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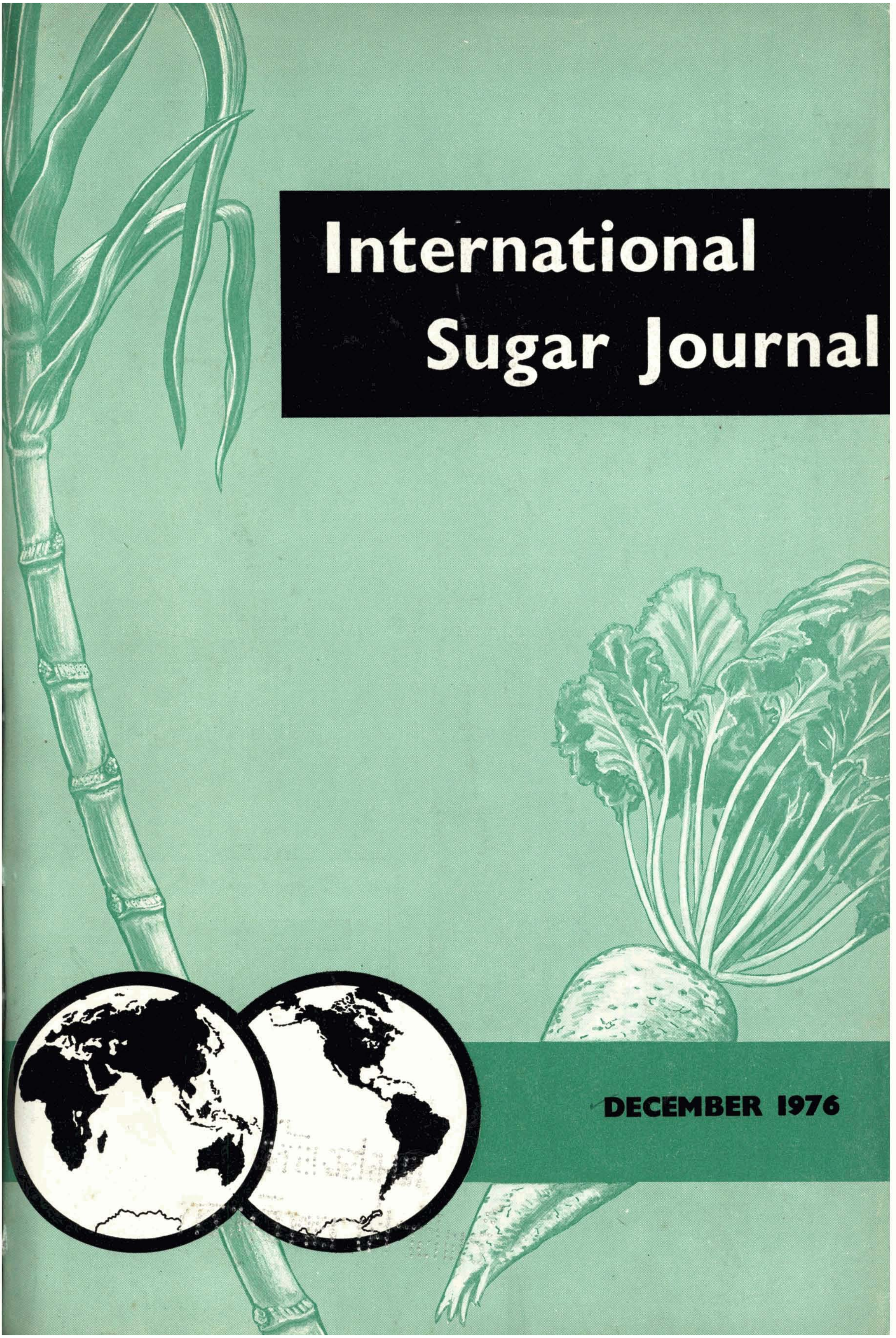

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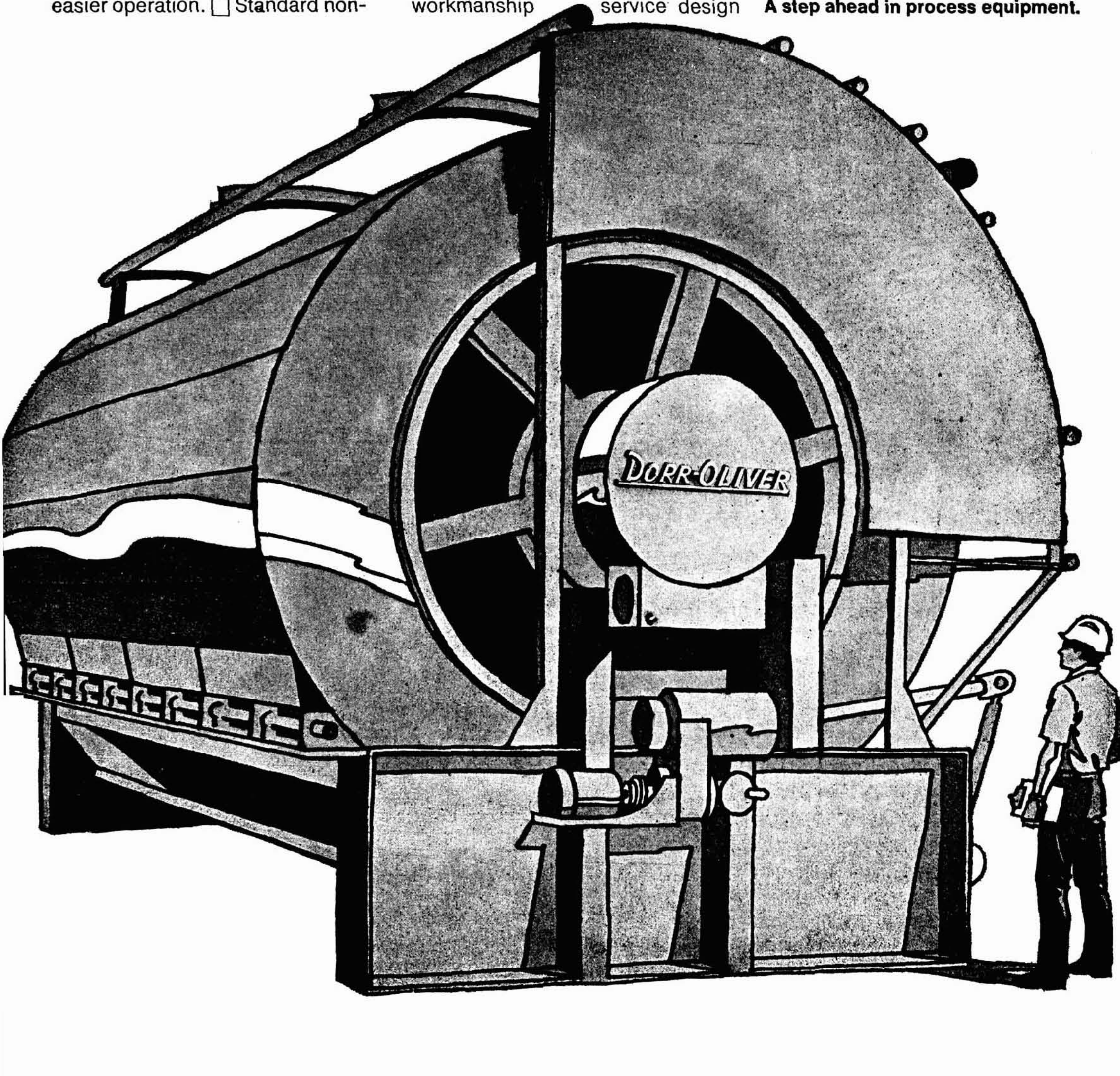
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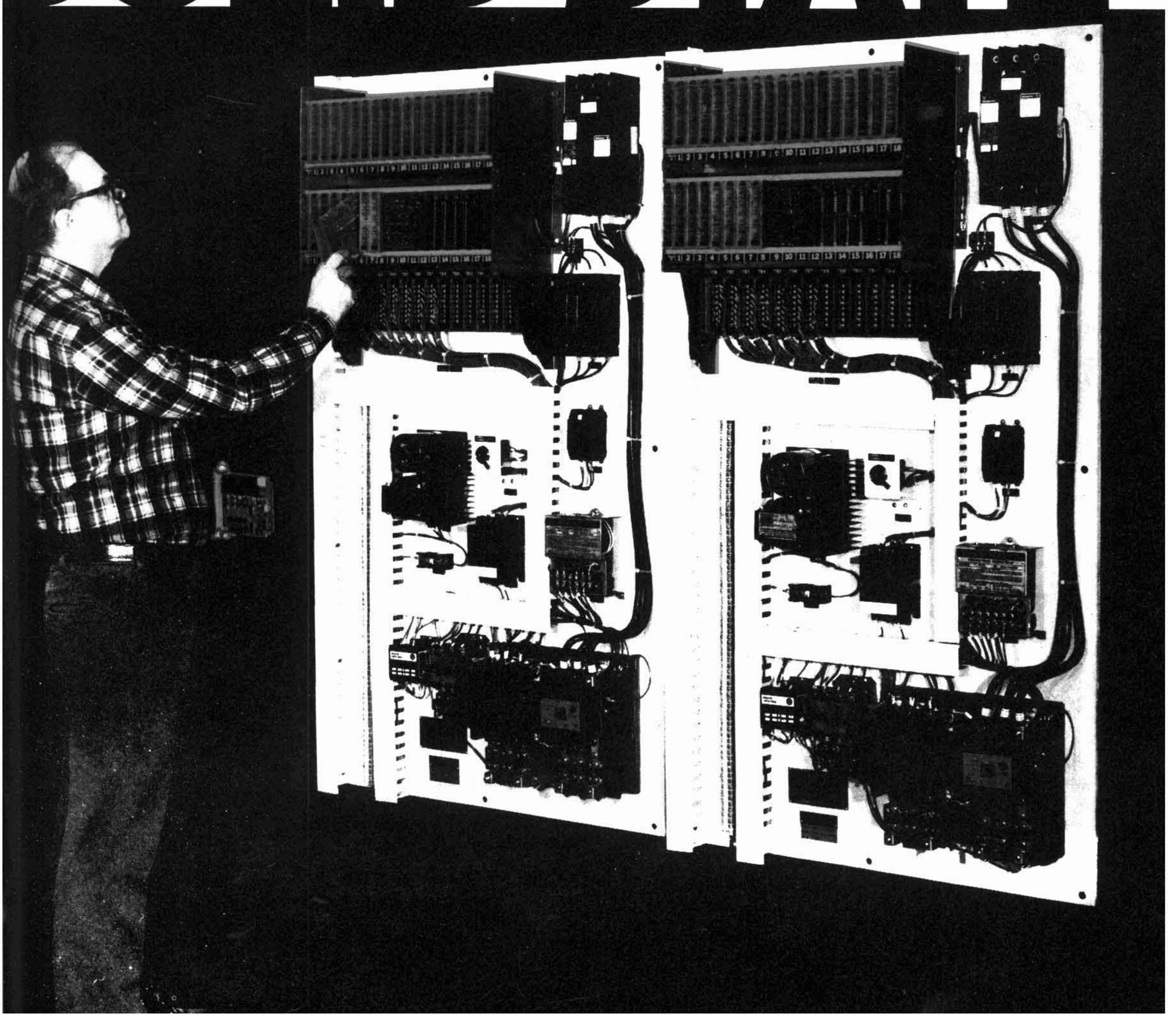

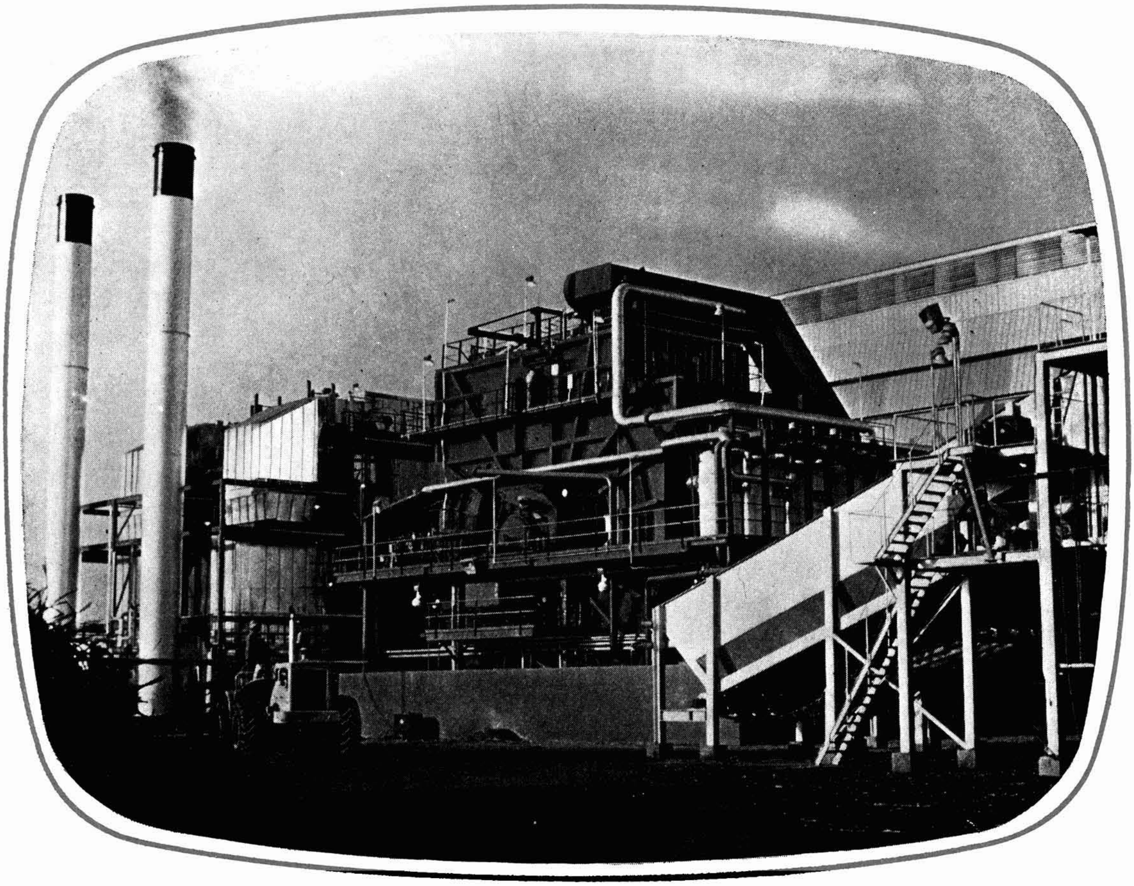

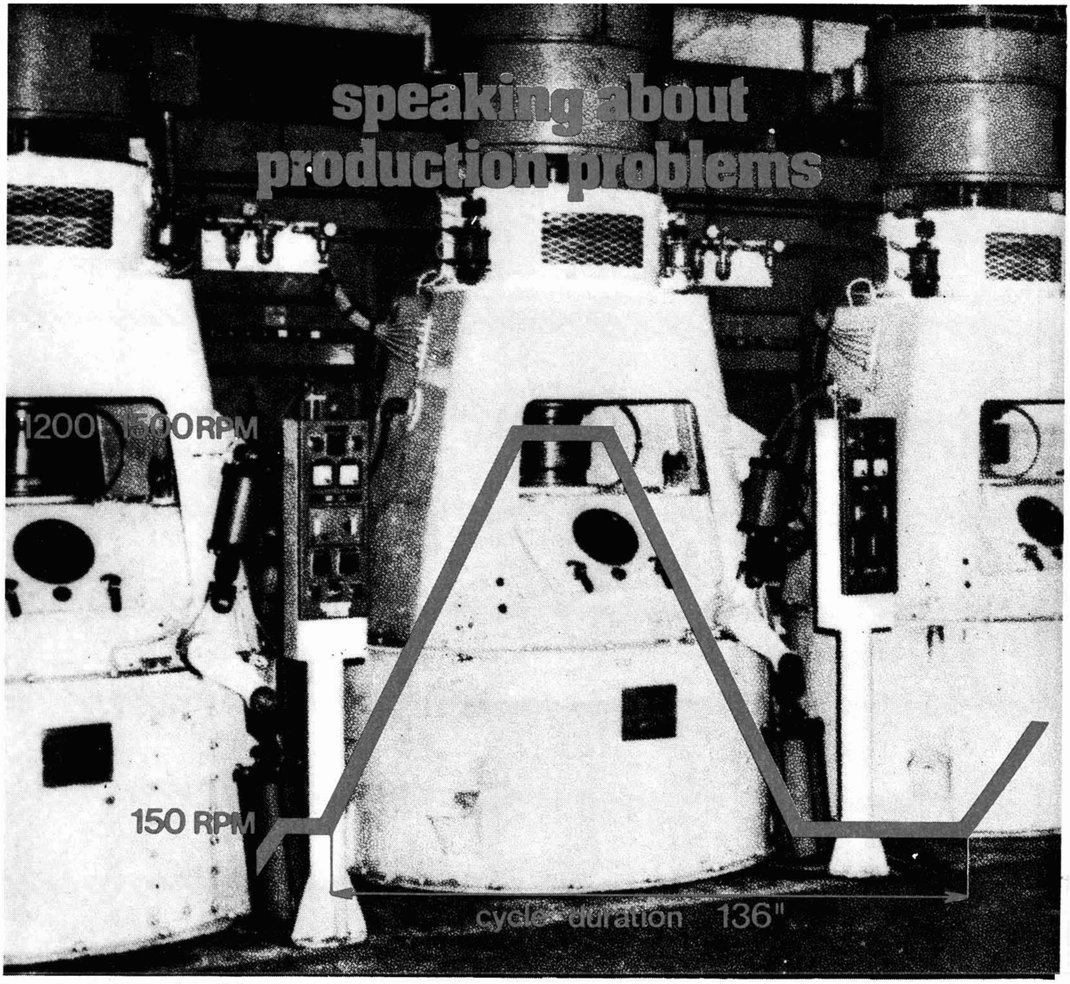

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Published by
The International Sugar Journal Ltd.,
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe
Telex: 21792 REF 869

International Sugar Journal

December 1976

Contents

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Annual Subscription: $15.00 post free
Single Copies: $1.80 post free

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UK ISSN 0020-8841

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Propriétés physico-chimiques du sucre égyptien. M. A. MOHAMED, K. A. HAMMADY et S. H. ABOU-EL-HAWA. *p.* 355–357

On donne un bref compte rendu d'études sur les propriétés physico-chimiques d'échantillons de sucre blanc et de sucre raffiné égyptien et on discute les résultats. Alors que la qualité du sucre raffiné est comparable à celle du sucre raffiné produit dans d'autres pays, la qualité du sucre blanc est assez mauvaise. On mentionne les facteurs qu'il faut considérer pour établir les standards du sucre en Egypte; on considère que le spectre d'absorption en ultra-violet du sucre est un critère important dans l'évaluation de la qualité.

* * *

Inversion aprés récolte dans différentes variétés de canne. R. S. KANWAR et J. K. KAPUR. *p.* 358–359

On a déterminé les variations moyennes de la teneur en sucre, de la pureté, de la teneur en sucres réducteurs et du poids au cours d'un stockage allant jusqu'à neuf jours pour quatre variétés à la station de Recherches sur la Canne à Sucre de l'université agricole de Punjab. On discute les résultats présentés dans des tableaux.

* * *

Corrections de l'indice de réfraction des solutions de saccharose à hautes températures. D. BASKER. *p.* 359–360

On donne une méthode pour ajuster les valeurs de l'indice de réfraction de solutions de saccharose à 5–90% poids/poids, obtenues à des températures de 30–90°C, aux valeurs correspondantes à une température standard de 20°C. On donne un exemple qui illustre la méthode utilisée pour le calcul.

* * *

Broyage et centrifugation de la canne à sucre pour une meilleure extraction. IIème Partie. M. STERZINGER et J. ZDARSKY. p. 361–364

On décrit l'évaluation biologique de la rupture des cellules de la bagasse par un moulin n° 1 suivant ou précédant un défibreur et/ou un "Gorator" plus une centrifugeuse. On discute les résultats obtenus. On a trouvé que le procédé d'extraction à froid avec broyage et centrifugation était prometteur malgré des imperfections dans l'équipement de l'installation pilote.

Physikalisch-chemische Eigenschaften des ägyptischen Zuckers. M. A. MOHAMED, K. A. HAMMADY und S. H. ABOU-EL-HAWA. *S.* 355–357

Untersuchungen über die physikalisch-chemischen Eigenschaften an Proben von ägyptischem Weisszucker und ägyptischer Raffinade werden beschrieben und die erhaltenen Ergebnisse diskutiert. Während gefunden wurde, dass die Qualität der Raffinade der in anderen Ländern vergleichbar ist, war die Qualität des Weisszuckers relativ gering. Es werden die Faktoren aufgeführt, die bei der Aufstellung von Standards für Zucker in Ägypten zu berücksichtigen sind. Das ultraviolette Absorptionsspektrum des Zuckers wird als wichtiges Kriterium für die Qualitätsbestimmung angesehen.

* * *

Inversion bei verschiedenen Zuckerrohrsorten nach der Ernte. R. S. KANWAR und J. K. KAPUR. *S.* 358–359

Die Autoren haben in der Zuckerrohr-Versuchsstation der Landwirtschaftlichen Hochschule Punjab für vier Zuckerrohrsorten die Durchschnittswerte für Zuckergehalt, Reinheit, Gehalt an reduzierenden Zuckern und Gewicht nach Lagerung bis zu einem Zeitrum von 9 Tagen bestimmt. Die in Tabellen zusammengestellten Resultate werden diskutiert.

* * *

Korrektur des Brechungsindex von Saccharoselösungen bei hohen Temperaturen. D. BASKER. *S.* 359–360

Der Verfasser gibt eine Methode zur Angleichung der bei Temperaturen von 30 bis 90°C erhaltenen Brechungsindizes von Lösungen mit 5 bis 90 Gew.—% Saccharose an die entsprechenden Werte bei einer Standardtemperatur von 20°C an. An einem Beispiel wird die zur Berechnung benutzte Methode aufgezeigt.

* * *

Kombiniertes Mahlen und Zentrifugieren des Zuckerrohrs zum Zweck der besseren Extraktion. Teil II. M. STERZINGER und J. ZDARSKY. *S.* 361–364

Die Verfasser beschreiben die biologische Bewertung der zerstörten Zellen nach dem Durchgang des Zuckerrohrs durch die Mühle Nr. 1, der ein Shredder nach- oder vorgeschaltet ist, und/oder durch den "Gorator" und eine Zentrifuge. Die Ergebnisse der Untersuchungen werden diskutiert. Es wurde gefunden, dass die kalte Extraktion durch kombiniertes Mahlen und Zentrifugieren trotz aufgetretener Störungen in der Versuchsanlage Erfolge verspricht.

Propriedades fisicoquímicas de azúcar del Egipto. H. A. MOHAMED, K. A. HAMMADY y S. H. ABOU-EL-HAWA. *Pág.* 355–357

Se describen investigaciones de las propriedades fisicoquímicas de muestras de azúcar Egipciano refinado y blanco, y las resultas se discuten. Aunque la calidad del azúcar refinado se halló comparable con ésa de azúcar producido en otros paises, la calidad del azúcar blanca fué bastante baja. Se mencionan factores que tienen que considerarse en el establecimiento de normas para azúcar en el Egipto; es considerado que el espectro de adsorción ultra-violeta es un criterio importante en el evaluación de calidad.

* * *

Inversión después de la cosecha en diferentes variedades de caña. R. S. KANWAR y J. K. KAPUR. *Pág.* 358–359

Los medios cambios en contenido de sacarosa, pureza, contenido de azucares reductoers y peso se determinaron para alamacenaje hasta nueve días de cuatro variedades de caña a la Estación Experimental de Caña de Azúcar de la Punjab Agricultural University. Las resultas tabuladas se discuten.

* * *

Correcciones para temperaturas altas al indice de refracción de soluciones de sacarosa. D. BASKER. *Pág.* 359–360

Se presenta un método para arreglar valores del indice de refracción de soluciones de sacarosa de 5–90% peso/peso, obtenido a temperaturas en la gama 30 a 90°C, a los valores corespondiente a una temperatura normal de 20°C. Por medio de un ejemplo, se demuestra el método usado para calcular la corrección.

* * *

Molienda-con-centrifugación de caña de azúcar para extracción. Parte II. M. STERZINGER y J. ZDARSKY. *Pág.* 361–364

Evaluación biológica de la ruptura de células del bagazo en un primer molino después o antes de un desmenuzaóora y/o un "Gorator" más una centrífuga se describe y resultas de las investigaciones se discuten. Es considerado que el proceso de extracción en el frío por molienda-con-centrifugación tiene promesa a despecho de defectos en el equipo de la planta pilota.

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII DECEMBER 1976 No. 936

Notes & Comments

World sugar production estimates, 1976/77

Their first estimates of world sugar production in the current crop year have been published by F. O. Licht KG[1]. Their information suggests that 1976/77 world sugar crops may be 6 million tons or 7·5% larger than the record 81·8 million tons of 1975/76, despite the drought in some European countries. The estimated total will certainly result in a considerable production surplus if sugar consumption does not improve drastically—which does not seem very likely, however.

Western Europe's rainfall in recent weeks has given rise to improved prospects, particularly in France, and Licht's latest estimate is for an increase of almost 470,000 tons more than in 1975/76. The figures for East Europe are unchanged from the earlier estimate[2] although it is recognised that that for the USSR may well be subject to amendment, depending on frost damage. Most other beet areas are much the same as in 1975/76 but a 300,000-tons fall is expected in the US crop.

Most of the increase in production is expected to be cane sugar; this contrasts with 1975/76 when the increase in production was mainly the result of a larger beet area. Good crops are forecast for many areas, although drought has caused serious damage in Cuba while the Brazilian figure, although 20% up on 1975/76 at 7·4 million tons, is less than the originally anticipated bumper crop of 8·1 million tons as a result of heavy rains.

After the frost-affected crop of 1975/76, Argentina's sugar production is expected to return to its normal level, as is the Mauritius crop which was last year devastated by cyclone damage. In South Africa production is expected to recover from the low level of 1975/76 and to exceed the high output level of 1974/75. In India output is expected to recover from the reduced crop of last year but not to reach the peak of two years ago. Good weather and expanded area are expected to provide Australia with a record crop in 1976/77, nearly 16% above that of the previous season.

* * *

International Sugar Organization

A meeting of the Committee called to advise the ISO Executive Director of the further preparations for a new International Sugar Agreement was held in London at the beginning of October. According to C. Czarnikow Ltd.[3], representatives of the EEC and the USA took part for the first time in these discussions of the bases and framework of a new Agreement. If the delegates have been successful their discussions will form the basis on which a new Agreement can be negotiated in Geneva next year. The Executive Director was to report the outcome of his discussions to the Consultative Committee at its meeting scheduled for 18th–19th November.

One particular aspect which the committee examined was the role which must be played by stocks in the context of a new Agreement.

C. Czarnikow Ltd. comment[4], in this respect, "In any new Agreement it would be most valuable to have the active participation of the United States of America. Indeed, if her future sugar arrangements enable her still to take her supplies as a part of the world market the very size of the tonnage required would make it necessary for her to be a member of the International Sugar Agreement if the latter were to be a feasible proposition. Even if the USA reverted to the old type of Sugar Act under which her supplies were considered to be a special arrangement and thereby precluded from the world market, her active participation in a new International Agreement would certainly ensure that suppliers to her market also adhered to the Agreement.

"For this reason it is particularly interesting to note that the US Assistant Treasury for International Affairs is reported to have stated recently that the US will refuse to join any international commodity agreement which fixes prices or sustains them above the level of the market and that furthermore the USA does not believe that the common buffer stock fund proposed by UNCTAD is necessary. If this is, indeed, the position of the USA on this subject there would seem to be very little likelihood of the possibility of including buffer stock arrangements within a new International Sugar Agreement."

* * *

World sugar prices

Sales on the New York market at the beginning of October left most of the immediately available sugar in the hands of one dealer who was anticipated to have customers since delivery is required within 75 days. This gave a buoyancy to the markets and the LDP rose from £118 to £130 per ton. Little interest was shown during the remainder of the month, however, and prices eroded slowly with a small rise at the end of the month which was due to

[1] *International Sugar Rpt.*, 1976, **108**, (29), 1–4.
[2] *I.S.J.*, 1976, **78**, 321.
[3] *Sugar Review*, 1976, (1304), 163.
[4] *ibid.*, (1306), 174.

weakening of sterling, to reach £118 again on the last trading day of October.

The white sugar market was not affected appreciably by the earlier effects on the raw sugar market and the LDP(W) rose only from £162 per ton to £171 during the first two weeks of October. Thereafter it slipped back to £162 in the next week while the weakness of sterling brought about a rise to £167, although the lack of demand produced a renewed fall to £161 by the end of the month.

* * *

Sugar consumption in the EEC

F. O. Licht KG recently published[1] tables of monthly consumption data for individual countries and all-Community data for October/September periods in 1972/73 to 1975/76. The figures for July-September 1976 are preliminary and so subject to amendment; nevertheless, they show that from March 1976 offtake has been consistently higher than a year earlier in contrast to the figures from February 1975 which had been consistently lower than the corresponding figures of a year before. Total consumption for the period October 1975–September 1976 is set at 9,587,500 metric tons, white value, compared with 9,475,800 tons in 1974/75, 10,279,100 tons in 1973/74 and 9,840,900 tons in 1972/73.

Thus, in spite of an increase of 111,700 tons or 1·18% by comparison with 1974/75 the latest figures are still below those of 1972/73. The 1973/74 figures showed a then-normal increase of 4·45%, but the high prices and shortages of the following period brought about a fall of 7·8%. The figures for March–September 1976 show an increase of 17·8% over the corresponding period of 1975; Licht notes that it is certainly not to be expected that such a high rate of increase will persist even during the near future but that the figures are indicative of a good increase in sugar consumption. Licht also points out that an increase of more than 7% will be necessary to reach the consumption level of 1973/74.

* * *

British Sugar Corporation expansion and modernization

The British Sugar Corporation has announced that £26 million will be spent in 1977 on factory expansion and modernization as part of the five-year £100 million expansion plan announced last year.

The aim is to increase home-grown sugar production in a normal year to 1,250,000 metric tons by 1980, making the UK at least 50% self-sufficient for sugar.

During the twelve months beginning September 1976 work on capacity increase will take place at Brigg, Bury, Cantley, Ipswich, Kidderminster, King's Lynn, Newark and Wissington. A total of £7,500,000 will be spent on the completion of the massive reconstruction of Newark factory. This will increase the slice from 1750 to 6100 metric tons a day, making Newark one of the most modern beet sugar plants in the world. The factory will not operate during the 1976/77 campaign to allow the reconstruction to proceed without interruption. Work is to be completed by September 1977 in time for the 1977/78 campaign.

More than £4 million has been earmarked for work at Cantley where a capacity increase from 5000 to 6350 tons per day will be completed for the 1978/79 campaign.

At Wissington £3,250,000 will be spent to increase capacity and almost £2 million will be spent to boost Bury's slice rate. Smaller increases will be completed at Ipswich and Kidderminster.

More than £1 million will be spent on improving beet reception facilities at Bardney, King's Lynn and Spalding. This will include the provision of long platform weighbridges to accommodate larger lorries, new automatic beet sampling units and, in some cases, new road systems to provide a faster turn-round of vehicles. Provision has also been made for smaller projects which are initiated by factories to assist their general running and improve their efficiency.

* * *

US sugar import duty

The recent trebling of import duty on sugar[2] was modified on the 5th October when President Ford declared exemption from the increase for any sugar on its way to the United States or which had left the warehouse in its country of origin by 21st September and was to arrive by the 8th November. This met the protests of suppliers some of whom had sugar in ships on their way to US ports and, under the terms of their contracts, were responsible for paying all duty.

The International Trade Commission, which has been charged by the President to determine whether sugar is being imported into the country in such quantities as to threaten the domestic industry, was scheduled to commence its hearings in the first week of November, with further hearings later in the month. C. Czarnikow Ltd. note[3] that the Committee has been asked to act speedily but meantime there is a great deal of uncertainty and this is acting as a damper on buying interest.

* * *

Sugar exporters' meeting[4]

The Latin American and Caribbean sugar exporters group, GEPLACEA, met in Mexico City in September and, according to informed sources, tried to agree on a minimum price for sugar exports. A minimum price of 12 cents per pound was mentioned (which compares with the actual ISO range of 7·55 to 9·25 cents/lb during September) but no decision was reached. The Group between them supply more than 60% of all sugar finding its way to the world market and has tried for some time to stabilize world market prices to protect export revenues. Although the actions of the Group had some success earlier this year they could not prevent the recent drastic fall in world prices. However, it is understood that the delegates came to the decision that they should refrain from making further sales until prices improve. This will be difficult, however, in view of the fact that some member countries are expecting good crops which might cause storage problems if the cautious selling policy is continued over a longer period.

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1 *International Sugar Rpt.*, 1976, **108**, (28), 1–6.
2 *I.S.J.*, 1976, **78**, 322.
3 *Sugar Review*, 1976, (1307), 180.
4 F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (26), 14.

Physico-chemical properties of Egyptian sugar

By MOSTAFA A. MOHAMED, KAMAL A. HAMMADY and SALAH H. ABOU-EL-HAWA

(Dept. of Food Technology, Faculty of Agriculture, Assiut University)

Introduction

Up to the present, little information is available in the literature concerning the physico-chemical properties of Egyptian sugar. The investigation described herein was therefore planned to evaluate the gross physico-chemical properties of this sugar. Such analysis will furnish enough data to establish standards and general specifications for sugar. The values obtained in this work may also be of use in improving the quality of sugar produced in Egypt.

Materials and methods

Sampling: Gross samples of 100 kg of both refined and white granulated sugar were obtained at random from the local market. These gross samples were thoroughly mixed and reduced by the standard method of quartering to give a final sample of 3 kg, termed sugar *A* and sugar *B*, respectively. In the same manner, a final sample (sugar *C*) was prepared from the white granulated sugar, obtained from the market by ration card. (In Egypt sugar is obtained with a ration card and also from the free market.)

Methods of analysis: Determinations, using methods described in the literature[1,2,3], were run in duplicate and results reported as the mean of the two runs. The following properties were studied: bulk density (as poured, and after compacting); hardness of setting; pH value; reduced buffer power; colour using Bottlers' standards; insoluble matter; crystal purity; % moisture; polarization; % sucrose; % reducing sugars; % ash and % sulphates. Sodium, K and Ca contents were also estimated applying the method described by JACKSON[4]. Waxes, starch, iron and SO_2 contents were studied using the methods described by PLEWS[2] and MARCHENKO[5].

The U.V. absorption spectra for aqueous solutions of sugar under study were measured using a "Unicam IV" spectrophotometer.

Results and discussion

In Table I are presented the physico-chemical properties of the sugars investigated. Remarkable differences in the studied properties could be noticed between the three groups of sugar. Data show that sugar *A* and sugar *B* were hardened much less than sugar *C*. DEKKER, WEBSTER and others[6] found that with higher invert percentage the tendency to harden was greater than with lower invert percentage. Our results agreed with these findings. At any rate, there are other factors affecting the hardness of setting for sugars, such as: sugar quality; temperature at bagging; weather and climatic conditions and storage conditions. The values obtained have a practical importance, since there is very close relation between hardness of setting and keeping quality of sugar.

Fig. 1 shows the buffer power of the investigated sugar. It will be noted that the buffer power of sugars *B* and *C* was respectively 1·5 and 5 times higher than

Table I. Physico-chemical properties of Egyptian sugar

Properties	*Sugar A**	*Sugar B**	*Sugar C**
Bulk density as poured, lb.ft^{-3}	57·2	60·3	55·6
Bulk density after compacting, lb.ft^{-3}	60·7	63·0	60·4
Hardness of setting, g	200†	200‡	500†
pH value	6·55	6·25	6·30
Reduced buffer power, cm^3 0·1N HCl	3·80	5·70	18·50
Colour (reference basis colour)	80	170	410
Mean aperture, mm	0·85	1·01	0·70
Coefficient of variation	35·3	47·5	27·9
Crystal regularity in quantitative terms, %	73·2	69·0	78·7
Insoluble matter, mg/100 g	100§	95§	100§
Crystal purity	99·78	99·68	99·61
Moisture, %	0·052	0·215	0·534
Polarization	99·75	99·12	98·16
Sucrose, %	99·82	99·27	98·41
Reducing sugars, %	0·04	0·110	0·380
Carbonated ash, %	0·050	0·135	0·283
Fe, mg/100 g	0·107	0·180	0·280
Na, mg/100 g	2·098	9·252	16·258
K, mg/100 g	5·246	26·092	38·665
Ca, mg/100 g	13·080	48·356	68·269
Waxes, %	0·015	0·048	0·081
Starch, mg/100 g	2·00	2·00	2·500
Sulphates, % SO_3	0·019	0·038	0·078
SO_2, ppm	20·8	20·8	94·1
Safety factor	0·208	0·244	0·290

* Sugar *A* = refined granulated sugar; Sugar *B* = white granulated sugar; Sugar *C* = white granulated sugar obtained under ration.
† within first minute.
‡ within second minute.
§ sugar not clean.

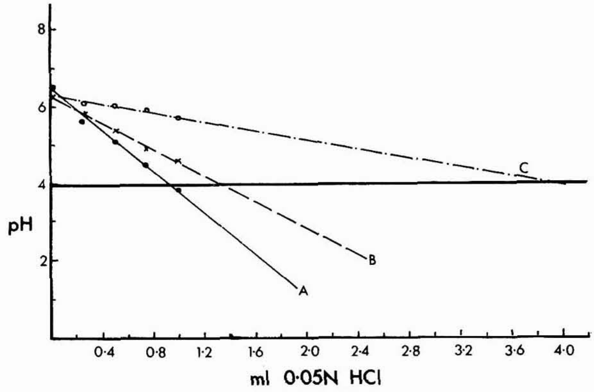


Fig. 1. Buffer power of sugars A, B and C

[1] PAYNE: "Sugar cane factory analytical control". (Elsevier, Amsterdam), 1968, pp. 81–89.
[2] PLEWS: "Analytical methods used in sugar refining". (Elsevier, Amsterdam), 1970, pp. 63–79, 84–88, 215–217.
[3] DE WHALLEY: "ICUMSA methods of sugar analysis". (Elsevier, Amsterdam), 1964, pp. 7–13, 36–45, 84–97.
[4] "Soil chemical analysis". (Prentice-Hall, London), 1964, p. 285.
[5] "Photometric determination of elements". (Moscow), 1971, pp. 163–168.
[6] MEADE: "Cane sugar handbook". (Wiley, New York), 1959, pp. 238–239, 266–278, 418–450, 540–555.

the buffer power of sugar *A*; this is probably due to variations in invert sugar, colloids, coloured matter and other sugar constituents, which may have a buffering action. Attention should be directed to the colour of the sugar under study in Table I. Sugar such as sugar *C*, with a high content of coloured matter, may not be stored or handled for long periods without deterioration. Production of white sugar of such intensive colour indicates that the conditions of manufacture were unsatisfactory.

Among characteristics studied was the size distribution of sugar as a measure of its quality. Data obtained are illustrated in Fig. 2. It was observed that the Egyptian sugar has a mean aperture (M.A.) ranging from 0·85 to 1·01 mm. The high values of coefficient of variation (C.V.) in Table I show the lack of homogeneous crystals in sugar produced in Egypt.

It is agreed that the regularity of crystal form is an important consideration in an estimate of the quality of granulated sugar. The method employed herein provided a means of expressing crystal regularity in quantitative terms (Table I). Photographs of sugar crystals, prepared by the methods described by PLEWS[2], are illustrated in Fig. 3. As shown in this figure, the crystals are not perfectly even. There are some twins and a few conglomerates. It was found that sugar *B* contained a large proportion of twins, and sugar *A* comprised a few irregular crystals with excessive proportion of conglomerates, these considerations being reflected on expression of crystal regularity in quantitative terms as shown in Table I. It is important here to point out that regularity of crystals has a great influence on the keeping quality of sugar.

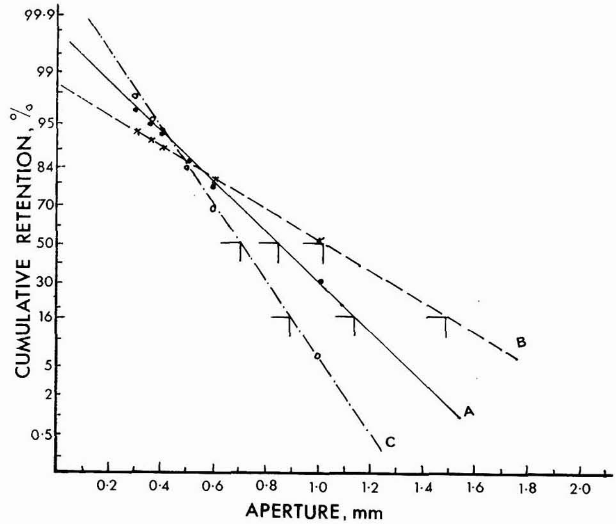


Fig. 2. Size distribution of sugars A, B and C

Fig. 4 illustrates the U.V. absorption spectra for aqueous solutions of the sugar under study. A shoulder may be clearly observed in the optical absorption curves for sugar *B* and *C* in the wavelength

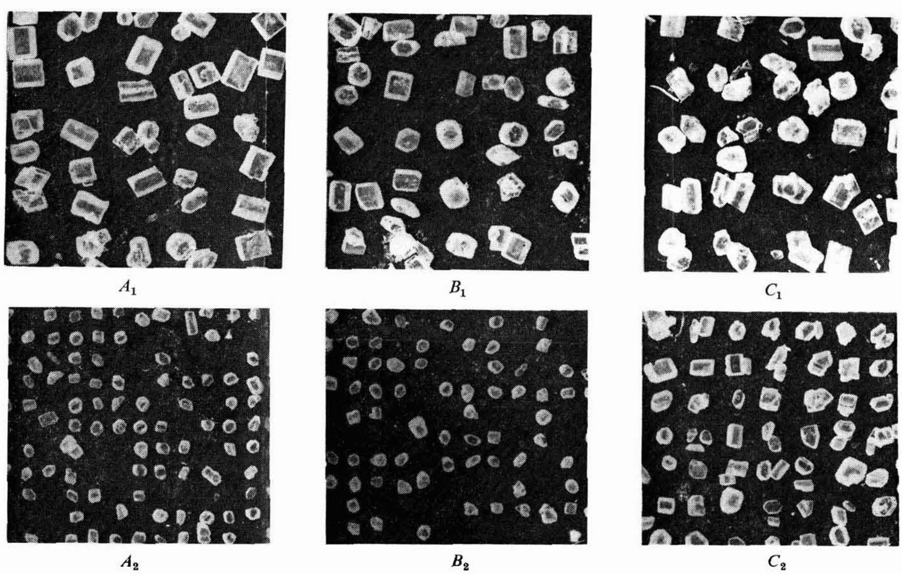
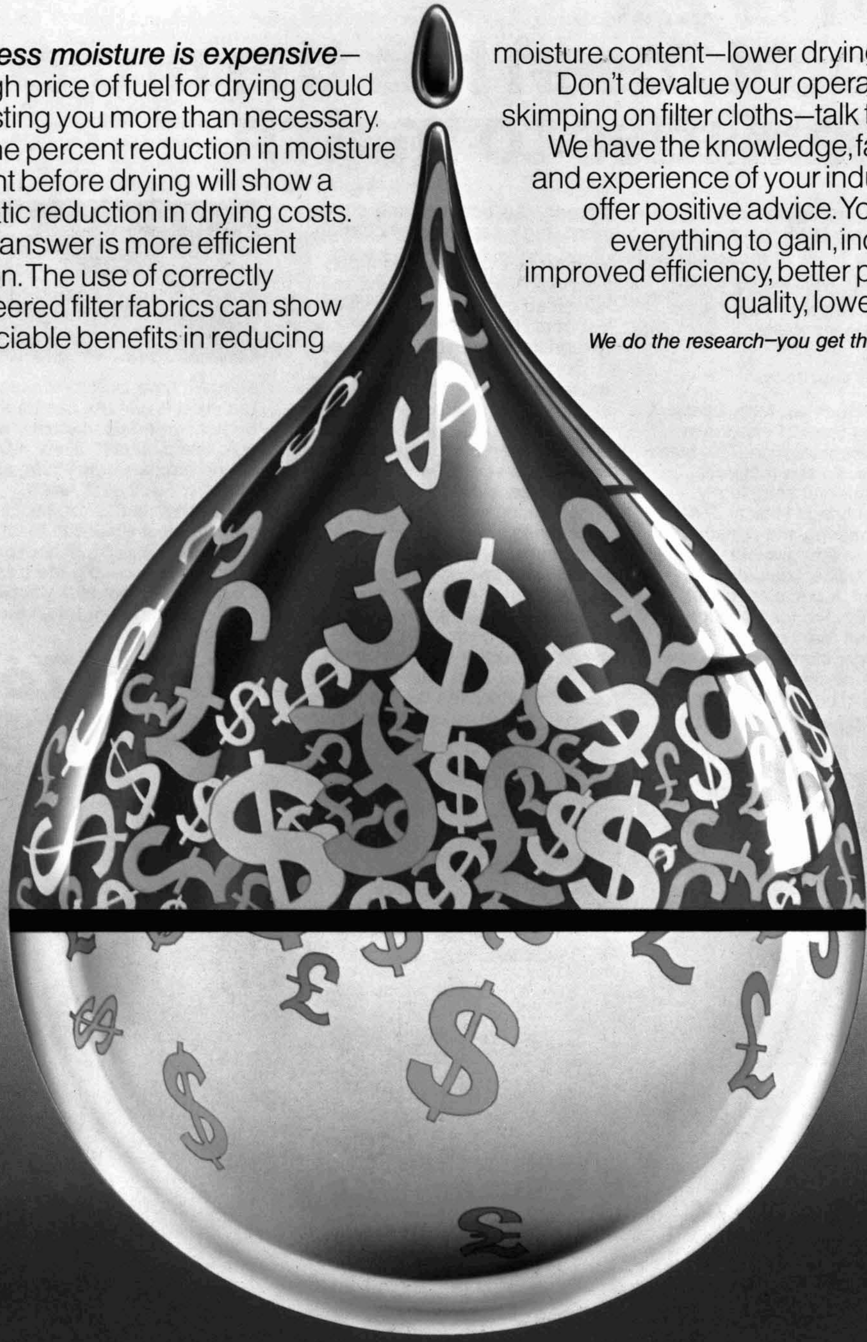


Fig. 3. Crystal regularity of sugar
A_1, B_1 and C_1—crystals coarser than mean aperture
A_2, B_2 and C_2—crystals smaller than mean aperture



range 265–270 nm, this shoulder being more obvious in the case of sugar *C*. It is attributed to the presence of coloured matter in sugar crystals, since coloured products from the alkaline degradation of reducing sugars show an absorption peak in the same wavelength range[7]. The absence of any shoulder in the case of sugar *A*, which showed the lowest value in colour, confirms our conclusion. This may justify the using of U.V. absorption spectra of sugar as a measure of its quality in Egypt.

With reference to Table I, special significance has to be attached to the chemical analysis of Egyptian sugar. In general, significant differences were observed between the three groups of sugar. It should be mentioned that the values of insoluble matter, moisture content, reducing sugars, ash content and SO_2 in sugar *B* and *C* were considerably higher than the corresponding values recorded for sugar produced in other countries[8,9,10,11]. This could be attributed to the conditions prevailing in Egyptian sugar factories and also to the handling of sugar in our market. Thus, it seems improbable that sugar with such analysis could be kept for long periods without deterioration.

The relationship between the percentages of water and non-sucrose (safety factor) was calculated for the sugars under study, and recorded in Table I. According to FRIML's chart of safety factor[11], both sugar *A* and *B* fall within the safety zone, while sugar *C* falls in the zone of deterioration. From the above discussion it can be concluded that:

(1) The quality of Egyptian sugar is rather low except for refined granulated sugar, which has a good quality comparable to that produced in other countries.

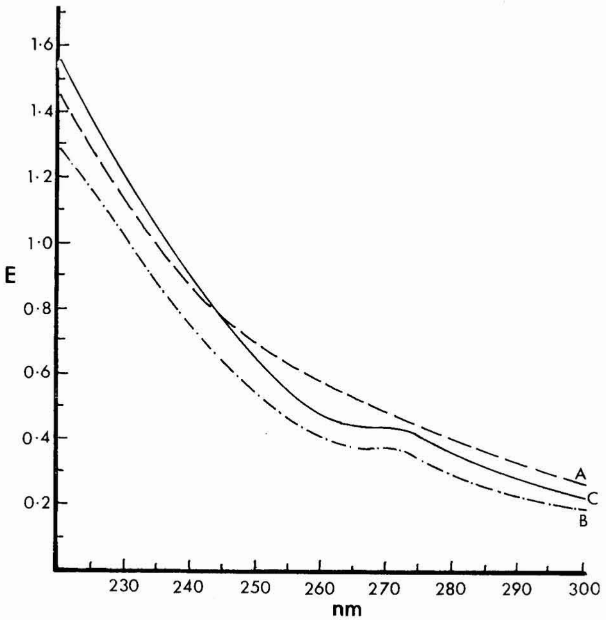


Fig. 4. U.V. absorption spectra of sugar solutions

(2) Certain other factors have also to be taken into account when establishing general specifications for sugar in Egypt; these factors comprise crystal regularity in quantitative terms, size distribution, buffer power and colour.

(3) The U.V. absorption spectrum of sugar is an important consideration for estimating of its quality.

Summary

An investigation has been carried out to furnish enough data to set up standards and general specifications for Egyptian sugar and to be of use in improving its quality. Representative samples of white and refined granulated sugar were obtained from the local market and their physico-chemical properties studied. The results obtained lead to the following conclusions:

(1) The quality of Egyptian sugar is rather low, except for refined granulated sugar which has a good quality comparable to that produced in other countries.

(2) Certain other factors have also to be taken into account when setting up general specification standards for sugar in Egypt.

(3) The U.V. absorption spectrum of sugar is an important consideration in an estimation of its quality.

[7] PREY *et al.*: *Zeitsch. Zuckerind.*, 1966, **91**, 379–385.
[8] BECKER: "Principles of sugar technology", Vol. III. Ed. P. HONIG. (Elsevier, Amsterdam), 1964, pp. 453–472.
[9] CARPENTER & BICHSEL: *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 369–378.
[10] CHEN: *Sugar J.*, 1969, **32**, (4), 9–15.
[11] FRIML: *CubaAzúcar*, 1969, (March/April), 24–28, 50–54.

Post-harvest inversion in different cane varieties

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Introduction

MUCH stale cane giving low recoveries is crushed by Indian sugar factories, cane being left in the field as a result of transport constraints as well as factory hold-ups. During this period the cane declines in quality. LAURITZEN & BALCH[1], SAYED[2] and RIZK[3] reported inversion of sucrose within a few hours after cutting and diminution in the available sugar (rendement)[4].

Variety, climatic conditions after harvest, stage of maturity and cane quality at harvest affect the rate of deterioration. Mean losses reported by previous investigators were as follows:

GUILBEAU *et al.*[5], Louisiana (1956)	12—50% after 14 days
DIKKER[6], Louisiana (1960)	0·5% per day
BONETA GARCÍA & LUGO LÓPEZ[7], Puerto Rico (1962)	0·127—0·373% per day
RAMAMOORTHY *et al.*[8], India (1975)	2·0–3·2% over 96 hours

The present studies were made to measure losses under Punjab conditions.

Materials and methods

The investigation was carried out at the Jullundur Research Station in March 1975 and March 1976. During the period, the maximum temperature varied from 21° to 27°C and the minimum from 11° to 15°C. The mean relative humidity was 65%. Four varieties were used: CoJ 64 (early-maturing), CoJ 67 (mid-season), CoJ 46 (moderately late) and Co 1148 (late-maturing). Cane from each variety was topped, cut and stored separately in heaps under natural conditions, i.e. exposed to the sun as usual in farmers' fields. Ten stalks from each variety were crushed daily for nine days after cutting and the expressed juice analysed for Brix, pol % and reducing sugars % and the purity derived. Weight loss was calculated from the daily weight of cane stored separately under similar conditions.

Results

Examination of the data in Table I indicates that CoJ 64 had the maximum sucrose at sampling on Day 0, followed by CoJ 67, Co 1148 and CoJ 46. Sucrose content decreased as the time of storage (staling) increased, regardless of variety. Maximum loss of sucrose was in Co 1148, followed by CoJ 46, CoJ 64 and CoJ 67, respectively, after nine days' storage.

Daily losses were as follows:

CoJ 67	0·31%
CoJ 64	0·38%
CoJ 46	0·46%
Co 1148	0·48%

Losses were lowest in CoJ 67 although CoJ 64 was earlier-maturing and had a slightly higher initial quality. Other authors[6,7] have reported daily pol losses up to 0·5%.

The difference is attributed to the thinner canes of CoJ 67 variety; its cross-sectional area of the cut stalk is smaller than for the thicker variety CoJ 64, resulting in a smaller moisture loss and sucrose inversion in the latter variety. This view would be in accordance with the work of HALL[9] who found that inversion in Java and Argentina varieties was correlated with the thickness and, therefore, cross-sectional area of the cut ends. Between the late varieties CoJ 46 and Co 1148 the above view would explain the relative rates of loss of sucrose.

The net losses of sucrose for 0–3 days, 3–6 days and 6–9 days are presented below in Table II.

Table I. Mean changes in sucrose, purity, reducing sugars and weight loss (all in percentage) as a result of staling.

		Days of storage									
Quality constituent	*Variety*	0	1	2	3	4	5	6	7	8	9
Sucrose %	CoJ 64	19·58	18·90	18·79	18·41	17·93	17·36	17·20	17·43	17·00	16·20
	CoJ 67	19·34	18·93	18·79	18·36	17·83	17·12	17·16	16·61	16·56	16·58
	CoJ 46	16·80	16·61	15·17	14·95	14·57	14·18	13·35	13·91	13·65	12·87
	Co 1148	17·74	17·29	15·86	15·43	14·94	14·67	13·78	13·57	13·63	13·30
Purity coefficient	CoJ 64	89·4	84·2	81·7	80·7	77·3	75·2	71·4	73·9	71·9	70·0
	CoJ 67	87·9	86·5	82·0	80·5	78·3	74·8	71·3	70·7	71·0	70·0
	CoJ 46	83·8	79·2	77·2	75·5	68·6	65·0	64·7	64·7	64·1	64·1
	Co 1148	81·7	79·0	77·6	75·0	69·6	67·8	63·9	63·8	63·5	62·6
Reducing sugars %	CoJ 64	0·19	0·26	0·39	0·60	1·90	2·10	2·40	2·80	2·80	3·20
	CoJ 67	0·18	0·23	0·56	0·80	1·50	2·40	2·40	2·60	2·90	3·00
	CoJ 46	0·71	0·68	1·10	1·65	2·50	3·15	3·20	3·50	3·70	3·75
	Co 1148	0·53	0·64	1·09	1·55	2·45	2·95	3·15	3·10	3·45	3·55
Weight loss %	CoJ 64	0	3·9	4·7	4·7	9·3	9·3	10·1	11·8	12·0	13·6
	CoJ 67	0	1·3	2·3	3·0	5·4	6·8	6·8	8·1	9·0	9·5
	CoJ 46	0	2·4	5·6	5·9	7·1	8·6	10·2	10·4	11·8	13·9
	Co 1148	0	3·7	4·2	6·1	7·3	9·4	11·4	11·9	13·8	16·3

Table II. Mean changes in % sucrose during the storage period

Variety	*0–3 days*	*3–6 days*	*6–9 days*	*Total drop*
CoJ 64	1·17	1·21	1·00	3·38
CoJ 67	0·98	1·20	0·58	2·76
CoJ 46	2·05	1·60	0·48	4·13
Co 1148	2·31	1·65	0·48	4·44

1 *U.S.D.A. Tech. Bull.*, 1934, (449).
2 M.Sc. Thesis, College of Agriculture Library, University of Assiut.
3 Ph.D. Thesis, Louisiana State University Library, 1967.
4 SAYED *et al*: *Research Bull.* (Egyptian Sugar & Distillation Co., Sugarcane Dept.), 1972, (38).
5 *Sugar Bull.*, 1956, **34**, 28–30.
6 *Sugar J.*, 1960, **22**, (8), 15.
7 *J. Agric.* (Univ. Puerto Rico), 1962, **46**, (3), 189–194.
8 *Sugar News* (India), 1975, **7**, (4), 5–10.
9 *Rev. Ind. Agric.* (Tucumán), 1913, **4**, (4), 148–150.

Loss in fresh weight was positively correlated with the loss in sucrose as is evident when sucrose losses (Table II) are compared with weight loss in Table III below.

Table III. Mean weight changes by drying during the storage period

Variety	0–3 *days*	3–6 *days*	6–9 *days*	*Total drop*
CoJ 64	4·7	5·4	3·5	12·6
CoJ 67	3·0	3·8	2·7	9·5
CoJ 46	5·9	4·3	3·7	13·9
Co 1148	6·1	5·3	4·9	16·3

These observations are in accordance with those reported by ALEXANDER[10] and SRINIVASAN *et al.*[11]

Mean changes in percentage purity are presented in Table IV. The fall in purity was maximal during the first three days, substantial in the period from the 3rd to 6th day, and much less during the last three days of storage.

The sequence of changes in reducing sugars content for 0–3, 3–6 and 6–9 days are presented in Table V.

Table IV. Mean changes in purity during the storage period

Variety	0–3 *days*	3–6 *days*	6–9 *days*	*Total drop*
CoJ 64	7·70	9·30	1·40	18·40
CoJ 67	7·40	9·20	1·30	17·90
CoJ 46	7·30	11·80	0·60	19·70
Co 1148	6·75	11·10	0·90	18·75

Table V. Mean changes in reducing sugars % during the storage period

Variety	0–3 *days*	3–6 *days*	6–9 *days*	*Total increase*
CoJ 64	0·41	1·80	0·80	3·01
CoJ 67	0·62	1·60	0·60	3·02
CoJ 46	0·94	1·55	0·55	3·04
Co 1148	1·02	1·60	0·45	3·07

Those varieties which were mature as indicated by high sucrose and low reducing sugars at the beginning of the trial showed the lowest increase over the first three days of storage; thereafter losses were as high or higher. (Cf. CoJ 64 and CoJ 67 with CoJ 46 and Co 1148).

[10] "Sugar cane physiology" (Elsevier, Amsterdam), 1973.
[11] *Sugar News* (India), 1975, 7, (5), 14—15.

Corrections at high temperatures to the refractive index of sucrose solutions*

By DOV BASKER

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Introduction

MANY industrial processes are followed and controlled with in-line instruments, of which the refractometer is an example[1,2]. In particular, the concentration of solutions, such as fruit juices, by evaporation under vacuum, is typically followed refractometrically, using an instrument graduated in °Brix, equivalent to % by weight of sucrose[3]. It is known that the refractive index is strongly temperature-dependent[4,5], and that industrial processes are frequently carried out at elevated temperatures. However, no tables appear to be available for correcting refractive index readings obtained at temperatures above 30°C, to standard temperature (20°C).

Discussion

In a previous paper[5], a method was discussed for the determination of density of solutions at various temperatures, as a function of the refractive index. This relationship may also be employed to calculate the refractive index when the density is known. Using subscripts to refer to different temperatures, we have[5]:

$$D_2 = D_1 (R_2 - a_2) / (R_1 - a_1) \quad (1)$$

where D = density of solution, R = refractive index of solution, a = refractive index of solvent,

and thus

$$R_2 - a_2 = D_2 (R_1 - a_1) / D_1 \quad (2)$$

The density of aqueous sucrose solutions of different concentrations is known at various temperatures up to 95°C[6]. The refractive index of water is also known[7] and thus R_2 may be calculated.

The experimental data of THIELE[6] were obtained on solutions the concentrations of which were not integral percentages by weight. In order to interpolate and to construct a table based on integral % w/w, the linear relationship between $(R_t - a_t)$ and concentration by weight per unit volume (w/v)[8] may be used at each experimental temperature[6] (see Appendix). The regression equations (see Table I) were solved for selected integral concentrations w/w, converting to concentrations w/v according to the specific gravities at 20/20°C[9]. R_t was calculated and converted to Brix units[3] where applicable, and is detailed in Table II; in some instances the values are off the Brix scale (see Appendix).

On theoretical grounds[8] it would appear more appropriate[10] to calculate the regression equations through the points a_t; the constant terms in Table I would then be zero, and the variable terms would have slightly greater factors. However, small in-

* Contribution from the Agricultural Research Organization, Volcani Center, Bet Dagan, Israel. 1975 Series, No. 177-E.

[1] FEINBERG: "Food Processing Operations". Ed. JOSLYN & HEID. (Avi Publishing Co. Inc., Westport) 1964, p. 331.
[2] MALEY: *Food Technol.*, 1963, 17, 25.
[3] "Official Methods of Analysis", 12th edn. (AOAC, Washington), 1975, Sec. 52.012.
[4] *ibid.*, Sec. 52.015.
[5] BASKER: *J. Assoc. Off. Anal. Chem.*, 1975, 58, 618–619.
[6] *Zeitsch. Zuckerind.*, 1962, 87, 424–434.
[7] WEAST: "Handbook of Chemistry and Physics", 52nd edn., (Chemical Rubber Co., Cleveland), 1971, p. E-203.
[8] GLOVER & GOULDEN: *Nature*, 1963, 200, 1165–1166.
[9] "Official Methods of Analysis", 12th edn. (AOAC, Washington), 1975, Sec. 52.008.
[10] BROWNLEE: "Statistical Theory and Methodology" (Wiley, New York) 1965.

Table I. Regression of refractive index (*minus* refractive index of water) at various temperatures, on concentration by volume at 20°C

Temperature, °C	*Regression of refractive index*
30	0·000373 + 0·001395262 × % sucrose w/v
40	0·000377 + 0·001389421 × % sucrose w/v
50	0·000356 + 0·001383514 × % sucrose w/v
60	0·000355 + 0·001377686 × % sucrose w/v
70	0·000346 + 0·001370875 × % sucrose w/v
80	0·000313 + 0·001364511 × % sucrose w/v
90	0·000294 + 0·001357968 × % sucrose w/v
95	0·000269 + 0·001355363 × % sucrose w/v

accuracies are present[11] in the reference table of refractive index[3] and/or of specific gravity[9]; in consequence, the residual standard deviations due to the regression lines given in Table I are lower (decreasing from 0·00052 refractive index units at 30°C to 0·00039 at 95°C) than those through the points a_t (decreasing from 0·00057 refractive index units at 30°C to 0·00043 at 95°C); the former are therefore preferred. In terms of sucrose, the values of the residuals vary somewhat with temperature, but principally with concentration, being equivalent to approximately 0·3% w/w at concentrations below 45%w/w and approximately 0·2% w/w at higher concentrations.

Table II. Refractive index of aqueous sucrose solutions at various temperatures (Brix scale)

Sucrose, % w/w	*Temperature, °C* 30	40	50	60	70	80	90	95
5	4·4	3·5	2·4	1·1	—	—	—	—
10	9·3	8·4	7·3	6·1	4·6	3·1	1·3	0·4
15	14·3	13·3	12·2	11·1	9·6	8·1	6·4	5·6
20	19·2	18·3	17·3	16·1	14·6	13·2	11·5	10·7
25	24·2	23·3	22·2	21·1	19·7	18·2	16·6	15·8
30	29·2	28·3	27·2	26·2	24·7	23·3	21·8	20·9
35	34·1	33·2	32·2	31·2	29·8	28·4	26·9	26·1
40	39·1	38·2	37·2	36·2	34·8	33·5	32·0	31·3
45	44·1	43·2	42·3	41·3	39·9	38·6	37·2	36·4
50	49·1	48·3	47·3	46·3	45·0	43·7	42·3	41·6
55	54·2	53·4	52·4	51·4	50·2	48·9	47·5	46·8
60	59·3	58·4	57·5	56·5	55·3	54·1	52·7	52·0
65	64·4	63·5	62·6	61·7	60·5	59·3	57·9	57·2
70	69·5	68·7	67·8	66·8	65·6	64·4	63·2	62·5
75	74·6	73·8	72·9	72·0	70·8	69·7	68·4	67·7
80	79·8	79·0	78·1	77·2	76·1	74·9	73·6	73·0
85	85·0	84·2	83·4	82·5	81·3	80·2	78·9	78·3
90	—	—	—	—	—	85·5	84·2	83·6

In industrial practice, the differences between Table II and the true Brix provide a more convenient manner of applying these results; the differences are detailed in Table III. To obtain the true Brix of aqueous sucrose solutions, therefore, the corrections

Table III. Corrections to be added for determining the percentage of sucrose in sugar solutions by a refractometer

Sucrose, % w/w	*Temperature, °C* 30	40	50	60	70	80	90	95
5	0·6	1·5	2·6	3·9	—	—	—	—
10	0·7	1·6	2·7	3·9	5·4	6·9	8·7	9·6
15	0·7	1·7	2·8	3·9	5·4	6·9	8·6	9·4
20	0·8	1·7	2·7	3·9	5·4	6·8	8·5	9·3
25	0·8	1·7	2·8	3·9	5·3	6·8	8·4	9·2
30	0·8	1·7	2·8	3·8	5·3	6·7	8·2	9·1
35	0·9	1·8	2·8	3·8	5·2	6·6	8·1	8·9
40	0·9	1·8	2·8	3·8	5·2	6·5	8·0	8·7
45	0·9	1·8	2·7	3·7	5·1	6·4	7·8	8·6
50	0·9	1·7	2·7	3·7	5·0	6·3	7·7	8·4
55	0·8	1·6	2·6	3·6	4·8	6·1	7·5	8·2
60	0·7	1·6	2·5	3·5	4·7	5·9	7·3	8·0
65	0·6	1·5	2·4	3·3	4·5	5·7	7·1	7·8
70	0·5	1·3	2·2	3·2	4·4	5·6	6·8	7·5
75	0·4	1·2	2·1	3·0	4·2	5·3	6·6	7·3
80	0·2	1·0	1·9	2·8	3·9	5·1	6·4	7·0
85	0·0	0·8	1·6	2·5	3·7	4·8	6·1	6·7
90	—	—	—	—	—	4·5	5·8	6·4

Table IV. Example: Data for calculating regression of refractive index at 60°C on concentration by volume at 20°C

Concentration, % w/v	$R_{60°C} - a_{60°C}$
0·0	0·0000
1·000	0·0014
2·000	0·0029
3·000	0·0042
4·000	0·0056
5·000	0·0070
10·000	0·0141
20·000	0·0281
30·000	0·0420
40·000	0·0560
50·000	0·0698
60·000	0·0836
70·000	0·0972
80·000	0·1109
88·676	0·1226
96·108	0·1327
122·860	0·1684

(Table III) must be added to the refractometer readings.

The figures now calculated for 30°C differ slightly from those of the International Temperature Correction Table[4], and are therefore considered to be approximate and tentative only.

Considerable similarity is noted between Table III and the table of temperature corrections to the readings of Brix hydrometers[12].

Appendix

An example is given in order to illustrate the method of calculation.

At 60°C, the refractive index of a solution the concentration of which at 20°C is 5·000% w/v (4·91% w/w) is given by [raw data from (6) and (7)]:

$$R^{4\cdot91\%}_{60°C} - 1\cdot3272 = 1\cdot002117\,(1\cdot3401 - 1\cdot3330)/1\cdot017509 \qquad (3)$$
$$= 0\cdot0070;$$

i.e.

$$R^{4\cdot91\%}_{60°C} = 1\cdot3342 \qquad (4)$$
$$= R^{0\cdot85\%}_{20°C} \qquad (5)$$

The remaining data for 60°C are calculated similarly, and can be set up as in Table IV.

The regression equation of refractive index (*minus* the refractive index of water) can then be obtained, and is given in Table I, together with the regression equations at the other experimental temperatures. Thus, the refractive index at 60°C of a solution of concentration 5·0% w/w (5·09825% w/v at 20°C) is given by:

$$R^{5\cdot0\%}_{60°C} - 1\cdot3272 = 0\cdot0074; \qquad (6)$$

i.e.,

$$R^{5\cdot0\%}_{60°C} = 1\cdot3346 \qquad (7)$$
$$= R^{1\cdot12\%}_{20°C} \qquad (8)$$

while

$$R^{5\cdot0\%}_{70°C} = 1\cdot3324 \qquad (9)$$
$$< R^{0\cdot0\%}_{20°C} \qquad (10)$$

Summary

Corrections have been calculated to the refractive index of sucrose solutions at various temperatures up to 95°C. These corrections are expressed on the Brix scale, where applicable.

[11] Basker: *J. Food Sci.*, 1976, **41**, (in press).

[12] Kramer & Twigg: "Quality Control for the Food Industry" Vol. 2, 3rd edn. (Avi Publishing Co. Inc., Westport), 1973, p. 540.

Milling-cum-centrifuging of sugar cane for higher extraction

By M. STERZINGER* and J. ZDARSKY†

PART II

Biological Evaluation

Material and method

Defibrated cane or bagasse (2 kg) was sampled from each processing operation. For subsequent treatment the moist material was stored in the drying cupboard for 4–5 hours at a temperature of 65–70°C. After drying the sample could be transported. The rupture of individual cells in the bagasse was determined by using a maceration technique[3,4].

The bagasse is placed in 20% nitric acid and 5% chromic acid for 5–12 hours according to the ambient temperature, the higher the temperature the shorter the maceration period. If necessary, moderate heating is applied at the end of the maceration. Acids are removed by washing in water. The fibrous mat is stained with methylene blue or safranin (dilute solution); the former gives a blue or blue-green colour and the latter a red or yellowish-red. Excess stain is removed and the mat placed in glycerine, preferably 99%. The fibrous mat is unravelled by gently teasing with a needle mounted on a slide and covered with a cover glass. The samples thus prepared can be stored in Petri dishes for later research.

Bagasse cells are basically made up of three groups. The first and smallest in number are the epidermis cells; these are subjected to longer maceration. The second group is formed by the pith cells, which are subjected to a medium maceration time; the third group is formed of vascular bundle cells and reinforcing fibres which are the easiest and quickest to macerate.

Investigation of the condition, type and number of macerated cells was carried out informatively at a magnification of 100× and definitively at 450×. About 300 cells were counted on each slide and the numbers of ruptured and non-ruptured cells expressed in percentages.

Counts for each slide were made in duplicate, while each process operation comprised 10 duplicate tests.

For calculation of the ruptured cells we used pith cells which fill the space between the epidermis and the vascular bundles. Results were evaluated statistically[5]. The arithmetic mean $\bar{x}$ was calculated from Equn. (1), the standard deviation s from Equn. (2), the standard deviation of the mean $s_{\bar{x}}$ from Equn. (3) and the coefficient of variation v from Equn. (4):

$$\bar{x} = \frac{\Sigma\,(x)}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$s = \frac{\Sigma\,(x)^2 - \Sigma\,(x)(\bar{x})}{N} \quad \ldots\ldots\ldots (2)$$

$$s_{\bar{x}} = \frac{s}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$v = \frac{100.S}{\bar{x}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Symbols used: $\Sigma\,(x)$ = total of all values (variants), n = number of values, $\Sigma(x)^2$ = sum of squares, and N = degrees of freedom (= $n - 1$).

Microscopy of the ruptured cells is a direct method; it can be considered as basic but is time-consuming. In practice indirect determination methods do exist[6–9] and involve as a first step the ratio between extraction and pol or pol in juice and in between cane. To the number of ruptured cells is added the cells of all types of fibrous matting. We assume that only pith cells should be considered since they contain most sucrose.

Experimental part and discussion

For the purposes of this work we will define bagasse as the waste after milling (hence, bagasse proper) and chopped, not completely extracted, cane before extraction. From the physical viewpoint, bagasse occurs at various stages of maceration, where individual portions may even have a size measurable in dm. Bagasse is a complex of more or less ruptured cells. The majority are ruptured pith cells which have characteristically the thinnest walls.

Bagasse cells are firmly attached to one another by so-called intermediate lamellae; if these are chemically dissolved, the cells separate—they macerate. Examples are shown in Figs. 7 and 8 and results are given in Table II.

The minimum number of ruptured cells was found in bagasse from the shredder (67·69 ± 1·71%) and the maximum was found with use of the No. 1 mill + shredder + centrifugal (92·38 ± 1·56%). The ruptured cell walls varied considerably for individual cells in both size and form.

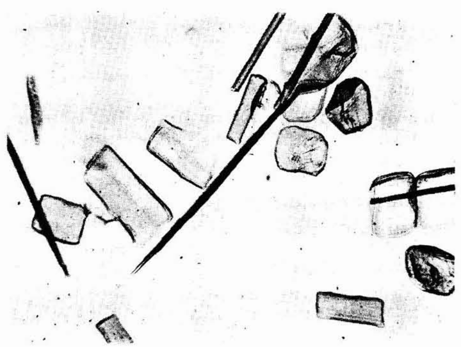

Fig. 7

[3] Prát: "Rostlina pod drobnohledem" (The plant under the microscope), (Praha), 1952.
[4] Shah *et al.*: *Phytomorphology*, 1968, **18**, (1), 102–105.
[5] Hrubý & Konvička: "Polní pokusy, jejich zakládání a hdonocení" (Field tests, their completion and evaluation), (Olomouc), 1954.
[6] Aldrich & Rayner: *Proc. 11th Congr. I.S.S.C.T.*, 1962, 1004–1013.
[7] Saxena & Agarwal: *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (1), 17–43.
[8] Gupta *et al.*: *Proc. 33rd Ann. Conv. Sugar Tech. Assoc. India*, 1965, 1–10.
[9] Khainovsky: *Proc. 3rd Congr. I.S.S.C.T.*, 1929, 457–479.

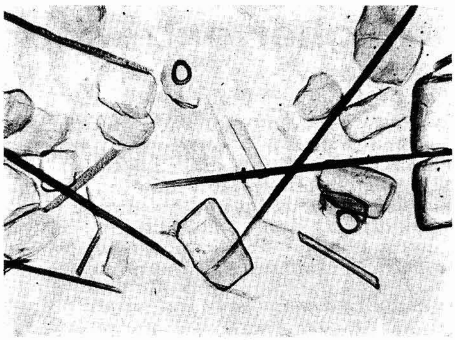

Fig. 8

Table II

Survey of cell rupture for individual technological operations (values in %)

Operation:	$\bar{x}$	s	$s_{\bar{x}}$	v
Shredder	67·69	1·71	0·54	2·53
1st mill	74·43	1·85	0·58	2·48
Shredder + 1st mill ..	78·16	1·41	0·45	1·81
1st mill + shredder ..	84·29	4·20	1·33	4·98
1st mill + "Gorator" + centrifugal..........	81·71	2·08	0·66	2·55
1st mill + shredder + "Gorator" & centrifugal	92·38	1·56	0·49	1·69
Last (6th) mill—control	83·30	1·71	0·54	2·05

From the results we can endeavour to obtain more information on the characteristics of certain operations. If we assess only the shredder, we find that the extent to which it increased cell rupture depended on the arrangement, i.e.:

Shredder followed by 1st mill	78·16%
1st mill alone	74·43%
Cell rupture due to shredder	3·73%
1st mill followed by shredder	84·29%
1st mill alone	74·43%
Cell rupture due to shredder	9·86%

Similarly, the cell rupture due to the 1st mill is 10·47% when it follows the shredder and 16·60% when it precedes the shredder; nevertheless it may be seen that the 1st mill exerts greater cell-rupturing effect than does the shredder:

Shredder followed by 1st mill	78·16%
Shredder alone	67·69%
Cell rupture due to 1st mill	10·47%
1st mill followed by shredder	84·29%
Shredder alone	67·69%
Cell rupture due to 1st mill	16·60%

The difference between cell rupture values for the 1st mill following and preceding the shredder is surprising but statistically proven. From further combinations, the "Gorator"-plus-centrifugal is shown to give a 7·28% or 8·09% increase in the number of ruptured cells depending on whether they follow a mill alone or mill-plus-shredder combination.

1st mill + "Gorator" and centrifugal	81·71%
1st mill alone	74·43%
Cell rupture due to "Gorator" and centrifugal..........................	7·28%
1st mill + shredder + "Gorator" and centrifugal..........................	92·38%
1st mill + shredder.................	84·29%
Cell rupture due to "Gorator" and centrifugal..........................	8·09%

Our results for number of ruptured cells may be compared with values in the literature:

Equipment	GUPTA *et al.*[8]	SAXENA & AGARWAL[7]
Crusher	48–68	—
1st mill	75–82	55·64–80·62
2nd mill........	82–90	60·80–82·25
3rd mill	91–93	66·95–87·12
4th mill	94–96	87·27–88·24
5th mill	96·5–98·5	91·70–91·40
6th mill	—	92·80

Operational information

Operation of the equipment provided much new information and useful experience. The "Gorator" came up to full expectation and carried out the functions of disintegration, simultaneously rinsing the contents of the mechanically ruptured cells, and of conveying. The cane residence time in the "Gorator" governed the degree of defibration. A positive effect on extraction was exerted by two-stage passage through the "Gorator" with gradual reduction in concentration of the transport medium as tested and confirmed with the laboratory centrifuge in Variant (*A*).

Having found the answer to the question of suitable means for feeding the cane-circulation juice mixture to the first stage of the KO 1000/4 centrifugal and after connecting up and testing all the imbibition circuits, we found it impossible to overcome certain problems directly associated with the centrifugal construction. Its four stages (200, 140, 160 and 100 mm) were too short. Mixing of the juice below the screen and in the distributor was not uniform; as a result, the imbibition pump at the 2nd and 3rd centrifugal stages transferred juice of the same concentration. Imbibition at the 1st stage was provided by cold water. The juice from the first three centrifugal stages was discharged at about the same concentration because the juice was mixed in the basket before entering the distributor.

The end faces of the individual stages entrained juice in the direction of movement of the bagasse, which favoured non-uniform counterflow in the centrifugal. For this reason a multi-stage centrifugal with short stages will not be suitable for future tests. Even with a short bagasse retention in the last (4th) stage (about 4 sec), a good bagasse moisture level was achieved (70–74%), permitting further dewatering in the mills. The peripheral speed of the centrifugal was excessive even after reduction of the main shaft speed to the lowest possible, i.e. 668 rpm. Surging of the spun juice in the basket caused it to foam in the distributor tank. Layer displacement at 60 double-strokes per min took 15 sec at a basket length of 600 mm.

The centrifugal operated on indirect extraction of cane or bagasse at the rate of 10–15 tch (average processing in Variant (*D*) was 12·27 tch or 5·95 tons bagasse per hr). For a sugar factory processing 1000 tons of cane per day this would mean increasing the centrifugal capacity by approximately 400%, which would present no problems when the merits and demerits of the equipment are considered. Should the centrifugal basket screens deteriorate because of sand, they can be replaced.

Conclusions

Comparison of the individual test variants from the technological viewpoint is shown in a simplified form in Table III. The laboratory tests showed that the

Table III. Comparison of alternative tests

Type	PREPARATION		EXTRACTION						DEWATERING				PURITY OF JUICES					
	Pol %	*Fibre %*	*E%*	*RE%*	*E%*	*RE%*	*E%*	*RE%*	*E%*	*RE%*	*E%*	*RE%*	Primary	1st Centr.	2nd Centr.	Dewatering 1st Mill	Dewatering 2nd Mill	Mixed
A	Pilot Plant		Laboratory Plant															
	9·71	11·13			63·71	59·44	89·33	87·73			97·69	97·35	74·32	65·42	49·55	—	51·48	—
B	Pilot Plant		Laboratory Plant															
	10·41	11·26	77·96	75·38	85·84	84·25					97·57	97·31	73·18	61·42	—	—	52·20	—
C	Pilot Plant								Mills 24 in × 48 in									
	13·85	13·75					58·69	62·69			90·33	91·17	86·68	83·97	—	81·03	78·10	—
D	Full Operation Plant				Pilot Plant				Mills 24 in × 48 in									
	12·86	12·94	68·01	68·99			77·72	78·46	91·28	91·60	95·28	95·98	83·22	77·28	—	73·25	69·93	82·58

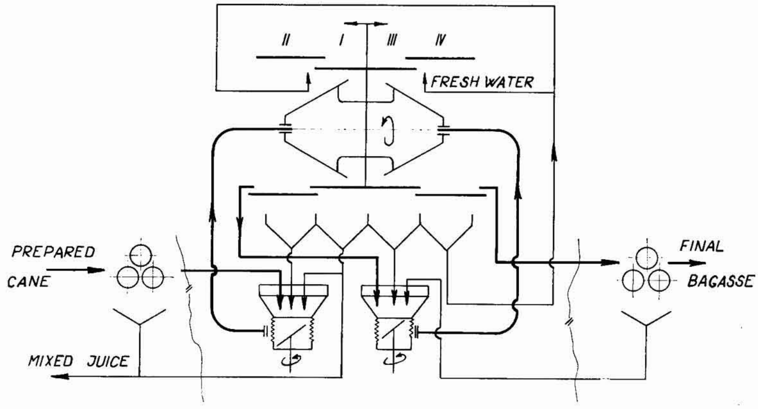

Fig. 9

process is very promising, although there were misgivings about the juice purity at the individual stages. It must be remembered, however, that the laboratory tests were carried out during the inter-campaign period when the cane quality was low and the juice (from the laboratory mill) quality poor (see Variant *A*—average 74·32%—and Variant *B*—73·18%). The results were also affected by the prolonged period of operation and evaluation of the individual phases in *A* and *B*. On the other hand, pilot-plant operation showed that there was some entrainment of impurities from the juice to the bagasse layer in the centrifugal basket. Table III, Variants *C* and *D*, shows that there was no great drop in purity between juice from the cane and from the centrifugal or between juice from the centrifugal and from the final No. 2 mill. Cold extraction and lack of increase in the juice non-sugars also led to a low drop in purity (primary juice —mixed juice). The bagasse retention time in the extractor was about 15 sec, so that the juice passed through the process in a very much shorter time than in other types of extractor.

According to the results in Table III, extraction on a pilot-plant scale was on average lower than in the laboratory tests. The tests for individual variants were compared, and the results obtained as follows: (*a*) tests on variant *C* were comparable with laboratory tests for Variant *A*. It was found that a 4-stage centrifugal having short stages does not meet the requirements of stepwise juice-bagasse counter-flow and only permits use of single-stage imbibition with water (cf. extraction $E_A = 87{\cdot}73\%$ and $E_c = 62{\cdot}69\%$). The final mills were unable to reduce the sugar content in the final bagasse sufficiently for RE_c (91·17%) to reach the 97·35% of RE_A. The final bagasse moisture content was about the same in both cases. For full-scale operation a centrifugal must be designed which would meet the conditions of the arrangement in Variant *A*, shown schematically in Fig. 9.

(*b*) The test for Variant *D* demonstrated the suitability of bagasse extraction as regards the centrifugal dimensions. Where primary extraction is about 75% as in Variant *B*, or where primary extraction is that such as obtained with the DDS diffuser at Phaltan[2,3], total extraction could be greater than 97%. For pilot-plant tests the 1st mill of the tandem was used for primary extraction, and according to the table an extraction of 68·01% and a reduced extraction of 68·99% were achieved.

(*c*) Laboratory tests showed that the processes in Variants *A* and *B* are technologically practically the same and that with good primary extraction in the mills it would be possible to carry out the process using one single centrifugal and thus reduce production costs with full-scale operations.

Despite the shortcomings in the equipment used for the pilot-plant tests, the results for Variants *C* and *D* are good and the new method of cold extraction (milling + centrifuging) can be regarded as promising and encouraging for future full-scale operation.

Yellow wilt-resistant beet research.—A search for sugar beet varieties resistant to yellow wilt, a virus disease, will be accelerated under a cooperative agreement between the Beet Sugar Development Foundation, Fort Collins, Colo., and the U.S. Department of Agriculture (USDA). Yellow wilt stunts, wilts and eventually kills beet plants. It is comparable to severe curly top virus. Because of the wilt, sugar beet production in Argentina has been abandoned. Wilt is now causing damage in Chile, and the agreement is designed to give U.S. beet producers a head start on control if and when the disease strikes the U.S.A. Yellow wilt threatens sugar production in the eastern states where climatic and ecological conditions provide a favourable habitat for leafhoppers, the insect carrier of the disease. Under the two-and-a-half-year $50,000 agreement with USDA's Agricultural Research Service (ARS), a scientist from the foundation, in cooperation with Chilean scientists, will evaluate varieties and parental lines for tolerance to the disease. They will also select and breed for resistance and study the nature of the organism that causes the disease. While economical methods of control are unknown, previous research has shown that there is a possibility of breeding tolerance into the plants. J. H. FISCHER is the principal investigator for the foundation and Dr. J. S. MCFARLANE, Salinas, Calif., is the ARS representative.

* * *

Louisiana cane variety programme.—Scientists at the USDA Sugar Cane Laboratory at Houma, La., will study cane variety improvement and weed control under a trust fund cooperative agreement with the American Sugar Cane League of the U.S.A. Inc. The League will provide USDA's Agricultural Research Service with $40,000 for the research. The expanded variety improvement programme will include crossing, screening for disease resistance and testing for high sucrose, yielding ability and processing qualities. Intended to provide superior varieties adapted to Louisiana, the research will be planned cooperatively by ARS and the League. It will also include investigations on controlling cane weeds. Dr. JAMES E. IRVINE, Director of the U.S. Sugar Cane Laboratory, is the ARS representative, and GILBERT J. DURBIN is the League representative in New Orleans, La.

Sugar cane agriculture

Cane agriculture in Réunion. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1975, 117 pp.—Among aspects of cane agriculture treated in this report are: the setting-up in 1976 of seed cane farms, using setts treated against RSD; mechanical harvesting, with mention of the various types of harvesters and loaders in use and to be introduced; results obtained with the Doucet stone collector which has shown promise, though costs have not been calculated—it is stated that collecting and transporting stones from a field are economically justified only when the quantity is below 100 tons per ha. Otherwise, it is more economical to discharge the stones on hillocks created by bulldozers at the sides of the fields. Gas-liquid chromatography was used to compare the sugar content in burnt standing and burnt chopped cane. Losses were found to be higher than indicated by polarimetry, e.g. 18% in standing burnt cane after 9 days as given by GLC compared with 9% found by polarimetry. On the other hand, GLC is considered too time- and labour-consuming for use as an industrial routine method, and is only recommended as a reference method. Enzymatic analysis for determination of sugar losses in cane is to be tested. Because of the new regulations banning the use of mercurial compounds, "Benomyl" is recommended for the control of pineapple disease, and has proved more effective than "Aretan" in this. A summary is presented of the disease situation in Réunion. Varietal susceptibility to smut has been determined in several regional trials. *Cephalosporium sacchari* (wilt) has occurred in varietal trials and in commercial fields in various regions, but at present it offers no obvious risk to the crop. The reappearance of the pest *Pulvinaria iceryi* is reported. Results are given of herbicide trials, particular mention being made of tests to control *Rottboellia exaltata* (rice grass), which has spread rapidly and is becoming a serious problem. While pre-emergence control is difficult, post-emergence control is possible with "Roundup" at 6 litres.ha^{-1} for field perimeter treatment, and "Karmex" + "Hyvar X" + "Gramoxone" (3 kg + 1 kg + 3 litres per ha) for infield treatment when the cane is sufficiently developed. Full details are given of varietal trials in the different parts of the island. Interesting photographs depict intercropping with onion and with tobacco plus beans.

* * *

A study on ripening of sugar cane plants. I. The growth pattern of sugar cane and the accumulation of sugar in the ripening period. T. T. YANG and T. S. HSIEH. *Rpt. Taiwan Sugar Research Inst.*, 1975, (69), 9–17.—The effects of N, P and K deficiency on cane quality and growth were determined in greenhouse tests with plants of variety F 160. As control, cane was treated with an adequacy of all three nutrients in a mixture, while other samples were treated with only two out of the three nutrients. Results after 72 days showed that the juice quality (expressed by Brix, purity, reducing sugar content and pol) for both mother stalks and tillers was highest in the N-deficient cane, followed by the P-deficient cane, control and K-deficient cane in that order. As regards accumulated growth, the maximum was achieved by the control, followed by K-deficient cane, P-deficient cane and finally N-deficient cane which had a growth index less than half that of the control. These results demonstrate that the amount of sugar produced in the growing cane can accumulate in the stalk as growth stops, so that the daily growth pattern of N-deficient cane is of value as a guide for cane ripening control. Similar results to the greenhouse experiments were obtained in field-grown irrigated and unirrigated cane.

* * *

Cane breeding in Louisiana. L. L. LAUDEN. *Sugar Bull.*, 1976, **54**, (14), 10–11.—The cane breeding programme in Louisiana and the parts played by Louisiana State University, the US Dept. of Agriculture and the American Sugar Cane League are outlined.

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Sugar cane technology in the past half-century in India. I. Sugar cane production. S. THANGAVELU and K. SUNDARESAN. *Indian Sugar*, 1976, **25**, 779–783.—Information is given on the cane area, cane production and yield per acre in India from 1923 to 1974; the proportion of the area under Co canes and the actual area involved are also given up to 1946. Although the proportion of cane not processed (but used as seed cane or for chewing) has tended to fall during the period investigated, the authors consider that the amount (16·5 million tons in 1974) should be drastically reduced so as to increase sugar output.

* * *

The role of Co 449 in the evolution of newer sugar cane varieties. N. BALASUNDARAM, S. THANGAVELU and K. SUNDARESAN. *Indian Sugar*, 1976, **25**, 785–790.—The role played by Co 449 (obtained from POJ 2878 × Co 331) as genetic stock is examined. Lists are given of varieties having Co 449 or its progeny as a parent. A total of 249 varieties can trace their ancestry to Co 449.

* * *

Yellowing disease of sugar cane and its control. K. N. GOYAL and R. N. S. TYAGI. *Indian Sugar*, 1976, **25**, 791.—Yellowing disease, a severe problem in Rajasthan, causes stunted growth and yellowing of the leaves, which finally die; eventually the entire clump withers. Tests have shown that it is not caused by viruses or nematodes. Application of 1% ferrous sulphate containing citric acid, tartaric acid or an imli fruit extract has proved successful in restoring the green colour to the leaves. A 1% solution of ferrous sulphate containing 2·5 g.litre^{-1} citric acid is more effective and cheaper than sulphur dust.

A chemical ripener for sugar cane. ANON. *S. African Sugar J.*, 1976, **60**, 205–207.—"Ethrel", a product of Industrial Chemical Products Ltd., has been registered by the South African Government for use as a cane ripener after 5 years of field tests. "Polaris" has not proved as successful as "Ethrel" under South African conditions, similar results being obtained only when 4 times as much "Polaris" as "Ethrel" was applied. Results have indicated a sugar yield increase averaging 0·7 $tons.ha^{-1}$ following application of 2 $litres.ha^{-1}$ "Ethrel"; tests are under way to see if 1 $litre.ha^{-1}$ would be as effective. Advice is given on optimum conditions for application of the ripener, and the economic effects of chemical ripening are briefly discussed.

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Cane trailer braking systems. ANON. *Producers' Rev.*, 1976, **66**, (4), 11–13.—Under new regulations in Australia which were to come into force on 1st July 1976, cane trailers used on roads must be provided with brakes. Details are given of the regulations and possible exemptions. Photographs are given of some of the types of cane trailers used by farmers in Queensland.

* * *

Aerated steam as heat source for control of stunting disease. L. L. LAUDEN. *Sugar Bull.*, 1976, **54**, (13), 8.—Advantages of steam over hot air for cane sett treatment against RSD include the removal of need for hand stripping, greater adaptability to mechanical handling, a shorter treatment period (4 instead of 8 hours), and greater uniformity of temperature during the last 3 hours of treatment. Good control of the disease is obtained by treatment at 51°C; the setts should be stacked in mats not more than 15 inches tall with a 3-inch gap between the mats. It is emphasized, however, that growers who do not care to use steam but have hot air units should use these, since the virus will still be destroyed and falls in cane yield thus prevented.

* * *

Suggested use of "Asulam" ("Asulox") in Louisiana sugar cane. ANON. *Sugar Bull.*, 1976, **54**, (13), 15. Advice is given on ground or aerial application of "Asulox" post-emergence herbicide to control rhizome Johnson grass in ratoon cane in cases where the level of infestation is moderate-to-high.

* * *

Controlling Johnson grass, Raoul grass (itch grass) and *Equisetum* ("popping" weed) in the Louisiana sugar cane areas. D. T. LOUPE and L. L. MCCORMICK. *Sugar Bull.*, 1976, **54**, (15), 10, 14.—Advice is given on chemical control of the three weeds named in the title. It is pointed out that the type of vegetation which will grow on ditch banks after control of Johnson grass is governed by the herbicide used, treatment with MSMA usually being followed by an invasion of Bermuda grass, while "Dalapon" treatment is generally followed by growth of various broadleaved weeds and vines; of the two types of weeds, Bermuda grass is considered as probably more effective in reducing soil erosion and in limiting reinfestation by Johnson grass seedlings. On the other hand, if Bermuda grass is invading cane fields from ditch banks, alternation of MSMA and "Dalapon" treatment is recommended.

* * *

Stalk height and number as components of sugar cane yield. J. A. MARIOTTI and I. A. TUROWSKI. *Rev. Agron. Noroeste Argentino*, 1975, **12**, (1/2), 7–24.—As a sufficiently varied group, 126 clones from 5 hybrid progenies bred at Tucumán Experiment Station were studied over a 6-month period. At monthly intervals 5-stalk samples were measured for height, average stalk weight, cane yield by weight and juice sucrose content. Different traits were shown by groups of certain characteristics within the total population, and the heights and stalk numbers in each control strongly determined these characteristics in the following period. On the other hand, no associations were detected between the patterns of increase in height and decrease in stalk number. The final heights and cane yields were strongly affected by the elongation pattern during the ripening period April–June.

* * *

Response of sugar cane genotypes to natural and induced environmental stimuli. J. A. MARIOTTI, D. L. PLOPER, E. S. OYARZABAL, A. R. BULACIO, I. A. TUROWSKI, J. M. OSA, M. T. DIVIZIA and R. A. AVELLANEDA. *Rev. Agron. Noroeste Argentino*, 1975, **12**, (1/2), 25–44. The effects on 100 clones of different planting sites, different levels of N fertilization and variable weed competition were examined and the response graded between values of +5 and —5. It was concluded that the scale could be used satisfactorily for the purpose; that the clones responded differently to variation in the environmental stimuli, showing a wide range of interactions; and that this provided a possibility of identifying valuable varietal material. The stability of the clone characteristics in the populations investigated is associated with phenotypes of the same characteristics under certain environmental levels, and the reactions to environmental stimuli shown by several yield components appear not to be inter-associated.

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Studies of clonal selection of sugar cane in conditions of competition with natural weed communities. J. A. MARIOTTI, I. A. TUROWSKI, D. L. PLOPER and E. S. OYARZABAL. *Rev. Agron. Noroeste Argentino*, 1975, **12**, (1/2), 45–64.—The effect of weed competition over a 45- and 90-day period on the yield and quality characteristics of a group of 100 clones was examined. The data were analysed, estimating heritability, phenotype and genotype correlations and selection efficiency. Absence of weed competition induced a smaller clonal discrimination for characteristics such as stalk number and weight. Efficiency of indirect selection by environment was 80% of that with greater competition. It was evident that increasing weed competition affects the yield structure, and selection criteria should therefore be modified to relate to normal commercial practice.

* * *

Studies of clonal selection in sugar cane at different levels of nitrogen fertilization. J. A. MARIOTTI and O. GIMÉNEZ L. *Rev. Agron. Noroeste Argentino*, 1975, **12**, (1/2), 65–78.—A total of 100 clones were grown in replicated plots having 0, 60 and 120 kg N per hectare applied, and the yield and cane quality data obtained were analysed for repeatabilities, heritabilities and phenotype and genotype correlations. Estimations were also made of theoretical efficiency of cross-selection from a control environment. The bulk of the population investigated showed a response to N similar to that in highly selected commercial varieties. Levels of N did not greatly affect estimates of repeatabilities or heritabilities of most traits, although the latter were higher for some characteristics with the 120 g N level, and associations were low at the 60 kg N level.

* * *

Genetic variability studies of isoperoxidases and morphological characters in sugar cane sub-clones obtained by means of "*in vitro*" cultivation. A. M. FRIAS DE F., H. J. ANTONI and M. E. LOZZIA DE C. *Rev. Agron. Noroeste Argentino*, 1975, **12,** (1/2), 79–91.—The genetic variation connected with peroxidase isoenzyme was studied as well as some morphological variations which were found in 46 sugar cane clones. These clones were obtained by tissue culture from a commercial variety, NA 56-79. The difference between clones—checked by a statistical test—were in the range of 10–30% of the controls. Morphological features of ligule and auricule showed differences between the commercial clones and the 46 sub-clones, although no significant correlation was observed between enzymatic and morphological variations. Factors possibly reponsible for such variations are also discussed.

* * *

Sugar cane weed species in the Argentine Republic. R. A. AREVALO. *Rev. Agron. Noroeste Argentino*, 1975, **12,** (1/2), 95–105.—A list of 194 weed species observed during the past ten years is presented, classified by family, genus and whether annual or perennial. The most important are *Sorghum halepense* (L.) Pers., *Cynodon dactylon* (L.) Pers., *Panicum maximum* Jacq., *Brachiaria plantaginea* (Link) Hitchc., *Setaria leiantha* Hackel, *Cyperus rotundus* L., *Eryngium ebracteatum* Lam, *Cucurbitella duriaei* (Nand.) Cogn., *Sicyos polyacanthus* Cogniaux and *Ageratum conizoides* L.

* * *

Fiji disease and boron. O. W. STURGESS. *Australian Sugar J.*, 1976, **68,** 72.—In answer to a suggestion that boron deficiency gives symptoms similar to those of Fiji disease, and that possibly cane which is destroyed because of Fiji disease infection is in fact not diseased, it is pointed out that all the evidence of infection is irrefutable. Virus particles have been found in infected cane and the leafhopper vector; disease has been transmitted to uninfected canes only when leafhoppers have been placed on them but not otherwise (even when infected and healthy canes are growing side by side); Fiji disease was controlled years ago by systematic measures but has reappeared in the same areas, despite non-boron fertilization under both disease and disease-free conditions; and boron application to healthy and Fiji-disease infected cane had no effect on the disease in investigations. Mention is made of two varieties which have proved to be resistant to Fiji disease in field tests and may help to contain the disease.

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Plant-parasitic nematodes associated with sugar cane in Barbados. C. W. D. BRATHWAITE. *Plant Disease Reporter*, 1976, **60,** 294–295.—Of 20 genera of plant-parasitic nematodes found in soil and root samples from 45 cane fields in scattered areas of Barbados, the most widely distributed were: *Aphelenchus* spp. (89% occurrence), *Helicotylenchus* spp. (77%), *Pratylenchus* spp. (64%), *Tylenchus* spp. (61%), *Rotylenchus* spp. (35%), *Criconemoides* spp. (30%), *Meloidogyne* spp. (27%), *Trophurus* spp. (25%), *Tylenchorhynchus* spp. (16%), *Aphelenchoides* spp. (14%), *Ditylenchus* spp. (11%) and *Trichodorus* spp. (9%). Important species identified were: *Aphelenchus avenae*, *Helicotylenchus curvatus*, *H. concavus*, *H. dihystera*, *Pratylenchus zeae*, *Hemicriconemoides cocophilus*, *Rotylenchus reniformis*, *Boleodorus thylactus* and *Paratrophorus loofi*. The high frequency and high densities of lesion nematodes (*Pratylenchus* spp.), which cause dark brown-to-black lesions on buttress roots and were particularly numerous in older crops, suggest that they may contribute to yield decline, although spiral nematodes (*Helicotylenchus* spp.) may also play a part. Leaf chlorosis and poor cane growth were observed in areas of high spiral and lesion nematode densities; these areas also suffered from low rainfall. It is suggested that nematode infestation may affect the ability of roots to absorb water under moisture stress conditions. Root-knot nematodes (*Meloidogyne* spp.) were less abundant than lesion or spiral nematodes, but did occur at high densities in some areas, although severe galling of roots was generally not obvious.

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The development of farming mechanization on TSC plantations. ANON. *Taiwan Sugar*, 1976, **23,** 49–52. Developments in mechanical cane planting and harvesting on farms of the Taiwan Sugar Corporation during the 30 years of the Corporation's existence are surveyed.

* * *

Switching to road transportation. ANON. *Taiwan Sugar*, 1976, **23,** 63–66.—The gradual changeover from rail to road transportation of cane and other factory raw materials in Taiwan is discussed and future developments indicated.

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Sugar cane breeding (between 1946 and 1976). I. S. SHEN. *Taiwan Sugar*, 1976, **23,** 83–86.—A survey is presented of 30 years of cane breeding at the Taiwan Sugar Research Institute, which up to 1975 had resulted in the release of 43 varieties in the F series, which are now grown on 98% of the total cane area of Taiwan. Developments in breeding techniques, the characteristics of certain F varieties, and mutation breeding are discussed.

* * *

Thirty years' research and development in sugar cane cultivation. S. J. YANG. *Taiwan Sugar*, 1976, **23,** 89–92.—Work conducted at the Dept. of Agronomy, Taiwan Sugar Research Institute, is described, covering establishment of the special nursery system for cane cuttings, ratooning, paddy sugar cane growing, intercropping, field mechanization, cane ripeners, irrigation and drainage, weed control and the agricultural meteorological service.

* * *

Research progress in plant protection. Y. S. PAN. *Taiwan Sugar*, 1976, **23,** 93–96.—The author describes disease and disease control research in Taiwan, work on cane entomology, and chemical control of soil-inhabiting insects and rats.

* * *

Our groundwater research. Y. CHU. *Taiwan Sugar*, 1976, **23,** 101–103.—The irrigation well construction programme in Taiwan is surveyed. It is pointed out that 75% of the combined agricultural and industrial water requirement in the sugar industry is met by groundwater.

Agro-industrial characteristics of some commercial varieties. A. I. BASSINELLO. *Brasil Açuc.*, 1976, **87**, 320–322.—Descriptions are given of the varieties CB 41-76, IAC 51/205, IAC 52/150, NA 56-62, CB 46-47, CB 56-126, CB 40-69, IAC 48/65, IAC 51/201, CO 40-77, CB 61-80 and CB 47-89.

* * *

Contribution to the study of the system of mechanized harvesting of sugar cane. T. C. RIPOLI and L. A. BALASTREIRE. *Brasil Açuc.*, 1976, **87**, 323-329. Equations are developed by means of which a number of factors are taken into account in assessing the minimum number of transport vehicles to be used in conjunction with a single cane harvester.

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Effect of growth regulators on growth, juice quality and yield of sugar cane in CoJ 64. G. SINGH and K. SAREEN. *Indian Sugar*, 1976, **25**, 911-915.—Investigations were made of the effect of gibberellic acid (GA) and of ascorbic acid (AA) on stalk formation, tillering, number of millable canes and juice quality of CoJ 64 cane. Tabulated results showed that GA applied at 75 and 100 ppm in the pre-monsoon period caused significant stalk elongation, while lower concentrations were less effective. However, GA had no beneficial effect on stalk length in the monsoon and post-monsoon periods, but rather inhibited growth. AA had no effect on stalk elongation at any time, and neither GA nor AA affected the other factors studied.

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Influence of foliar application of potassic fertilizer on chemical composition of sugar cane foliage. S. SITHANANTHAM, T. K. SRINIVASAN and T. K. G. RAO. *Indian Sugar*, 1976, **25**, 917-918.—Spraying with 3% KCl solution three times at 3-week intervals starting 35 days after planting (giving a total of 33·75 $kg.ha^{-1}$) caused a reduction in leaf P, Na, Si and total sugars contents compared with the controls (sprayed only with water), while N, K, Ca and Mg were increased. When 0·1% "Endrin" was applied with the KCl, the P and Na contents were increased by comparison with the controls, while the Ca content fell. The decrease in total sugars and Si was markedly reduced by the "Endrin", while the increases in N and Mg contents were greater than with KCl alone. "Endrin" had been found earlier to have growth-promoting effects on cane. The increase in N content caused by the insecticide may also add to the borer-controlling effects of "Endrin".

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Drip up-date. W. S. HAINES. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 19–28.—Progress made with drip irrigation in Hawaii since its introduction on test plots in 1970 is surveyed. To prevent plugging of the orifices in the plastic piping, sterilization with chlorine is used as well as periodical flushing—it was found that small particles were agglomerating, probably as a result of bacterial growth in the water. Damage by pests has proved to be insignificant as a consequence of the use of insecticide and rodent bait. The possibility of incorporating repellents in future tube materials is suggested. Capital costs of drip irrigation systems have varied widely; variables affecting costs are listed. While harvest data for 1974 and 1975 indicate that sugar yields should be as high with drip irrigation as with furrow irrigation used previously, there is insufficient material to indicate water utilization efficiency.

Harvesting up-date: Amfac concepts. A. S. HALL. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 29–30. Examination of the cane material in a push-raked windrow showed that about two-thirds of the extraneous matter occurred in the bottom third of the pile, so that delivery of cane from the top two-thirds of the pile would reduce the extraneous matter transported as well as halve the waste at present removed (and needing disposal) by cleaning plant. On rocky, flat land tests were conducted on the use of high-pressure water to cut cane; a system using 100 $gal.hr^{-1}$ at a pressure of 45,000 psi is suggested, and further tests are, it is hoped, to be carried out. Cane cutting with a flail was also tested. The cut was not sufficiently clean, so that stalk material was lost, although the leaves were easily removed without stalk damage. However, there is potential danger from flying stones when a flail is used, and power requirements are probably much higher than for a sharp blade. A Thomson-Duncaña two-row cut-windrow harvester has shown promise.

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Mechanical harvesting up-date. C. C. MONTGOMERY. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 31–33.—The author describes the system used by the Hawaiian Sugar Co. in whole-stalk harvesting and cleaning. Chopped cane harvesting has been abandoned because of certain problems, particularly the inability to take the cane trailers into the field and the high costs resulting from this.

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Sub-surface irrigation—engineering research. S. LANTING. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 57–62.—Research on sub-surface drip irrigation at the HSPA Experiment Station is reported. An experimental "plough injector" for insertion of piping at a required depth in a furrow has given good results in well-prepared soil; a packing wheel helps to firm the disturbed soil. Large stones must be avoided, and a method must be found for maintenance of an adequate tube depth at field ends, where access to the tube is required. Interruption of flow of flushing water through the tubing was caused by pinching where tube depth had not been maintained, although irrigation flow may not be affected by pinching. After seed cane harvesting, pinching was found in 22 out of 24 laterals, but after several weeks of operation and a short period with increased water pressure, pinching nearly disappeared and germination of the ratoon crop was excellent.

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Single-chamber drip irrigation laterals on various field slopes and contours. U. BUI and W. GIBSON. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 63–68.—Advantages and disadvantages of the dual-chamber distribution tube, as used on most of the Hawaiian cane land under drip irrigation, are discussed. The principal defect is its proneness to orifice plugging, which has been found to be reduced in single-chamber tubes. While unplugging can be easily accomplished by increasing water pressure and single-chamber tubes are cheaper than the dual-chamber types, problems arise with the uneven contours on the downhill slopes which are typical of the irrigated cane land in Hawaii. The single-chamber tubing has been adopted by several plantations on land with low and generally uniform slopes, and investigations are under way with a computerized model to see if water distribution and

vigorous tube flushing can be obtained with such tubing under the more adverse conditions of variable gradients and irregular contours.

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Flushing valve for drip irrigation tubes. W. GIBSON and U. BUI. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 69–72.—Information is given on a special valve developed by the HSPA and manufactured under licence by Wisdom Industries, Honolulu, which is intended for flushing drip irrigation tubing with water and chlorine. Details are given of the procedure used in installation and operation of the valves.

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Recommendations for avoiding plugging of drip irrigation tubing. R. BELEW. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 73–74.—A list of recommendations is given for prevention of plugging of drip irrigation tubing.

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Drip irrigation: problems and solutions on the island of Hawaii. R. M. BADER. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 75–78.—Experience with drip irrigation on two cane plantations, one owned by Ka'u Sugar Co. and the other by Honokaa Sugar Co., is reported. The Ka'u plantation plans to use sub-surface drip irrigation for all of its seed cane, while the Honokaa system has shown considerable improvements on the previous sprinkler system despite a number of problems.

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Drip irrigation—problems and solutions. McBryde's experience. G. WILLIAMS. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 79–82.—Experience with drip irrigation on cane land belonging to McBryde Sugar Co. Ltd. is discussed. Despite a number of problems mentioned, the company planned to increase the area under drip irrigation to 1076 acres by the end of 1976. Brief mention is made of ratooning in drip-irrigated fields.

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"Polaris" response in 1975. L. OUDMAN. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 87–92.—From examination of the results of a number of block trials with "Polaris" as cane ripener, it is concluded that the poor result (an increase of only 0·11 tons of sugar per acre over that from untreated cane) was the outcome of harvesting during heavy rain and that such results are unreliable where the difference between the rainfall in the area of treated cane and that in the control area exceeds 2 inches.

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Basic cane growing at Gay & Robinson. W. S. ROBINSON. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 96–100.—The agricultural techniques used on the smallest cane plantation in Hawaii (consisting of 2800 acres) are described.

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Basic cane growing at Waialua. M. UEHARA. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 101–105.—Cane agriculture on the 15,000 acres of land owned by the Waialua Sugar Co. is described.

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How drip irrigation affects cultural practices at Oahu Sugar Company. S. M. TUTTON. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 106–108.—The type and quantity of equipment required for drip irrigation as it is being gradually extended over all the cane land owned by Oahu Sugar Co. are indicated for each year of expansion, and the costs are shown.

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The effect of drip irrigation on cultural practices and equipment on Maui. C. T. FISHER. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 109–112.—The effect of drip irrigation on cane agricultural practices on the three plantations owned by Hawaiian Commercial and Sugar Co. is examined, with particular mention of soil preparation, replanting and ratooning, but also with briefer references to problems associated with other aspects of cane growing.

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Cultural practices for drip irrigation for Kauai. J. B. THOMSON. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 113–114.—Information is given on the agricultural practices used in conjunction with drip irrigation on cane plantations on the island of Kauai.

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Sugar cane harvester and transport developments in Florida, Texas and Louisiana. J. E. CLAYTON and B. R. EILAND. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 115–121.—A survey is presented of progress with mechanical cane harvesting and transporting in the three US mainland cane-growing states.

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Methods of removing trash from sugar cane on chopper harvesters. J. E. CLAYTON, B. R. EILAND and G. N. FRANKS. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 1975, 122–127.—After discussing the effect of the chopping system on cane cleaning, the authors examine the role of spiked-tooth cylinders (found to give good preparation of the cane for pneumatic cleaning) and then discuss cane losses caused by suction fans used to remove extraneous matter. Tests are reported, and research on fan blade design is described. Mention is made of experiments to screen trash before it enters the fan blades so as to reduce cane losses. A device for separating trash from air comprised an open-mesh conveyor belt 3 ft below the fan blade; trash on the belt passed through the fan housing and was released when the suction was reduced. Any light trash on the returning section of the belt (which was closer to the fan blade than the outgoing section) was "lifted" through the blade. A small quantity of unburnt cane was still held by the trash and discharged with it, giving a loss of 1–2% cane; this loss would be lower in the case of burnt cane. The trash was discharged by a chute to a point beside the harvester but at a level at which it would not blow onto the cane transport. A rotary perforated disc is being tested for trash screening; the advantage would be a reduction of the number and complexity of the moving parts.

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The use of rubber-tyred four-wheel drive tractors in sugar cane operations. J. LYONS. *Rpts.* 1975 *Meeting Hawaiian Sugar Tech.*, 191–195.—A representative of Steiger Tractor Inc. discusses the advantages of the title tractors in cane field operations.

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***Dactyloctenium aegyptiacum*, an additional host of sugar cane mosaic virus.** S. SINGH. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 1–2.—*D. aegyptiacum* growing in the vicinity of cane fields in Coimbatore, India, has revealed symptoms of mosaic. (See also SINGH & BHARGAVA: *I.S.J.*, 1976, **78**, 143.)

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Current status of sugar cane mosaic virus strains in Louisiana sugar cane fields. H. KOIKE. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 3–5.—Surveys of the mosaic strains in Louisiana have shown that strain H predominates, infecting 75–97% of the cane in three areas. The incidence of strain I has varied during the past 8 years, but does not appear to have increased. This strain is more severe in its effects on stands and yields than is strain H.

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Association of unusual symptoms with smut of sugar cane in the Sudan. I. A. NASR. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 6–8.—The author reports unusual symptoms of culmicolous smut on N:Co 310 cane in the Sudan. The symptoms took the form of flower derangement; the flower had seven glumes which were converted into green foliar structures, while the stamens were either suppressed or absent. The gynoecium terminated in a miniature curved or convoluted whip 1·5–8·0 cm long. The symptoms were found on many stalks in different parts of the same field.

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Fodder sorghums as hosts of ***Perkinsiella saccharicida.*** R. OUTRIDGE and D. S. TEAKLE. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 9–10.—*P. saccharicida* adults were caged with wild and cultivated seedlings of *Sorghum sudanense* and *S. bicolor* in greenhouse tests, and the numbers of the leafhopper (a vector of Fiji disease) were counted after 11 and 56 days. Most of the 15 adults added to each seedling pot died within 11 days, but oviposition sites were clearly visible in the midribs of the leaves, and small numbers of first instar nymphs were seen. Counts after 56 days showed that on three of the sorghums some nymphs had reached adult stage. To determine if field-grown sorghum might support the leafhopper, a number of plants were collected and investigated. Although many insects hatched from oviposition sites in the plants, only one nymph from a cultivated fodder sorghum proved to be *P. saccharicida.*

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Nature of the bacterium associated with ratoon stunting disease of sugar cane. A. G. GILLASPIE, R. E. DAVIS and J. F. WORLEY. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 11–15.—It is stated that, while most workers agree that the RSD agent is probably a bacterium, the exact nature of the organism and its size remain controversial. Ultrafiltration and phase-contrast, dark-field and electron microscopy have been used to increase the knowledge on the pathogen, and it is concluded that it is a non-motile coryneform bacterium measuring approximately 0·3–0·4 μm × 3–10 μm. Regarding reports that *Xanthomonas albilineans* or *X. vasculorum* is the agent, the authors point out that these pathogens do produce symptoms which are similar to RSD in certain stages.

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A sclerotial disease of the basal stem and root in sugar cane. K. C. ALEXANDER. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 16–17.—A fungal disease found on Co 419 cane in 1972-74 caused complete stunting of the stools, while the cane stalks were pale, shrunk and dying in many cases. In earlier stages of infection, the plants appeared to be wilted during late afternoon, but the leaves regained turgor during the cooler hours. In advanced stages, the stalks were dead, and the roots were found to be completely infected and stubby, while no young roots were found. Lower sheaths, wherever present, were shredded and easily removed. Diseased stools were easily pulled out of the ground; white mycelia covered the underground parts and up to 6 internodes above ground, while sclerotia were formed on dead roots just below ground level. Affected stalks, when split open longitudinally, revealed light brown, water-soaked sunken lesions which later turned dry. The pathogen is a basidiomycete with white mycelium having clamp connexions; no sporophore was noticed, and attempts to induce any were unsuccessful. The disease was reproduced with all the symptoms in pot culture studies; it was controlled by drenching with 0·25% "Ceresan" followed by copious irrigation. The fungus did not appear to belong to the *Marasmius* genus.

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Digitaria adscendens **Henrand—a natural host of sugar cane mosaic virus in the Bhabhar belt of Nainital District (of India).** R. D. JOSHI and U. P. GUPTA. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 18–19.—*D. adscendens*, an important fodder grass in the title area, has been found to be a natural host of cane mosaic. Symptoms of the disease and transmission tests involving a large number of different plants are reported.

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Bacterium associated with ratoon stunting disease in Louisiana. K. E. DAMANN and K. S. DERRICK. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 20–22.—Details are given of two techniques used to obtain bacterial extracts from RSD-infected cane for use in electron microscopy. A bacterium having distinctive morphological features was found, while healthy cane yielded no such bacterium. From the evidence, it is concluded that the bacterium is the same as that described by GILLASPIE *et al.*[1]. Staining with phosphotungstate revealed the presence of mesosomes, whereas *Xanthomonas* spp., associated by some authors with RSD, should not exhibit mesosome structure when stained.

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Anti-fungal property of mosaic virus-affected sugar cane leaf extracts. L. N. DUBEY and R. D. JOSHI. *Sugarcane Pathologists' Newsletter*, 1976, (15/16), 23–25.—Investigations to determine if extracts of cane mosaic-infected leaves inhibited germination of spores of *Colletotrichum falcatum* (the red rot pathogen) and *Ustilago scitaminea* (smut pathogen) are reported, details being given of the technique used. Results showed that the leaf sap from the infected cane significantly inhibited spore germination, the effect on *U. scitaminea* being greater. Strain B of the mosaic virus had the greatest effect on germination of *C. falcatum*, followed by strains A, F and D; strain A of the virus had the greatest effect on *U. scitaminea*, followed by strains B, D and F.

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[1] *I.S.J.*, 1976, **78**, 370.

Sugar beet agriculture

Variety tests pinpoint the best hybrids. R. C. ZIELKE. *Sugar Beet J.*, 1976, **39**, (3), 5–7.—The beet characteristics determined in varietal trials as conducted in the USA are listed, and details are given of the various types of trials conducted. Results obtained in 1975 are briefly discussed, and general trends for the future are indicated.

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Increased information from Saginaw Valley Research Farm. D. R. CHRISTENSON. *Sugar Beet J.*, 1976, **39**, (3), 8–10.—Results of experiments obtained at the Saginaw Valley Bean and Sugar Beet Research Farm in Michigan are reported. Comparison of beet yields in four 3- and 4-year rotation systems showed that maximum was achieved with a corn-corn-beet system, followed by beans-beans-beet and corn-corn-beans-beet, although corn-corn-corn-beet yielded the lowest of all systems; while oats-beans-beet gave the lowest beet yield of the 3-crop systems, oats-alfafa-beans-beet gave the second highest yield of the 4-crop systems. *Rhizoctonia* crown rot was found to be affected by crop rotation and was 4 times greater when beans were grown immediately before the beet crop. The organism survives on bean residue but not on corn stalks, although the incidence of the disease is so small that it has not affected yields. Beet and sugar yields per acre were greater with 19-inch row spacing than with a 14-inch spacing, while results for a 28-inch spacing were the poorest of the three. Moreover, beet quality tended to be better with the narrower rows. While broadcast application of 200 lb di-ammonium phosphate plus banding of 100 lb gave the highest beet yield of the various combinations tested (all based on a total application of 300 lb), increase in the amount applied by banding caused a general fall in yield, but the lowest yield was given by broadcast application of all 300 lb. Beet and sugar yield were higher when 60 lb N was carried over from a previous corn crop, and 80 lb was applied to the beet, than when 160 lb N was carried over. On the other hand, 160 lb N carried over plus 40 lb applied gave the highest sugar yield per acre. However, juice purity fell with the quantity of N carried over and/or applied. The extent of N carry-over depends on the type of previous crop.

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A long look at sugar beet quality at harvest. M. G. FRAKES. *Sugar Beet J.*, 1976, **39**, (3), 11–15.—The growth stages of the sugar beet are described, with particular attention focused on the physiological processes taking place at maturation, when the cell walls harden and sugar is accumulated. Agronomic and climatic factors affecting beet growth and quality are discussed, and recommendations are given on how the grower can achieve maximum results by optimizing soil condition, nitrogen application and harvest time.

Trials of commercial varieties of sugar beet. D. S. KIMBER and S. F. H. MCCULLAGH. *British Sugar Beet Rev.*, 1976, **44**, (2), 8–9.—Details are given of beet varietal trials conducted by the National Institute of Agricultural Botany (NIAB) in 1973–75. Data for 10 varieties include root number and yield, sugar content, sugar yield, clarified juice impurities content, and bolter percentage. A new variety, "Amber", has been added to the list of recommended varieties, since it has higher than average sugar content and low impurities content, gives above-average sugar yield and suffers from only a low incidence of bolting. "Sharpes Klein E", more widely grown than any other variety in the UK during the past 40 years, has suffered from a drop in performance in recent years and has been removed from the recommended list.

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Group harvesting. D. CHARLESWORTH. *British Sugar Beet Rev.*, 1976, **44**, (2), 11–13.—Information is given on three farmers' groups in Suffolk, made up of 5, 5 and 6 members, who pool labour resources and equipment for beet harvesting and transportation to Ipswich sugar factory. The pattern of operation in each group is explained and advantages of the system are indicated.

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Effective subsoiling. G. SPOOR. *British Sugar Beet Rev.*, 1976, **44**, (2), 28–29.—In a discussion of subsoiling, it is pointed out that there is a critical depth, below which operation of a subsoiler may cause compaction rather than the desired loosening of the soil. The critical depth can be increased by widening the share point on the subsoiler or by loosening the surface layers before subsoiling, the second method being regarded as the more efficient. Various aspects of subsoiler operation are discussed, and a number of points listed, consideration of which is recommended so as to ensure that the maximum effect of subsoiling is obtained for the large amount of energy expended.

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The wild beet danger—bolters must be removed. ANON. *Die Zuckerrübe*, 1976, **25**, (4), 13.—The problem of "wild" beet and the need to eliminate these bolters are briefly discussed. Best remedial means is considered to be removal of the flower heads. Advantages of bolter removal are indicated.

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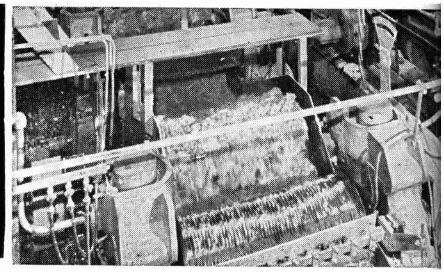
Straw—what is to be done with it? ANON. *Die Zuckerrübe*, 1976, **25**, (4), 13.—Where cattle breeding is not practised or stubble not burnt (because of discouragement by local authorities), the question of what to do with straw is important. Its incorporation in the soil is one answer, but a number of measures need to be carried out in this case, and these are discussed.

Cane sugar manufacture



Pulverized coal firing of small boiler plant. A. G. HURTER. *S. African Sugar J.*, 1976, **60**, 217–229. See *I.S.J.*, 1976, **78**, 183.

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Classified crystal recycle with continuous pans. A. D. RANDOLPH and E. T. WHITE. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 179–181. Of major concern in continuous boiling is the crystal size distribution, which tends to increase as a result of the differences in residence times. While the usual approach is to use a large number of units in series or a multi-compartmented vessel, and thereby give a residence time distribution approaching that of a batch pan, such multiple units are costly to construct and pose certain operational problems. An alternative solution is to pass the final product through a classifier which would remove the large crystals as product and recycle the under-sized crystals for further growth. Advantages of such a scheme are discussed, and mention is made of a computer programme developed for calculation of continuous boiling parameters where classified crystal recycle is used. The model was used to compare two systems, one with and the other without classified crystal recycle; the classifier was found to permit considerable reduction in the coefficient of variation. Use of the model to examine other variables, such as the effect of crystal breakage on steady-state operation, and seeding rate, is also mentioned.

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Sugar crystallization: a pan stage advisory scheme. J. A. FREW and P. G. WRIGHT. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 191–198. The application of a mini-computer and visual display at Racecourse factory to decision making in the pan station is reported. Two out of four levels of generally increasing complexity into which the decision system is divided were implemented in 1975. In the first level, the cycle is largely pre-determined and all the advice is based on measurements available at the time of decision, so that no prediction is involved. The starting procedure is divided into requirements which are mandatory and those that are recommended. The recommendations relate to the level in the feed tanks; while values of the parameters are selected to maintain the stage in balance and to minimize pan idling, when the level in any one tank falls below a minimum, the advice is given to place all the pans fed by that tank on idle. Advice on the rate of pan feeding is handled in a similar way, the rate being directly related to the level in the feed tank. If the level in a pan exceeds the normal value when full (plus a tolerance) and is continuing to rise, warning is given to terminate the feeding period and start heavying-up. Advice on centrifugal operation is on a first-come, first-served basis. The second level extends the recommendations for starting of the pans by replacing the feed tank level parameter with a prediction of feed requirements and supplies over the feeding period, which involves forecasting centrifugal operation and the likely pan dropping time. Results obtained from 4 months of operation are discussed. The Level 1 starting advice was only of help when pan operation was according to plan, and, while it could be useful in eliminating some erratic behaviour, it did not consider enough of the factors to be of assistance when abnormal conditions arose. The Level 2 scheme was a considerable improvement in this respect and could match the supervisors over a much wider range of conditions. However, its shortcomings lay in the determination of the massecuite receiver and centrifugal status, since the system assumed a fixed boiling cycle with maximum feeding, whereas the station at Racecourse allows for considerable flexibility in the boiling cycle arrangement.

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Final actuators—there is a choice. P. J. PIETILA. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 199–203.—Of importance in a control loop is the final actuator, which provides motive power for operation of valve, damper, etc. Desirable features of an actuator are listed, and the basic types of final actuators described. Advantages and disadvantages of each type (pneumatic, electric and hydraulic) are indicated.

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Control of a clarification station. R. L. MULLER. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 215–218.—At Millaquin, the mud level in the clarifier is controlled by ultrasonic interface probes, signals from which are transmitted to pre-set timers controlling the draw-off valve, so that flow rate can be increased or decreased or maintained constant (for which the timers are adjustable) according to requirements. The mud flows by gravity to a receiver and thence to a positive-displacement air pump which transfers it to a surge tank mounted above the bagacillo mixer. From this mixer, the mud gravitates to the mud filter. Possible future controls are also briefly discussed.

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Flocculant:juice ratio control. D. J. HALE and B. PARTRIDGE. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 219–225.—For control of the flocculant:juice ratio in a clarifier, a Fischer & Porter magnetic flowmeter in the juice line transmitted signals to a flow recorder and to a Foxboro ratio station which in turn fed signals to a variable-speed drive unit controlling the pump used to transfer the stock solution of flocculant to the juice line. The open loop system used operated satisfactorily in tests within a range of 1·6–4·0 ppm flocculant at an average clarifier feed rate of 250 m^3 per hour with fluctuations of $\pm$ 50 $m^3.hr^{-1}$. Costs are briefly discussed.

Clarification of cane juice between inclined surfaces. G. A. BROTHERTON. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 227–234.—Experiments on juice clarification in inclined tubes are reported, in which it was found that the same efficiency could be attained as in a vertical tube at a much higher upward flow velocity. It was subsequently found that inclined surfaces could give the same effect as tubes, and a test unit was set up having a slope of 60° to the horizontal (at which angle the greatest increase in upflow rate was achieved compared with vertical surfaces). Results showed a similar performance to vertical surfaces but at a 100% increase in flow rate. However, a commercial unit would need a number of tubes or surfaces, and the distribution of feed in such equipment has yet to be examined. The question of mud blockage also requires more investigation.

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Improved mud centrifuge performance at Mossman. P. N. STEWART, A. G. NOBLE and G. A. BROTHERTON. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 235–240.—Investigations of cane mud treatment in the "MercoBowl 22 L" centrifuge at Mossman[1] showed that cane treatment by a new shredder installed at the factory provided finer bagacillo and thus improved centrifuge performance, particularly when the shredder speed was raised from 750 to 900 rpm. The pol loss and mud retention compared favourably with the results obtained with a filter. Wax and nitrogen removal was also the same in the centrifuge as in the filter. While mud solids retention was improved by adding dilution water to the feedline, this was at the expense of an increased pol loss, and it is therefore preferable to add all or most of the wash water in the bowl. While the centrifuge is easier to operate and there is less ancillary equipment needed, the economics still do not favour the centrifuge because of its limited capacity, although future availability of larger machines could alter the situation.

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Characteristics of a louvre-type bagacillo separator. P. C. IVIN and R. N. CULLEN. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 241–247. Tests on a pilot-scale louvred bagacillo separator, such as is being used in South Africa, are reported. Bagasse is fed across a louvre screen by means of a metering roll which controls feed rate. The bagacillo is sucked through an adjustable gap between the louvres and is conveyed pneumatically to a cyclone. At an optimum louvre pivot angle of 80°, a gap of 38 mm between louvres and a drum speed of 2 rpm (corresponding to a bagasse feed rate of about 77 $kg.min^{-1}.m^{-1}$), 98% of the bagacillo obtained was of 14 mesh size. If the air capacity was increased and hence the collection rate (from 550 to 1300 $kg.hr^{-1}.m^{-1}$), the proportion of 14-mesh bagacillo was reduced to 92%. Reduction in the number of louvres from 8 to 6 reduced bagacillo quality and considerably decreased recovery.

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Residence time of crystals in a continuous centrifugal. R. J. SWINDELLS and E. T. WHITE. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 249–253. So as to improve the accuracy with which estimation is made of the massecuite layer thickness on the wall of a continuous centrifugal basket, measurements were made of the velocity of the layer by means of a cine camera filming at stroboscopic speed (i.e. one exposure per revolution); this enabled a picture to be taken each time the basket rotated through one revolution, so that the same crystal could be captured on a number of frames and its motion up the basket traced. Velocities were plotted for a massecuite throughput of 5–8 $tons.hr^{-1}$; wide scattering occurred (reasons for this are suggested), and only 60% of the basket height could be photographed because of the stroboscope light dimness and the presence of steam. Velocity did not seem greatly affected by crystal position on the screen, so that extrapolation for the whole basket was considered valid. From the crystal velocity profile, both layer thickness and residence time can be estimated by means of an expression which is given. Calculation showed that at a mean crystal size of 0·35 mm, the layer varied from 17 crystals thick at the bottom of the screen to 7 crystals thick at discharge, i.e. an approximate ratio of 2·5:1.

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Massecuite heating by finned tubes. L. K. KIRBY, J. N. NESS and E. J. STEWART. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 255–262. Experiments with a finned-tube massecuite reheater of 75 m^2 heating surface are reported in which massecuite temperature was raised from 41·3–51·1°C to 54·8–62·3°C at a throughput averaging 5·55 tons per hour. The overall molasses purity rose by 1·08 units from unheated massecuite to centrifugal discharge. The results are tabulated from 27 trials. Possible applications include a single-stage scheme in which massecuite is heated in individual units, one per centrifugal, from 38° to 55°C, and a two-stage system in which the cold massecuite is first heated in a common finned-tube heater and then in individual heaters; the authors favour the single-stage system. Also suggested is the installation of a finned-tube heater just after the crystallizer to raise the temperature to 45°C before existing resistance heaters. The results also indicate the possibility of raising the temperatures in the centrifugals so as to gain the advantage of reduced molasses purity with higher loading.

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Effect of crystal on the viscosity of massecuites. M. AWANG and E. T. WHITE. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 263–270.—The effects of crystal properties (amount, size range and shape) and properties of the mother-liquor (total solids, purity and type of impurities) as well as temperature and shear rate on the apparent viscosity of a massecuite were investigated; the importance of each variable is indicated by the increase required to cause a 20% drop in viscosity, showing that temperature, molasses total solids content and crystal content are the major variables. Correlations between the last two parameters and viscosity were established and plotted for molasses from various sources, but it is stated that they are based on limited data and apply to deaerated samples; air bubbles have marked effects on results.

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Comparisons of a reciprocating-element crystallizer with a coil-type crystallizer. J. N. NESS and E. J. STEWART. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 271–282.—Comparative tests were

[1] STEWART *et al.*: *I.S.J.*, 1976, **78**, 85.

conducted on a new, patented crystallizer with reciprocating element, designed and manufactured by the Bundaberg Foundry Co. Ltd., and a Burnett crystallizer with rotating coil. While comparison of the crystallizers cooling the same massecuite was possible, assessment of the relative performance of the same crystallizer from test to test was more difficult because of the effects of uncontrolled variables, principally the change in massecuite properties. The new crystallizer gave substantially higher cooling rates than did the Burnett crystallizer, chiefly because of the greater surface area per unit volume, but an increase in the heat transfer coefficient was also established. The quantitative effects of the speed of reciprocation and of water flow rate on the coefficient could not be measured because of other uncontrolled variables. The new crystallizer also provided a greater molasses purity drop, viz. a 1·5 units decrease after 8 hours, compared with the Burnett crystallizer.

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Rapid "dextrans" formation in stale cane and its processing consequences. W. D. WELLS and G. P. JAMES. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 287–293.—The situation at South Johnstone, where a mill breakdown lasting some 29 hours caused a 3400% increase in cane dextran content and a c.c.s. loss greater than 14%, is described. Since the 5400 tons of cane affected could not be processed efficiently, a loss of $A1800 per hour was estimated. In view of this, enzymatic removal of dextran is recommended for such cases of rapid juice deterioration.

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Dextranase. II. Practical application of the enzyme to sugar mills. P. A. INKERMAN and G. P. JAMES. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 307–315.—The use of "Glucanase D-1" enzyme to hydrolyse dextran was tested at South Johnstone and Babinda. Full details are given of the investigations. Results indicated a 95–97% removal of dextran, leading to major improvements in factory performance and sugar quality despite the crushing of seriously deteriorated cane. However, it is stressed that the process is not to be recommended for general use because of the high cost of the enzyme and the possible introduction of inefficiency into harvesting, but it is of value where mill breakdowns or unavoidable delays occur. Complete removal of dextran is not considered essential in order to obtain major benefits.

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Treatment of sugar mill waste by shallow ponding. J. F. BOND and K. E. MCNEIL. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 317–318. The scheme used at Pleystowe for treatment of effluent consists of five shallow ponds (1 m deep) of 15·31 ha total surface area; waste water (containing oil, grease and large quantities of fly-ash as well as the normal impurities) of 300–1200 $mg.litre^{-1}$ BOD_5 is discharged to the ponds at a maximum rate of 90 $m^3.hr^{-1}$, while at the weekend a maximum of 227 m^3 of effluent of 5000 $mg.litre^{-1}$ BOD_5 is also transferred, the ponds taking 1–3 weeks to fill. In 1975, the longest treatment period was 9 weeks, and the temperature was 20–27°C. Anaerobic treatment lasted for the first 3 weeks, during which 70–90% of the BOD was removed, after which aerobic treatment took place, with growth of algae. The BOD_5 of the treated effluent was below 26 $mg.litre^{-1}$, while the dissolved oxygen content of the emptied ponds was 1–9 $mg.litre^{-1}$; however, the oil and grease contents as measured at three discharges were above the permitted level, so that traps to prevent these substances entering the ponds are necessary. Mechanical aeration was found necessary for some ponds to cope with the load; otherwise, for a factory of 400 t.c.h. capacity and producing 140 $m^3.hr^{-1}$ effluent, the minimum total pond surface area should be almost double that at Pleystowe.

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The water cycle in a sugar mill. K. A. STUART. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 319–321.—A typical hot water balance for a factory crushing 100 t.c.h. is presented and means of reducing water outflow are examined. Since the major source of effluent is excess hot water, the logical approach is to cool this water and recycle it where possible, thus reducing outflow and decreasing cold water requirements.

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What every sugar mill owner should know—and is afraid to ask. A. L. WEBRE. *Sugar J.*, 1976, **38**, (12), 15–16.—The two cane sugar factory processes where there is greatest scope for increasing efficiency, i.e. milling (with its effect on bagasse losses) and sugar-house work (with its effect on molasses losses) are examined. Failure of cane mill top rollers to float may be an indication of too rapid a throughput, leading to reduced extraction, or of excessive hydraulic pressure, which may also reduce extraction by compressing the bagasse and causing reabsorption. The author advocates that all mills be fitted with float indicators, and also recommends restricting the speed of the rollers to 5–6 rpm as is generally considered advisable. The value of the glucose:ash ratio as a criterion of molasses exhaustibility is discussed. Where final molasses purity is too high, attention should be paid to boiling, crystallization and centrifugal performance. Determining the molasses purity in the massecuite after the crystallizers but before spinning, and comparing the result with the purity of molasses discharged from the centrifugal, is recommended as a means of deciding whether centrifugal operation is responsible for poor results. Possible causes of inefficiency in boiling and cooling are briefly mentioned.

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The progress of TSC's engineering. ANON. *Taiwan Sugar*, 1976, **23**, 55–60.—Modernization of Taiwan Sugar Corporation's sugar factories in the 10-year period starting in 1958 is discussed, with details given of the number of new pieces of equipment installed. The crushing capacities of certain mills in 1967 are compared with 1976 figures, and the fuel consumption and surplus bagasse over the 30 years of TSC's existence are given. Improvements in processing techniques and control are indicated, and other measures introduced to increase efficiency are discussed.

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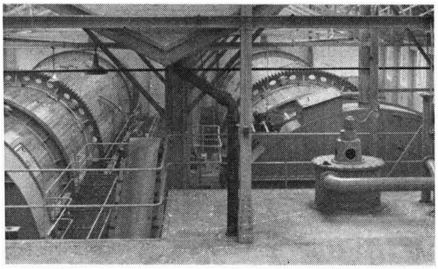
Thirty years' research achievements of the Sugar Technology Department. C. J. LU. *Taiwan Sugar*, 1976, **23**, 105–106.—The research and development work undertaken by the Department of Sugar Technology at the Taiwan Sugar Research Institute is surveyed.



Beet sugar manufacture

Purity determination by on-line method in sugar factories. J. Ponant and G. Windal. *Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 14 pp.—From investigations of factors governing conductivity of sugar solutions, it has been found that a linear relationship between temperature and conductivity is valid for only a limited temperature range, since temperature rise is accompanied by a rise in the Brix at which conductivity is maximum. As temperature rises, it increases the ionic dissociation and ionic mobility, so that the viscosity falls and affects the conductivity measurement at temperatures far greater than 20°C but not yet approaching boiling point. The increase in conductivity is not proportional to the rise in Brix, however, because of the associated decrease in ionic dissociation and mobility (viscosity being linked to Brix). However, conductivity increases with fall in purity, and purity P is related to the maximum conductivity y_{max} thus: $P = 100 - ky_{max}$, where k is a constant. (Tabulated values of k obtained by continuous measurements at 10 factories during the 1975/76 campaign showed that the value changes only slowly.) Formulae have been derived which relate conductivity to Brix and purity at a given temperature as well as to the non-sugars:water ratio, including an exponential term to cover ionic dissociation and viscosity. The expressions apply to a wide range of sugar factory products.

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Purity determination in sugar factories. Realization of an on-line measuring device. G. Windal. *Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 16 pp.—The studies reported in the preceding abstract were applied to investigation of a method for purity determination based on the relationship between purity and maximum conductivity. Since a change in Brix causes the conductivity to pass through a comparatively "flat" maximum, a type of "landing" being reached when the temperature is fairly high, measurement of the conductivity "landing" was selected as being simple and inexpensive. The equipment consisted of an electronic box (containing conductimeters and temperature and speed controllers) connected to 1–3 hydraulic boxes, each containing two pumps for controlled dilution to give a Brix of 30° (at which variation in conductivity is minimal), a preheater, decanter, measuring cell and rinsing device. Eleven sets were installed in sugar factories for the 1975/76 campaign. Results were completely satisfactory, with an indication accuracy usually greater than 0·5 units. Some improvements have been made to the equipment and are briefly described.

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Patterns of work—factory operations. P. M. S. Dixon. *Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 13 pp.—The social aspects of sugar factory work are discussed, and trends in staffing requirements and in employee demands under the effect of modern developments in equipment and processing are indicated.

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Micro-processor control of sugar boiling. R. J. Bass and J. Donovan. *Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 17 pp. The use of mini-computers using direct digital control techniques for vacuum pan operation is discussed. It is stated that the cost of an installation was so high as to make its use for one pan economically unjustifiable, but that the mini-computer had the potential to control many pans and would, in addition, offer the service of logging factory process parameters and provide alarm monitoring throughout the factory. For such a task, the computer needed a relatively large memory, a comprehensive plant interface system and an extensive network of interconnecting cable; the design, construction, installation and commissioning of such a project is a major undertaking. The hardware and software used for the system introduced at Bury St. Edmunds to control a *C*-massecuite pan on the basis of conductivity measurement is explained. Centred around an Intel 8080 micro-processor, the system monitors all the measurements from the pan every 100 milliseconds, checks interlocks and calculates the new outputs. The memory device is a programmable read only memory (PROM) which is erasable by ultra-violet light. Electrons are injected into a floating gate and the charge held until it is irradiated with U.V. light, resulting in a flow of photo-current from the floating gate and return of the memory to its original unprogrammed state. The system has achieved very good control of pan boiling, as demonstrated by a trace of massecuite level, conductivity and absolute pressure.

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Schemes for mechanization of loading, unloading, conveying and storage operations with basic goods at sugar factories. N. M. Kichigin, N. A. Emel'yanov, I. B. Somorov, A. V. Balakan and A. A. Kozyarevich. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 3–22.—A survey is presented of the present level of and future trends in development of mechanical schemes for handling beet, pulp, limestone and sugar at factories in the USSR, and a number of suggestions are put forward on the basis of technical and economic analysis.

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Determination of the level of loading, unloading, conveying and storage mechanization at sugar factories. N. A. Emel'yanov. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 22–27.—A mathematical method for determination of the level of mechanization in the title operations is explained.

Present-day technical and technological requirements of beet pilers. I. A. Marochko, L. A. Kuznetsova and V. A. Novikov. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 28–43.—The desirable features of modern beet piling systems, as used in the USSR, are discussed, and results are given of trials to evaluate the extent to which the values of given parameters approach theoretical values.

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Determination of the optimum distance of beet delivery by pneumatic-tyred front-end loaders. I. B. Romashkevich and V. A. Novikov. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 43–47.—The economics of beet recovery and loading by front-end loaders and tipper trucks are briefly discussed.

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An improved mechanization scheme and equipment for bagged sugar storage. V. I. Vasil'ev *et al.* *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 47–59.—The present state of mechanization in bagged sugar storage is described and details are given of a modern scheme for conveying the sugar in bags and stacking it in the warehouse.

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Pneumatic conveying of white sugar. T. K. Vasil'eva. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 59–68.—A survey is presented of pneumatic conveying of white sugar to and from transporters, and recommendations are given on the basis of results achieved in various countries.

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Examination of pneumatic conveying of white sugar at high air mixture concentrations in an experimental pilot-scale unit. T. K. Vasil'eva, A. F. Zaborsin, A. P. Fedorov and N. F. Kosogor. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 69–77. Details are given of an experimental pneumatic conveying unit for transferring white sugar at a sugar: air weight ratio greater than 10:1. Trials showed that crystal breakage over a distance of 150 m was within the limits corresponding to attrition in modern dryers.

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White sugar bulk carriers. N. M. Kichigin, I. I. Novogurskii, V. A. Prostibozhenko and V. I. Grushchenko. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **22**, 78–84.—The design of a road carrier for bulk white sugar with gravitation discharge is described and some tests are reported.

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Adsorption of colorants during carbonatation of sugar-lime solutions. S. Z. Ivanov, M. V. Goncharuk and N. P. Kozel'tsova. *Izv. Vuzov, Pishch. Tekh.*, 1976, (2), 17–21.—In studies of colorant adsorption by $CaCO_3$, aqueous solutions of caramels, melanoidins and reducing sugar alkaline decomposition products were added separately to a 2% CaO solution with and without the presence of sucrose. The solutions were heated to 80°C and subjected to controlled laboratory carbonatation. Results showed that at a pH corresponding to 11–12 at 20°C, the presence of sucrose greatly increased adsorption compared with the lime solution alone; increase in the sucrose concentration from 10% to 20% affected only caramel adsorption, which rose by 25–30%, but, since 98% of carbonatation juice colour is caused by the other colorants investigated, this effect is considered unimportant. Adsorption of melanoidins and caramels was not affected by addition of 1–2% pure $CaCO_3$ before gassing; only at 3% did the carbonate cause a drop in adsorption, while reducing sugar alkaline decomposition products remained unaffected. Addition of washed recirculated carbonate mud caused a 15–20% fall in caramel adsorption and a 3–5% fall in adsorption of the other colorants; absence of washing led to even less effect on adsorption, which was thus confirmed as practically irreversible, so that juice and mud can be recycled with the aim of improving filtration. Oversaturation (to a pH below 11 at 20°C) led to an increase in optical density, indicating colorant desorption and pointing to the need to maintain the 1st carbonatation pH at optimum. The mechanism of colorant adsorption during carbonatation for 20–22 minutes is explained for each colorant with the aid of curves showing the progress of decolorization and alkalinity. Wide fluctuation in colorant adsorption was observed, maximum effect being achieved at greatest accumulation of colloidal $CaCO_3$.

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Method of controlling continuous centrifugals. G. M. Chudakov, V. A. Maslikov and V. I. Pugachev. *Izv. Vuzov, Pishch. Tekh.*, 1976, (2), 96–99.—In an investigation of the possibility of stabilizing low-grade sugar quality in a continuous blade-type centrifugal similar to that described earlier[1], the weight ratio between the 1st and 2nd run-offs was used as control parameter, with two slit-type flowmeters acting as ratio-regulating means by altering massecuite feed under the effect of an electronic control linked to a differential manometer measuring system. Mathematical expressions are written for the various relationships involved in control under non-steady conditions, viz. mother-liquor viscosity and effective sugar crystal size, and run-off level in the collector.

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Mathematical simulation of continuous multi-compartmented vacuum pans. I. S. Gulyi, I. M. Fedotkin and E. M. Brusilovskaya. *Izv. Vuzov, Pishch. Tekh.*, 1976, (2), 114–118.—Response curves were plotted for the continuous vacuum pan at Gnivan with the aim of establishing the effect of the number of crystal growth chambers (up to 10) on boiling of *A*- and refined massecuites. The mathematical simulation method used was based on the Markov circuit theory whereby each compartment is represented as a non-ideal mixing vessel definable by a stochastic mixing model. Each compartment is sub-divided into ideal mixing zones and it is assumed that the residence times of a marked particle in each zone will be identical. Three variants were calculated by computer. The probability matrices for each are given. Calculated and experimental results were in agreement.

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Statistical method of establishing optimum conditions for intensification of heat transfer to sugar solutions of high concentration. S. M. Konstantinov and N. N. Bezpal'ko. *Izv. Vuzov, Pishch. Tekh.*, 1976, (2), 119–123.—Investigations were conducted with a single-tube circulation circuit in which steam was injected into 70°Bx sugar solution in order to increase heat transfer. The tube was separated into 8 equal sections, and the amount of condensate formed on the tube wall during 20 minutes' heating was deter-

[1] Oplt & Přidal: *I.S.J.*, 1976, **78**, 312.

mined as well as temperature of solution, tube wall and reheat steam, and steam pressure. The effect of steam injection on heat transfer was evaluated statistically and a regression equation developed which was found to describe the relationship sufficiently accurately.

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Split separation of crystals with low-grade massecuite working—trials in the 1975 campaign. F. AMDING. *Zucker*, 1976, **29**, 317–319.—The effect of crystal content on low-grade massecuite viscosity is discussed, wherein it is shown that an increase from 40% to 45% in crystal content at 50°C causes the same rise in viscosity as does a reduction in the temperature from 75° to 50°C. Since the aim is to reduce viscosity and increase sugar recovery, tests were conducted at Munzel in 1975 in which the contents of four low-grade pans were discharged to the first of a series of six crystallizers. The massecuite from the last crystallizer was transferred to four continuous centrifugals. About 35% of the total massecuite was withdrawn from the first crystallizer and spun in a separate centrifugal. The sugar was then mixed with that from the other four centrifugals and dissolved in thin juice for boiling together with thick juice; the molasses from the four continuous machines was transferred to a storage tank, while that from the separate machine was pumped via a feed tank to the second crystallizer in the series. The process, which has reduced massecuite viscosity considerably and thus contributed to improved molasses exhaustion, was incorporated in the normal factory scheme during the second half of the campaign.

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The development of the Greek sugar industry in the last 15 years. D. HADJIANTONIOU. *Zucker*, 1976, **29**, 325–330.—A survey is presented of the Greek sugar industry, including beet and sugar production data from 1961 to 1975, descriptions of the factories (with mention of equipment and products), average performance data from the five campaigns up to and including 1975/76, and future prospects.

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Scaling of sugar factory evaporators during the 1975-76 campaign. P. DEVILLERS, R. DETAVERNIER and M. GROULT. *Sucr. Franç.*, 1976, **117**, 245–249.—Weekly measurements were made by atomic absorption spectrometry of the calcium and silicon contents of juice before and after evaporation at 18 factories. Results are tabulated, showing that in only 4 cases was there no calcium deposit on the tubes and in only 1 case was there no silicon deposit. The effects of scale inhibitors at selected factories were also determined, but it is stressed that the effectiveness of these will vary according to conditions. The silicon content can be reduced by careful attention to 1st carbonatation juice filtration and by maintenance of as high a pH as possible during 1st carbonatation.

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Reverse osmosis in the sugar industry. A. BALOH. *Sugar J.*, 1976, **38**, (12), 19–25.—See *I.S.J.*, 1976, **78**, 122.

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Iodophores for beet disinfection. F. X. KAMMERER. *Zeitsch. Zuckerind.*, 1976, **101**, 409–411.—Reasons for increased usage of formalin in beet diffusion are discussed, and disadvantages and limitations of this and other disinfectants indicated. The use of iodophores is explained; these contain complexes of iodine with a surface-active agent, so that the active ingredient is made water-soluble and does not have the corrosive effect that iodine has on its own. A list is presented of commercial brands manufactured by firms in a number of countries, and a typical composition is given. The concentration recommended for most purposes lies in the range 15–300 ppm a.i. For beet treatment after washing, 40 kg of iodophore per 10,000 tons of beet is adequate for disinfection. Although at 5–35°C the iodophore is independent of temperature, above 35°C volatilization takes place with rapid decomposition of the complex. Addition of 1·5 litres of "Webco" (manufactured by Biesterfeld-Chemietechnik KG) per hour to beet at the rate of 36 litres per 10,000 tons (at a concentration of 50–100 ppm) plus 1000 litres of formalin, coupled with spraying of the beets with 30 m^3 condenser water per hour, reduced the thermophile population from about 4 million to about 27,000 per cm^3. The economics are briefly discussed; despite the relatively high cost of iodophores, the overall disinfection costs are reduced by one-third through the decrease in formalin consumption.

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Qualitative classification of 14 limestones of Greek origin for their use in the Greek sugar industry. K. M. SIPITANOU and D. S. MITKA. *Hellenic Sugar Ind. Quarterly Bull.*, 1976, (25), 67–101.—Limestone samples from the six different regions of northern Greece from which the sugar factories draw their supplies were analysed for settling rate, available CaO and thermal reactivity of the lime produced. Results are given in graph form, and photomicrographs showing the surface structure of each type are reproduced.

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The (Greek) sugar industry and the energy crisis. P. HRISTODOULOU. *Hellenic Sugar Ind. Quarterly Bull.*, 1976, (25), 119–127.—Details are given of the boilers, turbo-generators and evaporators at the five Greek sugar factories (Larissa, Platy, Serrai, Xanthi and Orestias); oil consumption for steam generation and pulp drying, and coke consumption for lime kiln operation at the factories in 1975 and at all but Orestias in 1972-74 are also tabulated, showing a progressive improvement with each campaign. Best performance has been achieved at Platy, where average fuel consumption in 1975 was 3% on beet, compared with a rated consumption of 4·2% on beet guaranteed by the factory suppliers. A heat flow scheme for Platy factory is presented.

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Reduce beet handling losses. J. B. FITTS. *Sugar Beet J.*, 1976, **39**, (3), 2–4.—Comparison between the sugar recovery from beet at the Monitor Sugar Co. in 1975 and 1973 shows that the results were better for the earlier years, whereas the 1975 figures should have been better, judged on the basis of average beet sugar content as delivered to the factory. The resultant loss in 1975 was calculated to be over $800,000. The losses were mainly attributed to injury caused to the beet by mechanical handling from harvesting to piling, and to increased respiration rates during storage when temperatures rose to 20°C or higher. The company has introduced means of cushioning the fall of beet into road trucks and pilers.

Sugar factory quantities. M. FRIML. *Listy Cukr.*, 1976, **92**, 102–106.—Formulae are given for calculation of chemical control parameters under the SI system.

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Sugar beet and sugar cane in Spain. ANON. *Die Zuckerrübe*, 1976, **25**, (4), 23.—A short survey is given of beet and cane agriculture in Spain, with brief mention of factory processing.

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Experience in operation of Zhabinka sugar factory. G. I. BEL'KO, N. A. SHUT, N. B. SHESTAK and L. G. BELOSTOTSKII. *Sakhar. Prom.*, 1976, (6), 23–27. Information is given on equipment and processes at this Soviet factory, performance of which in October-December of the 1975/76 campaign was better than rated.

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More about biological treatment of sugar factory waste waters. B. M. SHAKHNOVICH. *Sakhar. Prom.*, 1976, (6), 28–30.—The chief reason for failure to introduce biological treatment of effluent in factory schemes in the USSR is considered to be the large land requirements, which have been put at 100–150 ha for a factory of 3000 tons daily slice. However, there are a number of factors which need examination, and these are discussed. The question of mechanical treatment and subsequent use of the treated water for irrigation of crops is also examined.

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Treatment of sugar factory waste waters for irrigation of agricultural crops. V. T. DODOLINA. *Sakhar. Prom.*, 1976, (6), 30–33.—The use of Class III effluent as irrigation water, after suitable treatment to reduce the contents of bicarbonates, suspended matter and organic matter, is discussed and the contents of valuable nutrients in effluent from a number of Soviet factories are indicated.

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Provision of beet pilers with sprayers for treatment of beet roots with liquid preparations during piling. N. M. IGNATOV and M. F. KINYAKIN. *Sakhar. Prom.*, 1976, (6), 48–52.—Full details are given of the layout and operation of a spray system for application of e.g. milk-of-lime to beets as they are being piled.

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Control of calcined lime and wash water feed to the slaker. A. A. VIL'SHANSKII, K. F. GERBUT and B. A. EREMENKO. *Sakhar. Prom.*, 1976, (6), 52–56.—A description is given of an automatic control scheme for maintenance of desired quantity and density of milk-of-lime according to factory requirements.

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The level of modern slicer technology—design and features, economics and trends in development. H. KOETHKE. *Zucker*, 1976, **29**, 368–377.—The history of beet slicer development is surveyed, starting from the three basic types from which present-day machines have evolved. Slicer arrangements for factories of given daily slice are discussed, as are the capital, running and repair costs of modern slicers. Types of drive as used in slicers manufactured by H. Putsch & Comp. are examined, and slicer performance evaluation is explained.

The centrifugal in the sugar industry and its development. P. H. PITHOIS and A. MERCIER. *Ind. Alim. Agric.*, 1976, **93**, 535–541.—After a résumé of the role of the centrifugal in crystal sugar recovery, the authors examine the development of the batch and continuous machine. While the batch centrifugal has reached its zenith in the form of the fully-automatic machine, the continuous centrifugal, having appeared much later, is still undergoing development. Advantages and disadvantages of continuous machines are considered, and operational conditions under which optimum performance can be achieved are explained. While little progress was made in improvement of continuous centrifugal performance for some time after the machines were first introduced in the sugar industry, more recently major developments have been brought about, e.g. increase in basket diameter, steam treatment of massecuite before it is fed into the centrifugal, and means of maintaining desired crystal size by reducing the fines content.

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Recent progress in electrodialysis. P. PIERRARD. *Ind. Alim. Agric.*, 1976, **93**, 569–581.—The principle of electrodialysis, its use on an industrial scale and its fields of application are discussed. Among the processes described is demineralization of *B*-massecuite run-off and beet molasses to recover sugar. Tests by Raffinerie Tirlemontoise S.A. have shown that up to 38 kg of sugar per m^3 can be recovered at a daily throughput of 1000 m^3 and a demineralization efficiency of only 25·6%. The 20–30°Bx molasses is treated at a temperature of 40–50°C, which gives the best compromise between conductivity and viscosity.

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Flocculation processes for clarifier underflow in beet sugar factories. V. M. JESIC. *Zeitsch. Zuckerind.*, 1976, **101**, 457–459.—Experiments were conducted on a modification of the "Rapi-Floc" process for use in beet sugar factories, in which clarifier mud was adjusted to the pH of 1st carbonatation juice and 5–6 ppm flocculant added before the vacuum filter. Lime salts content, colour content, filter cake sugar losses and sweet-water purity were determined. The filtrate was clear and of sufficient purity to be sent direct to 2nd carbonatation. Advantages of the process are indicated.

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The effect of limestone and coke particle size on the quality of lime and carbon dioxide produced. F. SOBEK. *Zeitsch. Zuckerind.*, 1976, **101**, 463–464.—The author discusses the effect of limestone and coke grain size on lime and CO_2 quality, and recommends the following for uniform calcination and optimum waste gas CO_2 concentration: a limestone size within narrow tolerances of 60–80 or 80–120 mm (but not 60–120 mm), and a slow-reacting coke in the size ratio coke:limestone of 0·5–0·76:1. Such coke can be smaller than high-reacting coke.

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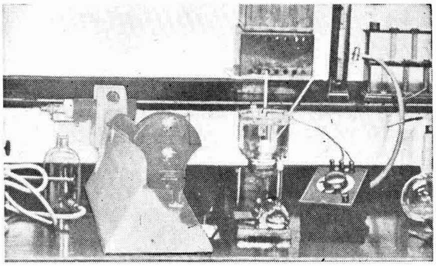
Protection of extraction juices in beet sugar factories by bacteriostat "I 32". M. VELINGS. *Zeitsch. Zuckerind.*, 1976, **101**, 464–465.—The author, representing Sopura S.A., gives information on "I 32", a bacteriostat containing 35% iodoacetone, which is stable as a 0·1% solution for 24 hours and has proved effective in reducing inversion in beet diffusion.



Laboratory methods & Chemical reports

Dextranase. I. Characterization of the enzyme for use in sugar mills. R. P. FULCHER and P. A. INKERMAN. *Proc. 43rd Conf. Queensland Soc. Sugar Cane Tech.*, 1976, 295–305.—The effects of dextran, dextranase and sucrose concentration, temperature and pH on the hydrolysis of dextrans by two commercial enzymes were investigated with dextran 2000, as were the hydrolysis rates, substrate specificities and choice of enzyme addition point. Results, in the form of graphs, showed: that the percentage of dextran hydrolysed fell with rise in dextran concentration above 4000 ppm; that for each enzyme there is a temperature at which activity is maximum; that the amount of dextran hydrolysed was directly proportional to enzyme concentration and to time of incubation; that maximum activity occurred at a specific pH or within a narrow pH band; that dextranases had maximum activity in the absence of sucrose, while low concentrations had only limited effect on the hydrolysis rate, although high concentrations caused a considerable fall in activity; that the hydrolysis rate for cane dextran is lower than for dextran 2000; that the catalytic action of the enzyme was of a specific nature; and that the enzyme is best added to mixed juice. Of the two enzymes, "Glucanase D-1" is more suitable, since it may be added to the juice without major modifications to normal processing, while "Talozyme D" is unsuitable because of the low temperature (45°C) at which activity is maximum. The specificity of the enzymes is considered to limit their usefulness.

* * *

Study on the influence of sucrose and other constituents of molasses on the extraction of its free acids by organic solvents. O. I. BELOVA and T. BEGALIEV. *Trudy Frunzensk. Politekhnich. Inst.*, 1973, **63,** 157–160; through *S.I.A.*, 1976, **38,** Abs. 76-613.—Tests on multiple extraction of lower fatty acids from 50°Bx solutions of (beet) molasses or sucrose are reported with tabulated results. Extraction with acetone: ether (1:1) was eventually more complete than extraction with acetone, although acetone gave higher initial extraction. Removals of acetic and formic acids were 98 and 95·2%, respectively, when 50 g model solution was extracted with three 100-ml portions of mixed solvent; similar extraction removed only 91·5% of added formic acid from previously extracted molasses solution. Thus, while the sucrose in molasses does not impair extraction, the non-sucrose does.

* * *

Chemical composition of vinasses from alcohol and yeast manufacture. V. G. KOVAL', A. A. MALASHKEVICH and O. I. SYCH. *Trudy Ukr. Nauch.-Issled. Inst. Spirt. Likero-Vodoch. Prom.*, 1973, **15,** 156–159; through *S.I.A.*, 1976, **38,** Abs. 76-619.—Ranges of contents of the major organic and inorganic components (% on dry solids) and 14 trace elements (mg per 100 g dry solids) in vinasses from 7 alcohol-fodder yeast combines are tabulated and compared. Growth of *Candida* or *Trichosporon* on vinasses used up mainly carboxylic acids, glycerol and added N compounds; the main trace elements present were B, Ba, Mn, Cu, Ti and Ni.

* * *

Trace elements in dried pulp. D. HIBBERT, R. T. PHILLIPSON and W. WOODWARK. *Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 23 pp.—Maximum levels of certain elements in animal fodder permitted under UK and EEC legislation are indicated, and the nature of the toxic effects of some of them is indicated. Details are given of the quantities of arsenic, lead, mercury, copper, fluorine, cobalt, manganese and vanadium in composite samples of molassed dried pulp from BSC factories. Although the molassed pulp conformed to the regulations, arsenic caused some concern. As with the other elements (with exception of vanadium), its average content was greater when coal firing was used than when gas or oil was used as fuel. Vanadium was increased by use of oil firing, while the contents of the other elements with gas and oil firing were about the same. The arsenic content of hard coal was greater than that of brown coal. Higher arsenic and mercury concentrations occurred in the pulp dust fractions, while disproportionately high levels of arsenic, copper and mercury were found in fly-ash taken from the dryer inlet; the relatively high volatility of arsenic and mercury is also considered to be of great importance. While the copper content was increased to a certain extent when coal was used, most of the element was introduced with the beet, while contact with copper or brass in the factory also contributed. The copper content of the molasses, and hence of the molassed pulp, was markedly influenced by the incidence of copper alloys in the 1st and 2nd evaporator effects.

* * *

Reaction partners in the carbonyl-amino reaction in technical sugar juices. E. REINEFELD, K. M. BLIESENER and A. REINEFELD. *Zucker*, 1976, **29,** 287–292.—Six different carbonyl components were reacted, individually, with each of four amino-acids at a 1:1 molar ratio. The reactants were heated in a phosphate buffer solution of pH 8 for 24 hours to 95°C, after which the yield, extinction coefficient and C, H and N contents of the high-molecular browning product were determined. Highest yields were obtained from glyceraldehyde, dihydroxyacetone and invert sugar, while lowest yield occurred with hydroxyacetone; glycolaldehyde and acetaldehyde gave intermediate yields. In all cases, γ-aminobutyric acid gave the highest yield of the four amino-acids, followed by lysine; sometimes glutamic acid was next as regards yield, sometimes alanine. The pattern of the extinction coefficients was similar to that of the yields. Infra-red spectra for dihydroxyacetone and acetaldehyde with each of two amino-acids were identical. Gas chromatography revealed differences between the various reactants as regards amino-acid liberation after acid hydrolysis. Further investigations in which 2-deoxyglucose and 2-*O*-methyl glucose were reacted, individually, with butyric acid showed that browning products were formed under the severe test conditions despite the unavailability of a free hydroxyl in α position, although the reactivity of the carbonyl components was much lower than of the previous group, so that colour formation was slower. Possible methods of obtaining Maillard reaction intermediates as a contribution to further study of their structures are discussed.

* * *

Some aspects of the theory and practice of sugar crystallization. D. SCHLIEPHAKE and K. AUSTMEYER. *Zucker*, 1976, **29**, 293–301.—The effect of hydrodynamic conditions on crystal growth in boiling is discussed from the viewpoint of mass transfer and resistance to this. The theory of mass transfer resistance is examined in detail, mathematical expressions being derived to define various relationships and reference being made to earlier experiments involving both sucrose and potassium alum crystallization, results of which are compared. For Reynolds' numbers greater than 10^{-2}, a Frössling equation for calculation of the rate coefficient of mass transfer for given supersaturated solution parameters was found to give values in close agreement with experimental data. This permits a relationship between Reynolds' number and crystallization resistance to be established, as demonstrated graphically. Limitations imposed on white sugar crystallization by reduced flow conditions were demonstrated by comparing simulated processes in a bubble tube and a suspended bed vessel. While use of a circulator in a batch pan has been found to improve performance, inadequate mass transfer rates result from the unsuitability of the heating surface area which is too great for the first stage of boiling (because of a high evaporation rate) but is insufficient for optimization of the second main stage. These problems can only be resolved, it is stated, by use of continuous boiling in which the heating surface area can be adjusted to the process requirements and the massecuite level maintained constantly at an optimum value. By contrast, in the batch pan the crystal sedimentation path continues to increase during the main boiling stage, while the circulation rate is reduced by the pressure exerted by the column of massecuite. Hence, the chief aim in improving boiling is to reduce the hydrostatic head of the massecuite column, reduce the superheat zones in the calandria and thus restrict massecuite consistency.

* * *

Investigations of diffusion in pure and technical sucrose solutions. II. Diffusion of sucrose and non-sucrose compounds in multi-component systems. A. EMMERICH, D. FINKE, N. PANITZ and H. RIECK. *Zucker*, 1976, **29**, 302–307.—The earlier described capillary method[1] was used in an investigation of the auto-diffusion of sucrose and three non-sugars obtained from molasses: lactic acid (representing organic hydroxy acids), glutamic acid (representing amino-acids) and pyrrolidone carboxylic acid (as main component of nitrogenous acids in purified sugar solutions). Results showed that sucrose diffused at a faster rate in the molasses solution than in pure solution of the same dry solids content, while each of the non-sugars in highly diluted pure solutions had almost the same diffusion rates as did sucrose, whereas in technical solutions the rates were considerably higher. Reasons for the findings are suggested. As regards the factory diffusion process, the non-sugars would not be expected to exert much influence because of their low concentration in the cell juice, nor do they accumulate on the surface of the growing sucrose crystal, since their back-diffusion is more rapid than is the forward diffusion of the sucrose.

* * *

The determination of invert sugar in technical sugar juices. I. New photometric method with 4-amino-3-hydrazino-5-mercapto-1,2,4-triazole as colour reagent. E. REINEFELD, K. M. BLIESENER, H. VAN MALLAND and C. REICHEL. *Zucker*, 1976, **29**, 308–316.—Details are given of a method for determination of invert sugar in juices in which the fructose moiety is split into trioses at 80°C in highly alkaline medium; the title reagent reacts only with the glyceraldehyde to form a reddish-violet colour which is measured spectrophotometrically at 535 nm against a blank or is compared visually with one of three named colour solutions. The method was applied in tests to beet factory juices (including thick juice) and to press juice after clarification with lead acetate. Comparison with results obtained for thick juice by SPENGLER *et al.* using Müller's solution showed close agreement. Two variants of the new method are described: in one, the reagent is dissolved in NaOH, while in the other it is dissolved in basic lead acetate solution. At an invert sugar concentration up to 200 μg, the relative error was 1·5–10% (a standard deviation of ± 2·4 $\mu g.cm^{-3}$). The method can be adapted to measurement of glucose separately.

* * *

Problems of the sugar laboratory. Performance of the disintegrator element adapted for the Brazilian digester for cane analysis. J. P. STUPIELLO, E. R. DE OLIVEIRA and L. U. SILVA. *Brasil Açuc.*, 1976, **87**, 342–346. The standard disintegrator used for direct analysis of cane in Brazil employs a goblet of 4·5 litres capacity and a blade as disintegrator element. Experiments were made using a bar of 10 mm square steel, 75 mm long and with tips chamfered to 3 mm. Disintegration was equally efficient and the new element should be adopted, since it will last much longer than the blade, so reducing maintenance requirements.

* * *

Determination of lead, cadmium and zinc in sugar. N. M. MORRIS, M. A. CLARKE, V. W. TRIPP and F. G. CARPENTER. *J. Agric. Food Chem.*, 1976, **24**, (1), 45–47; through *Anal. Abs.*, 1976, **31**, (1), Abs. 1F5.—A graphite furnace was used for flameless atomic absorption spectrophotometry on samples that had previously been fermented with yeast at pH 4·5–5·0 to eliminate matrix interference by the sugar. After fermentation, the solutions were centrifuged to remove yeast, then evaporated, and the residues were charred at <500°C and atomized in the furnace. Recoveries of Pb, Cd and Zn added before fermentation were 97±7%.

[1] SCHNEIDER *et al.*: *I.S.J.*, 1976, **78**, 347.

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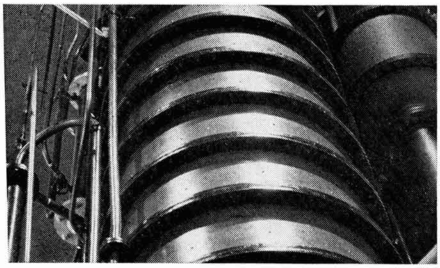

By-products

Pelletizing offers new options for food waste recovery profits. L. E. SLATER. *Food Eng.*, 1975, **47**, (10), 58, 61; through *S.I.A.*, 1976, **38**, Abs. 76-353.—The manufacture of bagasse pellets at Clewiston factory, Florida, is described. Bagasse is dried to a moisture content of 5% in two rotary drum dryers, passed through a hammer mill, and pneumatically conveyed to the supply bin for the pellet mills; the extruded pellets are cooled and screened to remove fines. Output was 10 $tons.hr^{-1}$ during the 1974/75 grinding season. When fed to dairy cattle, the pellets provide valuable roughage.

* * *

Utilization of sugar factory filter cake. G. VERNOIS. *Die Lebensmittelind.*, 1976, **23**, 133–134.—Possible uses of filter cake which are briefly discussed include its application as fodder, as a soil conditioner and as a raw material for cement manufacture. Recovery of the lime for re-use in the factory is also considered, and suitable drying means for scattering on soil are described.

* * *

Pilot plant scale trials on the treatment of distillery effluents. S. C. GUPTA and K. A. PRABHU. *Sharkara*, 1974, **13**, 7–10.—Large-scale trials were conducted on distillery effluent treatment with an acclimatized culture of ammonifying bacteria[1]. The COD of a 3·5°Bx diluted spent wash was reduced by 86·8% (from 50,237 ppm) in 96 hours; BOD reduction was about 80%, although a 92–93% decrease is considered possible, and the pH was raised from 5·2 to 7·3–7·5. Daily treatment of 12,000–15,000 gal of spent wash of 30,000–40,000 ppm initial COD proved possible. Urea added with superphosphate every other day as N source could be replaced with yeast sludge (dried or as slurry), it was found.

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A new potential product from sucrose: microbial gum. W. P. CHEN and C. H. TSOU. *Taiwan Sugar*, 1976, **23**, 14–16.—See *I.S.J.*, 1975, **77**, 158.

* * *

Plant for the production of fine alcohol and potable spirits in Thailand. ANON. *BMA Information*, 1975, (14), 24–25.—Information is given on the Mahaguna distillery in Bangkok which produces alcohol from cane molasses and rice.

* * *

Possibilities and limits of use of sugar-containing cattle fodder. E. PFEFFER. *Die Zuckerrübe*, 1976, **25**, (3), 31–34.—See *I.S.J.*, 1974, **76**, 382.

* * *

Alcohol from molasses as a possible fuel and the economics of distillery effluent treatment. P. KUJALA, R. HULL, F. ENGSTRÖM and E. JACKMAN. *Sugar y Azúcar*, 1976, **71**, (3), 28–39.—The economics of molasses alcohol production are discussed and the possible use of ethanol as a motor fuel examined. While the Melle-Boinet method of fermentation is rapid but gives a relatively high alcohol yield, the molasses must first be pasteurized and pre-treated to remove Ca salts, gums and sludges which tend to have an adverse effect on yeast clarification. However, since the pasteurization permits a cleaner alcohol to be produced, the purifying column needs fewer stoppages for descaling, while there is reduced sludge accumulation in the boiling column, and the effluent from the stills is cleaner. The question of distillery waste disposal is discussed at some length, and indications are given of the high BOD_5 values occurring in various countries. The molasses distillery waste is wholly liquid, so that its treatment for use as animal fodder is restricted. However, various methods of treatment are described whereby the BOD_5 can be reduced to an acceptable level. While evaporation to a syrup for use as animal fodder is one possibility discussed, it is pointed out that the product has a high ash content, particularly K, Mg and Na salts (which have a laxative effect on animals), so that dilution with molasses is recommended, thus reducing the feed value of the syrup. An alternative is to recover the potash by incineration. Methods which have been used for crude potash recovery on a commercial scale are described, and details are given of a process for refined K salt recovery. Torula yeast manufacture from distillery waste as used in Taiwan is also discussed. Finally, it is stressed that economics of distillery waste treatment must first be worked out, since the capital and operating costs are high; refined K salt (KCl and K_2SO_4) manufacture appears to be the most profitable of the systems described, although this will be governed by price movements in these chemicals. Local market conditions and the suitability of a given system of waste treatment for the individual distillery should be assessed before any process is introduced.

* * *

A thought on sugar by-product, molasses. A. C. CHATTERJEE and B. M. DUTT. *Sugar News* (India), 1976, **7**, (10), 5–6.—The potential for production of alcohol from cane molasses in India is discussed, including possible markets, molasses quality and transport, and distillery capacity, fuel (preferably coal and bagasse rather than oil) and power consumption.

* * *

Storage of dried and pelleted sugar beet pulp in silos. H. SCHNELLE. *Zucker*, 1976, **29**, 238–240.—The tendency towards storage of pelleted pulp in cylindrical silos of 20,000 tons capacity and a maximum discharge height of 40 m is accompanied by the need for greater care to prevent fires resulting from spontaneous combustion. Tests in the US have shown that pellets of only 7% moisture content but containing 30–40% fines decompose rapidly at 50°C and 100%

[1] PRABHU & PRAKASH: *I.S.J.*, 1974, **76**, 90.

R.H. and quickly reach a temperature at which spontaneous combustion occurs; similar results occur where there are no fires but the moisture content is at least 15%. On the other hand, a pulp having a moisture content of 7% but very little fines content will not readily decompose, even at an ambient temperature of 70°C. Hence, there is need for removal of fines before storage and for adequate air conditioning; continuous checking of pulp temperature by means of distance thermometers linked to the conditioning controls ensures rapid increase in the cold air feed should the temperature rise. However, it is pointed out that such a system is not always proof against local hot spots which could be shielded because of the heat insulation properties of the pulp, so that there would be a time lag before the thermometer actuated the conditioning system. Should this break down, the silo would have to be emptied as quickly as possible. The question of discharge rate is discussed, and mention made of an emergency entrance provided in the wall of modern silos for use of a front-end loader to supplement the conventional discharge conveyors.

* * *

New sucrose epoxy resins. H. JACQUES and L. LEBLANC. *Sucr. Belge*, 1976, **95**, 179–187.—Experiments are reported in which an attempt was made to use oxyalkylated sucrose derivatives as internal plasticizers of epoxy resins. Tricomponent systems (epoxy resin-oxyalkylated sucrose-curing agent) were tested in order to obtain improved curing; with water-free materials, hard products having no tackiness were obtained in yields up to 55% (by weight) on oxyalkylated sucrose. Suppleness of the product was found to increase with increase in sucrose derivative quantity. With the aim of increasing the compatibility of the sucrose derivatives with resins, oxyalkylated sucrose was reacted with epichlorhydrin in the presence of KOH as catalyst. Infra-red spectroscopic investigations revealed that the resultant resins had absorption bands of the oxirane cycle. Hardening tests on the resins mixed with bisphenol-A epoxy resin yielded well-cured, supple, transparent products having excellent compatibility with epoxy resins.

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Use of sulphonol as antiseptic for molasses in alcohol manufacture. E. R. ALIEVA-VITUKEVICH. *Trudy Ukr. Nauch.-Issled. Inst. Spirt. Likero-Vodoch. Prom.*, 1973, **15**, 67–72; through *S.I.A.*, 1976, **38**, Abs. 76–617. Molasses containing 375 million bacterial cells per g was treated with 17–113 g Na dodecylbenzenesulphonate per metric ton (as 20–150 g crude powder, paste or liquid of various origins), and kept for 15 days at 20°Bx; acidity increase was usually delayed 10 days by doses greater than 50 g.ton^{-1}. Such doses had beneficial effects on alcohol yield and residual sugars content in fermentation by yeast.

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Energy conservation in beet pulp dryers. B. HUTCHINSON *et al. Papers presented at 23rd Tech. Conf., British Sugar Corporation Ltd.*, 1976, 48 pp.—Tests are reported for determining the effect of a number of factors, including savings in energy resulting from recirculation of exhaust gases from the dryer outlet to the combustion end for dilution of fresh incoming gas; other effects determined were those of recirculation on emissions to the atmosphere, on dried pulp combustion and throughput, and the effects of modifications to the outfall equipment on product and dust carry-over to the cyclones. Results indicated a 5–6% saving in fuel; while the potential saving increased with increase in the gas outlet temperature, there is a simultaneous reduction in the chances of achieving the savings in practice. There was negligible effect on emissions and on pulp combustion and throughput, although it is emphasized that the effects on throughput and fuel consumption would depend on the heat transfer capacity of the individual dryer. Grit and dust carry-over to the cyclones varied directly as the flue gas volume and inversely as the moisture content of the dried pulp, the flue gas volume being the more significant factor. Removal of the centre sections of alternate volutes had little or no effect on retention time or pulp drying; it is important that the volutes should overlap, although their length is not necessarily significant. A number of other factors which could be evaluated in further tests are listed.

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Studies on the fermentative production of citric acid. II. Screening of the yeasts producing citric acid from cane molasses. Y. T. LIU. *Rpt. Taiwan Sugar Research Inst.*, 1975, (68), 55–66.—Details are given of tests on citric acid production from molasses and glucose, respectively, using various yeast strains. Yields of the anhydrous product ranged from 20 to 70% where three particular strains were applied. An increase in yield is thought to be possible. The isolated yeasts appeared to be *Candida* species.

* * *

Economy in sugar industry by-products. A. CHATTERJEE and B. M. DUTT. *Sugar y Azúcar*, 1976, **71**, (4), 18–19.—The economic aspects of cane by-products utilization are discussed and potential availability of each by-product as a percentage of processed cane is indicated. The value of molasses alcohol fermentation is discussed, among other things, in relation to world petrol shortage; production of bagasse paper in a central mill supplied with the raw material from a number of sugar factories is recommended, since it is stressed that only the surplus bagasse should be used; as regards furfural manufacture, the plant cost is so high that the process would be economically viable only if there were an adjacent sugar factory and distillery to utilize the surplus steam, the fermentable sugar-containing liquor and the residual products (recommended as boiler fuel). Mention is also made of particle board manufacture from bagasse, wax recovery from filter cake, and use of boiler ash as fertilizer and, in the building industry, together with cement.

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Studies on industrial gum production by fermentation. II. Cultivation conditions in the laboratory. W. P. CHEN, S. L. CHENG and C. L. LAI. *Rpt. Taiwan Sugar Research Inst.*, 1975, (69), 45–52.—Investigations of gum production by *Xanthomonas manihotis* (obtained from the cassava tree) showed that the best medium contained 4% sucrose, 0·2% KCl and 2% defatted soybean powder extract with 0·45% K_2HPO_4 solution. Inoculation of 100 ml of this medium and cultivation on a rotary shaker for 3 days at 28°C yielded 51% industrial gum (on initial sucrose concentration) of 2·17% concentration. The broth culture viscosity was 34,000 cP.

World sugar production estimates 1976/77[1]

BEET SUGAR	1976/77	1975/76	1974/75
EUROPE	(metric tons, raw value)		
Belgium/Luxembourg	652,000	711,000	607,000
Denmark	440,000	423,000	415,000
France	2,800,000	3,230,000	2,947,000
Germany, West	2,600,000	2,534,000	2,439,000
Holland	924,000	914,000	778,000
Ireland	203,000	203,000	145,000
Iraly	1,650,000	1,442,000	1,012,000
United Kingdom	790,000	697,000	601,000
Total EEC	*10,059,000*	*10,154,000*	*8,944,000*
Austria	400,000	512,000	394,000
Finland	95,000	88,000	82,000
Greece	315,000	307,000	187,000
Spain	1,300,000	917,000	572,000
Sweden	308,000	277,000	305,000
Switzerland	71,000	65,000	72,000
Turkey	1,149,000	986,000	834,000
Yugoslavia	560,000	483,000	556,000
Total West Europe	*14,257,000*	*13,789,000*	*11,946,000*
Albania	20,000	18,000	16,000
Bulgaria	240,000	157,000	200,000
Czechoslovakia	700,000	800,000	750,000
Germany, East	595,000	665,000	655,000
Hungary	410,000	331,000	338,000
Poland	1,960,000	1,840,000	1,589,000
Rumania	760,000	600,000	620,000
USSR	9,400,000	7,700,000	7,800,000
Total East Europe	*14,085,000*	*12,111,000*	*11,968,000*
Total Europe	28,342,000	25,900,000	23,914,000
OTHER CONTINENTS			
Afghanistan	15,000	15,000	9,000
Algeria	20,000	18,000	14,000
Azores	7,000	7,000	7,000
Canada	140,000	133,000	101,000
Chile	326,000	320,000	219,000
China	980,000	980,000	950,000
Iran	625,000	615,000	565,000
Iraq	80,000	75,000	50,000
Israel	40,000	38,000	31,000
Japan	224,000	244,000	280,000
Lebanon	5,000	18,000	9,000
Morocco	270,000	257,000	264,000
Pakistan	24,000	22,000	24,000
Syria	30,000	25,000	18,000
Tunisia	11,000	9,000	7,000
United States	3,400,000	3,719,000	2,726,000
Uruguay	110,000	116,000	85,000
Total Other Continents	6,307,000	6,611,000	5,359,000
TOTAL BEET SUGAR	34,649,000	32,511,000	29,273,000
CANE SUGAR			
EUROPE			
Spain	20,000	19,000	26,000
NORTH & CENTRAL AMERICA			
Belize	92,000	63,000	85,000
Costa Rica	200,000	191,000	179,000
Cuba	6,000,000	5,700,000	6,432,000
Dominican Republic	1,200,000	1,250,000	1,234,000
Guadeloupe	95,000	96,000	88,000
Guatemala	530,000	515,000	381,000
Haiti	55,000	56,000	58,000
Honduras	103,000	88,000	77,000
Martinique	15,000	14,000	16,000
Mexico	2,750,000	2,725,000	2,707,000
Nicaragua	265,000	247,000	196,000
Panama	196,000	164,000	134,000
Puerto Rico	307,000	279,000	271,000
El Salvador	290,000	256,000	273,000
USA—Mainland	1,640,000	1,657,000	1,334,000
Hawaii	1,001,000	969,000	1,004,000
West Indies—Barbados	104,000	101,000	107,000
Jamaica	365,000	368,000	366,000
St. Kitts	37,000	37,000	26,000
Trinidad	225,000	205,000	163,000
Total N. & C. America	15,470,000	14,981,000	15,131,000
SOUTH AMERICA			
Argentina	1,592,000	1,353,000	1,532,000
Bolivia	263,000	210,000	165,000
Brazil	7,400,000	6,180,000	6,985,000
Colombia	1,036,000	959,000	970,000
Ecuador	328,000	305,000	273,000
Guyana	362,000	371,000	311,000
Paraguay	65,000	55,000	77,000
Peru	984,000	950,000	990,000
Surinam	11,000	11,000	10,000
Uruguay	32,000	29,000	23,000
Venezuela	544,000	478,000	527,000
Total South America	12,617,000	10,901,000	11,863,000
AFRICA			
Angola	50,000	40,000	49,000
Cameroun	32,000	30,000	29,000
Congo (Brazzaville)	46,000	32,000	29,000
Egypt	680,000	626,000	550,000
Ethiopia	156,000	134,000	140,000
Ghana	18,000	18,000	12,000
Ivory Coast	38,000	23,000	5,000
Kenya	185,000	177,000	174,000
Madeira	3,000	2,000	3,000
Malagasy Republic	119,000	127,000	123,000
Malawi	95,000	68,000	68,000
Mali	15,000	14,000	15,000
Mauritius	725,000	496,000	738,000
Morocco	5,000	4,000	0
Mozambique	270,000	233,000	272,000
Nigeria	39,000	34,000	38,000
Réunion	240,000	226,000	228,000
Rhodesia	250,000	260,000	250,000
Somalia	39,000	30,000	36,000
South Africa	2,150,000	1,928,000	2,033,000
Sudan	170,000	154,000	140,000
Swaziland	222,000	224,000	207,000
Tanzania	120,000	112,000	110,000
Uganda	25,000	22,000	34,000
Zaire	70,000	69,000	68,000
Zambia	100,000	85,000	64,000
Total Africa	5,862,000	5,168,000	5,415,000
ASIA			
Bangladesh	115,000	95,000	108,000
Burma	85,000	75,000	72,000
China	2,800,000	2,700,000	2,600,000
India, excl. khandsari	4,900,000	4,630,000	5,212,000
Indonesia	1,300,000	1,258,000	1,137,000
Iran	90,000	85,000	83,000
Iraq	75,000	75,000	50,000
Japan	213,000	223,000	192,000
Malaysia	80,000	70,000	50,000
Nepal	15,000	12,000	0
Pakistan	500,000	565,000	514,000
Philippines	2,850,000	2,735,000	2,471,000
Sri Lanka	28,000	24,000	20,000
Taiwan	860,000	817,000	751,000
Thailand	1,714,000	1,665,000	1,216,000
Total Asia	15,625,000	15,029,000	14,476,000
OCEANIA			
Australia	3,400,000	2,933,000	2,921,000
Fiji	318,000	281,000	273,000
Total Oceania	3,718,000	3,214,000	3,194,000
TOTAL CANE SUGAR	53,312,000	49,312,000	50,105,000
TOTAL BEET SUGAR	34,649,000	32,511,000	29,273,000
TOTAL SUGAR PRODUCTION	87,961,000	81,823,000	79,378,000

[1] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (29), 1–4.

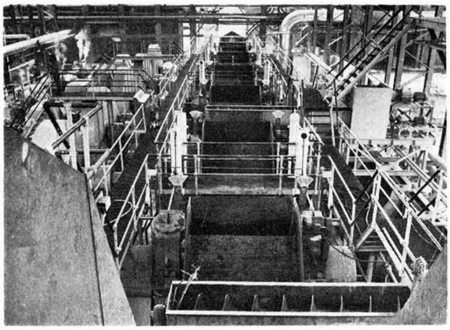
Philippines sugar exports

	1975	1974	1973
	(metric tons, raw value)		
China	11,016	0	0
Finland	0	32,315	0
France	0	23,817	0
Iran	57,031	0	0
Japan	377,039	214,846	29,063
Korea, South	0	0	13,630
Malaysia	0	0	12,391
Morocco	27,909	0	0
Portugal	11,376	0	0
Switzerland	0	5,613	0
UK	182,882	32,315	0
USA	339,411	1,347,686	1,389,186
Vietnam, South	0	0	10,754
	1,005,664	1,635,637	1,455,024

A/S De Danske Sukkerfabrikker 1975/76 report.—With revision of the EEC sugar policy the 1975/76 Danish *A*-sugar quota was increased from 290,000 to 328,000 metric tons of which the DDS share was 282,491 tons. New acreage was contracted and a production target of 410,000 tons was set for the campaign. However, cold and windy weather in early June damaged the young beet plants and growth was severely hampered during the rest of the summer by drought. Rain came in September so that the roots started to develop new tops instead of the normal increasing of root volume and sugar content. As a result the beet crop reached only 2,580,000 tons to give 336,000 tons of sugar. The factories operated satisfactorily and Saxkjöbing also refined about 27,000 tons of cane raws for export to Norway. Assens factory has been expanded, a similar project has been under way for the Nakskov factory for the 1976 campaign, and Stege will be expanded for the 1977 campaign. The company is investing heavily in measures against environmental pollution, particularly for recycling of beet transport and wash water. The 1976 target sugar production has been set at 381,000 tons. Sales of beet seed have increased, particularly in Italy and Spain, while sugar production machinery sales have been a record, with outlets in the USSR, France and Yugoslavia, as well as the first DDS cane diffuser in Argentina.

* * *

Brazil's largest cane mill tandem.—On 24th September 1976 the largest milling tandem to be built and installed in Brazil was inaugurated at Usina da Barra, Barra Bonita, São Paulo. Designed and manufactured by M. Dedini S.A. Metalúrgica, the tandem has rollers measuring 42 in × 84 in and a crushing capacity of 12,000 tons per day. Each mill uses four rollers with separate drives to the inlet roller and discharge roller. The two lower rollers are close, requiring only a narrow turn-



plate, while the hydraulic head acts on the top roller at an angle of 15° corresponding to the angle of the resultant of forces exerted on the roller. The mill bearings are of solid bronze, water-cooled. Each mill is individually driven by a 1000 hp steam turbine operating at up to 4600 rpm with gear reducers and a final spur and pinion gearing, all built by Dedini. The new mill represents the latest achievement by the Dedini Group which built its first small mill in 1929.

Trinidad sugar exports[2]

	1975	1974	1973
	(metric tons, raw value)		
Canada	0	2,458	0
France	0	14,567	0
Holland	0	1,528	0
Japan	0	11,004	0
Tunisia	0	7,888	0
UK	74,022	69,142	133,180
USA	22,313	27,596	8,603
Venezuela	14,013	0	0
	110,348	138,783	141,783

South American beet sugar technologists meeting.—The beet sugar technologists of Uruguay have formed an organization (Asociación Nacional de Técnicos en Remolacha Azucarera) which is cooperating with the technologists of Chile to form a Latin American Association of Beet Sugar Technologists (ALTER) which is holding its inaugural Congress at Bella Vista, 90 km east of Montevideo during the 28th November—5th December 1976. A number of papers on agricultural subjects are to be presented and visits have been arranged to sugar factories and experimental field sites. Both the Chilean and Uruguay associations are non-Governmental institutions and are under the patronage of the Uruguay Ministry of Agriculture and Fisheries, the F.A.O. and the Interamerican Institute of Agricultural Sciences.

* * *

Corrigendum.—In a recent item[3] we referred to Fives-Cail Babcock sugar factories for Yugoslavia. We have now been advised by ABR Engineering of Brussels, Belgium, that they are responsible for the whole contract as leaders of a Belgian-French group associated with a Yugoslav company in the undertaking. ABR Engineering will provide complete design engineering and detailed designs, delivery of machinery and equipment (some to be obtained from Fives-Cail Babcock), and technical assistance for erection and commissioning. The factories are to be built at Bac, Zabalj, Kovacida, Pecinci and Nova Crnja and are scheduled for commissioning for the 1978 campaign.

* * *

EEC import quota reductions for three ACP countries[4]. Article 25 of the Lomé covers the procedure followed when a supplier fails to provide his full quota of sugar to the EEC. For the period 1st July 1975 to 30th June 1976 this applied in the case of Mauritius, Uganda, the Congo Republic and Fiji who all claimed that the deficiency was caused by *force majeure*. In the case of Mauritius the EEC Commission agreed the validity of this claim since the island had had its sugar crop badly damaged by a cyclone which reduced exports to the EEC from the forecast 487,200 metric tons to 421,200 tons. Uganda had supplied only 3000 tons against its 5000-ton quota but the Commission rejected the claims that this was due to difficulties of reorganization and transport, noting that production had fallen continually since 1968 so that it could not be expected that Uganda would meet its higher commitment; the quota was consequently reduced to 3200 tons. The reasons put forward by the Congo for non-delivery of its 10,000-tons quota (incendiarism, interruption of fuel and supplies for one enterprise) were also rejected and the quota cancelled completely. In the case of Fiji, which had delivered 137,000 tons against a 163,000-tons quota, the Commission did not consider that the floods which had affected the cane fields were sufficient reasons since Fiji had suffered continually falling crops since 1968 and, in addition, had signed long-term contracts with other customers; as a consequence the quota was reduced to 142,900 tons.

* * *

Bagasse paper in South Africa.—The September 1976 issue of the *South African Sugar Journal* was a special issue in that it was printed for the first time on coated paper made by Stanger Pulp & Paper (Pty.) Ltd. at Gledhow, Natal. This new R60m project came on stream recently and is the first paper mill in the world to use bagasse for the making of coated paper of the glossy art type. The mill will eventually produce 34,000 metric tons of fine paper a year and an extension by the end of 1976 will make it possible to produce 17,000 tons of tissue paper annually as well. At present it uses 160,000 tons per annum of bagasse from the Gledhow sugar factory.

1 *I.S.O. Stat. Bull.*, 1976, **35**, (5), 84.
2 *ibid.*, (4), 105.
3 *I.S.J.*, 1976, **78**, 286.
4 *Le Betteravier*, October 1976, 13, 19.

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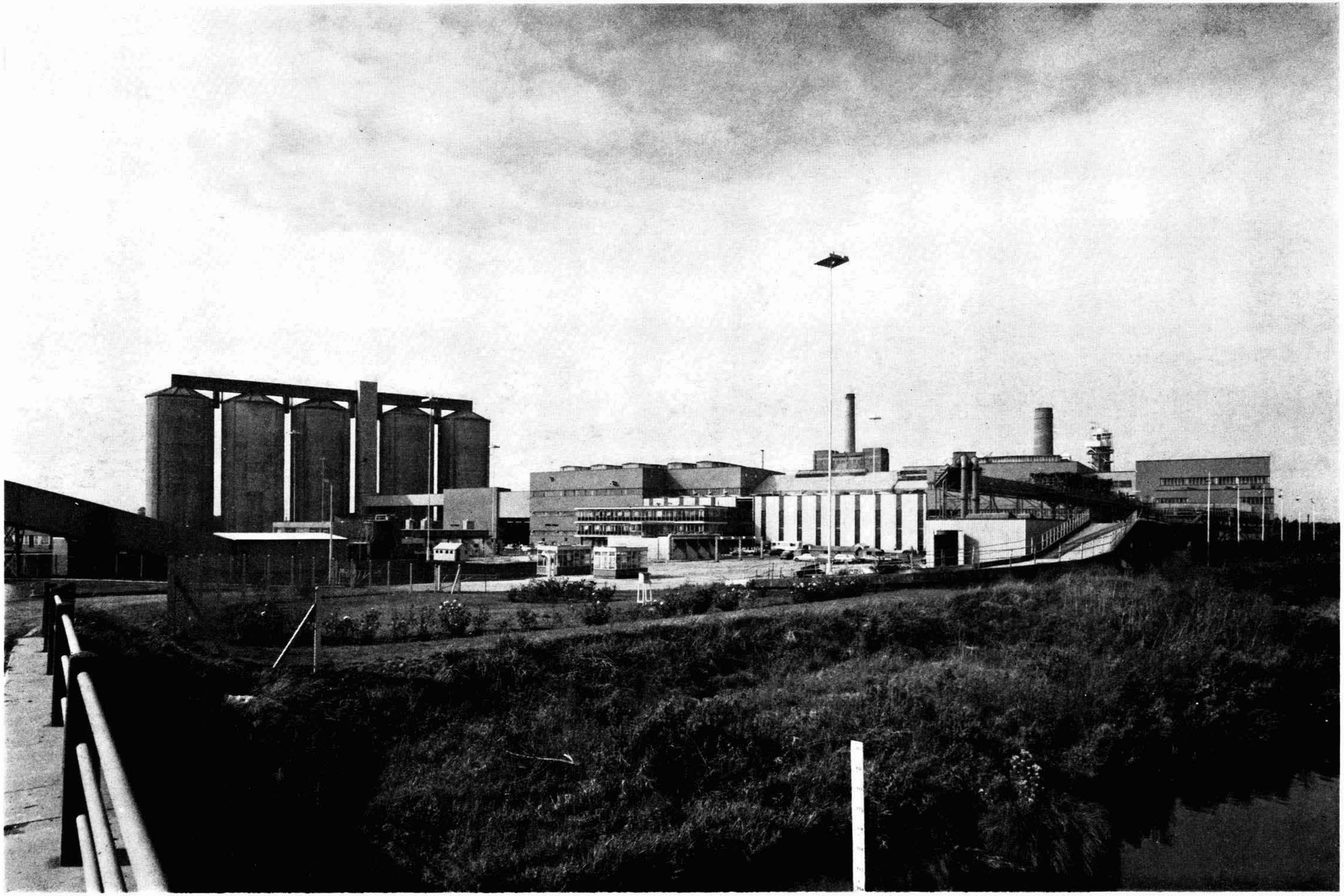

(*Photo*: British Sugar Corporation Ltd.)

The Wissington sugar factory

THE INTERNATIONAL SUGAR JOURNAL

A TECHNICAL AND COMMERCIAL PERIODICAL
DEVOTED ENTIRELY TO THE SUGAR INDUSTRY

EDITED BY:
D. LEIGHTON, B.Sc., F.R.I.C.
M. G. COPE, M.I.L.

JANUARY TO DECEMBER
1976

VOLUME LXXVIII

PUBLISHED AT
23a EASTON STREET
HIGH WYCOMBE
BUCKS.
ENGLAND
1976

PANEL OF REFEREES

ERRATA AND CORRIGENDA

Page 27.	Line 27 of Column 1.	Read "SVOBODOVÁ" for "SVOBODÁ"
Page 56.	Line 13 of Column 2.	Read "(5), 16–21; (6), 10–15" for "(6), 10–15, 16–21".
Page 76.	Line 35 of Column 2.	Read "wilt" for "red rot".
Page 119.	Line 35 of Column 2.	Read "118–120" for "118–119".
Page 124.	Line 4 of Column 1.	Read "60" for "29".
Page 125.	Line 42 of Column 1.	Read "*I.S.J.*, 1973, **75**, 3–6, 44–46" for "*I.S.J.*, 1973, **75**, 44–46".
Page 126.	Line 40 of Column 1.	Read "L. GONRY" for "I. GONRY".
Page 150.	Line 37 of Column 1.	Read "1973, **75**, 116" for "1974, **76**, 84".
Page 182.	Line 2 of Column 1.	Read "MCMASTER" for "MCMASTEY".
Page 183.	Lines 36 and 37 of Column 1.	Read "*Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*" for "*Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*".
Page 218.	Line 4 of Column 1.	Read "factory" for "vapour".
Page 247.	Line 57 of Column 1.	Read "26" for "27".
Page 248.	Line 2 of Column 2.	Read "217" for "215".
Page 285.	Line 35 of Column 2.	Read "KRASNOPOL'SKII" for "KRANSNOPOL'SKII".
Page 286.	Line 47 of Column 2.	Read "ABR" for "Fives-Cail Babcock".
Page 306.	Line 12 of Column 2.	Read "J.F." for "F.J.".
Page 308.	Line 13 of Column 1.	Read "KALASWAD" for "KALSWAD".
Page 315.	Line 49 of Column 1.	Read "V. S." for "H. S.".

MADE AND PRINTED IN ENGLAND
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INDEX TO VOLUME LXXVIII

SOME REMARKS ON ITS USE

In using this Index it should be noted that the principal entries cover the several stages of production: CULTIVATION (*see* Beet; Cane; Diseases; Fertilizers; Irrigation; Mechanization; Pests; Soils; Transport; Varieties; Weeds, etc.); SUGAR PROCESSING (*see* Bagasse; Boilers; Boiling; Carbonatation; Centrifugals; Clarification; Crystallization; Diffusion; Evaporators; Filters; Massecuite; Milling; Mills; Molasses; Pans, Vacuum; Scale; Sucrose; Sugar; Sulphitation; Water, etc.); REFINING (*see* Bone Char; Carbon; Refining; etc.); and BY-PRODUCTS (*see* Alcohol; Animal Fodder; By-Products; Fermentation; Paper; Pulp; Yeast, etc.).

Subjects covered separately include Ash; Bulk handling and storage; Colour; Control, Automatic and Chemical; Countries; Ion exchange; Juice; Micro-organisms; pH; Polarization; Transport; Weighing, etc. Glucose and Fructose are to be found under Dextrose and Levulose. Obituaries, Statistics and Trade Nnotices are collected together under those headings. "Sucrose" implies the pure chemical; "Sugar" the commercial product; and "Sugars" the chemical family, rather than grades of sugar. When looking under the author's name, it should be remembered that the surname may be the penultimate in Spanish. Names starting with "Mc" are treated as if they start with "MAC", and the next letter in the name after the "c" will determine the position in the author index. Where a name includes the prefix "AL", "EL", "D", "DA", "DE", "DEL", "EL", "LA", "VAN" or "VON" it is indexed under A, E, D, L or V, respectively. Where a name begins with the abbreviation "ST." or "STO." it is indexed as if this were spelt in full.

(Abs.) indicates *Abstract*; (Brev.), *Brevity*; (Corr.), *Correspondence*; (N.B.), *New Books*; (N.C.), *Note and Comment*; (Stat.), *Statistics*; (T.N.), *Trade Notice.*

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.

PRINTED IN GREAT BRITAIN.