68	1·12
Standard deviation % mean response	4·8	3·1	3·2	3·3	5·2	1·8

The simultaneous determination of the majority of the acids present in beet juices can be carried out in about the same time as was previously required for the determination of the individual acids[1,2,3].

The results in Table V for recoveries of the individual acids at the different levels present in process juices show that the accuracy of the method is good. In table IV good precision is shown for the majority of the acids and although the precision is somewhat less for lactic acid and PCA it is adequate for most applications.

Summary

A combination of an ion exchange separation followed by a fast GLC procedure for the identification and determination of organic acids and phosphoric acid in beet process juices is described.

Anions, separated from sugars and cationic material by an ion exchange procedure, are reacted as their dry ammonium salts, with N,O—*bis* (trimethylsilyl) acetamide (BSA) to form volatile trimethyl silyl ethers and ether esters which are separated by temperature-programmed GLC.

The concentrations of the acids are determined from their GLC responses relative to that obtained for an internal standard which is added to the original juice. A plot of relative peak height for each acid (tartaric acid = 1·0) against acid concentration is linear in the range equivalent to between 20 mg and 1000 mg/litre of juice (2000 mg/litre for citric acid and PCA) and the concentration of each juice acid is deduced from a standard curve using the relative peak height (tartaric acid = 1·0) measured on the elution chromatogram.

Recoveries of acids added to beet process juices ranged from 95 to 103%.

Table V. Recoveries of standard acids added to process juices

Acid	*Juice*	*Acid added, range mg/litre*	*Total acid, determined range mg/litre*	*Mean recovery %*
lactic	raw juice	40–120	56–120	99·6
	dil. thick juice	130–600	394–800	98·5
	dil. molasses	1250–2500	4380–6000	100·9
glycollic	dil. thick juice	12·5–25	75–180	96·3
	dil. molasses	125–250	470–640	97·2
oxalic	raw juice	150–684	655–1000	101·9
	dil. thick juice	40–120	56–120	97·8
phosphoric	raw juice	150–960	406–1180	100·6
malic	raw juice	75–300	104–730	99·5
	dil. thick juice	12·5–25	62–75	95·0
	dil. molasses	125–250	400–666	99·0
PCA	raw juice	50–120	56–130	98·4
	dil. thick juice	400–960	1120–2150	96·8
	dil. molasses	4000–8000	11860–16200	100·1
citric	raw juice	175–1200	535–1417	96·4
	dil. thick juice	20–120	77–160	103
	dil. molasses	200–400	540–770	101·9

Sugar cane agriculture

Testing sugar cane varieties for leaf scald disease resistance. H. KOIKE. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—Leaf scald disease is difficult to eradicate once it is established. The disease, due to a bacterium (*Xanthomonas albilineans*), can be effectively controlled only by means of resistant varieties. Testing of sugar cane varieties for resistance is necessary wherever the disease is established. Factors that need to be considered in conducting leaf scald resistance trials include: (1) age of the plant at time of inoculation, (2) strains of the bacterium tested, (3) preparation of the inoculum, (4) methods of introducing the inoculum, (5) environmental conditions as they affect symptom expression, and (6) grading of the response of the plants in terms of susceptibility and resistance. A brief history of the development of trial procedures in Australia, Hawaii and Mauritius is presented. In these three areas leaf scald trials have been conducted extensively during the past 4–5 decades. The trial methods which are used in many countries today were developed there.

* * *

The elimination of leaf scald from infected planting material. D. R. L. STEINDL. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—It is known that leaf scald disease may be masked for long periods in the cane plant. The work detailed in this paper was undertaken to find a curative treatment. The initial approach, which failed, was through the standard heat treatments as used for ratoon stunting disease. Then a wide range of antibiotics were used *in vitro*; streptomycin gave promise, but proved to be ineffective for the control of the organism by soaking of setts. More than 3500 setts of diseased material were used in the final series of experiments. They included a range of soaking, hot water, hot air and antibiotic treatments, as well as some under reduced pressure. With the proviso that the disease in the resulting apparently healthy plants is not necessarily eliminated but could possibly still be existing in an attenuated form, it is recommended that suspect material should be soaked for at least 24 hours in cold water and then subjected to the long hot water treatment of 3 hours at 50°C.

* * *

International exchange of varieties: introduction. C. G. HUGHES. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 3 pp.—Several new developments in cane pathology since the last I.S.S.C.T. symposium on the subject in 1959, as well as the greatly increased production of new varieties (often inadequately tested against disease) made this symposium timely. The free interchange of varieties between countries is a long-standing and desirable practice. It involves some responsibility on the sender that he makes certain the best possible material is sent, properly packed, by air. The receiver must also take all possible care that no disease gets through his defences. The symposium was intended as a forum for the discussion of all aspects of the exchange of varieties.

* * *

The world collection and international exchange of sugar cane varieties. R. E. COLEMAN. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—The World Collection of sugar cane clones maintained by the USDA plays an important part in the international exchange of sugar cane varieties. This paper updates information on the various groups of varieties and species now included, discusses some of the problems of managing and maintaining the collection, and some of the changes that have occurred. The present collection includes 686 clones of *Saccharum officinarum*, 286 clones of *S. spontaneum* and over 300 other forms of *Saccharum* or grasses closely related to sugar cane. The secondary quarantine station for the US is now at Fort Piece, Florida. Problems created by various phytosanitary certificates and seed piece treatments required by different countries, and the types of material exchanged, are discussed.

* * *

Post-entry sugar cane quarantine. G. M. THOMPSON and J. WILSON. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—The tempo of variety exchange between sugar cane growing countries has considerable increased in the last decade, largely owing to improved air freight services. This has increased the risk of introducing diseases and pests. It is in the best interests of all cane experiment stations concerned with the exchange of varieties that they become involved to the fullest permissible extent in all stages of post-entry quarantine. This paper outlines in general terms the procedures to be followed from receipt of the cane setts or true seeds, through the glasshouse and open quarantine to ultimate use of the imported cane.

* * *

Occurrence of strains A and F of sugar cane mosaic virus in Uttar Pradesh (India). K. S. BHARGAVA, R. D. JOSHI and N. RISHI. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—Two virus isolates from cane varieties Co 1347 and BO 47 were confirmed as sugar cane mosaic virus by serological and cross protection tests, and identified as strains A and F, respectively, on the basis of symptoms produced in different cane varieties. This is the first report of Strain F from India, and of strain A from Uttar Pradesh. Strain A usually produces much more elongated chlorotic stripes and more severe and bright chlorosis than strain F. Strain A also causes more stunting of canes and showed brightest symptoms from July to the middle of September, whereas strain F produces prominent symptoms from August to October. Both the strains are transmissible to graminaceous plants only. Other details are given.

* * *

Control of sugar cane mosaic by serial heat treatment. G. T. A. Benda. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—Repeated hot water treatments of single-bud cuttings of sugar cane stalks controlled the sugar cane mosaic disease. In some cuttings infected with strains A, B, and D the virus was inactivated by 7-minute treatments at daily intervals at successive temperatures of 54·8°, 56·5°, 57·3° and 57·3°C or 54·8°, 57·3°, 57·3° and 57·3°. In some cuttings infected with strain H or I the virus was inactivated by the 10½-minute treatments at temperatures of 54·8 and 55·8°C a day apart. These plants assayed negative for sugar cane mosaic virus, were free of symptoms through two or more vegetative generations, and developed typical symptoms when reinoculated with the strain involved. Cuttings which were not heat-treated remained typically diseased.

* * *

Sugar cane mosaic virus purification. A. G. Gillaspie. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 9 pp.—This paper summarizes the evaluation of several purification procedures for use with sugar cane mosaic virus (SCMV). A method derived from this evaluation for SCMV is also presented. Sorghum tissue infected with strain A, B, D, or H is extracted in 0·3% ascorbic acid, 0·3% 2-mercaptoethanol, and 0·01 M sodium diethyldithiocarbamate; corn tissue infected with strain I and maize dwarf mosaic virus strain A is extracted in 0·5 m sodium citrate and 0·3% 2-mercaptoethanol. The extract is clarified by emulsifying with one third volume of chloroform. Further treatment is described resulting in a purified preparation of SCMV.

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Reciprocal transmission of sugar cane and Johnson grass mosaic viruses: a summary report. I. L. Forbes, M. Giamalva and G. Coburn. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 2 pp.—Since mosaic was first reported in Johnson grass in Louisiana in 1967 it has been transmitted to sugar cane seedlings, to Johnson grass seedlings, to Johnson grass clones and to sorghum by the sand-abrasion technique. Never was it transmitted to sugar cane clones by physical means, nor was sugar cane mosaic transmitted to Johnson grass clones by sand-abrasion. However in 1970 Johnson grass mosaic was transmitted to sugar cane clones by the aphid *Rhopalosiphum maidis* and sugar cane mosaic was transmitted to Johnson grass clones by the aphid *Dactynotus pseudoambrosiae*.

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Purification and seriology of sugar cane mosaic virus. H. Handojo and D. Noordam. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 12 pp.—Sugar cane mosaic virus (SCMV) belongs to the potato virus Y group. The isolation of viruses of this group in quantities is made difficult by the unacceptable loss of virus in the clarification and purification procedures. This paper reports experiments on the purification of SCMV. The efficiency of diethylether and carbon tetrachloride and adjusting the pH to 4·7 in the purification of sugar cane mosaic virus (SCMV) was traced by applying these treatments first to healthy leaves of maize. The efficiency of these treatments on the homogenate was judged by ultraviolet spectrophotometry after 2 cycles of high and low speed centrifugation. After a treatment with ether nucleic acid impurities were present. Adjusting the pH to 4·7 was useful but before ultracentrifugation the pH had to be changed to 7·0. With an ether treatment followed by adjustment of the pH to 4·7 and afterwards to 7·0 the purest preparations were obtained.

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Reaction to ratoon stunting disease of new sugar cane varieties grown commercially in Louisiana. R. J. Steib. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—The two major diseases in Louisiana today are mosaic and ratoon stunting disease (RSD), responsible for severe losses in both plant and ratoon crops. RSD tests using plant cane and 1st ratoon cane grown the same years in 1969 and 1970, showed that RSD caused greater loss in 1st ratoon. The two new varieties L.60-25 and L.62-96 yielded significantly fewer tons of cane and of sugar per acre when diseased. The variety L.60-25 is more tolerant to RSD than L.62-96. In tons of cane per acre for an average of two plant and 1st ratoon crops, the losses were 5·4 and 9·9 tons respectively.

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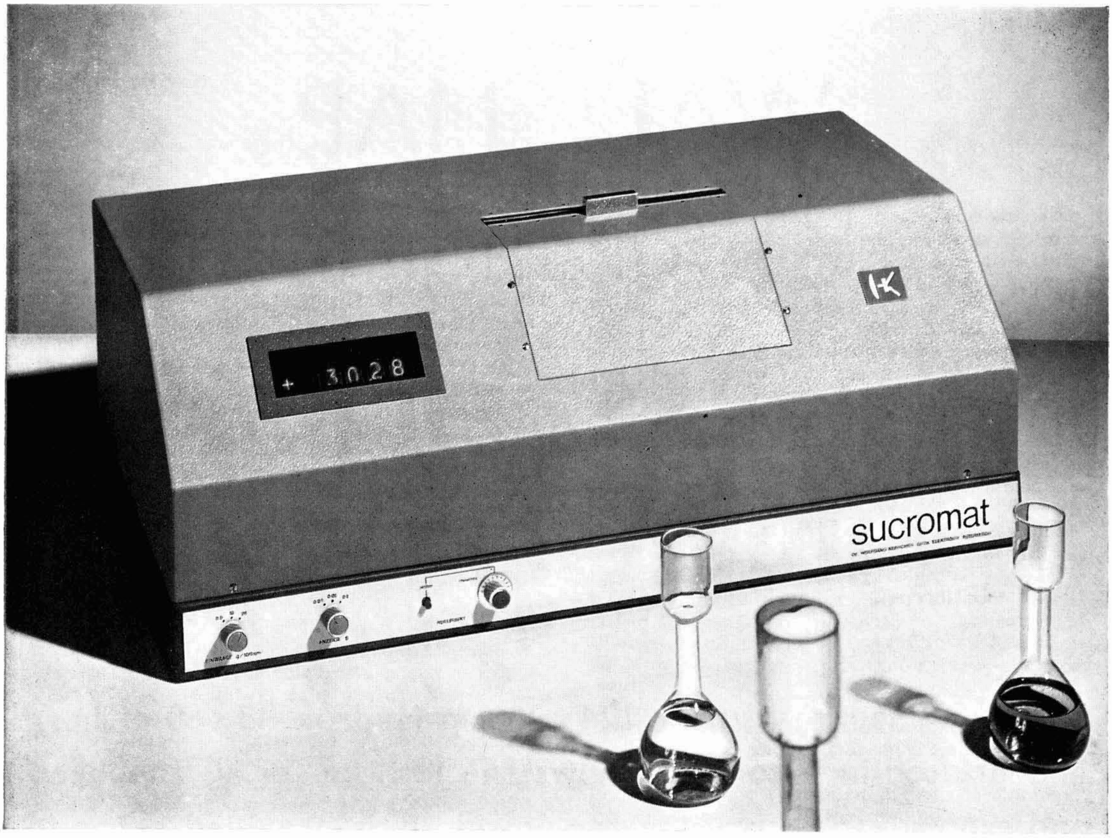
The IISR hot-air seed cane treatment plant. R. G. Menon, K. Singh, N. S. L. Srivastava and S. R. Misra. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—An experimental hot air treatment plant capable of treating about 20 kg of cane at a time, and of maintaining a constant and uniform temperature of 54°C for 8 hours was designed and made at the Indian Institute of Sugarcane Research, Lucknow, in 1964. Extensive experimentation during the next 5 years showed that the unit is capable of maintaining the seed cane at the desired temperature for the desired length of time, that the temperature is uniform throughout the chamber, and that the treatment does not desiccate the cane to a level where germination is impaired, provided that the unit is reasonably airtight. Following the success with the experimental unit a commercial size unit capable of handling about ½ ton of cane at a time was designed, fabricated and tested in 1969. Full details accompanied by photographs are given.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Temperatures and treatment durations with hot air for control of ratoon stunting disease in Louisiana. D. M. Tantera and R. J. Steib. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—The recommended hot air treatment for control of ratoon stunting disease (RSD) in Louisiana is 58°C for 8 hr (air entering rear of oven set at 58°C for treatment duration of 8 hr). This treatment has been recommended since 1956, using the present commercial oven. Tests in 1970 were made at 58°C for 6, 7 and 8 hr and at 59°C for 6 hr. A shorter period seemed desirable, being preferred by growers because of labour shortage and rising costs. It was found that all four treatment combinations gave acceptable control of RSD, with time savings of 1–2 hours.

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Further experience with the insectary method of testing sugar cane varieties for resistance to Fiji disease. A. A. Husain and P. B. Hutchinson. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—In Fiji cane varieties resistant to Fiji disease are all-important as this disease is indigenous and spread by a local leafhopper. An insectary method of testing sugar cane varieties for resistance to Fiji disease is in use. In this paper is described standardization of a number of factors contributing to the use of the insectary. These are: a study of viruliferous insects, mass rearing facilities for producing infective leafhoppers, exposing plants to infection—including plants to be used for screening, the age of plants at incubation, length of transmission time and methods of confining insects on plants to be inoculated.

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The control of sugar cane diseases in Fiji. J. Daniels, A. A. Husain and P. B. Hutchinson. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 8 pp.—The diseases downy mildew and Fiji disease are the only ones which have caused major losses in Fiji cane areas. In recent years they have been reduced to a very low level by the release of resistant varieties coupled with an intensive system of disease control. The intensive disease control system involves establishment of a detailed checking system to locate infected fields, roguing of diseased plants, and the use of disease-free seed. The intensive control system combined with resistant varieties has reduced the incidence of both diseases to such low levels that a less rigid system of disease control has been in use since 1967.

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Research on grassy shoot disease of sugar cane in Maharashtra State. G. K. Zende and N. B. Shaikh. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 7 pp.—Data on this virus disease collected over 1½ decades showed that the two diseases grassy shoot and albino were but manifestations of the same disease. The quality of seed material used for planting purposes is an important factor in determining incidence of the disease. Seed from prematurely sprouted canes and affected canes shows a very high incidence, particularly in the case of ratoon crops. The disease is mainly transmitted through infected seed material and through knives used for cutting the seed cane. The disease is completely arrested when the seed material is given hot water treatment at 50°C for two hours. Untreated seed material can cause yield losses of 40 to 90%. Cane varieties differ in degree of susceptibility.

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Effect of some nematicides on plant nematodes and sugar cane yield. W. Birchfield. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 8 pp.—Fourteen genera of plant nematodes have been found associated with sugar cane in Louisiana. Field application of some recently discovered nematicides has resulted in increased sugar cane yields in Louisiana. During the past five years various granular materials applied to plant cane gave the best nematode control and the highest yields in tonnage and sugar per acre. None of these materials was toxic to sugar cane at dosages used or reduced sugar per ton. All helped to control nematodes, were effective at low rates and were easy to apply. The best of the halogenated hydrocarbons used was "DBCP" (1,2-dibromo-3-chloropropane) which also increased sucrose in some years.

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The effects of certain soil organic amendments on chlorotic streak infection. C. Ricaud. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—Chlorotic streak disease of sugar cane is the major problem in the super-humid zone of Mauritius, which receives more than 250 cm annual rainfall and constitutes nearly 30% of the total area under cane. The short hot water treatment of cane setts (52°C for 20 min or 50°C for 30 min) inactivates the pathogen and is current practice for the establishment of virtually all plantations in areas where the disease is important. The disease is soil-borne. Further control of the disease must therefore be achieved through the use of varieties with better resistance and cultural practices that will delay reinfection and reduce the severity of the disease in infected plants. The exclusive use of resistant varieties involves long term breeding and selection. This paper deals with a first attempt at biological control of chlorotic streak by the use of certain organic soil amendments. Experiments with filter cake or molasses as soil amendments on two varieties of established cane (one highly and one slightly susceptible) did not give favourable results, but appeared to favour the build-up of the disease.

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Soil micro-organisms and yield decline of sugar cane in Louisiana. S. M. Yang. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 7 pp.—The objective of this work was to determine the effect of quantity of organic matter and of cane variety on the microbial populations at different seasons, and to determine the significance of antipythium microbial population levels at different seasons on growth of the first ratoon crop. It is thought that yield decline of sugar cane varieties may be due to root pathogens (*Pythium*), the severity being inversely correlated with levels of the microbial population, especially actinomycetes, antagonistic to the root rot pathogens. Statistical analyses (five sugar cane varieties) indicated no association between numbers of fungi and the amount of organic matter or the moisture status of the soil. A similar lack of relationship also appeared to exist between the range of soil moisture or amount of organic matter and the number of actinomycetes and bacteria.

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The pineapple disease of sugar cane in Puerto Rico. L. J. LIU, A. CORTES M. and J. MIGNUCCI. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 7 pp. Two strains of the fungus which causes the pineapple disease of sugar cane, *Thielaviopsis paradoxa*, one light and one dark, were isolated from diseased cuttings of sugar cane in Puerto Rico. Details are given concerning them. Four fungicides, "Dithane M-45", "Busan 72", phenyl mercuric acetate and "Benlate" were tested in the laboratory for their relative toxicity against mycelial growth of *T. paradoxa*; "Benlate" appeared to be the most effective for inhibiting mycelial growth *in vitro*. Dipping inoculated seed pieces of sugar cane varieties PR 980 and PR 1085 in a 1% solution of "Benlate" increased germination by as much as 40%.

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Sugar cane diseases in Mozambique. A. R. NORONHA. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 3 pp.—In Mozambique sugar cane is third in importance as a crop, after cotton and cashew. The results of a survey of the sugar cane diseases or disorders in the country are here recorded. Of the total of 17, two, ratoon stunting disease and smut, are of major importance while leaf scald and the yellow wilt condition are of potential danger. Ratoon stunting is particularly important in the non-irrigated commercial plantations. The several varieties under cultivation are susceptible to it in varying degrees and thermotherapy is being recommended.

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Air pressure incorporation of fungicides for the control of red rot. L. ANZALONE. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 4 pp.—In Louisiana sugar cane is commonly planted with seed pieces of whole or half stalks ranging in length from 90 to 180 cm. The use of shorter seed pieces (setts 20–40 cm long with 2 or 3 buds) would be more economical but unfortunately short seed pieces or setts deteriorate more rapidly under Louisiana conditions, one of the main causes being the red rot fungus, *Colletotrichum falcatum.* This paper describes a method of reducing deterioration of short seed pieces by treating 9-bud sections of sugar cane stalks with fungicides suspended in water under an added air pressure of 10 psi for 15 minutes.

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The shape of things to come. L. G. VALLANCE. *Australian Sugar J.*, 1971, **63,** 228–229.—A brief illustrated description is given of a new double-row chopper harvester for cane designed by L. MIZZI and built by Wyper Bros. Ltd.

Aerial rat-baiting at Proserpine. R. H. ROBINSON and A. E. OLIVER. *Producers' Rev.*, 1971, **61,** (8), 9–11.—Encouraging results have been obtained after distribution of poisoned baits for rat control in cane fields which were semi-lodged as the result of cyclonic weather. Baiting from the ground in the normal way would have been difficult. Some 14,000 acres were treated and 10,000 lb of bait distributed.

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Sidon—a new cane variety for Goondi. ANON. *Producers' Rev.*, 1971, **61,** (8), 31.—This variety is a cross between Cadmus and MQ 48-2901, raised at the Macknade Experiment Station. It shows rapid germination and vigorous early growth. Stooling is medium and compact, ratooning vigorous and reliable. Lodging only takes place in the richest silty soils and it shows resistance to flooding. Arrowing and side-shooting may be problems on the poorer soils.

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Two aspects of pollution. ANON. *Producers' Rev.*, 1971, **61,** (8), 54.—It is argued that the criticisms that have been made about the burning of sugar cane for trash removal and atmospheric pollution may well be ill-founded, also that there appears to be no evidence that human health is in anyway affected by the smoke of cane fires. Problems which would arise if burning ceased are briefly mentioned.

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Photo-respiration of sugar cane. C. C. CHU and L. KONG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 1–14.—Infra-red analysis and radio-carbon tracer studies have been carried out in regard to photosynthesis in sugar cane and production potential. Photo-respiration of cane was directly proportional to the oxygen content of its environment and also to air temperature; it was inversely proportional to light intensity. Photo-respiration was about 1% of total photosynthesis.

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The effect of climate on cane growth in 1970. W. H. TUNG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 15–21.—Owing to warm and favourable climatic conditions with no typhoons, sugar cane made very good growth. Even from August to October stalks continued to elongate. This could be correlated with temperature and rainfall data. This profuse vegetative growth resulted in poor sugar yield in the early milling months.

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Effect of bagasse compost and green manure on sugar cane yield in Taiwan. J. FRIEDRICHSEN and C. C. WEI. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 22–33. Experiments are described which were carried out to ascertain whether fertilizing with bagasse compost or green manure was desirable or profitable in the cane fields of the Taiwan Sugar Corporation. Bagasse compost was applied to 3 different soils. Beneficial effects were slight, being greatest on sandy soil. With the cost of bagasse and of composting and application, the use of bagasse in this way was not economical. Results were similar with green manure. Furthermore green manure prevented the use of land for other crops during the growing season.

* * *

Studies on the dense planting of sugar cane seedlings. C. Y. KWO and B. C. MOK. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 40.—In recent years some 700,000 cane seedlings have been raised annually in Taiwan. Owing to limitation of land it has not been possible to adopt single planting altogether. Six experiments for comparing dense spacing and single planting during 1963–68 are described. Dense planting (25 cm spacing instead of 50 cm) gives three times as many seedlings; these are inferior in size but survival rate, selection percentage and seedling height are the same.

* * *

The effect of competitive ability among various varietal habits of sugar cane. P. Y. JUANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 41.—Six commercial varieties of cane were used in the experiments here described. Plants at the ends of rows were compared with those in the rows.

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Relationship between cane yield and the main characters of sugar cane. P. Y. JUANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 41–43.—From correlation coefficients it is apparent that sugar cane yield cannot be related solely to a single factor among those associated with yield (number of tillers, number of millable stalks, and stalk length and diameter). Analyses of partial regression and correlation and multiple correlation of sugar cane yield to other characters did not show statistical significance.

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The difference in water consumption between interplanted cane and single-planted cane. H. CHANG, F. W. HO and J. S. WANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 43–44.—Interplanted cane requires more water than single-planted cane, the difference depending on the inter-planted crop, e.g. 6% with cotton and about 40% with wheat.

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Studies on the characteristics of water consumption of sugar cane. Effects of the first and the second ratoon on water consumption of sugar cane. Y. T. CHANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 44. Lysimeter studies showed that with first and second ratoons water consumption was the same but that energy utilization was greater with first ratoons.

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Study on infiltration and irrigation water requirement in the sugar cane field. I. The modified siphon for furrow irrigation. Y. CHU, M. S. CHIU, Y. S. CHANG, Y. T. FAN and T. J. HUANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 44–45.—Water application is more evenly controlled by use of a new siphon which is calibrated so that the discharge can be read from a scale instead of requiring often-inaccurate estimation.

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Studies on sugar cane irrigation. III. Effect of irrigation on the responses of different sugar cane varieties. IV. On the depths of placing the gypsum block in the soil as the irrigation index. V. Effect of controlling the ground water levels on sugar cane irrigation. Y. T. CHANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 45–46.—Yield of F 152 and F 146 cane is increased by irrigation; however, too much irrigation increases dead stalks in N:Co 310. Variations arise in regard to irrigation control when the gypsum block (used to determine soil moisture) is placed at varying depths in different soils. Yield was increased and less irrigation was necessary when the cane had access to ground water (from below 1·6 metres depth) than when this was cut off by a plastic sheet. The water flows up to the cane by capillary action in the soil but is stopped by the sheet.

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A study on the fertilizer application for spring-planted sugar cane. C. C. WEI. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 46.—Results of N-P-K experiments on various soils are given. Conclusions reached were that a system of timing and splitting of fertilizer applications for spring-planted sugar cane is desirable. On clay and loamy soils all the fertilizers would be better applied in a single dose after germination. On sandy soils splitting potash fertilizer into two and nitrogenous fertilizer into two or three increments would seem to be preferable.

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Usage of fertilizers in sandy soil. D. S. CHANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 46–47. Fertilizer mixed with clay soil or farm yard manure and applied deep into sub-soil increased cane yield and fertilizer efficiency with sandy soil. Evaporation from the surface means that there is more water at greater depth and the fertilizer is thus made more accessible to the roots. The increased yield more than covers the higher cost of such placement.

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Experiments on the rates of three major elements for the new autumn-planted sugar cane varieties F 151, F 153 and spring-planted varieties F 154, F 156. C. C. TSE, J. S. CHENG, D. S. CHENG and S. S. WAN. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 47–48.—Responses of the four varieties to N, P and K during six years of trials are recorded.

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Study of the relationships between net radiation, soil temperature and cane growth in an intercropping field. H. CHANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 52–53.—Net radiation absorbed by cane and soil temperatures were higher where cane was the sole crop than where other crops were interplanted, the effects depending on the nature of the intercrop. The presence of an intercrop also reduced the number of cane tillers.

Sugar beet agriculture

Estimating general combining ability from an incomplete crossing system. G. A. Milliken, H. L. Bush, A. W. Ericksen and A. Suzuki. *J. Amer. Soc. Sugar Beet Tech.*, 1970, **16,** 264–274.—A computational procedure is presented to estimate the general combining abilities of the parents of an incomplete crossing system in sugar beet. Besides presenting the computational procedures an example is discussed in detail to demonstrate the necessary calculations. A computer programme was available for doing the described analysis.

* * *

Current outlook and perspectives in the selection and utilization of industrial beet seed. J. Christmann. *Ind. Alim. Agric.*, 1971, **88,** 929–938.—Breeding of sugar beet is reviewed and the recent development of genetically monogerm varieties of satisfactory yield is mentioned. Farmers are slow to adopt new techniques or varieties; however, by using mostly rubbed and graded seed, together with selective herbicides, the growers have been able to lessen appreciably the manual work which used to be necessary for hoeing and singling of the crop.

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Current aspects of the genetic improvement of the sugar beet. J. Deneuche. *Ind. Alim. Agric.*, 1971, **88,** 941–943.—A survey of beet breeding is presented and it is explained how the breeder has been able to produce plants having new biological characteristics (tetraploid instead of diploid, male-sterile instead of fertile, monogerm instead of multigerm). Combination of suitable types indicates the possibility of developing triploid seeds which the author considers of great value.

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Considerations of mineral nitrogen fertilization of sugar beet. G. Lefevre. *Hautes Etudes Betterav. Agric.*, 1971, **3,** (11), 6–10.—Various aspects of the nitrogen fertilizing of sugar beet are discussed, including the effects of the previous crop and of drainage or leaching.

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Trials with new insecticides for protecting sugar beet seed. W. R. Schäufele and C. Winner. *Zucker*, 1971, **24,** 699–703.—Experiments are described designed to test several insecticides in the treatment of sugar beet seed in place of "Heptachlor". Several different procedures (seed and soil treatment) and methods of application were tried. So far it has not been possible to form final conclusions.

Sugar beet cultivation [in India]: an alternative source of sugar production. S. C. Gupta, A. P. Gupta and J. S. Mehta. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 37–41.—The general requirements of the sugar beet crop are discussed with special reference to its behaviour under Indian conditions. Advantages and disadvantages are discussed, one of the major advantages being that the crop matures in India in 6 months so that it may be grown in conjunction with other crops.

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Results of preplant fumigation trial for the control of sugar beet nematode on cabbage. J. D. Radewald, B. J. Hall, F. Shibuya and J. Nelson. *Plant Disease Reporter*, 1971, **55,** 841–845.—Results are given of successful fumigation of land used for cabbages and heavily infected with the nematode *Heterodera schachtii* which commonly attacks sugar beet as well as cabbages. Preplant fumigation was with 1,3-dichloropropene and related C_3 hydrocarbons and methyl bromide 67%, chloropicrin 31·75%, gel 1·25%. Annual fumigation was deemed necessary with a susceptible crop.

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Drought, not seed quality, causes poor emergence. Anon. *Sugar Beet J.*, 1971, **35,** (1), 3.—In the spring of 1971 drought prevailed in many sugar beet areas of Canada resulting in poor germination of seed and inability of herbicides to function in the normal manner. April and May can be critical months for rain with sugar beet and no amount of rain later can make up for deficiency during these months.

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Clean beets for storage. Anon. *Sugar Beet J.*, 1971, **35,** (1), 6–8.—The advantages to be derived from clean beet, especially where beet storage is concerned, are discussed and the benefit to be obtained from grab rolls on the harvester, particularly in a muddy season, considered. Clean beet in a storage pile allows of free air exchange between beets and much better storage.

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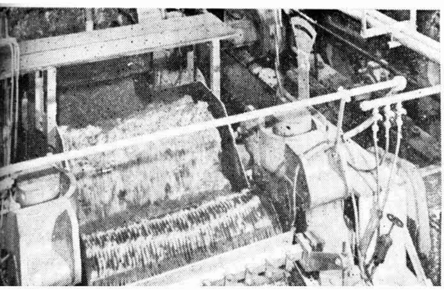
The relationship between soil phosphorus and response by sugar beet to phosphate fertilizer on mineral soils. A. P. Draycott, M. J. Durrant and D. A. Boyd. *J. Agric. Sci.* (Cambridge), 1971, **77,** 117–121; through *Soils and Fertilizers*, 1971, **34,** 719.—Data from 55 experiments are given and recommendations made for phosphorus dressings for different soils, these ranging from 0 to 180 kg/ha.



Cane sugar manufacture

The influence of the method of trashing and the storage period on the quality of cane. F. V. Novaes. *Doctorate of Agronomy Thesis, Univ. of São Paulo*, 1971, 58 pp. + 13 tables.—Experimental plots at four locations in the State of São Paulo were used for the experiments during the 1968/69 season. Leaves were burnt or removed by hand. Samples, consisting of 10 bundles each of 10 stalks, were subjected to juice analysis. It was found that stalks declined in weight after 24 hr and juice soluble solids increased after 48 hr, irrespective of burning or non-burning. Pol in non-burnt cane declined significantly after 96 hr; with burnt cane there was no alteration during this time. Juice purity decreased equally up to 48 hr with both burnt and unburnt cane; subsequently, pol losses were higher with unburnt cane. Fibre content increased during storage after both treatments. Total acidity increased equally with both treatments. Other minor differences are outlined.

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Cane yard feeding table being tested at Taitung sugar factory. L. S. Kuo. *Taiwan Sugar*, 1971, **18,** 210–213. The cane handling system at Taitung is described. The factory receives more of its cane by road than previously, while only about half of the previous 76,000 tons is now transported by rail.

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Improving raw sugar filtrability. G. P. James and J. M. Cameron. *Sugar J.*, 1971, **34,** (6), 14–15.—See *I.S.J.*, 1972, **74,** 251.

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Mechanization of harvesting and its effects on cane quality. (Cuba: 1964-68). A. F. Betancourt. *CubaAzúcar*, 1970, (July/Sept.), 2–22, 39–56.—Statistical details are presented of cane cutting and loading in the five crops, with amounts dealt with by hand and by machine, trashed and untrashed. Information is provided on the loaders and the KTC-1 combine harvester, as well as the cane conditioning or dry-cleaning plants. The minimum requirements for proper operation of a mechanical harvesting system are discussed. Cane supplies are examined for dirt tare by taking a complete load at random and weighing separately the clean millable cane and extraneous matter; this sampling amounts to 1 ton in 10,000 milled. Data are tabulated showing the results of analyses for different kinds of treated cane in each of the five crops. Further details are provided by records of the different types of extraneous matter—suckers, dead cane, trash, soil and stones, etc.—% gross cane for manually and mechanically handled cane. The losses recorded compared favourably with those found in other countries but are recognized as being higher as a result of increased mechanization and requiring elimination.

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The electronic computer in a sugar central. H. L. Oliveros. *Sugar News* (Philippines), 1971, **47,** 414–420, 441, 456–460.—Uses of electronic data processing and of the resultant computer-based information in a cane sugar factory are discussed and a pan boiling control sequence using a digital computer described. Details are also given of a proposed scheme for plant maintenance control.

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Low purity final molasses from continuous centrifugals at First Farmers. V. A. Custodio. *Sugar News* (Philippines), 1971, **47,** 422–424.—By adopting a more systematic approach to low-grade massecuite reheating and reducing the crystal size in *C*-massecuite it was possible to reduce the purity of final molasses from continuous centrifugals to 32·61 in 1970/71 compared with 35·06 in 1968/69 and 35·75 in 1969/70. Details are given of the techniques used.

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Protection of screens of continuous centrifugals. B. B. Pawar. *Sugar News* (India), 1971, **3,** (5), 17, 19. Measures adopted to protect screens in horizontal-shaft continuous centrifugals are listed. It is found that nickel chrome screens, 0·25 mm thick and having 0·09 mm perforations, wear faster than do brass or copper screens in batch centrifugals.

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Recent developments in sugar technology. M. Anand. *Sugar News* (India), 1971, **3,** (5), 20–22.—Developments in cane sugar factory processes and equipment in India are briefly discussed.

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Spontaneous combustion of final molasses at Mehran Sugar Mills Ltd., Tando Allah Yar. H. Ahmed. *Proc. 9th Conv. Pakistan Soc. Sugar Tech.*, 1971, 72–79. See *I.S.J.*, 1973, **75,** 20.

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Chemical cleaning of boilers under our conditions. A. Aziz. *Proc. 9th Conv. Pakistan Soc. Sugar Tech.*, 1971, 80–84.—At the author's sugar factory the water-tube boilers are descaled with a 50 lb/100 gal aqueous solution of "Nal Clean N-66", described as a mixture of organic and inorganic acids plus corrosion inhibitors and a dye indicator for checking solution strength. Treatment with a 5% solution followed by a 5% soda ash solution has permitted 140 days' operation of the boilers without trouble, pan condensate being used with 10–15% soft water.

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Effect of soft water on molasses purity. I. TALIB and Z. SAID. *Proc. 9th Conv. Pakistan Soc. Sugar Tech.*, 1971, 101–105.—Data are presented showing the adverse effect of hard water, i.e. reduced mixed juice purities, low reducing sugar:ash ratios and high molasses purities and yields compared with results obtained when soft water is used.

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Extra fuel optimization in a sugar factory. K. R. NAGPURAY and A. C. CHATTERJEE. *Indian Sugar*, 1971, **21,** 431–432.—Calculations are presented to show how it would be possible to reduce the steam consumption to 49% on weight of cane crushed at Kalambar sugar factory crushing 1250 t.c.d. and burning only bagasse.

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The full seeding method in vacuum pan crystallization. M. A. MANCILLAS. *Sugar y Azúcar*, 1971, **56,** (12), 14–17.—The theory of pan boiling is briefly explained and details given of the full seeding method used at the author's sugar factory in Mexico. Advantages of the method are listed.

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Keeping quality of bolder grains during storage in sugar godowns. D. R. PARASHAR. *Sugar News* (India), 1971, **3,** (6), 19–21.—Measurements of colour and SO_2 in bagged sugar of various grain sizes and 30 I.S.S. colour stored in a godown indicated that all suffered from slight colour increase and SO_2 loss during the observation period, the smaller crystals undergoing greater deterioration than the larger grains. Pol and reducing sugars content remained unchanged.

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The rôle of water treatment in the sugar industry. V. S. SUD. *Indian Sugar*, 1971, **21,** 479–482.—Details are given of the ion exchange plant at the author's factory which reduces the hardness of the boiler feed water to zero, the chloride content to 10 ppm, total dissolved solids to 50 ppm and total alkalinity (against methyl orange and phenolphthalein) to 20 ppm at a pH of 7·5. The problems which led to installation of the plant are discussed.

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Influence of the design of a low-grade station, pans, crystallizers and centrifugals on the obtainable purity of final molasses. M. OTALORA B. *Bol. Azuc. Mex.*, 1971, (261), 11–17.—A number of graphs are reproduced showing the relationships between massecuite viscosity and total solids, crystal content, ash content at different gravity purities, temperature, etc., the viscosity being an important factor in the exhaustion of final molasses. Aspects of boiling house design and operation which can affect massecuite viscosity are discussed.

* * *

Explosion caused by sugar dust. K. SHANKER, V. K. JAIN and S. N. M. TRIPATHI. *Sugar News* (India), 1971, **3,** (5), 23–25.—Details are given of a sugar dust explosion occurring in one of two dust collecting chambers at an Indian sugar factory during the 1970/71 season. Since there is no electric cable inside the chamber, it is concluded that the explosion was caused by a match used to light a cigarette.

* * *

The first Polish sugar factory in Pakistan. S. GIELZYŃSKI. *Gaz. Cukr.*, 1972, **80,** 12–17.—Equipment and processes at the cane sugar factory built by Chemadex for Bahawalnagar Sugar Mills Ltd. are described. The factory, about 180 km from Multan, has a capacity of 1500 t.c.d. expandable to 2000 t.c.d.

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Continuous centrifugals. J. P. MUKHERJI, A. C. CHATTERJEE and S. S. GANGAVATI. *Sugar News* (India), 1971, **3,** (7), 4–11.—The construction, operation, performance and advantages of the Hein, Lehmann "Wal-Konti" vertical-shaft, conical-basket continuous centrifugal are explained. A low-grade massecuite viscosity of 2500–3500 poises and a 40% crystal content are recommended. Crystal breakage of 10–15% of the discharged sugar was found to cause no difficulties when it was made into seed magma for high-grade sugar boiling.

* * *

Cane handling and preparation. M. ANAND. *Sugar News* (India), 1971, **3,** (7), 12–14.—Cane handling and preparation for milling in India, including cane knife reversal, are briefly surveyed and methods of judging the degree of cane preparation mentioned.

* * *

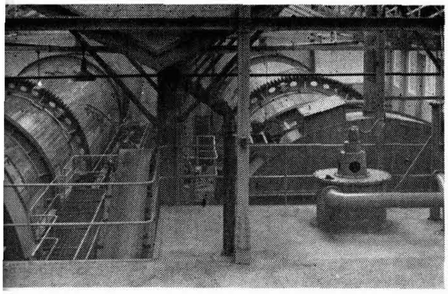
"Sparkle"—a substitute for hydros. T. P. SAKSENA, K. K. GUPTA, R. K. DIKSHIT and A. B. LAL. *Sugar News* (India), 1971, **3,** (7), 15–18.—Boiling tests showed that "Sparkle", a bleaching additive which is not described, was not markedly better than sodium hyposulphite in improving the whiteness of sugar obtained from high-grade massecuite.

* * *

Notes on centring technique (alignment). B. ARDANZA. *ATAC*, 1971, (3), 11–23.—Mis-alignment of axes of rotating equipment can lead to flexing, vibration, wear, etc., and notes are presented on the avoidance of this when coupling two pieces of machinery under various conditions.

* * *

How many workers does a factory need ? J. FERRÁN O. *ATAC*, 1971, (3), 24–38.—A method for comparison between productivity of workers in different mills is explained; it has application in showing areas in individual parts of a mill where higher labour efficiency might be achieved.



Beet sugar manufacture

Current problems in juice purification. S. Wolf. *Ind. Sacc. Ital.*, 1971, **64**, 157–160.—An account is given of the Novi Sad system of carbonatation of beet juices, and of problems and results obtained.

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Operation of an evaporator with internal circulation. N. Yu. Tobilevich and Yu. G. Porzhezinskii. *Izv. Vuzov, Pishch. Tekh.*, 1971, (5), 121–124.—Tests with an experimental evaporator in which the height of the riser tubes in the centre of the tube plate was almost double that of the tubes in the outer annular downtake section showed that operation under given optimum conditions reduced scale formation as a result of the reduction in the boiling zone.

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Dynamic conditions in operation of a continuous vacuum pan. V. P. Zubchenko *et al. Izv. Vuzov, Pishch. Tekh.*, 1971, (5), 125–130.—Studies are reported of the dynamic conditions during boiling in an experimental continuous vacuum pan in which the upper half acts as concentrator and crystal generator while the lower, separate half acts as a crystal growth chamber. Differential equations obtained for correlating various parameters have been applied to development of an automatic control system for the pan.

* * *

The interaction between sucrose and lime in sugar technology from the point of view of juice purification. L. Zavodsky. *Sucr. Belge*, 1971, **90**, 535–538.—The heats of reaction in the system water-sucrose-lime were determined under adiabatic conditions and the effects of various parameters (sucrose concentration, temperature, quantity and properties of lime and presence of $CaCO_3$) on the reaction examined. The reaction was found to be made up of two processes: a rapid acid-base reaction predominant at low temperatures and a slow process at higher temperatures involving formation of absorption compounds. The heat of reaction varies with alkalinity and follows a sinusoidal curve. Optimum coagulation (and, hence, optimum filtration and settling properties) occurs at minimum heat liberation and varies as a function of sucrose concentration. In the presence of carbonate a smaller amount of CaO reacts with the sucrose than in its absence. Progressive preliming causes the sucrose absorption compounds to form larger aggregates. From entropy increase, i.e. the heat of reaction between CaO and sucrose, it is concluded that 2nd carbonatation optimum pH can be found from equilibrium between sucrose, CaO and CO_2, so that it can have a number of values.

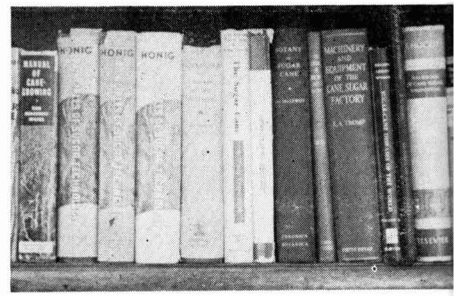
* * *

The technological value of unripe sugar beet. J. Trzebiński. *Gaz. Cukr.*, 1971, **79**, 285–287.—References to the work of other authors are used to demonstrate that unripe beet are not suitable for processing and that under Polish conditions beet lifted in mid-September are inferior in sugar and ash contents as well as juice purity and MB factor (predicted molasses yield per 100 kg of sugar) to beet lifted at the start of October. Moreover, in the intervening two weeks beet yield per ha will increase by about 10%.

* * *

Ultra-filtration as a method for juice purification. R. F. Madsen. *Zeitsch. Zuckerind.*, 1971, **96**, 612–614. Experiments conducted by the Danish Sugar Corporation on raw juice treatment by ultra-filtration are reported and some details given of the methods and different types of membranes manufactured by DDS and sold for such purposes as enzyme, egg white and fruit juice concentration and water purification. In the process, juice filters through a membrane which does not permit passage of proteins and pectins etc., although organic acids are not removed. The concentrate of impurities had a purity of 41·7 compared with a raw juice purity of 88·9 and a permeate of 91·5 purity compared with a juice purity of 92 after normal 1st carbonatation. Subsequent treatment of the permeate was tested; 1st carbonatation with a smaller amount of lime (1% $CaCO_3$ on beet compared with 2·5% in normal 1st carbonatation) gave a purity of 93, liming to pH 9 without gassing gave 92·9 purity, treatment with ion exchange resin to pH 9 gave 92 purity, while the same treatment to pH 11 followed by further treatment to give pH 9 gave a purity of 94·6. Ion exchange also gave the lowest lime salts and colour contents (0·020% and 1·0°St, respectively, compared with 0·096% and 12.7°St. respectively, with normal 1st carbonatation). Difficulties have been encountered with scale formation, and the economics of the various methods have not been considered. The use of reverse osmosis for thin juice concentration is considered uneconomical, although use of the process for molasses exhaustion shows promise, but existing membranes must be improved to make this economical.

New books



Physik und Chemie der Zuckerrübe (Sugar beet physics and chemistry). K. VUKOV. 458 pp.; 18 × 26 cm. (Akadémiai Kiadó, Budapest, V. Alkotmány u. 21, Hungary.) 1972. Price: £7.70.

Described as a reference work for beet breeders and farmers as well as beet sugar factory chemists and technologists, this is a monograph based on more than 20 years of research conducted by the author, a well-known member of the Hungarian sugar industry research institute in Budapest. Dr. VUKOV has taken as his subject the technological value of beet as expressed by its more important physical and chemical properties and the effects on these of genetic factors, geography of the growing area, weather and climate, planting and harvesting time, pests and diseases, planting density, irrigation and fertilizing, storage, etc. The influences of beet juice constituents on processing and difficulties associated with various abnormalities in the beet are examined. Finally, the author describes a number of little-known procedures for determining various beet and juice components and properties.

The subject is dealt with thoroughly and the subthemes are considered in logical sequence. The printing and layout are good, with apparently very few typographical errors. A subject index and 1349 references to the literature are given at the end of the book together with an explanatory list of mathematical symbols, but unfortunately there is no author index. There is an abundance of data quoted in the text as well as in tabular and graph form, making the work a worthy addition to the list of books concerned with beet sugar technology. The language may be a drawback, although many technologists can read enough German to follow the gist of what the author is saying.

* * *

Zuckerwirtschaftliches Taschenbuch 1972/73 (Sugar economic pocket book). G. JANEBA, E. KRENZ and G. BRUHNS. 236 pp.; 10 × 15 cm. (Verlag Dr. Albert Bartens, D-1000 Berlin 38, Lückhoffstr. 16, Germany.) 1972. Price: DM 28; £3.75.

The 19th edition of this plastic-bound pocket book, first introduced in 1954 by A. BARTENS and H. MOSOLFF, contains 68 tables of data, 6 graphs and 2 maps and is divided into three main sections: Statistics, Trade Regulations, and Addresses. The first of these includes data on (1) world sugar and molasses production, sugar consumption, imports and exports, balances and prices; (2) European data, including beet areas, sugar consumption, balances, prices, EEC sugar companies and numbers of factories and refineries as well as personnel strengths; and (3) data on the West and East German sugar industries. The second main section gives details of the International Sugar Agreement, the EEC sugar regulations and world sugar prices, while the third section gives addresses of international, EEC, West European and West German organizations and sugar factories and companies. Although the basic language used is German, English and French headings and summaries of the EEC regulations are also given. An English-French-German glossary of EEC trade terms is included. The book is to be highly recommended as a source of data on Germany and the EEC and will perhaps have greater importance now that the UK is a member of the expanded EEC. The print is very clear and the contents well laid out, but the price may be considered somewhat on the high side.

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F. O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1972 (International sugar economy yearbook and directory). H. AHLFELD. 407 + 64 pp.; 23 × 30 cm. (F. O. Licht K.G., P.O. Box 1220, 2418 Ratzeburg/Lbg., Germany.) 1972. Price: DM 50.00; £7.00.

Although the basic layout of the latest edition of this well-known directory of world sugar factories and refineries is unchanged, the system used for pagination has been altered so that each of the main sections has its own page numbers preceded by the section letter. This in itself is not necessarily a disadvantage, but it is somewhat confusing at first when the reader is consulting the contents pages. While on the subject of changes, the reviewer must say that the printing is of much poorer quality than in the past, with considerable non-uniformity in the inking and marked over-inking in some places. Moreover, the paper quality is not so good. Obviously, the publishers have had to make economies, but it seems a pity that quality has had to suffer so much.

As regards the information, there are some discrepancies, and details which were incorrect in the 1971 edition have been retained in some cases (this particularly applies to Peru). One other noticeable change in the beet sugar countries is the abolition of the division between European countries and countries outside Europe. However, for the non-German reader it is best to consult the English contents pages, since the names of various countries

in English follow a different alphabetical order than in German. Besides, the name used is not always the official one; hence, we have Great Britain instead of the UK, and the Soviet Union instead of the USSR. On this subject, it is somewhat surprising to see West and East Pakistan still given as such instead of Pakistan and Bangladesh.

The directory retains the usual information on EEC sugar trading regulations, German and other sugar organizations, the world's major sugar importers and exporters, reports from sugar machinery manufacturers, a Buyers' Guide, a 64-page statistical supplement on world sugar, and three articles ("Use of sugar in industry" by H. J. DELAVIER, "Yeast protein production from molasses" by P. HAWRANEK and A. STARKA, and "The centrifugal pump in the sugar industry" by W. STICHS). While German is the main language, English and French equivalents are given in some cases, so that even where a reader has no or very little knowledge of German he will usually be able to understand what is written. The directory remains a very useful work, the only one of its kind covering all the world's factories and refineries, but this edition is somewhat disappointing by comparison with the excellence of its predecessors; however, it is still to be recommended.

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Lamborn's highlights of the Sugar Act of 1948 including 1972 amendments. 24 pp.; 10 × 22 cm. (Lamborn & Co. Inc., 99 Wall St., New York, N.Y., 10005 USA.) 1972.

Lamborn & Co. Inc., the well-known sugar brokers, have published this booklet concerning the US Sugar Act of 1948 and the 1971 amendments. The various factors to be taken into account by the Secretary of Agriculture in administering the Act are set out and details are given of the sugar supply quotas for domestic areas and foreign supplying countries (the latter as percentages). Also included is a section on the raw sugar price objective, the importing into the US of sugar-containing products and liquid sugar, various contingency provisions made under the Act, provision for new beet areas, excise taxes with respect to sugar, conditional payment provisions, etc.

* * *

Sugar price movements in world and US domestic markets 1964-1971. (C. Czarnikow Ltd., Plantation House, Mincing Lane, London E.C.3, England.) 1972.

The considerable increase in world sugar prices which took place during the first quarter of 1972, with the LDP reaching £90 on 7th and 10th March, is anticipated by the end peak (representing £70) in the latest copy of this 56 × 76 cm graph which shows the price trends in the form of curves for sugar on the London market (bagged and bulk sugar) and on the New York market (Nos. 7/10, 8 and 11 Contract Spot Prices) as well as the Commonwealth Negotiated Price. Prices are expressed in £/ton (before and after the 1967 sterling devaluation) and cents/lb (the 8·57% dollar devaluation on 18th December 1971 occurred too late for there to be any need for adjustment in the graph scale). The period covered is 1964–1971 by months, while a small inset graph shows the average world value during 1934–1971. For anyone interested in world sugar price trends the graph represents a very worthwhile acquisition. Copies may be obtained from C. Czarnikow Ltd. at the above address.

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The Australian sugar year book. Vol. 31, 1972. 352 pp.; 19 × 25 cm. (Strand Press Publishing Pty. Ltd., G.P.O. Box 1185, Brisbane, Queensland 4001, Australia.) 1972. Price: $A6.50; £3.25.

For anyone seeking a suitable source of information on the Australian cane sugar industry this book will provide the answer, since it contains a wealth of data on the subject and gives an overall picture of the Australian "sugar scene". Apart from tabulated mill data covering periods up to and including 1970, there are details of the various Australian sugar organizations, with names of officers, reports, conferences, details of open days and reproductions of some of the papers read at the 1971 Conference of the Queensland Society of Sugar Cane Technologists. There are also numerous short articles, mostly concerning agricultural topics. From p. 193 to the end there is an index to Australian sugar mills and districts, with maps and photographs.

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IAA Terminal/Recife. 18pp.; 22×30 cm. (Instituto do Açúcar e do Alcool, Terminal Açucareiro do Porto do Recife, Brazil.) 1972.

Details are given of the molasses and sugar bulk terminal at Recife which started operations in September 1972[1]. The booklet is beautifully illustrated with coloured photographs and the print is extremely clear. The information is given in Portuguese and English. All the equipment was supplied by Soc. Fives Lille-Cail acting as principal partner with the Oxford Construction Co. and Terbrasil Consórcio. Raw sugar storage capacity is 200,000 tons and loading capacity exceeds 1000 $tons.hr^{-1}$. The terminal occupies some 42,000 m^2.

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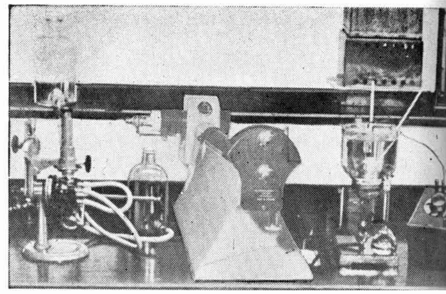
Sugar y Azúcar yearbook 1972. 152 pp.; 23 × 31 cm. (Palmer Publications, 25 West 45th St., New York, N.Y., 10036 USA.) 1972. Price: $10.00.

Volume 40 of this yearbook is divided into chapters covering world sugar developments in 1971 (in English and Spanish) and the sugar industries of Cuba, Dominican Republic, Florida, Hawaii, Louisiana, Puerto Rico and the Caribbean. The layout is good and the print is very clear, so that for readers interested in the developments in 1972 in the areas cited the book is undoubtedly a worthwhile acquisition.

[1] *I.S.J.*, 1971, **73**, 384; 1972, **74**, 384.

Laboratory methods & Chemical reports



The technological quality of sugar beet. L. Wiklicky. *Zucker*, 1971, **24**, 667–672.—At Tulln sugar factory beet quality has deteriorated over the last ten years, as indicated by a reduction in thick juice purity from 94·7 in 1960 to 92·8 in 1970 with a minimum of 92·3 in 1967. In an effort to find the cause, the potassium, sodium and nitrogen contents in beet samples were determined and the alkalinity coefficient and molasses sugar calculated from the results. The values for 1969 and 1970 are discussed. The effect of N uptake on potassium and sodium increase in the beet was also examined; on the basis of the results, advice has been given to beet farmers regarding optimum quantities of N fertilizer.

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Structural insight into a major cane molasses colorant. W. W. Binkley. *Sugar J.*, 1971, **34**, (4), 26–27.—See *I.S.J.*, 1972, **74**, 140.

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Determination of sodium, potassium and calcium in final molasses by means of flame photometry. S. N. Fleites, M. Muro and J. Monterde. *Bol. Ofic. A.T.A.C.*, 1971, (2), 28–45.—The method of determination is as a function of the illumination intensity at appropriate wavelengths of the coloured flame produced when a dilute molasses solution is sprayed into an acetylene/air flame under standard conditions. Details are presented of the technique studied and results obtained with molasses from various factories. Use of a direct dilution of 0·1% gives more rapid results than if the molasses is incinerated and the ash dissolved. It also gives results which are accurate enough for Na and Ca determination. More concentrated solutions should not be used, however, owing to the interference due to its viscosity. Although the K values obtained were within the range reported in the literature, the accuracy of the method was not as high as had been hoped.

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Notes on the use of the "Saturascope" for the determination of saturation temperature. J. F. R. Rivalland. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1970, 175–176 + 1 fig.—Because of difficulties in judging the exact moment at which a sugar crystal starts to dissolve when a "Saturascope" is used, con-considerable discrepancies may occur between the measured and true saturation temperature. To overcome this, the author suggests making use of a phenomenon observed on the $(1\bar{1}0)$ crystal face, where minute "dew drops" appear at the start of dissolution and develop into larger "fish scales" in regular layers along the surface of the inclined face. (This phenomenon is clearly shown in photomicrographs accompanying the article.) The molasses sample is mixed with a few sucrose crystals clearly exhibiting the $(1\bar{1}0)$ face and is placed between two glass slides in the heating cell of the "Saturascope". The heating rate of 5°C/min is reduced to about 2°C/min when the temperature is about 5°C below the expected saturation temperature (found by a rapid trial run); during heating the focal plane must be constantly moved up and down the inclined face so as to facilitate observations of any change in the smooth appearance of the face, particularly the straight edge of the inclined face adjacent to the $(\bar{1}00)$ face, where the phenomenon may be more easily noticeable in the form of zig-zag breaks along the straight edge. When dissolution starts, the cell temperature is recorded and corrected to the actual temperature of the glass slide found by calibration with thymol. With a further 2°C rise in temperature the "fish scales" will become noticeable; heating is then discontinued, the cell cooled and further runs carried out. Determinations made by two pairs of observers on two different molasses samples gave mean saturation temperatures of 47·5° and 47·3°C for one sample and 45·3° and 44·9°C for the other, although it is stressed that these were preliminary studies only.

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Quantitative study of organic and inorganic phosphates in juices. J. Studnicky, G. Sánchez and J. Rodríguez. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (1), 13–24.—Methods for determining phosphates in cane juices were compared; they included the uranyl acetate method (a direct titration method using $K_4Fe(CN)_6$ as an indicator, spotting on a porcelain tile), the Byall-Ambler method[1], the Queensland method[2], and the methods of Farnell[3] and Vignes[4]. None of these gives separate values for inorganic (ionized) phosphate and organic (non- or weakly ionized) phosphate, and a method has been devised for their separation by electrodialysis through ion exchange resins, after which the separate fractions can be analysed. The most suitable for factory use are the Queensland and Vignes methods provided a suitable photometer and calibration curves are used.

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[1] Browne & Zerban: "Sugar analysis", 3rd Edn. (Wiley, New York) 1941, p. 1072.
[2] Meade: "Cane sugar handbook", 9th Edn. (Wiley, New York), 1963, p. 549.
[3] *I.S.J.*, 1929, **31**, 149.
[4] *ibid.*, 1968, **70**, 333–334.

Determination of the size of particles in seed sugar. J. LODOS and G. LA SERNA. *Sobre los derivados de la caña de azúcar*, 1971, **5**, (1), 25–33.—See *I.S.J.*, 1971, **73**, 185.

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Determination of turbidity in sugar juices. J. OČENÁŠKOVÁ and R. OSVALD. *Listy Cukr.*, 1971, **87**, 223–225. Of methods compared for beet juice turbidity determination, i.e. gravimetric measurement, titration, ultra-filtration, turbidimetry and photocolorimetry, the last was found to be the most suitable for routine control. The procedure involved filtration of the juice and cooling to 20°C before measurement against a reference solution at 560 nm. The turbidity is then read from a calibration curve in terms of extinction.

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Microbiological control in a sugar factory with use of transport paper. L. VOKOUNOVÁ. *Listy Cukr.*, 1971, **87**, 232–234.—Details are given of a method applicable to microbiological studies in a sugar factory in which the bacteria are transferred to transport paper (strips of filter paper saturated with a special preserving medium such as Stewart's medium) and maintained at refrigeration temperatures. The use of the paper permits qualitative studies to be made in the central laboratory up to 48 hours after taking the culture sample. Counts will vary from 55% to 95% of the original number within this period.

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Results of an investigation into beet sampling for determination of true dirt content. A. E. POPOV and S. K. MEZENTSEV. *Sakhar. Prom.*, 1971, **45**, (10), 38–42.—Experiments showed that many factors affect beet dirt contents and that there are numerous inconsistencies even within one truck load. However, determination of dirt in samples taken from three points in a longitudinal or diagonal line for a given truck load will give a reasonable approximation of the total dirt content for the load.

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Instrument for measuring refined sugar moisture in a dryer. L. I. KON, V. A. DEMCHENKO and E. G. MAKSHIN. *Sakhar. Prom.*, 1971, **45**, (10), 52–54.—The circuit layout for the instrument designed on the basis of earlier investigations[1] is described and resistance values given. Maximum error of the method is about 0·15% absolute.

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Determination of molasses purity. E. YA. GOISMAN. *Sakhar. Prom.*. 1971, **45**, (10), 54–55.—The author demonstrates how calculation of molasses standard purity from massecuite and mother liquor analyses by the SILIN method is of value in determining the required low-grade massecuite crystal content corresponding to a minimum true molasses purity.

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Rapid method of determining the sugar content in beet cossettes and pressed pulp. A. YA. ZAGORUL'KO *et al.* *Sakhar. Prom.*, 1971, **45**, (10), 55–58.—Details are given of the layout and operation of a laboratory multi-station unit which determines the sugar content in cossettes and in pressed pulp (each measurement requiring 12 min). Maximum difference between the value given by hot digestion and the rapid method is ± 0·1% on beet weight, and the mean error of 20 analyses does not exceed ± 0·01% on beet weight.

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Effect of non-sugars on rate of sucrose extraction from beet tissue. S. ZAGRODZKI and J. KUBIAK. *Gaz. Cukr.*, 1971, **79**, 233–235.—In laboratory studies in which 20°Bx pure sucrose solution was passed at 70°C through a beet tube as described previously[2], non-sugars added to the solution were found to reduce the sucrose diffusion rate which was in all cases greater than that of individual non-sugars. While time, between 30 and 75 min, had no or relatively little effect on the diffusion rates, the latter rose sharply with rise in temperature from 50° to 85°C. The sucrose diffusion rate differed according to non-sugar composition. Similar results to the above were obtained with dilute molasses.

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Organic acid balance in a carbonatation sugar factory and its relation with the reducing sugar destruction. K. K. SHARMA and P. K. AREN. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 125–133.—Studies showed a sharp increase in organic acids from primary juice to mixed juice after which there was an equally sharp drop to a minimum in 2nd press juice which was lower than the content in the primary juice. The content than rose slightly in clarified juice after which it remained almost constant to sulphitation syrup. The CaO content followed almost exactly the same path as the organic acids curve. Linearity was established in the relationship between organic acids content and reducing sugar decomposition.

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A concept of purity loss: a versatile efficiency indicator. T. T. OOMMEN and B. S. GURUMURTHY. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 393–400B.—See *I.S.J.*, 1971, **73**, 92.

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Relationship between the colour of a solution and the white sugar ash content. M. MAROUNEK. *Listy Cukr.*, 1971, **87**, 244–246.—From a large number of measurements carried out on solutions of (i) refined sugar from beet, (ii) refined sugar from cane, and (iii) solutions of crystals from beet juice, linear relationships between colour and ash were established. The expressions are given as: (i) $b = 27p - 0{\cdot}004$, where b is the colour in °St and p is % ash (correlation coefficient of 0·79); (ii) $b = 16{\cdot}2p + 0{\cdot}031$ (correlation coefficient of 0·69); and (iii) $b = 6{\cdot}5p + 0{\cdot}075$ (correlation coefficient of 0·34).

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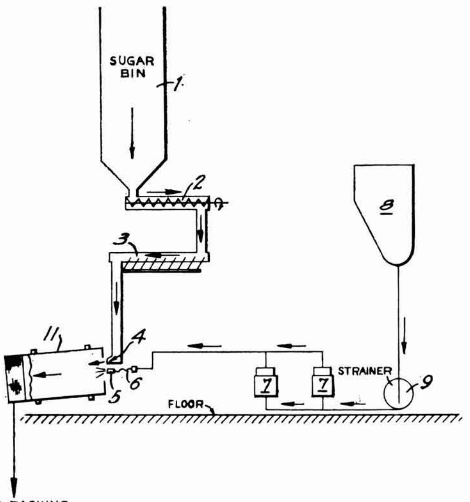
[1] KON *et al.: I.S.J.*, 1972, **74**, 347.
[2] *ibid.*, 1963, **65**, 28.

Patents

UNITED STATES

Soft sugar production. S. STACHENKO, A. J. ROBERTS and J. H. MAGEE, *assrs*. CANADA AND DOMINION SUGAR CO. LTD., of Montreal, Quebec, Canada. **3,584,617.** 14th March 1969; 15th June 1971.

White sugar from bin 1 passes through a variable feeder 2 to an oscillator 3 and spreader 4 whence it falls in a curtain into the entry of a rotary tumbler 11. A suitable syrup from tank 8 passes through strainer 9 and is delivered by high pressure (1000–3000 psi) pumps 7 through the nozzles 5 of sprayer 6,i m-pinging on the white sugar. The coated sugar passes through the tumbler which serves to convey it as a soft sugar to its discharge end and hence to packaging while containing dust and spray mist within an enclosed area.



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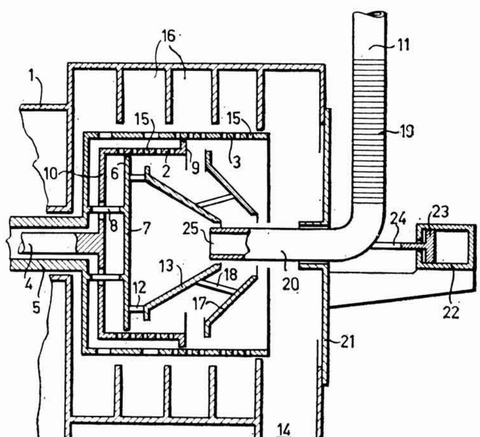
Non-sticky molasses meal animal feeds. P. N. BOYES and T. G. CLEASBY, of Maidstone, Natal, South Africa, *assrs*. MORELAND MOLASSES CO. LTD. **3,585,042.** 27th June 1967; 15th June 1971.—The molasses meal is inoculated with a micro-organism (*Achromobacter* or *Athrobacter* spp. of bacteria or *Penicillium* or *Aspergillus* spp. of fungi) selected from the microbial species developed by allowing the meal to undergo natural microbial attack, extracting from the resultant meal the micro-organisms developed on it, isolating the species which degrade the gum content and sticky components of the molasses, and artificially inoculating the molasses meal to be treated with the isolated micro-organisms or their descendants (by heating the molasses, mixing it with an absorbent cellulosic material, cooling to below 40°C and spraying the mass with liquor containing the micro-organisms). The inoculated molasses meal is charged into (sewn polyethylene) bags permitting the ingress of a small amount of air and the degradation of the gum allowed to proceed in the bags.

* * *

Push-type continuous centrifugal. E. RÜEGG, of Kusnacht, Switzerland, *assr*. ESCHER WYSS LTD. **3,585,132.** 17th October 1969; 15th June 1971.

Within the housing 1 of the centrifugal are two telescopically arranged drums 2, 3, the latter mounted on the hollow shaft 5 while the former is provided with a wall 10 and is mounted on the shaft 4 coaxial with and inside hollow shaft 5. A push ring 9 on the outer edge of drum 2 displaces centrifuged material along drum 3 while a push ring 6 mounted on push wall 7 is carried by webs 8 connected to shaft 5. Holes in wall 10 allow passage of the webs 8 and



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, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., 20231 USA (price 50 cents each).

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reciprocation of shaft 4 causes movement of separated material towards and over the outer edges of drums 2 and 3. Fresh material to be centrifuged is introduced through pipe 11 and flexible section 19 to pipe 20, out of the end 25 and into the funnel 13 which is attached by webs 12 to push wall 6.

When the shaft 4 moves outwardly (i.e. to the right in the diagram) the pipe 20 is also moved by the reciprocating mechanism 22 which is connected to the mechanism causing movement of shaft 4, so that the outlet 25 delivers material to the funnel 17 which is mounted on funnel 13. In this way additional material is delivered to the drum 3 so ensuring that the latter is better utilized and the capacity of the machine increased.

* * *

Animal feed. R. W. BISHOP, of Clewiston, Fla., USA. **3,586,511.** 1st July 1966; 22nd June 1971.—Standing cane is burnt under controlled conditions so that the dead, relatively dry leaves are burnt off without significant charring of the stalks which are then harvested, comminuted, dried to a low moisture content and pelleted.

* * *

Extraction of cane and bagasse. W. R. CRAWFORD, of Maryborough, Queensland, Australia, *assr.* WALKERS LTD. **3,586,535.** 3rd December 1968; 22nd June 1971.—See UK Patent 1,199,379[1].

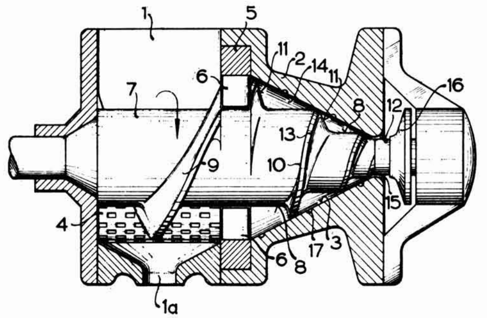
* * *

Cane harvester. H. A. WILLETT and J. A. GIARDINA, of Thibodaux, La., USA, *assrs.* CANE MACHINERY & ENGINEERING CO. INC. **3,587,214.** 3rd August 1970; 28th June 1971.

* * *

Screw press for cane. K. HEINRICH, of Wevelinghoven, Germany, *assr.* MASCHINENFABRIK BUCKAU R. WOLF A.G. **3,590,730.** 2nd April 1968; 6th July 1971.

The press housing includes a part 1 with an upper opening for feeding of cane particles and a hemi-cylindrical bottom portion provided with a screen 4 through which passes expressed juice to collect in funnel 1a. The section 1 is attached to the frustro-conical housing 2, the cone angle being between 40 and 80° (preferably 54°). Between the two is an annular flange 5 while inside the housing is a rotating core 7 which carries a spirally-wound flange 9. The latter is interrupted along its length in the region of flange 5 which carries guide vanes 6 to prevent rotation of the cane being pressed. The core 7 is cylindrical up to the point 10 where the flange 9, of reducing height, meets its surface. The edge of the cylinder at this point is chamfered to match the cone surface and the core diameter is reduced in steps so that a shoulder 11 is formed. At the end of the core 12 is a throttle 16 so that pressed cane passes through the small annular gap 15 and enters an annular space rapidly increasing radially.



Juice is expressed from the cane, passes back to section 1 and drains through screen 4 and funnel 1a while the cane is compressed within the cone section 2, rotation also being prevented by a series of grooves 17 in the inner surface of housing section 2. Water may be introduced at the exit 15 where it is rapidly taken up by the expanding cane, and thus it may be prepared for further sugar extraction by an additional pressing.

* * *

Weed control in beet fields. F. H. VAHLSING, of Allentown, Pa., USA, *assr.* VAHLSING INC. **3,591,360.** 8th August 1968; 6th July 1971.—*Chenopodium album* (pigweed, lamb's quarter or goose foot) is controlled in beet fields by applying [50–70 (60) gal/acre of] a [1–5% (2½%)] solution of sodium hydroxide on to the field (from above).

* * *

Ion exchange regeneration. J. F. ZIEVERS and C. J. NOVOTNY, *assrs.* INDUSTRIAL FILTER & PUMP MFG. CO., of Cicero, Ill., USA. **3,591,415.** 18th March 1968; 6th July 1971.—In a sugar refining system using an anion exchange resin to remove colour from the syrup and a cation exchange resin in Mg form to remove K from the molasses produced after boiling a strike of white sugar from the syrup, the exhausted cation exchange resin is regenerated by treating with a solution of about 7% $MgCl_2$ and the effluent used at about 3·5% concentration for regeneration of the anion exchanger resin, thereby using the same solution to regenerate both resins.

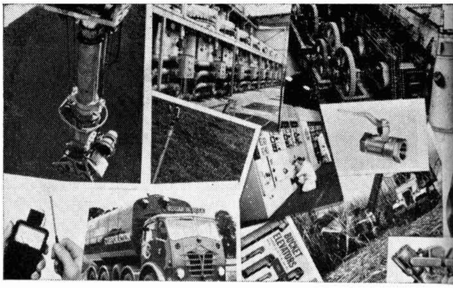
* * *

UNITED KINGDOM

Weed control in sugar cane. CIBA-Geigy A.G., of Basle, Switzerland. **1,260,460.** 13th February 1969; 19th January 1972.—Weeds are selectively controlled by application to the crop of (0·5–10 kg/ha of) N-(3-*A*, 4-chlorophenyl)-N′-methyl-N′-*B*-urea, where *A* is Br, CH_3, or OCH_3 (Br) and *B* is H, OCH_3 or a C_1–C_4 alkyl group (a C_1–C_4 alkyl group, preferably CH_3 or C_4H_9).

[1] *I.S.J.*, 1971, **73**, 189.

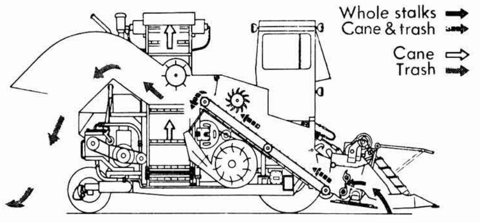
Trade notices



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.

"Libertadora 1400" cane harvester. Gebr. Claas Maschinenfabrik G.m.b.H., 4834 Harsewinkel, Germany.

The "Libertadora" cane harvester is designed for cutting green cane, chopping into billets and separating the cleaned billets from the trash. It is highly manoeuvrable, of robust construction and is powered by a 190 h.p. Mercedes-Benz diesel engine, giving ample reserves of power. It can handle upright or lodged cane up to 200 tons/hectare, the latter being raised by the scrolls mounted on the front of the machine. The stalks are separated by the height-adjustable base cutter knives and cut into 300–350 mm billets by the transverse blades at the bottom of the elevator which carries the cane upwards and beneath the rake wheels.



These clean the cane billets which fall over the upper end of the elevator to the bottom of the transverse elevator against a stream of air supplied by the fan. The trash is carried upwards by the air stream and, aided by a rotary deflector mounted above, is carried out of the ducting at the rear of the machine. The cleaned billets of cane are carried upwards by the transverse elevator and discharged to a transport unit alongside the harvester, a second fan removing the last amounts of trash from the billets as they are discharged.

Transmission to the wheels is hydrostatic, while hydraulic motors are used for the elevators, etc. The driver's cabin is ventilated for comfort, and the machine's control are simple. Gebr. Claas Maschinenfabrik have many years of international experience in harvesting machines for a wide range of crops and offer an efficient maintenance service.

PUBLICATIONS RECEIVED

WATER TREATMENT. The Permutit Co. Ltd., Pemberton House, 632/652 London Rd., Isleworth, Middx., England.

Three new brochures published by The Permutit Co. Ltd. describe the company's reverse osmosis systems (incorporating Du Pont B-9 permeators), designed to provide a supply of high-quality water for industrial use; Permutit plant for effluent treatment using various methods, including conventional treatment in sedimentation tanks, etc., ion exchange, biological treatment and aerobic digestion; and the Permutit after-sales inspection service for water and waste water treatment plant.

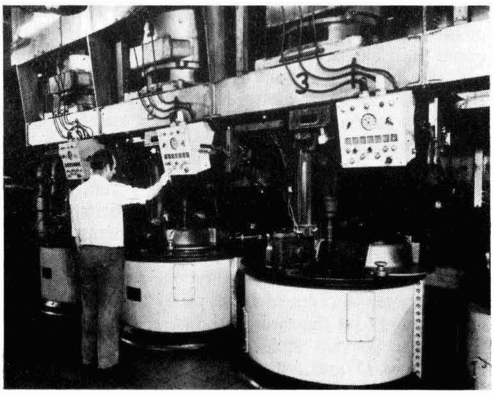
* * *

"AMBER HI-LITES". Rohm and Haas Co., Philadelphia, Pa., 19105 USA.

"Amber Hi-Lites" is a publication, usually of 4 pages, issued by Rohm and Haas and containing items written by Dr. R. Kunin on ion exchange. Issues No. 127 and 128 deal with the use of ion exchange resins in catalysis, describing the various types of reactions and catalyst regeneration. Sucrose inversion is among the applications listed. Issues No. 129 and 130 give helpful advice on ion exchange technology and show how to overcome problems associated with the performance of a system.

* * *

Refinery centrifugal drives.—The illustration shows affination centrifugals at a Tate & Lyle refinery which are having their Ward Leonard thyratron D.C. drives modernized by Thorn Automation Ltd. to overcome difficulties in obtaining replacement components, particularly the thyratron valves. The work, involving 18 machines (14 at Liverpool and 4 at Greenock), comprises fitting a "Stardrive SRC.5E" thyristor regulator in place of the thyratron section to control the field of the generator, thus providing control of the drive motor over a constant torque speed range of 0–1100 rpm and down again through 0 to 35 rpm in reverse. Since the regulators are being fitted into the existing cublicles, virtually no modifications to the wiring or layout are necessary. Production trials with a prototype unit at Liverpool have shown that all the control characteristics of the existing drives, which were manufactured and supplied by Thorn some 12 years ago and still operating perfectly satisfactorily, are obtained.



World sugar production estimates 1972/73[1]

BEET SUGAR	Campaign	Estimate 1972/73	1971/72
EUROPE		metric tons, raw value	
Belgium/Luxembourg	Sept./Jan.	667,000	843,607
France	,,	2,978,000	3,268,886
Germany	,,	2,315,000	2,394,476
Holland	,,	803,000	729,626
Italy	July/Oct.	1,222,000	1,274,443
Austria	Sept./Jan.	367,000	278,124
Denmark	,,	344,000	332,222
Finland	,,	88,000	66,076
Greece	July/Oct.*	140,000	158,313
Ireland	Sept./Jan.	190,000	191,811
Spain	July/March	798,000	1,045,570
Sweden	Sept./Jan.	283,000	273,333
Switzerland	,,	67,000	75,867
Turkey	Aug./Feb.	890,000	930,462
United Kingdom	Sept./Jan.	972,000	1,206,951
Yugoslavia	Aug./Jan.	390,000	388,539
Total West Europe		*12,491,000*	*13,585,465*
Albania	Aug./Jan.	19,000	18,000
Bulgaria	,,	230,000	210,000
Czechoslovakia	Sept./Jan.	750,000	730,000
Germany, East	,,	600,000	542,222
Hungary	,,	333,000	266,949
Poland	,,	1,826,000	1,712,500
Rumania	Aug./Feb.	610,000	510,000
USSR	Sept./Jan.	9,200,000	8,400,000
Total East Europe		*13,568,000*	*12,389,671*
Total Europe		26,059,000	25,975,136
OTHER CONTINENTS			
Afghanistan	Nov./Feb.	10,000	10,139
Algeria	June/Nov.*	20,000	18,800
Azores	June/March	8,000	7,606
Canada	Oct./Dec.*	113,000	152,032
Chile	April/June†	135,000	156,204
China	Jan./Dec.†	850,000	850,000
Iran	Oct./March	610,000	595,555
Iraq	,,	10,000	5,000
Israel	May/July†	30,000	28,889
Japan	Oct./Feb.	400,000	374,345
Lebanon	June/Nov.*	30,000	26,667
Morocco	May/Aug.†	260,000	240,000
Pakistan	June/July†	17,000	16,933
Syria	May/June†	35,000	37,800
Tunisia	May/April	3,000	2,800
United States	July/June	3,300,000	3,192,785
Uruguay	May/April	60,000	55,000
Total Other Continents		5,891,000	5,770,555
TOTAL BEET SUGAR		31,950,000	31,745,691
CANE SUGAR			
EUROPE			
Spain	March/Sept.	33,000	33,942
NORTH AND CENTRAL AMERICA			
British Honduras	Dec./June	72,000	71,753
Costa Rica	,,	180,000	190,000
Cuba	Nov./July	5,350,000	4,000,000
Dominican Republic	Nov./Sept.	1,200,000	1,238,000
Guadeloupe	Jan./June†	140,000	103,889
Guatemala	Dec./June	240,000	235,686
Haiti	,,	70,000	70,000
Honduras	,,	65,000	66,000
Martinique	Jan/June*	35,000	35,000
Mexico	Nov./July	2,800,000	2,510,000
Nicaragua	Dec./June	175,000	172,000
Panama	,,	110,000	87,251
Puerto Rico	Jan./July†	270,000	267,452
El Salvador	Nov./June	210,000	202,748
USA—Mainland	Oct./June	1,250,000	1,094,471
Hawaii	Jan./Dec.†	1,100,000	1,053,600
West Indies—Antigua‡	Jan./June†	0	0
Barbados‡	,,	140,000	134,600
Jamaica‡	,,	390,000	378,000
St. Kitts‡	,,	30,000	29,000
Trinidad‡	,,	245,000	231,968
Total North and Central America		14,072,000	12,171,418
SOUTH AMERICA			
Argentina	July/Dec.*	1,250,000	1,015,162
Bolivia	May/Sept.†	160,000	98,000
Brazil‡	June/May	6,000,000	5,200,000
Colombia	Jan./Dec.†	875,000	815,000
Ecuador	June/Jan.	280,000	249,253
Guyana‡	Oct./June	405,000	396,000
Paraguay	July/Nov.*	66,000	60,333
Peru‡	Jan./Dec.†	940,000	898,479
Surinam	Aug./May	12,000	10,800
Uruguay	May/April	15,000	15,000
Venezuela	Sept./Aug.	545,000	530,000
Total South America		10,548,000	9,288,027
AFRICA			
Angola‡	May/March	85,000	85,218
Cameroun	April/Sept.*	17,000	15,280
Congo (Brazzaville)	May/Nov.*	110,000	100,000
Egypt	Dec./June	590,000	535,000
Ethiopia	Nov./June	140,000	129,667
Ghana	April/Sept.*	10,000	8,300
Kenya	July/June	115,000	123,000
Madeira	March/Sept.*	3,000	3,300
Malagasy Republic	July/June	140,000	125,000
Malawi	May/Nov.*	60,000	39,311
Mali	April/Sept.	10,000	7,000
Mauritius‡	July/Jan	730,000	657,296
Mozambique‡	May/Nov.*	370,000	327,181
Nigeria	,,	28,000	24,369
Réunion	July/Jan.	245,000	186,181
Rhodesia	May/Nov.*	200,000	200,000
Somalia	Dec./April	50,000	50,000
South Africa	May/April	2,000,000	1,981,554
Sudan	Dec./June	90,000	80,000
Swaziland	May/Dec.*	180,000	182,903
Tanzania	July/June	110,000	107,000
Uganda	,,	150,000	155,000
Zaire	May/Nov.*	45,000	42,041
Zambia	May/Nov.*	51,000	41,500
Total Africa		5,529,000	5,206,101
ASIA			
Afghanistan	Oct./April	12,000	12,000
Burma	Nov./April	100,000	100,000
China	Jan./Dec.†	2,500,000	2,450,000
India, excl. khandsari	Oct./July	3,700,000	3,455,000
Indonesia	May/Dec.*	950,000	878,000
Iran	Oct./April	60,000	54,778
Japan	Nov./June	260,000	222,000
Nepal	Oct./April	10,000	4,535
Pakistan, incl. Bangla Desh	Nov./May	550,000	374,791
Philippines	Noc./July	2,050,000	1,848,050
Sri Lanka	Nov./June	10,000	10,000
Taiwan	Nov./June	820,000	746,118
Thailand	Oct./April	800,000	700,000
Total Asia		11,822,000	10,855,272
OCEANIA			
Australia	May/Dec.*	2,850,000	2,866,000
Fiji	,,	335,000	340,000
Total Oceania		3,185,000	3,206,000
TOTAL CANE SUGAR		45,189,000	40,760,760
TOTAL BEET SUGAR		31,950,000	31,745,691
TOTAL SUGAR PRODUCTION		77,139,000	72,506,451

[1] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (33), 1–4.
* 1972, 1971 † 1973, 1972 ‡ tel quel

ISSCT 15th Congress

Agricultural Engineering Papers

The Chairman of the Agricultural Engineering Section of the 15th Congress of the International Society of Sugar Cane Technologists, JOE E. CLAYTON, P.O. Box 758, Belle Glade, Florida, 33430 USA, is requesting submission of technical papers for the meeting to be held in Durban, South Africa, in June 1974. General papers concerning agricultural engineering subjects on production and harvesting are requested.

A session on mechanical aids or practices to increase the productivity of the workers is being planned and papers dealing with planting, trash stripping, cane cutting, handling and transportation may be submitted. These papers should cover subjects which might help the small producer, areas just encountering labour shortages or areas where full-scale mechanization will be difficult owing to terrain or crop conditions.

Vice-Chairmen for the Agricultural Engineering Section are JOSELO SANCHEZ, Land Authority, San Juan, Puerto Rico and GEORGE BARTLETT, Illovo Estates Ltd., P.O. Illovo, Natal, South Africa. Instructions for preparing the four copies and abstract of the paper, due on the 30th September 1973, may be obtained by writing to the General Secretary/Treasurer, ISSCT, P.O. Box 507, Durban, Natal, South Africa.

New Nigerian sugar factory[1].—The Government of Benue-Plateau in Nigeria is planning the early construction of a sugar factory in which it is to participate to the extent of 49%.

* * *

Land reform in the Dominican Republic[2].—The expropriation of certain uncultivated savannah land in the Guabatico plain has been announced. The land will be allotted to landless peasants in parcels of about 6 hectares, principally for the growing of sugar cane, under the direction of the sugar mill experts. Some 5000 landless families will be settled, aided by finance and technicians from the sugar industry.

* * *

Labour shortage in Swaziland[3].—The sugar industry in Swaziland is facing a manpower shortage and the Swaziland Sugar Association's President recently stated that it may be necessary to import workers from outside the country and to plan mechanization. The Association has already established a study group to keep these developments under review. Sugar production in 1971/72 was a record 177,194 metric tons, a 9% increase over production in the previous season.

* * *

New sugar factory for Dahomey[4].—The Government of Dahomey has reached an agreement with the British firm Lonrho Ltd. on the erection of a sugar factory and associated plantation. The agreement has a value of $24,000,000 and includes the plantation, and a 30,000 tons/annum white sugar factory with a tablet sugar plant. Half the production will be needed to satisfy domestic consumption, while the remainder will be exported to neighbouring countries.

* * *

USSR—Cuban sugar trade arrangements.—Subsequent to the accession of Cuba to the East European Comecon trading group, new financial arrangements for sugar trading between the USSR and Cuba have been announced. Repayment of existing debts is to be deferred for several years and the price paid by the USSR for Cuban sugar is to be almost doubled from the equivalent of 6 to 11 cents/lb. Loans are to be made and assistance given in the rehabilitation of Cuban sugar factories with Soviet equipment.

US sugar quotas 1972

	Previous quotas	*Net changes of 12th and 29th December 1972*	*Final quotas*
	(*short tons, raw value*)		
Domestic Beet	3,400,000	50,000	3,450,000
Mainland Cane	1,643,000	—	1,643,000
Hawaii	1,218,238	—103,600	1,114,638
Puerto Rico	175,000	—24,000	151,000
Philippines	1,401,761	30,000	1,431,761
Argentina	86,572	1,336	87,908
Australia	210,798	99	210,897
Bahamas	61	—	61
Bolivia	54	—	54
Brazil	624,673	10,825	635,498
British Honduras	38,477	667	39,144
Colombia	76,953	1,334	78,287
Costa Rica	100,037	1,560	101,597
Dominican Republic	724,256	12,551	736,807
Ecuador	92,229	1,598	93,827
Fiji	46,190	22	46,212
Guatemala	84,842	865	85,707
Haiti	22,522	—	22,522
Honduras	17,495	—	17,495
India	84,403	— 235	84,168
Ireland	5,351	—	5,351
Malagasy Republic	12,597	6	12,603
Mauritius	31,074	15	31,089
Mexico	640,515	11,100	651,615
Nicaragua	73,128	1,458	74,586
Panama	43,500	— 1,567	41,933
Paraguay	7,355	128	7,483
Peru	447,001	2,661	449,662
Salvador	48,752	971	49,723
South Africa	59,628	28	59,656
Swaziland	31,074	15	31,089
Taiwan	87,763	41	87,804
Thailand	19,316	9	19,325
Venezuela	69,597	613	70,210
West Indies	175,788	1,500	177,288
	11,800,000	—	11,800,000

Ghana sugar industry loan[5].—A credit equivalent to $15,600,000 for the rehabilitation of Ghana's sugar industry has been approved by the International Bank for Reconstruction and Development. The credit will help expansion of sugar cane production, replacement of field and factory equipment, provision of efficient management and a feasibility study for future expansion. The project also provides for some technical assistance to help strengthen Ghana's agricultural development bank.

* * *

Ex-refinery price of UK sugar.—It was announced in Parliament on 22nd December that the special payments made by the UK Government to the Sugar Board would continue to the end of January 1973. These payments were introduced in March 1972 and are provided from public funds in order that the ex-refinery price of sugar should be kept within a desired target range, currently £77–£87 per ton and approximately the range of prices which had applied through 1971. The total amount of the special payment is expected to be £29 million on the basis of current world prices.

* * *

Bolivia sugar expansion[6].—According to a report from the US Department of Agriculture Bolivia is to increase its sugar production in 1973/74 by 63%; the cane area will increase from 64,197 acres in 1972/73 to 104,029 acres in 1973/74.

[1] F. O. Licht, *International Sugar Rpt.*, 1972, **104,** (31), 8.
[2] *Bolsa Review*, 1972, **6,** 639.
[3] *Standard Bank Review*, November 1972, 25.
[4] *Zeitsch. Zuckerind.*, 1972, **97,** 658.
[5] *Public Ledger*, 23rd December 1972.
[6] F. O. Licht, *International Sugar Rpt.*, 1972, **104,** (33), 9.

MEN HAVE LANDED ON THE MOON AND HAVE WALKED AND DRIVEN OVER ITS SURFACE.

WE CANNOT EVEN REACH IT, ALTHOUGH IT MUST BE ADMITTED THAT NO PROSPECT OF CANE GROWING SEEMS TO EXIST THERE.

HOWEVER WE CAN, IN METAPHOR, REACH BEYOND THE MOON, TO THE STARS, IN OUR DESIGN AND MANUFACTURE OF SUGAR FACTORY MACHINERY.

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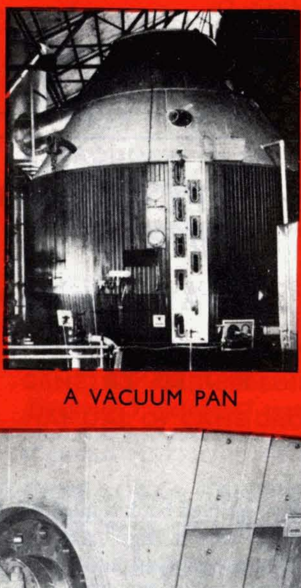
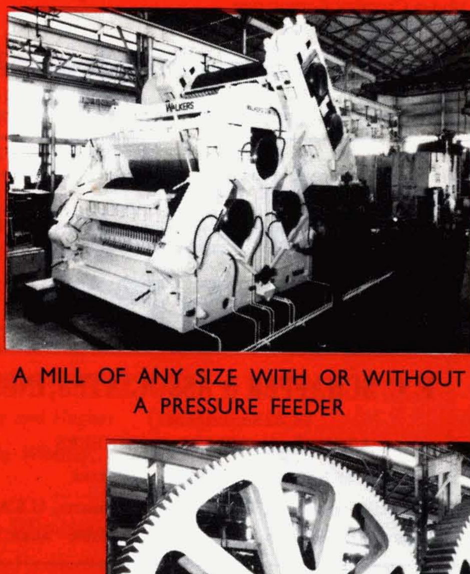
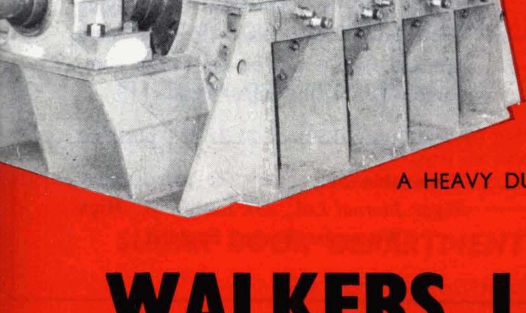


A VACUUM PAN



A MILL OF ANY SIZE WITH OR WITHOUT A PRESSURE FEEDER



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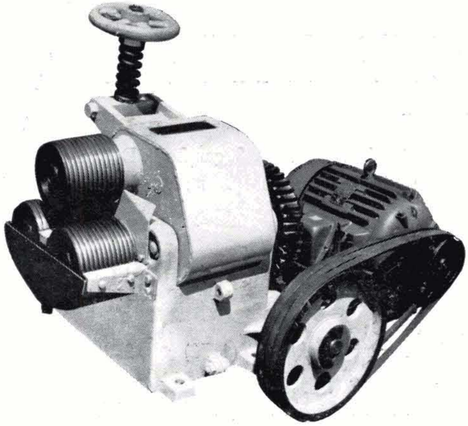
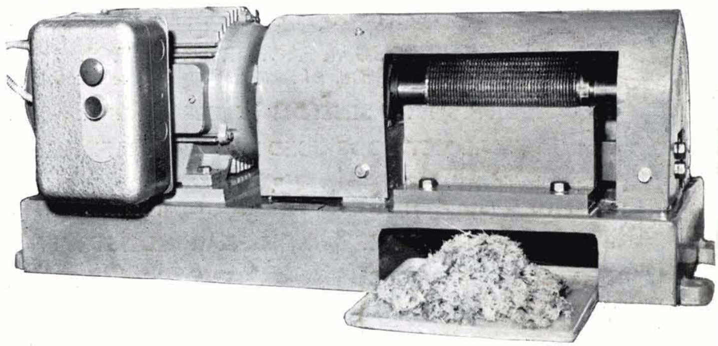
Suma Products

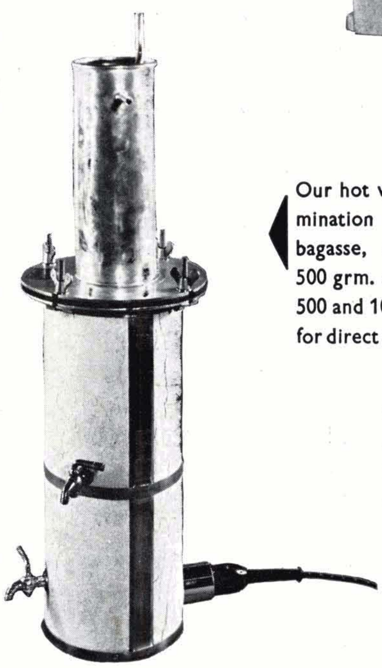
CANE AND BAGASSE ANALYSIS



Our **ROLEX** laboratory three-roller mill is provided with 5 in. × 5 in. rollers of Meehanite cast iron, while the spur gears and casting which carries the adjustable top roller are of steel. This top roller is fitted with a compression spring while scrapers are provided for both bottom rollers. Oilite bearings are fitted, and the juice tray and scrapers are removable for cleaning. The illustration shows a **ROLEX** mill belt-driven by a 3 h.p. electric motor.

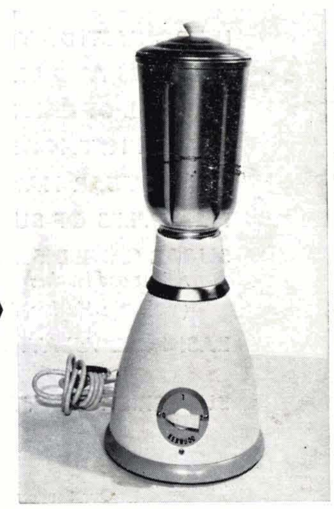
The **CUTEX** laboratory cane shredder has been redesigned as illustrated, with a direct-coupled totally enclosed 1.5 kW motor and integral starter unit. The cutter cylinder, cut from a solid piece of steel, has hardened teeth and is provided with ball bearings. The cane is held against the cutter and is shredded, the disintegrated sample falling into the container below.





Our hot water digester for determination of the sucrose lost in bagasse, electrically heated, for 500 grm. samples. Other types for 500 and 1000 grm. samples include for direct heating or steam heating.

Our high-speed mixer for analysis of fibre in bagasse has knives of improved design with two speeds of 7000 and 14,000 r.p.m. and a special feeder-type lid to prevent spillage. Its metal goblet is of 2000 ml. capacity. It is provided with a motor designed to take only single-phase A.C.



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