THE International Sugar Journal

JANUARY 1974

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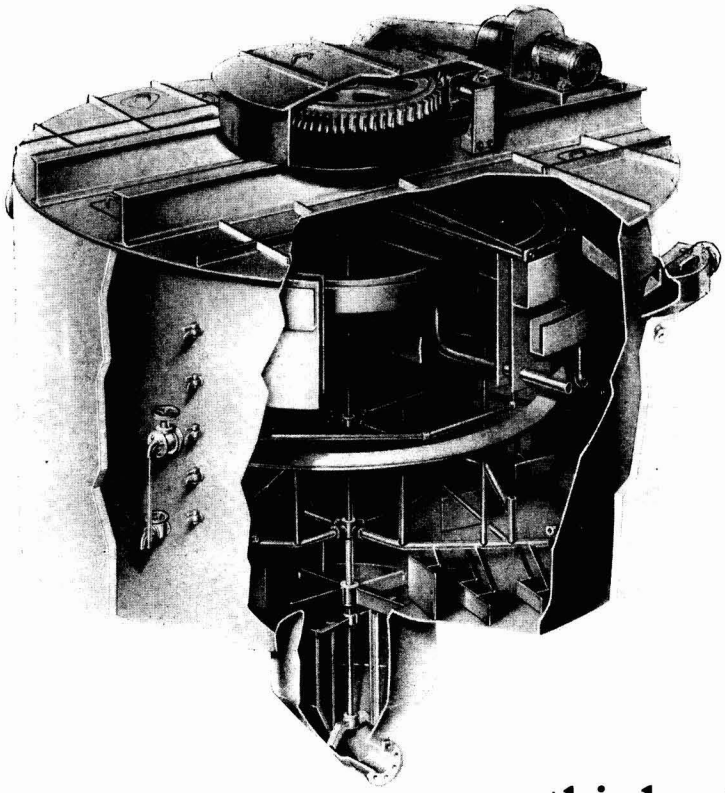

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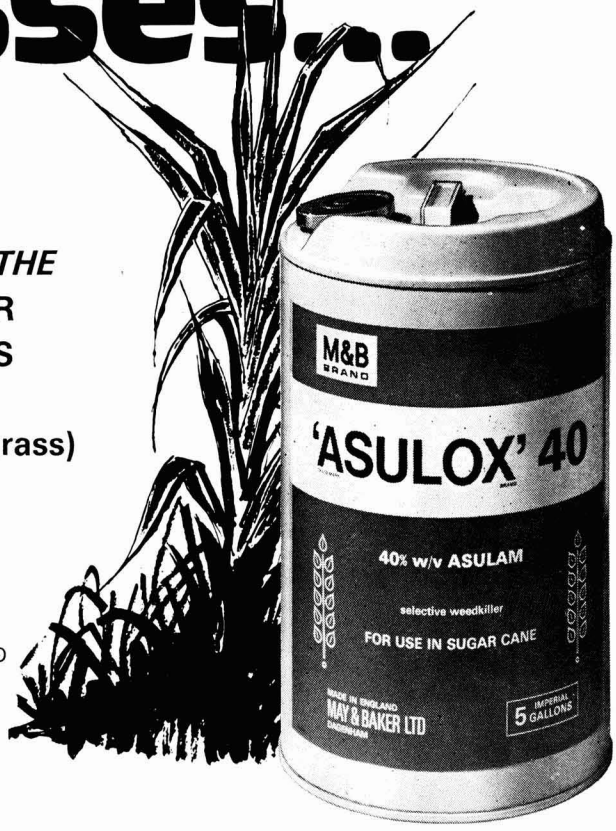

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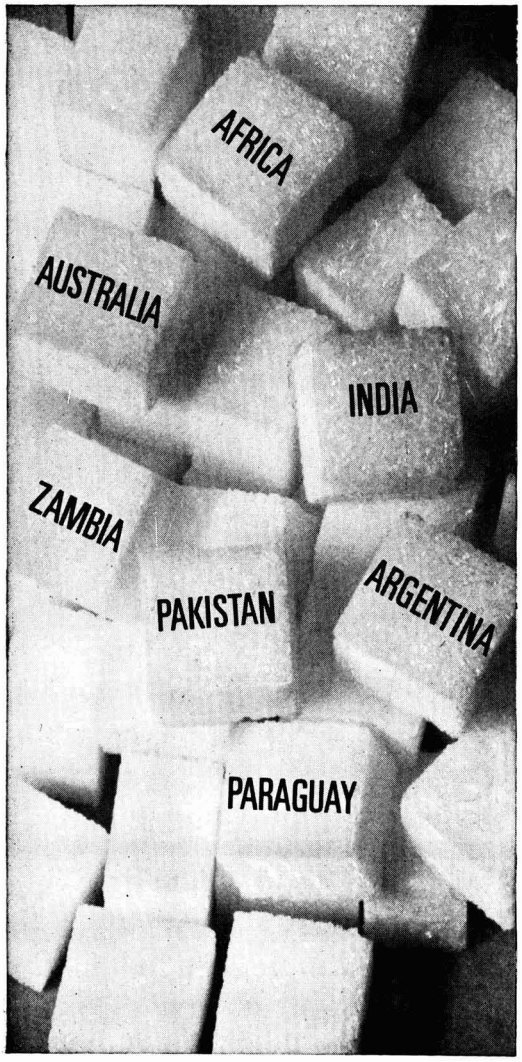

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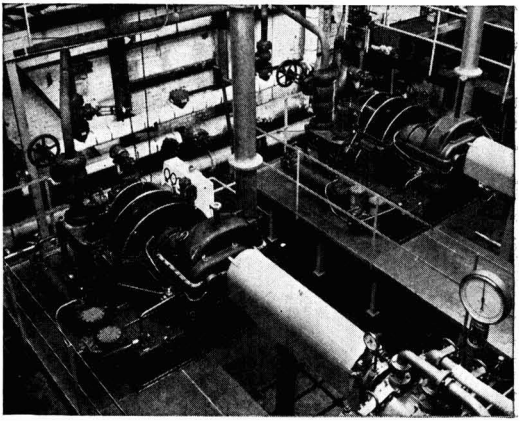

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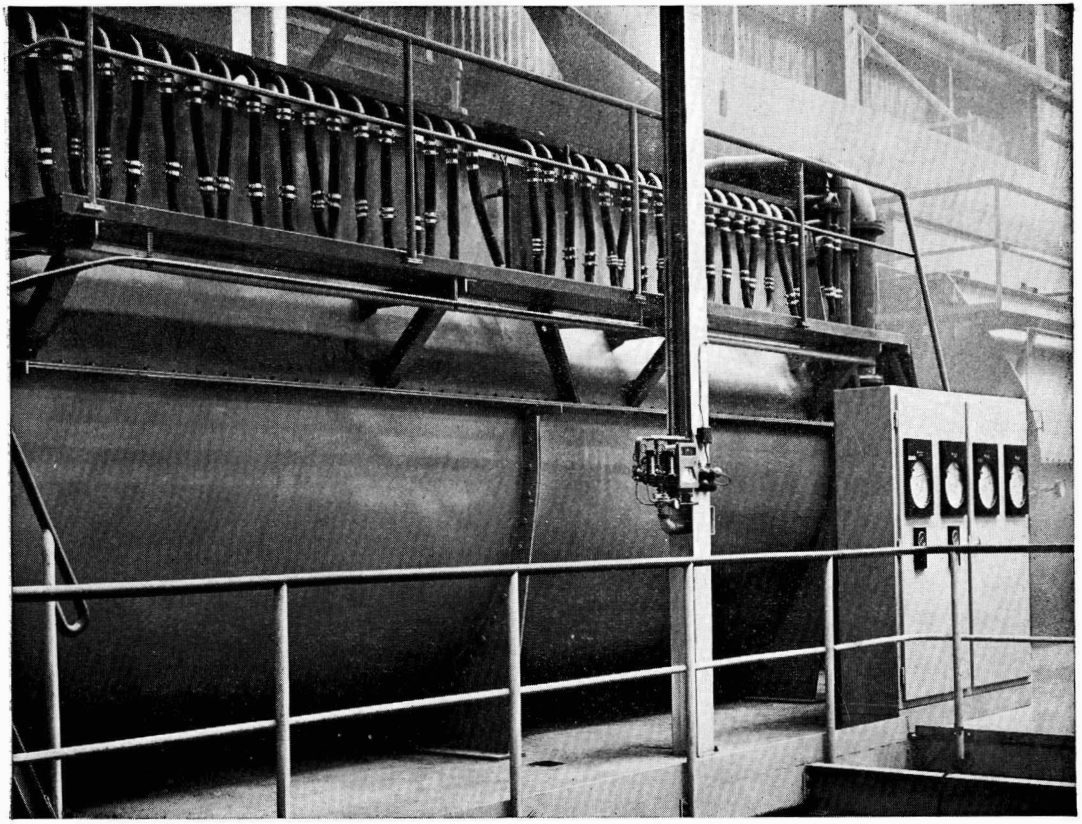

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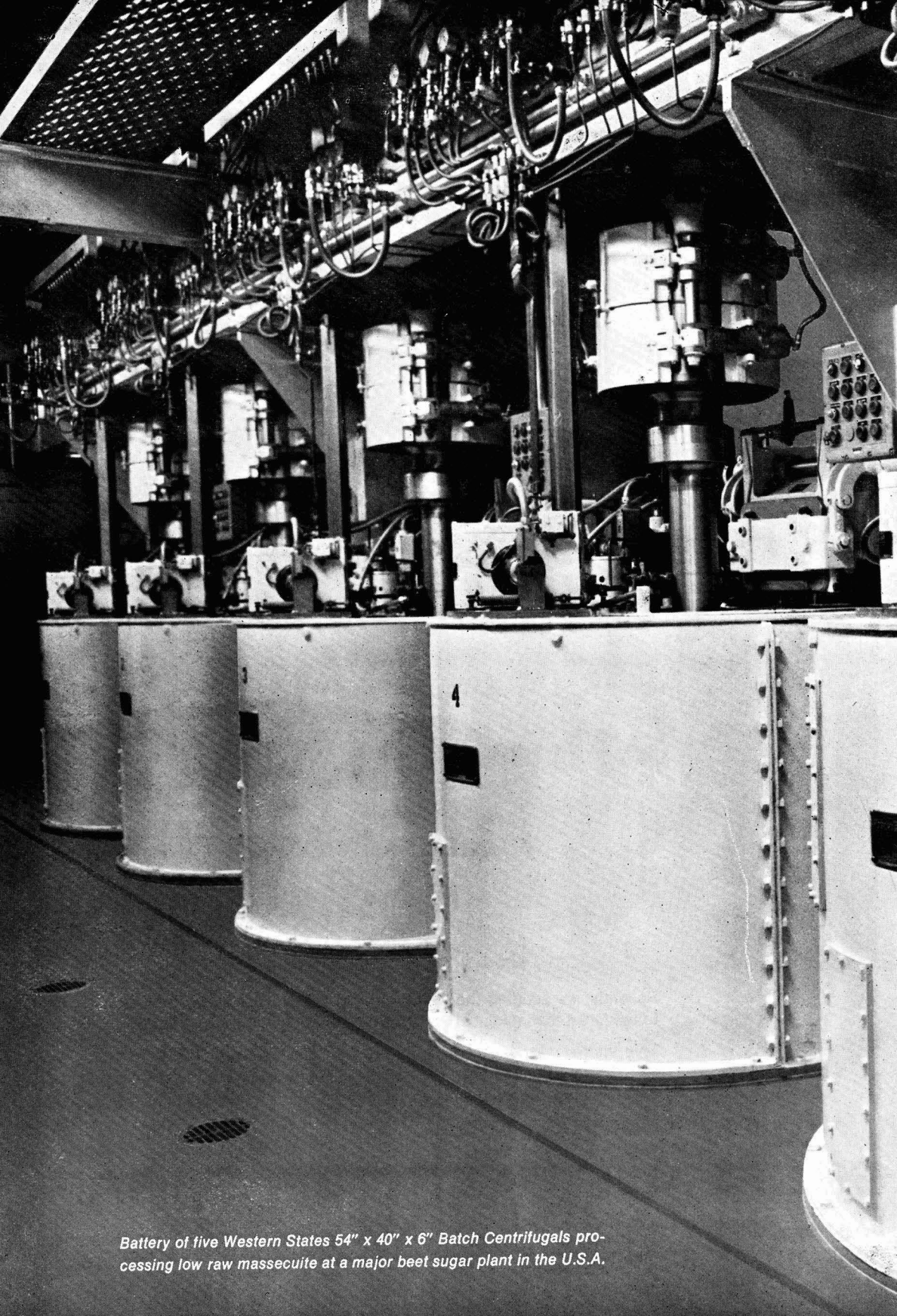
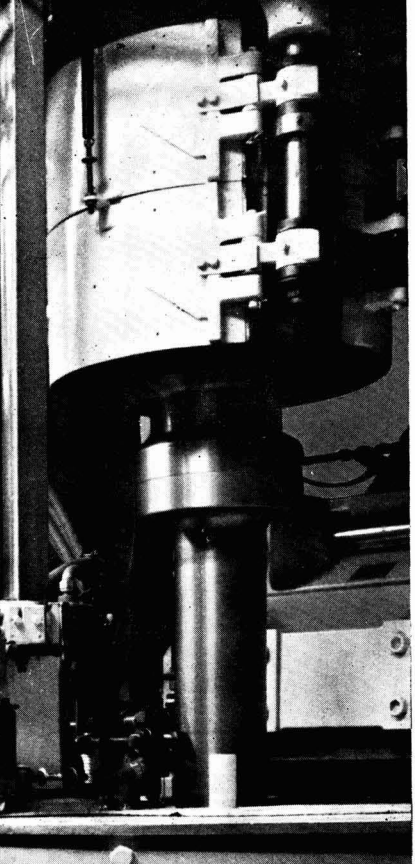


Battery of five Western States 54" x 40" x 6" Batch Centrifugals processing low raw massecuite at a major beet sugar plant in the U.S.A.



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The satisfaction of Gulf & Western with the performance of the Farrel units is manifested by the fact that at each stage of its progressive modernization program, engineered since 1961 by its sugar technology consultants, Miguel Chinchilla Varona & Associates, Farrel individual mill drives have replaced previous arrangements.

In 1967, 1970 and 1971 existing mill drive arrangements at Gulf & Western's other sugar factory, Okeelanta in Florida, were progressively replaced with Farrel individual mill drives. That factory now has a total of seven.

In 1972 at Romana three Farrel individual mill drives were installed to replace a steam engine which had previously been driving three mills of the factory's second six-mill tandem, and the second steam engine is now being replaced with three additional Farrel units. At that point Gulf & Western will have a total of 19 individual Farrel drives in its two factories.

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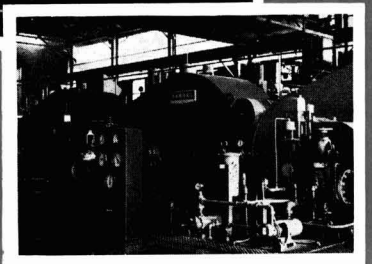

Aerial view of Gulf & Western's Okeelanta sugar factory and installation picture of Farrel drives in operation at the Central Romana factory.

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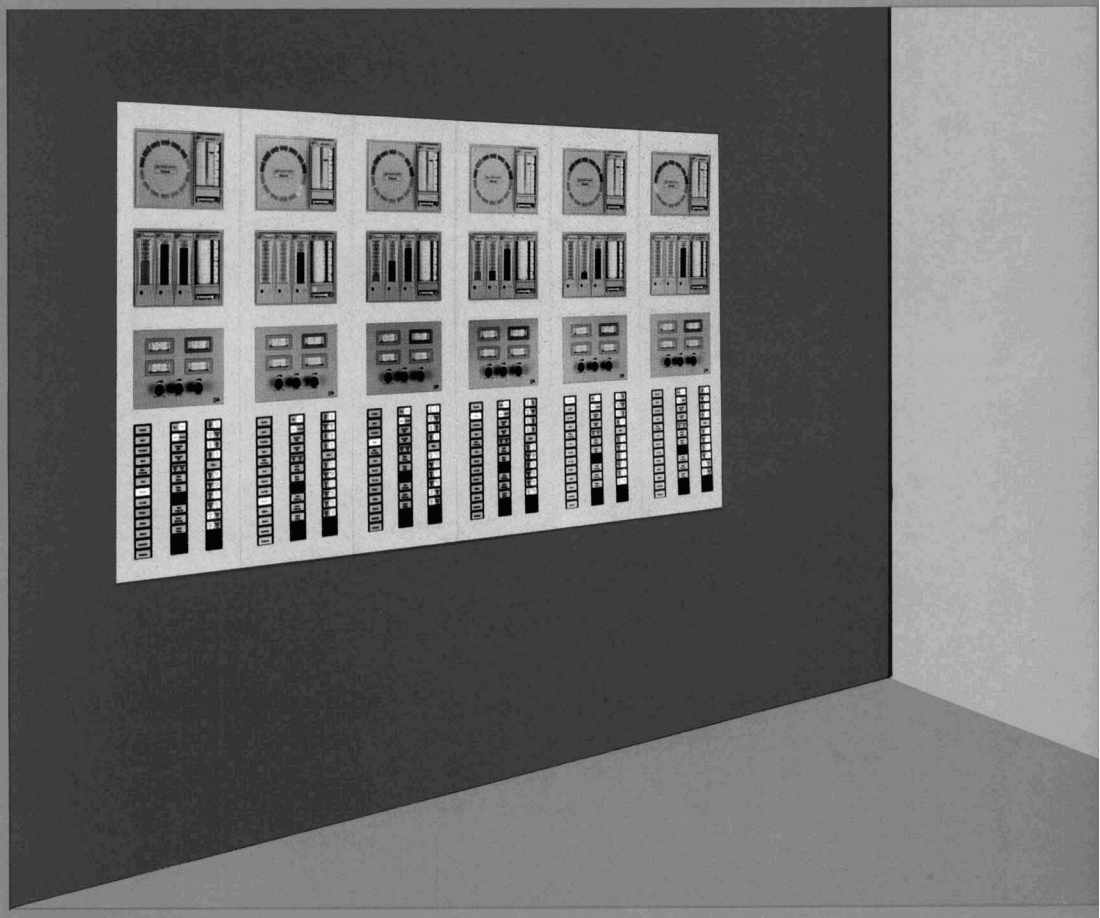

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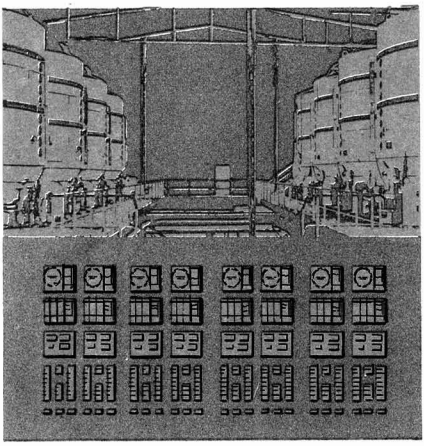

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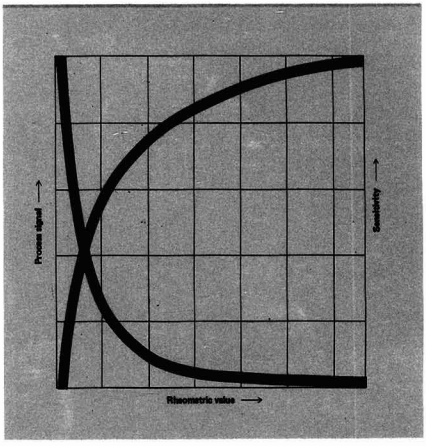

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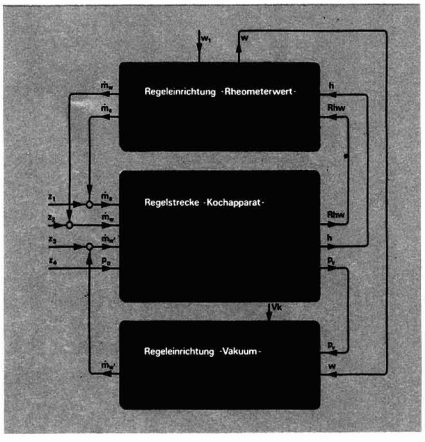

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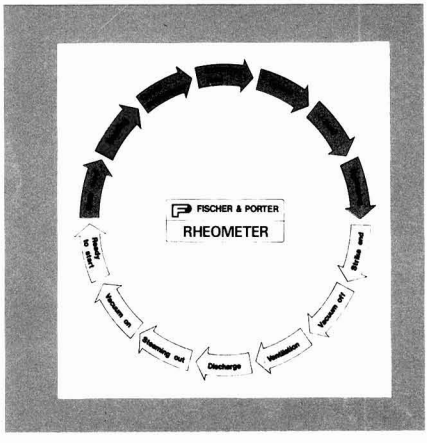
Program Cycle of the RHEOMETER-Automatic Vacuum Pan Control System



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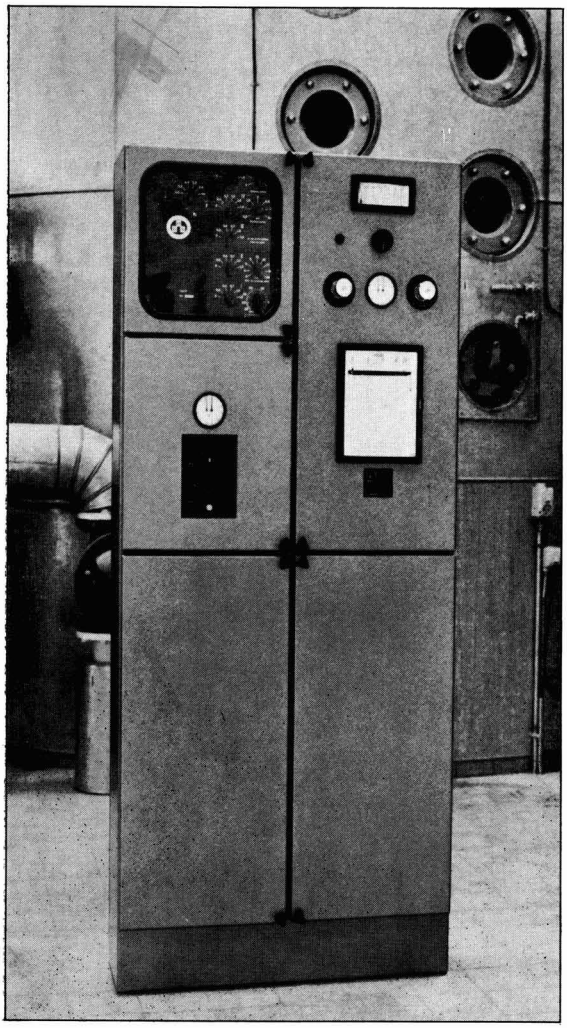

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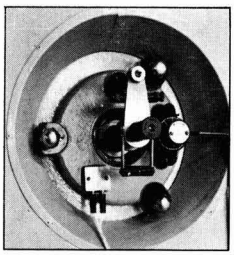

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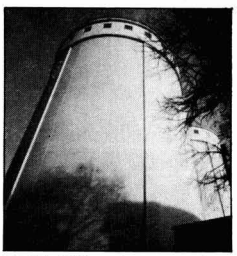

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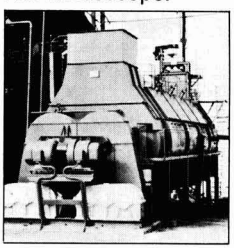

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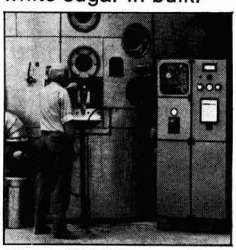

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International Sugar Journal

January, 1974

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Sources de matières colorantes dans le sucre commercial. C. C. Tu. *p.* 3–6

On décrit une méthode chromatographique pour séparer les colorants dans le jus de canne, le sirop et les cristaux de sucre. Les études ont révèlé que la matière brun jaune de faible poids moléculaire constitue les colorants les plus importants dans les jus et sirops tandis que les colorants les plus importants dans le sucre sont bruns et de poids moléculaire élevé. Ces 2 fractions proviennent principalement de la canne elle-même. Elles ne se forment pas au cours du traitement. Les têtes des cannes et les feuilles sont les sources principales des colorants bruns.

* * *

Destruction des sucres réducteurs par la chaux au cours de la diffusion. S. K. D. Agarwal et B. K. Gupta. *p.* 7–8

Des études faites sur la décomposition des sucres réducteurs dans un diffuseur à cannes De Smet dans une sucrerie des Indes montrent qu'elle diminue quand on arrête l'addition directe de chaux dans le diffuseur. La formation d'acides organiques s'élève brusquement lorsque la durée de rétention de la bagasse augmente. Vu que le Brix du jus reste presque constant dans le premier tiers du diffuseur, on a suggéré de réduire ou d'enlever cette partie du diffuseur étant donné qu'elle ne sert à rien sauf à augmenter les pertes en sucres réducteurs et la formation d'acides organiques.

* * *

Nucléation continue du saccharose. Partie I. A. D. Randolph et S. A. Ziebold. *p.* 8–12

Après une discussion sur la théorie de la cuisson continue, on décrit un procédé de cristallisation secondaire en continu pour la production d'une semence à fins grains pouvant être utilisée pour le grainage dans un système industriel de cuisson continue. On présente les rapports d'études expérimentales effectuées pendant 9 mois ainsi que les équations pour le calcul des facteurs les plus importants de la cristallisation.

Die Ursache des Auftretens von Farbstoffen in Handelszuckern. C. C. Tu. *S.* 3–6

Es wird eine chromatographische Methode zur Trennung der Farbstoffe in Zuckerrohrsäften, Abläufen und Zuckerkristallen beschrieben. Untersuchungen zeigten, dass die bräunlich-gelbe Substanz mit niedrigem Molekulargewicht den Hauptfarbstoff in Säften und Abläufen darstellt, während im Zucker vorwiegend ein brauner Farbstoff mit hohem Molekulargewicht vorkommt. Beide Fraktionen stammen hauptsächlich aus der Zuckerrohrpflanze; sie entstehen weniger während des Verarbeitungsprozesses. Die braunen Farbstoffe haben in erster Linie ihren Ursprung in den Rohrspitzen und den Blättern.

* * *

Die Zerstörung von reduzierenden Zuckern durch Kalkzugabe während der Extraktion. S. K. D. Agarwal und B. K. Gupta. *S.* 7–8

Untersuchungen, die in einer indischen Zuckerfabrik über die Zerstörung von reduzierenden Zuckern in einem De-Smet-Rohrdiffuseur durchgeführt wurden, haben ergeben, dass diese Zerstörung verringert wird, wenn die in der Praxis geübte Zugabe von Kalk direkt in den Diffuseur eingestellt wird. Die Produktion von organischen Säuren stieg stark an, wenn die Verweilzeit der Bagasse erhöht wurde. Da der Trockensubstanzgehalt über ein Drittel der Diffuseurlänge nahezu konstant blieb, wird vermutet, dass dieser Teil des Diffuseurs verkürzt oder völlig abgeschaltet werden kann, da er weiter nichts bewirkt als eine Erhöhung der Verluste durch reduzierenden Zucker und die Bildung von organischen Säuren.

* * *

Kontinuierliche Bildung von Saccharosekristallen. Teil I. A. D. Randolph und S. A. Ziebold. *S.* 8–12

Nach der Diskussion der Theorie des kontinuierlichen Kochens wird ein kontinuierliches sekundäres Kristallisationsverfahren zur Erzeugung von feinkörnigem Impfgut beschrieben, das sich zur Verwendung für ein kontinuierliches Verkochungschema im praktischen Betrieb eignet. Die Autoren berichten über neunmonatige experimentelle Untersuchungen und geben Gleichungen an, mit denen die wichtigsten Parameter der Kristallisation berechnet werden können.

Fuentes de material colorante en azúcar comercial. C. C. Tu. *Pág.* 3–6

Se describe un método cromatográfico para separar colorantes en jugo de caña, meladura y cristales de azúcar. Estudios han demostrado que el material morenento-amarillo de bajo peso molecular constituye el mayor parte de los colorantes en jugo y meladura mientras que los colorantes mayores en azúcar fueron morenos y de alto peso molecular. Ambas fracciones han originado principalmente de la caña y no como resulta de reacciones químicas en el proceso de fabricación. Las hojas y pajas estuvieron las fuentes mayores de los colorantes morenos.

* * *

Destrucción de azúcares reductores por cal mientras la diffusion. S. K. D. Agarwal y B. K. Gupta. *Pág.* 7–8

Investigaciones sobre la destrucción de azúcares reductores en un difusor de caña marca De Smet de una azucarera en la India han demostrado que creció cuando se terminó la tecnica de adición de cal directamente en el difusor. Producción de ácidos orgánicos creció rapidamente con aumento en la retención de bagazo. Porque la densidad Brix del jugo en casi un tercio del largo del difusor estuvo constante, los autores sugieron que esta parte del difusor puede reducirse or suprimirse porque no hacía nada sino que permitía un aumento de las perdidas de azúcares reductores y de la formación de ácidos orgánicos.

* * *

Nucleación contínua de sacarosa. Parte I. A. D. Randolph y S. A. Ziebold. *Pág.* 8–12

Después de un exposición de la teoría de cocción contínua, se describe un proceso contínuo de cristalización secundaria para producción de semilla pulverizado de tamaño fino apto al uso en un esquema de cocción contínua de gran-escala. Estudios experimentales que ocupaban 9 meses se discuten y se presentan fórmulas para calcular los más importantes factores que se conciernan en cristalización.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVI JANUARY 1974 No. 901

Notes & Comments

The EEC and the ISA

The Commission of the European Economic Commission has proposed that the EEC accede to the new International Sugar Agreement as both an importing and an exporting member. Although the new Agreement has only administrative and consultative functions at present, membership, it is argued, would give the Community a better negotiating position in the event that a new Conference is called to seek an Agreement with economic provisions. The Commission still stands by its original proposal that the 9-member EEC should be a net importer, taking raws from Commonwealth Sugar Agreement suppliers among the developing countries.

On the 24th October the Commission reduced its estimate of sugar available for export from the 1973/74 crop from 800,000 to 400,000 tons; producers in some countries were believed to be oversold and it was thought that there was no sugar available unsold. However, with world market prices at their present high levels, over the Community price levels, there is a temptation for some producers to seek overseas sales and not provide sufficient sugar for the domestic market. As a consequence, an export tax was imposed on the 21st November which is intended to discourage exports from the Community.

* * *

World raw sugar price

The rise reported in our last issue continued and new records were made and broken, with the London Daily Price reaching £115 per ton on the 20th November, with nearby futures traded at one point at £127 per ton. The Daily Price fell back somewhat since this all-time peak but has recovered to £115 at the time of writing.

* * *

Europe beet sugar production, 1973/74

On the 25th October F. O. Licht K.G. released their second estimate of beet sugar production in Europe[1], which takes advantage of the more recent information available since their first estimate at the beginning of September before most campaigns had started. The new figures show a total of 27,086,000 metric tons, raw value, which compares with the earlier forecast of 27,438,000 tons and a revised figure for 1972/73 of 25,578,574 tons. Except for Belgium's crop which is unchanged and a slight rise in the Italian estimate, small reductions are made in the figures for the rest of the EEC and other small decreases expected in Finland, Greece, Switzerland and Yugoslavia. Total West European production is set at 13,357,000 tons, 257,000 tons down from the first estimate, while in East Europe a drop of 120,000 tons for Poland is offset by a rise of 25,000 tons for Rumania.

* * *

US sugar supply quotas 1973

On the 2nd November the US Dept. of Agriculture announced an increase of 100,000 tons in the overall sugar quota for 1973 raising it to 11,700,000 short tons, raw value. A further 20,000 tons deficit was announced in the West Indies quota and to this was added 19,992 tons awarded to Australia at the previous quota increase but which had not been able to meet the deadline for shipping to the USA. Two weeks later the additional quotas granted, mainly on a first-come,first-served basis, were announced and the quotas and adjustments are tabulated elsewhere in this issue.

It was anticipated that this action would be sufficient to bring easier levels to the US domestic market and the Department postponed action for a time even though the price was outside the corridor. However, other factors appeared to have a stronger effect than supposed and at the end of November a further 100,000-tons increase in the overall supply quota was announced, bringing it to 11,800,000 tons. As before, the normal allocation of 17,333 tons was added to the Mainland Cane quota, and the balance is to be awarded to other suppliers except Cuba and Rhodesia again on a first-come, first-served basis so that details of the amounts are not available at the time of writing.

* * *

The oil crisis and the sugar industry

Cane sugar producers are in the happy position of producing their own fuel—bagasse—but beet sugar producers have found difficulties as a consequence of

[1] *International Sugar Rpt.*, 1973, **105**, (30), 1–2.

the reduction of Middle East supplies. Two Belgian factories, Sucrerie de Warcoing and Sucrerie Couplet, both near Tournai, have been forced to halt production[1], and similar closure have been forecast for some German plants.

In the United States, operation of the Michigan Sugar Company's three largest factories, at Caro, Carrollton and Sebewaing, and the fate of 85% of the company's contracted acreage were put in hazard as a consequence of a failure of the Consumers Power Company to provide the natural gas supply normally used in the plant, coupled with the non-availability of sufficient fuel oil to permit continuation of operations.

* * *

US sugar quota system abolition proposal

The US Sugar Act is due for revision since it expires at the end of 1974 and a proposal was announced in November by the Director of the USDA sugar programme, Mr. ARTHUR CALCAGNINI, whereby, after 40 years of controls, all import quotas would be eliminated and there would be no controls on domestic cane and beet sugar producers. The USA would become a purchaser of world market sugar and could take part in an International Sugar Agreement, but would support domestic producers by means of target price guarantees to farmers.

The plan has been discussed with representatives of the domestic industry and has met both criticism and welcome. While, at present levels, the US domestic price is slightly below the corresponding world market price, it is usually well above and the difference might total as much as $500 million in some years. However, the high US price has guaranteed a supply of sugar to meet US requirements, and the abolition of the foreign quota system would have such political as well as economic repercussions that it does not seem likely that the proposals will be adopted.

* * *

Commonwealth Sugar Agreement price proposals

At the 12th Annual Conference of the Caribbean Cane Farmers' Association a resolution was passed calling upon regional governments to seek amendment of the CSA price levels to make allowance for the recent inflation and falling value of money as well as the rise in production costs. Delegates stressed that the present price of £61 per ton was below the cost of production in some areas and compared with world market prices of over £100 per ton.

* * *

US sugar supply quotas 1974

In accordance with the Sugar Act, the US Secretary of Agriculture determines each year the amount of sugar required for consumption within the United States and proposes the individual quotas for domestic and foreign suppliers. This he did on the 5th October, proposing allotments based on an overall requirement of 11,700,000 short tons, raw value. Comments on the proposals had to be submitted by the 23rd October and this led to some delay before the actual initial quotas were announced early in November. By that time the overall requirement had been revised to 11,800,000 tons and a number of changes had been made from the original proposals.

The Domestic Beet allocation was originally set at 3·5 million tons out of the 11·7 million tons; it was reduced to 3·3 million tons out of the higher quota, reflecting the poorer prospects for the US beet sugar industry. Three suppliers—Peru, Venezuela and the West Indies—had had reductions made originally because they had not filled their 1973 quotas while exporting to other countries. In the case of the first two the cuts were relatively small but it was initially proposed that the West Indies quota be cut from 220,732 tons to 23,802 tons. Representations made by the West Indies stressed the severe drought conditions which had caused severe falls in production, as well as the dependence of the area on sugar, and had some success in that the quota set for 1974 was raised to 53,192 tons. Further, the West Indies would be able to meet reallocations of other shortfalls and could perhaps supply up to 100,000 tons, provided the sugar was produced and available.

Other proposals which were not changed include an increase of the quota for the new Texas cane area to 100,000 tons, and a reduction of no less than 700,000 tons in the Puerto Rico quota to 155,000 tons.

Details of the 1974 initial quotas are tabulated elsewhere in this issue.

* * *

Sugar exporters group proposal[2]

The Cuban Minister of Overseas Trade proposed in November that the world's main sugar exporting countries should join together to regulate sales to the world market and thereby endeavour to guarantee stable price levels. Exporters can hardly have cause to be dissatisfied with present levels of price, but the Minister was probably thinking of establishing a framework now so as to be prepared for the possibility of falling prices in the future.

There would, of course, be numerous obstacles to the establishment of such an arrangement, not least the objections of the importers who are at present having to pay high prices and who would almost certainly consider unilateral action by exporters inappropriate at the present time.

It will be recalled that exporters adopted a scheme in 1966 to improve the free market price and agreed, as a first step, that member countries would not sell sugar below 2.50c per lb. At a later stage higher prices were mentioned for shipment in certain forward delivery periods. The scheme was not a success and had eventually to be abandoned. It may be of interest to note that on that occasion Cuba found herself unable to participate in the arrangements.

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[1] *The Times*, 29th November 1973.
[2] C. Czarnikow Ltd., *Sugar Review*, 1973, (1155), 211.

Sources of colouring matter in commercial sugar*

By C. C. TU

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COLOUR is known to be a prime quality factor of raw or commercial sugar. Removal of coloured compounds from raw sugar is the major operation in sugar refining.

To have an effective and economical refining process, a decolorization agent compatible with the properties of the colorants should be employed. This will depend upon the identity and constitution of the colorants in various raw sugars.

During the last three decades, many papers have been published on the identification of colouring matter in raw sugar. Three types of coloured substances have been reported: caramels (formed by thermal degradation products of reducing sugars), melanoidins (reaction products between reducing sugars and amino compounds), and the naturally occurring polyphenols or polyphenol-iron substances.

The colouring matter in final molasses reported by WOLFROM, BINKLEY, *et al.*[1,2,3] were produced in processing juice to molasses. On the other hand, CARPENTER and co-workers[4] reported that the colorants in cane products were the phenolic acids and cane pigments, such as chlorogenic acid, caffeic acid, *p*-hydroxycinnamic acid, 4-hydroxy-3-methoxy-cinnamic acid, kaempferol, etc.

In order to know which type or types of colorants are present in the sugar crystal, colorants from various juice, syrup, and sugar samples were fractionated according to molecular weights, and the origin of these colorants determined. Liquid chromatography, using a Sephadex G-25 column, was applied throughout this work.

Sephadex G-25 has been reported[5] to be a good supporter for separation of sugar colorants of different molecular weights. Use of this material should effect the separation of colorants of different molecular weights in various samples from the cane plant and from a sugar factory. Colorants of the same molecular weight ranges fractionated from various samples can be compared. The high- or low-molecular-weight colorants responsible for high sugar colour (expressed as attenuation index at the wavelength 420 nm) in Hawaiian commercial sugar may be determined. Colorants having an adverse effect on sugar refining may also be evaluated from the results obtained from this work.

EQUIPMENT

The separation system, which has been made semi-automatic, consisted of a 12·7 × 1010 mm Sephadex G-25 column fitted with a sample injection valve, a micropump (45 ml.hr^{-1}), one ultraviolet monitor at the wavelength 280 nm, and a refractive index detector, each connected to a recorder. The instruments arrangement is shown schematically in Fig. 1; details of the system follow.

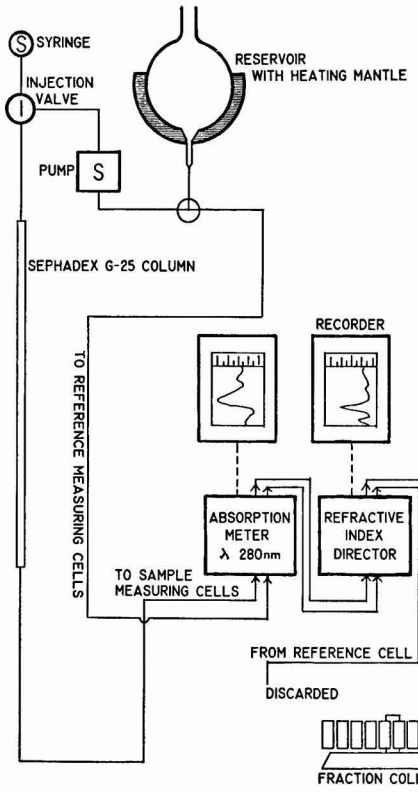

Fig. 1. Schematic instrument arrangement

Sample injection valve (I)

A SV-8031 injection valve from Chromatronix Inc., Berkeley, California, USA was used (see schematic flow diagram in Fig. 2). Solid lines indicate flow

* Printed in this Journal with the approval of the Director as Journal Series Paper No. 324 of the Experiment Station, HSPA.

[1] WOLFROM, BINKLEY and SCHUMACHER: *Ind. Eng. Chem.*, 1955, **47**, 1416.

[2] BINKLEY and WOLFROM: *Advances in Carbohydrate Chem.*, 1953, **8**, 291.

[3] BINKLEY: *Zeitsch. Zuckerind.*, 1970, **95**, 291.

[4] FARBER, CARPENTER and LIUZZA: *Tech. Rpt. Cane Sugar Ref. Research Project Inc.*, 1970, (15).

[5] TU and DEGNAN: *I.S.J.*, 1972, **74**, 259–260.

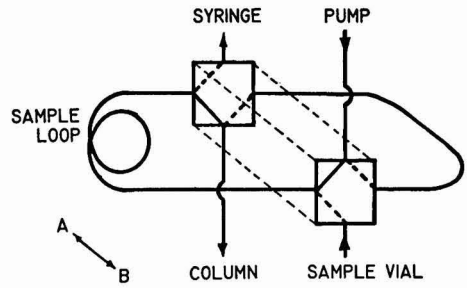

Fig. 2. Sample injection valve

passages in the slider when in the "inject sample" position (A); dotted lines indicate flow passages in the slider when in the load sample loop position (B).

Sephadex G-25 column

The column tube and its fittings were also from Chromatronix Inc.; it consisted of two internal bed support plungers fitted at each end of a precision bore glass tube. Sephadex G-25 was packed into the tube in the usual manner. A solution of 0·02% sodium azide was used as an eluant.

Pump

A miniflow micropump (LKB 4500A) from LKB Instruments Inc., Stockholm, Sweden was used to supply the eluant continuously to the Sephadex column through the sample injection valve at a flow rate of 45 ml.hr^{-1}.

Ultraviolet monitor

The 280 nm U.V. monitor from Pharmacia Fine Chemicals, Uppsala, Sweden, consisted of a control unit with a 0–10 mV output voltage and an optical unit. A 10-mm measuring cell was used in the optical unit. The monitor was a highly sensitive, double-beam, flow-through U.V. filter photometer (dual flow cells, sample and reference). A potentiometer-type recorder (680 strip chart) from Hewlett Packard Co., Pasadena, California, USA, was connected to the U.V. monitor.

Refractive index detector

An NFLC-100 refractive index detector from Nester/Faust Mfg. Corp., Newark, Delaware, USA was used. The detector, consisting of an optical unit and a control unit, employed Fresnel's principle for refractive index measurements through a differential optical system that continuously compared two streams, i.e. sample *vs.* reference. A "Speedomax H" potentiometer recorder, with a span from zero to 10 mV, from Leeds and Northrop Inc., North Wales, Pennsylvania, USA, was connected to the detector.

Reservoir

A 2-litre glass flask with a small opening in the bottom was fitted with a heating mantle to cover the bottom part of the flask. This maintained the temperature of the sodium azide solution a few degrees above room temperature, and minimized air present in the liquid throughout the whole system.

Fraction collector

The "7000 Ultro Rac" collector from LKB Instruments Inc., was equipped for timed-flow and volumetric siphoning. The collector can carry 200 tubes in 20 racks.

Miscellaneous valves and fittings

All valves, fittings, and polytetrafluoroethylene tubing (0·031-in i.d.) used in the system were obtained from Chromatronix Inc. (these are not shown in Fig. 1).

Materials

Juice samples from cane tops, top-cane leaves, and cane stalks

Cane tops between nodes 0–10, cane stalks between nodes 11–20 and between nodes 21 and below, and top leaves were obtained from hand-cut cane plants. The tops, stalks, and leaves were chopped into small pieces and juice samples were prepared according to Tanimoto's press method[6]. Each juice sample was centrifuged in a Spinco ultracentrifuge at 44300 *g* for 1 hour to remove water-insoluble matter. The samples thus prepared were used in liquid chromatography.

Mixed juice and evaporator syrup

Juice and syrup samples were collected from a cane sugar factory during a period of normal factory operation.

Sugar crystal solution

The sugar crystal solution sample was prepared by dissolving 6 g of washed commercial sugar (molasses outside the sugar crystal completely removed) in water to make a 60% sugar solution and centrifuged on a Spinco ultracentrifuge at 44300 *g* for 1 hour. The supernatant was used.

Method

Injection of samples

After the instruments (monitors and recorders) were stabilized, a proper amount of the sample solution (0·5 to 5 ml) was injected into the sample loop (Fig. 2). The size of the injected sample was determined by the size of the loop used (0·5, 1·0, and 5·0 ml available). At the "fill sample loop" position, the eluant (0·02% sodium azide solution) flowed into the Sephadex G-25 column via the bypass loop. Then the valve was pushed to the "inject sample" position, allowing the eluant to flow to the column via the sample loop and forcing the sample

[6] *Hawaiian Planters' Record*, 1964, **57**, 133.

ahead of the eluant into the column. A new sample could be injected at any time without opening the column or stopping the flow.

Elution of column

After the valve was changed to the "inject sample" position, the eluant was supplied continuously to the column through the sample injection valve by the micropump connected to the reservoir at rate of 45 ml. hr^{-1}. The effluents flowed through the U.V. monitor and the refractive index detector that were connected in series (see Fig. 1). The absorbancies at wavelength 280 nm and the refractive indexes were recorded and the fractions collected. The column was continuously eluted with 0·02% sodium azide solution for 5 hours, the length of time needed to wash all substances out of the column.

The absorbancy of the colorants was measured at wavelength 280 nm in a 1-cm depth measuring cell in the U.V. monitor. The use of the wavelength at 280 nm provided a higher absorption than at 420 nm, the wavelength at which sugar colour is measured. The ratio of the absorption at 420 to 280 nm was about one-third for the high-molecular weight colorants and one-seventh or less for some low-molecular weight colorants.

Results

Two distinctly coloured bands were separated on the top of the Sephadex G-25 column, after the sample was applied and moved into the column. The brown band migrated down the column as fast as the eluant; the brownish-yellow band migrated more slowly.

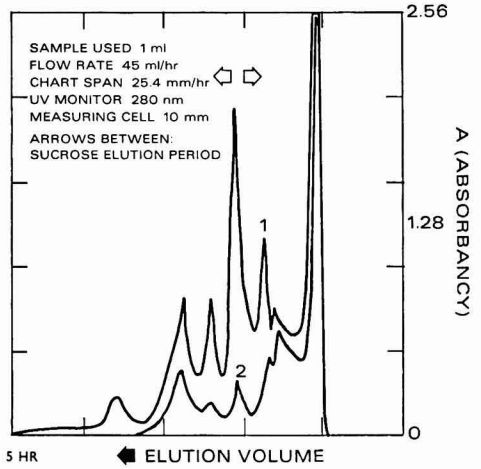

Fig. 3. Absorption curves at 280 nm of hand-cut millable cane: (1) Leaf juice from leaves between 0–10, (2) Cane-top juice from tops between 0–10 nodes

The U.V. absorption curves obtained from juice samples from various sections of the hand-cut plant (cane tops, leaves, stalks) and from typical mixed juice, evaporator syrup, and commercial sugar samples from a sugar factory, are shown in Figs. 3, 4 and 5.

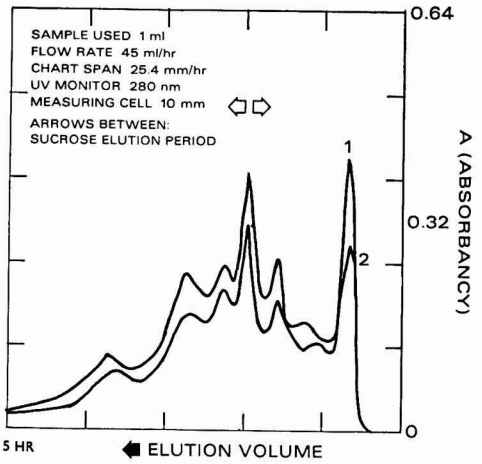

Fig. 4. Absorption curves at 280 nm of hand-cut millable cane-stalks juice samples: (1) Between nodes 11–20 (R.S. 12·9), (2) Between nodes 21 and below (R.S. 13·1)

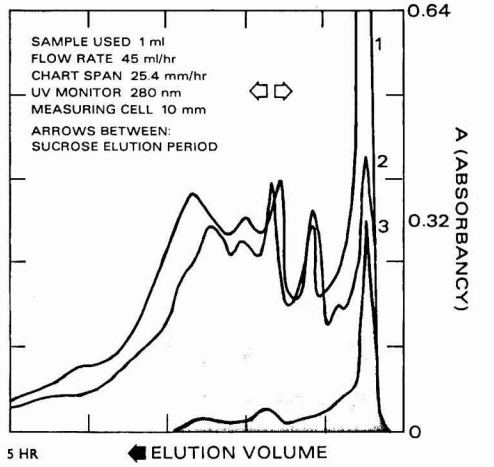

Fig. 5. Absorption curves at 280 nm of factory juice, syrup, and sugar samples: (1) Mixed juice (R.S. 16·5), (2) Evaporator syrup (R.S. 16·5) and (3) Washed commercial sugar (60% wt/vol)

The refractive index curves obtained from the samples are shown in Fig. 6.

Colouring matter in juice and syrup with different molecular weights

There were seven U.V. absorption peaks at 280 nm in the juice and syrup samples; one series of the samples is shown in Figs. 3, 4 and 5. This indicates that at least seven substances are present in the two major brown and brownish-yellow bands. The elution volume of the first peak was, in each case, found to be the same as the void volume (the volume external to the gel particles). This was determined by

measuring the volume of liquid required to elute a high-molecular weight substance, known to be excluded by the gel granules, such as Blue Dextran from Pharmacia Fine Chemicals. The exclusion limit of molecular weight of Sephadex G-25 is 5000, so the coloured substances in the first peak have molecular weights over 5000. The colorants represented by the subsequent peaks have molecular weights under 5000.

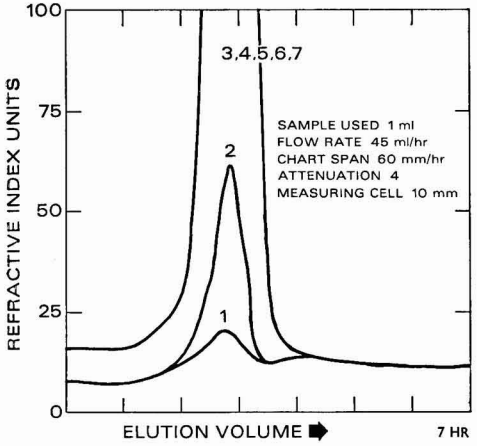

Fig. 6. Refractive index units of hand-cut cane juice samples from: (1) Top leaves between 0–10 nodes, (2) Cane tops between 0–10 nodes, (3) Cane stalks between 11–20 nodes, and (4) Cane stalks between 21 and below nodes. Refractive index units of factory samples from: (5) Mixed juice, (6) Evaporator syrup, and (7) Washed raw sugar.
Note: Leaf juice and cane top juice diluted to one-fourth original concentration; Refractive index unit, full scale, $0{\cdot}5 \times 10^{-3}$.

After the high M.W. brown fraction had completely moved out of the column, the refractive index of the effluent gradually increased and covered almost two to three peaks (Figs. 3, 4 and 5). This area corresponds to sucrose, the main component in juice and syrup, and thus the molecular weight of the substances (colorants) present in these peaks is around 300 (the molecular weight of sucrose is 350). The molecular weights of the colorants in the effluents of the last two or three peaks that contain no sucrose would be less than 300.

The results in each case (all absorption peaks except the first one and the very small second one, if present) demonstrate that low-M.W. substances (over 60% of the total colorants), rather than high-M.W. substances, are the major colorants in cane juice and syrup.

Colouring matter in washed commercial sugar

The results for washed commercial sugar (Fig. 5, curve 3) indicate that the first peak (over 50% of the total colorants) is the principal one in the sugar crystal. This suggests that the principal colorants in the sugar crystal are the high-M.W. substances (5000 and higher), rather than the low-M.W. substances, as reported by CARPENTER and co-workers[4], although they are the major colorants in juice and syrup shown in Fig. 5 (curves 1 and 2). This indicates that high-M.W. colorants, rather than low-M.W. colorants, are preferentially included in the sugar crystal during crystallization.

Colorants in various sections of cane plant

The absorption peaks shown in Fig. 4, 5 and 6 are qualitatively the same, i.e. the coloured substances in the factory juice and syrup and in the juice from cane leaves and cane tops are essentially the same. Both the high- and low-M.W. colorants were found to be present in significant quantities in cane tops and leaves, but were present in much smaller quantities in the cane stalks (except the top stalks), as shown in Fig. 3, 4, and 5.

Changes in processing

There was a drop in the level of the high-M.W. colorants in processing mixed juice to evaporator syrup, possibly because some of the high M.W. colorants are precipitated during the clarification and evaporation processes. Apparently no high-M.W. colorants are produced during processing under normal factory operating conditions. This suggests that the high-M.W. colorants in commercial sugar originate mostly from the cane plant rather than from being produced largely in processing, as reported by BINKLEY *et al.*[1,2,3].

By using the method of liquid chromatography described in this work, we have obtained a highly significant correlation value between the sugar colour (attenuation index at the wavelength 420 nm) and the absorbancy (at the wavelength 280 nm) of the high-M.W. colorants in the sugar crystal. This supports the theory that the high-M.W. colorants are the principal ones in commercial sugar.

SUMMARY

A method of liquid chromatography developed and used in the separation of colorants in juice, syrup, and the sugar crystal is described.

There are two groups of colorants (brown and brownish-yellow) of different molecular weights present in juice, syrup, and sugar. The low-M.W., brownish-yellow materials (those with a molecular weight less than 5000) are the major colorants in juice and syrup. The major colorants found in the highly coloured commercial sugar are the high-M.W. brown materials with a molecular weight over 5000. Both the low- and high-molecular-weight colorants in juice, syrup, and sugar crystals originate mainly from the cane plant rather than being largely produced in processing under normal operating conditions. The principal sources of the high-M.W. brown materials are from the cane tops and leaves.

ACKNOWLEDGMENT

The author wishes to thank Miss AILEEN KONDO for performing the experiments and obtaining data throughout the work.

The author's thanks also extend to Mr. DAVID TAKAHASHI for supplying the juice samples from hand-cut cane plants.

Destruction of reducing sugars by lime during diffusion

By S. K. D. AGARWAL and B. K. GUPTA

(National Sugar Institute, Kanpur, India)

TANUKU is the only sugar factory in India where the De Smet diffusion process is employed, which requires addition of lime directly in the diffuser. In the first few years of working at Tanuku, the juice pH varied from 6·0 to 9·0 between the feed and the discharge end of the unit. After studies made in 1969–70, it was suggested by the authors that lime addition directly into the diffuser should be discontinued and the pH inside the diffuser maintained between 6·5 to 8·0, as far as possible, by controlling only the pH of the dewatering mill juice after clarification and before returning it to the diffuser. The studies on the consequent working were made in 1971–72 and compared with the earlier operation. The studies were centred primarily on examination of the impact of lime addition.

The production of organic acids was studied by conductimetric estimations using the method[1,2] developed earlier. An examination of the pH inside the diffuser had shown that for more than 40% of the diffuser length, it was more than 8·5 and for another 40%, less than 6·5. Taking the bagasse retention time in the diffuser as 45 to 50 min, it may be seen that the pH of the juice remained more than 8·5 for about 20 min and less than 6·5 for another 20 min. It has been shown earlier by the authors[3,4] that, in the presence of lime, the destruction of reducing sugar and conversion into organic acids was maximum in the pH range 8·0 to 8·5. Above pH 8·5, part of the reducing sugar was also converted into colouring matter.

Actual examination of the juice from different stages of diffusion showed variations of reducing sugar in two sets of observations from one end of the diffuser to the other on two successive dates in the 1969–70 season from 6·14 to 3·64 and 8·22 to 3·49g/100°Bx. This destruction materially changed when the lime addition into the diffuser was stopped; the variation was then from 5·21 to 4·40 and 7·66 to 4·86 only on two occasions when observations were made during the 1971–72 season. The loss was decreased from about a half to about a quarter of the reducing sugar content.

The production of organic acids at various stages was also determined in the year 1971–72. It was observed that there was a steep rise in the production of organic acids as the bagasse was subjected to diffusion through various stages, i.e. with the increase in retention (Fig. 1). The organic acid content was of the order of 250 meq/litre at 20°Bx at the hopper end and the value increased continuously by 100–150% until it was discharged from the other end. An interesting observation was variation in Brix of the juices at different stages of diffusion. For about one-third of the diffuser length, juice Brix remained

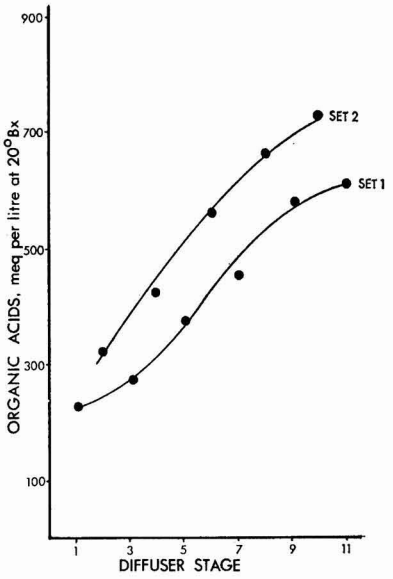

Fig. 1. Increase in the organic acid content of diffuser juice during retention of bagasse

within the range 3·0 to 3·5. It can therefore be inferred that this part of the diffuser could be diminished or cut from the process, since it not only remained unutilized but permitted an increase in the losses of reducing sugars and production of organic acids without any extraction of Brix.

The organic acid content of the primary, diffuser, last mill, mixed and clear juices were determined on three occasions and, converted to milliequivalents/litre at 20°Bx, were as follows:

Juice	*Set I*	*Set II*	*Set III*
Primary	214·3	223·6	270·0
Diffuser	504·7	518·2	510·8
Last mill	766·7	703·8	872·7
Mixed	255·2	293·1	288·1
Clear	252·5	265·3	275·2

The very pronounced formation of organic acids in the diffuser stage recorded during dewatering and clarification indicated the need to control the losses. The total organic acid content in the clear juice was lower than that of mixed juice; this could be due to

[1] RAMAIAH and CHANSARKAR: *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 83–84.
[2] RAMAIAH *et al.: Proc. 11th Congr. I.S.S.C.T.*, 1962, 932–940.
[3] AGARWAL *et al.: Proc. 38th Conv. Sugar Tech. Assoc. India*, 1972, M53–M64.
[4] AGARWAL and MATHUR: *ibid.*, M73–M85.

the elimination of organic acids as their calcium salts. Conductivity measurements were also made which showed the extraction of non-sugars in the process of diffusion. This varied in the order of L.M.J. > D.J. > M.J. > C.J. > P.J., i.e. a continuous increase in the conductivity as the process of extraction progressed. Even at as low a Brix as 3·0, the conductivity of the last mill juice was $0{\cdot}34 \times 10^{-2}$ and that of primary juice at 18·0°Brix as $0{\cdot}21 \times 10^{-2}$. By taking conductivity as a direct measure of non-sugars, it may be seen that considerable quantities of non-sugars were extracted and/or passed into the system during diffusion.

Acknowledgments

Authors' thanks are due to Sri S. L. SAXENA, Director, National Sugar Institute, Kanpur, for his kind interest in the work.

Continuous sucrose nucleation

Observations of secondary particle breeding in sucrose/water/organic systems as related to a continuous sugar pan

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(Chemical Engineering Department, University of Arizona, Tucson, Arizona, 85721 USA)

PART I

INTRODUCTION

THE development of a continuous sugar-boiling pan in the sugar industry is a major problem of long standing. DE VRIES[1], LUCE[2] and SILVER[3] all describe the state of development of continuous sugar processes as well as some of the problems encountered, while the system in use by the Verenigde Coöperatieve Suikerfabrieken G.A. has also been described[4]. Continuous sugar pans are particularly attractive for sugar refiners because of their centralization and large capacity together with the high state of automation of other unit operations. Savings to be expected include higher throughput per unit capital and operating costs as well as the possibility of improved product quality. BENNETT[5] has indicated the savings in steam costs to be expected in a continuous process.

Any continuous sucrose refining process must cope with the following items:

(*a*) operating costs should be reduced,

(*b*) better control should be achieved with reduced labour,

(*c*) product quality (ash, colour, purity) should be unimpaired or improved,

(*d*) crystal size distribution (CSD) should be uniform and controllable, i.e. mean size and narrowness of distribution should be acceptable,

(*e*) crystal habit and appearance should be attractive, and

(*f*) pan automation should fit in with existing automatic control.

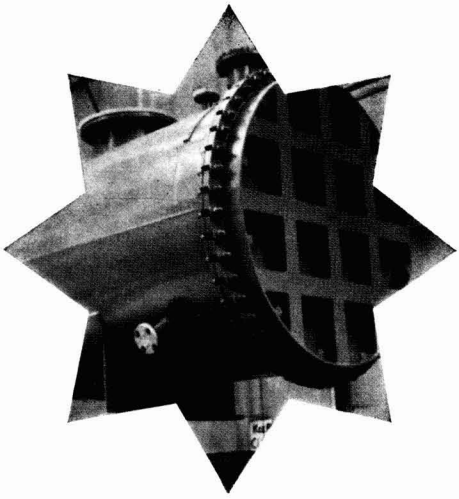
Raw sucrose crystallization processes are geographically more dispersed and generally of lower capacity. However, there is an equal incentive to reduce unit costs through continuous processing. A similar list of items to cope with can be written

NOMENCLATURE

B°	nucleation rate, number per cm³ per min.
CV	coefficient of variation; standard deviation divided by mean, based on mass-weighted particle size.
G	linear crystal growth rate, microns/min.
i	exponent of growth rate in nucleation kinetics expression
j	exponent of solids concentration in nucleation kinetics expression
k_n	coefficient in nucleation kinetics expression
k_v	crystal volume shape factor, (volume)(length)$^{-3}$
L	crystal size, microns
M_t	solids concentration, g.cm^{-3}
$n(L)$	population distribution function, number per cm³-micron
n°	nucleus population density, B°/G, number per cm³-micron
S	coefficient of supersaturation, C/C_s
T	temperature, °K
ρ	crystal density, g.cm^{-3}
τ	crystallizer retention time, V/Q, hr.

[1] *Sugar y Azúcar*, 1957, **52**, (4), 27.
[2] *I.S.J.*, 1970, **72**, 131–133, 170–172.
[3] *Sugar y Azúcar*, 1970, **65**, (6), 36.
[4] *I.S.J.*, 1970, **72**, 221; *Sugar y Azúcar*, 1970, **65**, (10), 29.
[5] *Chem. Eng. Progress, Symposium Series*, 1969, **65**, (95).

Sugar is our business



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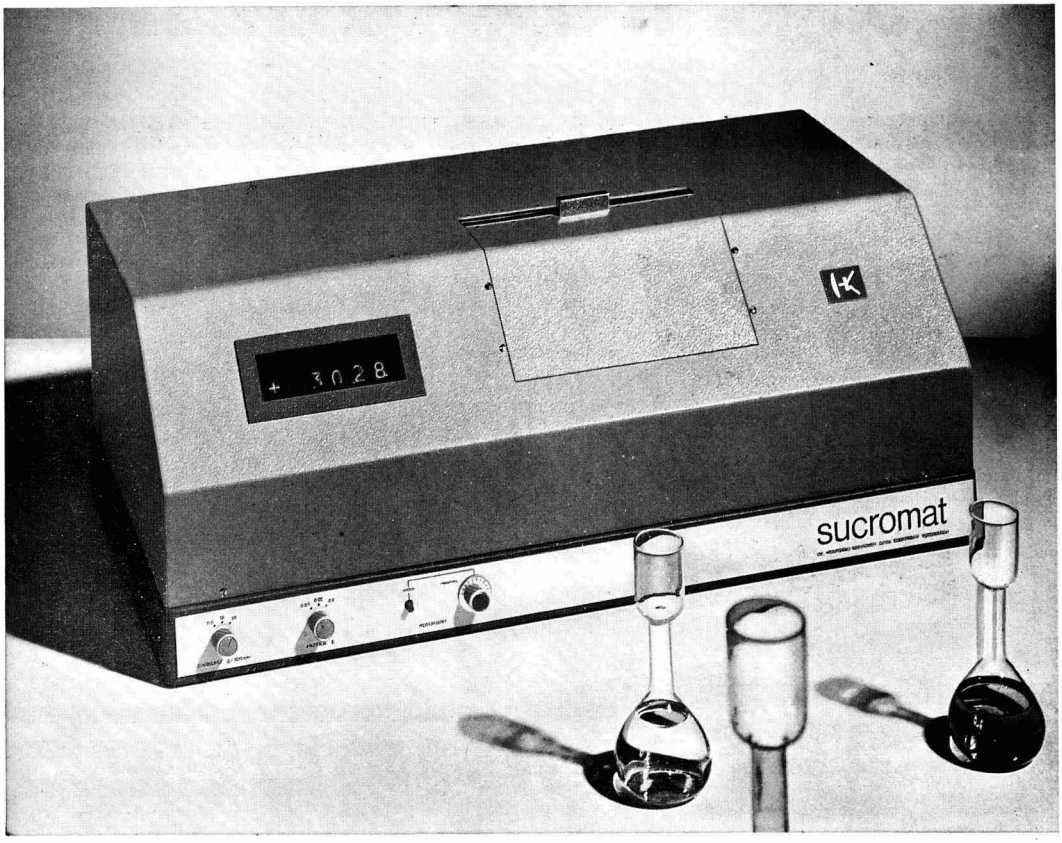

The automatic sugar polarimeter **sucromat** *has built-in reliability*

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2. Servo-driven quartz wedge compensator.
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for continuous raw sucrose processes; however, there is a greater emphasis on product quality (impurities must be removed later in expensive refinery steps). Continuous operation should be compatible with existing batch facilities as the dispersed state of the industry would make difficult the amortization of large sums for capital. Alternatively, improved product quality should pay for the new capital required. In raw sugar processing crystal size distribution and appearance are only important insofar as they affect final product purity.

The above discussion indicates that CSD, both magnitude and form (i.e. mean size and shape of distribution), is an important factor in the development of continuous raw or refined sucrose processes. RANDOLPH and LARSON[6] discuss the entire problem of manipulation of CSD and present a general algorithm relating crystal growth and nucleation rates with process configuration. These authors indicate the importance of the exponential population density distribution $n(L)$* in a data gathering and reference sense by means of equation (1).

$$n(L) = [\frac{B^\circ}{G}] \exp \{-L/G\tau\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This exponential form is the expected distribution from a continuous mixed suspension, mixed product removal (MSMPR) crystallizer. A measure of the wideness of a distribution is the coefficient of variation (CV) defined as the standard deviation divided by the mean[7]. The exponential population distribution has a CV (mass basis) of 50%. If the weight density distribution function can be approximated by a normal distribution, the CV may be calculated[8] as follows:

$$\text{CV} \simeq \frac{L_{0\cdot84} - L_{0\cdot16}}{2L_{0\cdot50}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Equation (2), easily computed from a cumulative screen analysis, is often used as a practical measure of wideness of particle distributions.

The MSMPR distribution is in general too wide to be acceptable for either raw or refined sucrose processing. HILL and ORCHARD[8] and RANDOLPH *et al.*[9] discuss the narrowing that can be expected in staged continuous processes with seeding of nuclei only in the first stage and with an equal product of growth rate times retention in all stages. In this case

$$\text{CV} = \frac{1}{(k+3)^{1/2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

for the expected wideness of product from the k'th stage of a staged continuous process. Equation (3) indicates that staging *per se* is not a very efficient way to duplicate the 25–30% CV's that can be obtained in careful batch sugar boiling pans. RANDOLPH *et al.*[9] indicate the fortuitous narrowing of CSD that occurs in a continuous staged, classified process, but do not suggest any feasible way that such size classification can be achieved in a viscous massecuite.

The problem of narrow CSD has been attacked in the Fives Lille-Cail continuous process[3] with an apparatus that approaches plug flow, this being analogous to a process that is batchwise in time. In the limit an infinite number of unseeded stages is equivalent to the ideal plug flow configuration. Equation (3) indicates the asymptotic narrowness to be expected with many stages in series; a few stages, e.g. two or three, may not duplicate batch or plug flow processes yet may produce acceptably narrow products. Product narrowness is a moot point for the raw sucrose industry if dewatering of massecuite is acceptable and final product purity is improved. BENNETT[10] indicates that continuous crystallization machines of the FC type produce smaller CV than machines of the DTB type, often through elimination of oversize particles. The former crystallizer type is a likely machine for use in continuous sucrose processes. Staging, with seed source only in the first stage, narrows a distribution by growth of the fine crystals. Thus, a staged FC crystallizer would appear to have advantages in producing an acceptable product. However, it is unlikely that backmixed continuous processes with existing technology can compete with carefully controlled batch processes in the area of product narrowness. If proper amounts of crystals can be made in each size range, sucrose refiners can sidestep the problem of narrowness by sieving the final product.

An area closely related to product CV, and equally important, is mean product size. Particle size is a direct function of the number of seed relative to production; batch crystallizers with controlled seeding can, within limits, manipulate both these variables to change size. However, a continuous process with a stable seed source should be able to control product size within tighter limits.

Seeding of sucrose pans is directly related to the mechanisms of nucleation in the system. VANHOOK[11] discusses three regions of sucrose nucleation as a function of supersaturation driving forces.

(*a*) *Homogeneous Region* (S>1·3). New growth centres are formed by homogeneous nucleation as a function of supersaturation driving forces alone so that unseeded batch processes will nucleate under these conditions. Nucleation kinetics can be reasonably explained with the well-known homogeneous model deriving from Gibbs free energy considerations.

(*b*) *Secondary Region* (S=1·2–1·3). Spontaneous nucleation does not occur, but existing centres continue to grow and may induce further secondary nuclei (false grain). BENNETT[5] has shown that secondary nucleation occurs in backmixed crystallizers of the FC type.

(*c*) *Metastable Region* (S<1·2). In this region negligible homogeneous or secondary nucleation occurs, but

* For the meanings of symbols see the key to nomenclature in the panel on p. 8.

[6] "*Theory of Particulate Processes*" (Academic Press, New York), 1971.
[7] POWERS: *I.S.J.*, 1948, **50**, 149.
[8] *Sucr. Belge.*, 1967, **87**, 200.
[9] *Amer. Inst. Chem. Eng. J.*, 1968, **14**, (5).
[10] *Chem. Eng. Progress*, 1962, **58**, 9.
[11] "Principles of Sugar Technology", Vol. 2, Ed. P. HONIG. (Elsevier, New York), 1959, pp. 113–148.

seed that is introduced will continue to grow. The existence of such a wide metastable region allows batch crystallizers to make sugar of exceptionally narrow CSD.

It becomes obvious that any continuous sucrose crystallization process must develop a stable continuous seed source and/or rely on secondary nucleation (false grain) mechanisms. The level of supersaturation driving forces encountered in typical continuous processes is such that some, if not all, growth centres will have to be added. Thus, development of a high quality continuous grain source is mandatory. The current practice of ball milling sucrose crystals in *iso*-propanol to make a seed innoculum may be adapted to continuous operation, but control of particle numbers and possible adverse effects of irregular seed shape on final crystal habit and purity have not been definitively investigated.

Scope of Present Work

The work reported in this paper describes a continuous secondary sucrose crystallization process that produces a fine-sized seed fondant of well-formed single crystals suitable as a seed source for a large-scale continuous process. Randolph[12] discovered that sucrose would breed copious quantities of secondary nuclei when a high concentration feed syrup (*ca.* 68°Brix) was continuously salted-out with lower molecular weight alcohols, ketones or mixtures of these. Low mass ratios of solvent:water (less than 2·0) were necessary to produce crystals of desirable single-crystal habit. Randolph and Crawford[13] and Crawford[14] studied this phenomenon and more carefully defined solvent type and condition required to produce acceptable numbers and quality of sucrose seed. Ziebold[15] continued this study and further maximized the yield of nuclei using a statistical experimental design of the significant variables.

That this process entails the mechanism of secondary nucleation is clearly shown by the fact that, after the feed streams are well mixed in the nucleator, considerable time (2 or 3 hours) elapses before breeding of secondary nuclei occurs. The appearance of these nuclei can be considerably speeded up by seeding the vessel initially with product-sized sugar. Kelly and Mak[16] describe an analogous technique for the homogeneous nucleation of sucrose using a salting-out process with ethanol or methyl cellosolve as the miscible organic agent. Excessive mass ratios (organic:water) of 25:1 to 120:1 were found to be necessary to promote homogeneous nuclei formation.

The present work continues process development of the salting-out secondary breeding process as a viable alternative for seed source in a commercial continuous sugar process. Specifically, conditions were sought which would produce sucrose nuclei densities of 10^6–10^7 nuclei/cm^3-micron with a population-weighted mean crystal size of 10–12 microns. A constraint on operating conditions was that the nuclei formed must be predominately of single-crystal habit.

Extensive calculations were then carried out to demonstrate the feasibility of using this technique for seeding large-scale continuous sugar processes. The purpose of these calculations was to demonstrate in a rigorous CSD simulation both the adequacy of such a nucleator as seed source as well as the concept of a continuous footing crystallizer[17] which would grow the crystals to an intermediate size for addition as partially developed grain in full-scale batch or continuous pans. The early period of grain development in current batch pans is particularly unproductive; such a technique would obviate this difficulty. In addition, increments of product quality might be expected using these well-formed seed, but such quality improvements could only be demonstrated in extensive pilot tests. The economic cost of this seeding technique can readily be deduced from these process calculations.

Synopsis of Experimental Studies

Research work was carried out over a period of nine months to answer the questions posed and achieve the goals set in the previous section. Specifically, the accomplishments of this study were as follows:

(1) A laboratory bench-scale salting-out MSMPR crystallizer was modified and operated to produce sugar crystals from a sucrose/water/solvent system. The solvent used was either a 50:50 methanol/*iso*-propanol mixture or "Vanzol A-1"-denatured ethanol [100 parts by volume of 190 proof alcohol, 1 part of methyl isobutyl ketone, 1 part of ethyl acetate, 1 part of a hydrocarbon solvent (Stoddard's)].

2. Preliminary crystallizer runs were made to solve initial difficulties with the system and to make necessary modifications. A standard run was established with set conditions to compare with Crawford's data[14]. Laboratory technique, which is very important, was also developed.

3. Optimization of chosen process conditions was carried out with the objective of finding conditions which would produce a crystal-size distribution with a nuclei density approaching 10^7 per/cm^3-micron with a characteristic population-weighted size of 10 microns.

Thus, the primary objective of the research was to produce a sucrose seed-crystal fondant with the salting-out process having superior single crystal form and with a high nuclei population density. Exploratory runs were executed to map out regions worthwhile to study in depth. This phase was guided by a Plackett-Burman, one-level statistical analysis design[18] to find a likely region in which to carry out more detailed kinetic studies. Independent variables of the salting-out nucleator that were explored were as follows:

(*a*) system temperature (5°C–27°C),

[12] Unpublished work on sucrose nucleation research carried out at the Dept. of Chemical Engineering, The University of Florida, Gainsville, Fla., 1966.
[13] US Patent 3,695,932; *I.S.J.*, 1973, **75**, 325.
[14] "The Continuous Nucleation of Sucrose" (Master's Thesis, The University of Arizona), 1970.
[15] "Continuous Sucrose Crystallization", (Master's Thesis. The University of Arizona), 1973.
[16] *I.S.J.*, 1972, **74**, 133–136.
[17] Petri: Private communication, 1971.
[18] Isaacson: *Chem. Engr.*, 29th June 1970.

(*b*) feed concentration (68°–75°Brix),

(*c*) solvent type (50:50 methanol/*iso*-propanol *vs.* "Vanzol A-1").

(*d*) surfactants [methylamine HCl and "Fluorocarbon FC-96" (3M Co.)]

(*e*) holding time (1–3 hours).

The goal was to find combinations of these variables to produce high population densities of small seed. This seed might then be used directly in a full-scale process or as a seed source for a footing crystallizer used to grow the seed to an intermediate size before seeding a vacuum pan. Eight exploratory runs at high and low level values of the above variables were made after the "shakedown" runs. An added constraint, verified by photomicrographs, was that the crystal habit should be of a single-crystal form. Key variables were selected and evaluated in a further kinetic study in an attempt to optimize the number and quality of seed produced. All CSD determinations were made using the Model "T" Multi-Channel Coulter Counter calibrated with ragweed pollen.

Synopsis of Computer Simulations

The kinetics developed were used in an extensive computer simulation of continuous seeded sucrose processes. A computer simulation of a three-stage process comprised of a nucleator (with optimized kinetic conditions) staged in series to a seed ripener and a forced circulation continuous crystallizer was implemented to study the feasibility of this system used as seed source in a continuous crystallizer. CSD values were calculated using the rigorous Mark I CSD simulator[19]. Auxiliary computations were made to determine the feasibility of recovering solvent from the nucleator by flash evaporation in the ripener.

Theoretical Considerations

MSMPR technique

The apparatus used in this research work could ideally be considered an MSMPR (mixed suspension mixed product removal) crystallizer. This unit is a continuously-fed mixed-magma crystallizer of volume V which produces crystals dispersed in mother liquor, in this case by salting-out with a miscible organic compound. Supersaturation thus generated causes both crystal growth and secondary nucleation. The feed rate, composition, and temperature as well as the crystallizer volume and temperature remain constant. Randolph and Larson[6] present the crystal population balance in an MSMPR crystallizer and derive equation (1) for the expected number distribution of the crystal product.

$$n(L) = [\frac{B^\circ}{G}] \exp(-L/G\tau) \quad \ldots\ldots(1)$$

In this equation, n is the population density which has dimentions of number/length-volume. The intercept at $L = 0$, given as B°/G, is defined as the population density of the embryo-size crystals. The characterizing dimension of the crystal is given the symbol L and the rate at which this dimension grows is termed the growth rate G. The drawdown time τ is the crystallizer volume divided by the suspension output, i.e. $\tau = V/Q$.

Some of the assumptions that must hold in order that equation (1) be valid are:

(1) McCabe's ΔL law[20], i.e. $G \neq f(L)$,

(2) the feed to the crystallizer contains no seed ($n_i = 0$),

(3) the population density of the crystallizer product is the same inside the crystallizer, i.e. no classification and perfect mixing, and

(4) the suspension volume remains constant in time.

The nucleation rate B° is related to the nuclei density and the growth rate by the following equation:

$$B^\circ = n^\circ G \quad \ldots\ldots(4)$$

Nuclei densities can be determined for various experimental runs by plotting $\ln(n)$ against L and determining the intercept at $L = 0$. The population-weighted characteristic size ($G\tau$) can be found from the slope of the line; B° is obtained from equation (4). Slurry density M_t is given by the equation[6]

$$M_t = 6k_v\rho n^\circ(G\tau)^4 \quad \ldots\ldots(5)$$

Here, M_t is the solids concentration, k_v is the crystal shape factor which relates the cube of the characteristic size dimension of the particle to its volume, and ρ is the crystal density.

Equations (1), (4) and (5) can be used to analyse the CSD of the MSMPR crystallizer. It should be noted that each parameter of equation (1) can be related to the kinetics of the system and the imposed system constraints. The growth rate G is determined by the kinetics of growth and τ, the holding time, which is known in any operating system. These two quantities, however, cannot be fixed independently. Generally, one fixes the mass and energy flows and the kinetics of growth and nucleation inherent to the crystal system determine the growth rate which exists. The adjustable controls in the sucrose system include the syrup feed concentration, the rate of energy input or removal, and the feed rate.

Crystal nucleation kinetics

In the sugar/water/solvent system, secondary nucleation is likely, owing to collision breeding. Nuclei result from the collision of seed crystals with solid surfaces which, in the case of a stirred crystallizer, may be other crystals, impeller blades, or crystallizer surfaces.

According to Youngquist and Randolph[21] no fundamental theory for prediction or correlation of secondary nucleation exists; most experimental data have been obtained using MSMPR crystallizers. Data are frequently correlated using a power-law model of the form:

$$B^\circ = k_n G^i M_t^j \quad \ldots\ldots(6)$$

[19] Nuttall: "Computer Simulation of Steady-State and Dynamic Crystallizers" (Ph.D. Dissertation, The University of Arizona), 1971.

[20] McCabe and Smith: "Unit Operations of Chemical Engineering" (McGraw-Hill Book Co., New York), 1967.

[21] *Amer. Inst. Chem. Eng. J.*, 1972, **18**, (2).

The mechanism of secondary nucleation (or self-nucleation) has also been studied by CLONTZ and MCCABE[22] and by RANDOLPH and CISE[23]. Their findings have indicated that contact secondary nucleation plays an important rôle in operating crystallizers. This phenomenon may be important in sucrose/water/organic systems owing to the reduced viscosity of the massecuite.

Crystal growth kinetics

In addition to secondary kinetics of the form of equation (6), a growth rate kinetics relationship is necessary for complete simulation of a seeded crystallization process. The following linear equation was obtained using the data that BENNETT[5] presented on the sucrose/water system in a continuous FC unit.

$$S = (G + 5{\cdot}36)/(4{\cdot}66) \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

In Equation (7) S is the coefficient of supersaturation and G is the growth rate in microns per minute.

Crystal modifiers

Trace chemical additives are often used to suppress or promote nucleation and/or promote better crystal growth and habit. Such additives are usually considered proprietary information by industrial companies and therefore few published data exist on this subject. These additives are usually quite specific in their effect on nucleation, and inhibit as well as accelerate nucleation.

Two surface-active agents, methylamine hydrochloride and "Fluorocarbon FC-96" (3M Company), were chosen for study, mainly because they accelerated nucleation in the KNO_3 system[6].

Other types of surfactants that affect crystallization in the sucrose system are discussed by VANHOOK[11]. It was pointed out that most impurities impede the crystallization velocity (growth rate) of sucrose. If an additive (e.g. an impurity or an electrolyte) can be found that will slow down the growth rate of the sucrose system, and if this surfactant can be readily dissolved in aqueous-alcohol mixtures, then a smaller crystal size in the sucrose seed nucleator may be achieved, with the net effect that higher supersaturation and more nuclei are created.

NICOL and FARMER[24] have recently studied the effects of lysine and glycine on the nucleation and crystallization of sucrose. They found that the nucleation rate of sucrose was increased by glycine because the impurity acted as a centre for heterogeneous primary nucleation.

CRAWFORD[14] tested the effect of the surfactant "Aliquat 26" (trimethyl tallow ammonium chloride) on sucrose crystal growth and nucleation. It was suggested that the surfactant may have changed the system kinetics but no conclusive evidence was given.

(to be continued)

[22] *Paper read at 62nd Annual Meeting Amer. Inst. Chem. Eng.*, 1969.
[23] *Amer. Inst. Chem. Eng. J.*, 1972, **18**, (4).
[24] *Sucr. Belge.*, 1972, **91**, 55–59.

Correspondence

To the Editor,
The International Sugar Journal.

Dear Sir,

SOME NOTES CONCERNING "THE POTENTIAL OF A SCREW PRESS TANDEM"

by S. G. Smart[1]

The writer would like to make some comments concerning the above-mentioned paper:

(1) It is well known that the rather poor performance of a three-roller mill(ing tandem) is due to:

(*a*) the incapability of a mill to achieve under normal working conditions a better liquid to solids (i.e. juice to natural fibre) ratio than roundabout 0·9:1. This ratio is attained when the bone-bry fibre content of the bagasse is 42%. Making allowance for the presence of Brix-free water in the fibre of cane and bagasse, the corresponding natural fibre content is calculated as 52·5% and the juice content as 47·5%.

(*b*) the incomplete mixing of the imbibition liquid with the residual juice present in the bagasse fed into a mill[2].

(2) For a new type of sqeezing apparatus to show a better performance than a three-roller mill it must either achieve a lower juice:solids ratio or a better mixing efficiency or, preferably, both.

(3) As to the moisture content of bagasse as discharged by a screw press Mr Smart states that a screw press is "capable of giving a much lower moisture figure". However the M%PB data given in his Table I, presumably obtained under normal working conditions, fluctuate between 57·17 and 49·25%. Such results could have been obtained also by a good mill.

(4) The extent to which the imbibition liquid mixes with the residual juice is reflected in the "mixing efficiency", the "stage efficiency" or the "mixing coefficient" figure.

DOUWES DEKKER (*l.c.*) defined the mixing coefficient as the fractional figure n denoting the proportion of the residual juice which has mixed homogeneously with all imbibition liquid before the excess of this mixture is removed by the next squeeze. By studying the results of a milling tandem he found that n was probably in the order of 0·25 to 0·40.

BUCHANAN[3] stated that stage efficiencies are rather low. The lowest one he found was under 25%; "this could be interpreted as only one quarter of the residual juice actually mixing with the imbibition juice at each stage before expressing".

Mr. SMART compares the actual Brix of press juice with the Brix which would have been obtained if complete mixing of imbibition liquid with residual

[1] *I.S.J.*, 1973, **75**, 371–375.
[2] DOUWES DEKKER: *Proc. 10th Congr. I.S.S.C.T.*, 1959, 86.
[3] *Proc. 39th Ann. Congr. S. African Sugar Tech. Assoc.*, 1965, 34.

juice had occurred. In an example involving a screw press which follows a last mill he found a mixing efficiency of 91·425% (Brix basis), a figure which is considerably better than the results of the calculations of the former authors.

However, there is a significant difference between the calculations of Mr. SMART and of the other authors. The latter calculations are based on the fact that fibre in cane and bagasse contains about 25% Brix-free water, i.e. moisture which cannot be removed by mechanical means. Mr. SMART seems to deny the existence of Brix-free water. In the following example based on data appearing in Mr. SMART's paper the effect of allowing for Brix-free water is illustrated.

To last mill bagasse of a moisture content of 54·33% and a Brix content of 4·49% 26·182 parts of imbibition water per 100 parts of bagasse are added.

The fibre content of this type of bagasse is 41·18%. Hence the absolute juice content is $100 - 41{\cdot}18 = 58{\cdot}82\%$, and the undiluted juice content is $100 - (1{\cdot}25 \times 41{\cdot}18) = 48{\cdot}52\%$. The concentrations of the absolute and undiluted juices are $4{\cdot}49/58{\cdot}82 \times 100 = 7{\cdot}63$°Brix and $4{\cdot}49/48{\cdot}52 \times 100 = 9{\cdot}25\%$ respectively.

As 26·182 parts of imbibition water are added per 100 parts of bagasse, i.e. per 58·82 parts of absolute juice or per 48·52 parts of undiluted juice, the amounts of mixture (assuming complete mixing!) are 85·00 and 74·70 parts, respectively.

Since both mixtures comprise 4·49 parts of Brix, the corresponding concentrations are 5·28°Bx and 6·01°Bx respectively. Supposing with Mr. SMART that the actual concentration of the press juice is 4·83°Bx, the mixing efficiency according to the absolute juice hypothesis is 91·47% and, after allowance has been made for the presence of Brix-free water, 80·36%.

Had mixing been worse and had, for example, the actual concentration of the press juice been 3·50°Bx, the two mixing efficiency figures would have been 66·29% and 58·24% respectively.

Conclusions to be drawn from the above are:

(*a*) when allowance is made for the presence of Brix-free water, lower mixing efficiency data are found than when the calculations are based on the absolute juice concept

(*b*) but even the lower figure (80·36) is noticeably higher than the figures found for three-roller milling tandems. This indicates that when a screw press follows a last mill better mixing occurs. But may we expect identical mixing efficiencies also for the second screw press in a tandem and, more particularly, for a first press working on prepared cane?

(5) It is usually assumed that there are two causes of poor mixing, (*a*) the presence of unopened cells in the feed of the mill, and (*b*) the presence of tiny air bubbles in the opened or partly ruptured cells of the bagasse (KHAINOVSKY).

The number of unopened cells decreases as the bagasse passes through the milling tandem. For this reason a better mixing efficiency can be expected for a last mill than for the first imbibition unit. About the difference between the effect of the air bubbles present in penultimate mill bagasse and in prepared cane no quantitative data are available, but it seems logical to assume that the effect of the greater number of ruptured cells in penultimate mill bagasse is the major factor in the achieved mixing efficiency.

(6) In the paragraph "Calculations for a three press tandem" Mr. SMART assumed equally high mixing efficiencies of 95% for each of the presses. Under (4) doubt has been expressed about the correctness of applying the same mixing efficiency to the second press and under (5) the reasons have been given for this doubt.

When we come to the first press where a large volume of imbibition liquid is added to prepared cane, i.e. cane from which no juice has been expressed, the doubt becomes a near certainty. Prepared cane cannot absorb so much imbibition liquid. On an ordinary cane conveyor the liquid would percolate through the cane and mixing with the juice in the hardly ruptured cells would be minimal.

Mr. SMART does not propose the use of an ordinary conveyor, but of a "mixing bin or screw conveyor system" wherein a homogeneous mixing of imbibition liquid and prepared cane is to be accomplished. But even if this goal were attained and the mixture in this state were to be fed into the press, it still seems very unlikely that the press could achieve a mixing efficiency of 95%.

(7) Although Mr. SMART may have succeeded in showing that better mixing can be expected from a screw press than from a three-roller mill, his paper lacks the factual information required to justify the conclusion that a three- or even a four-screw press tandem will give the same performance as, say, a six-mill tandem. Therefore the paper would not warrant the advice to a factory to install a screw press tandem. It is correct, however, that this is not what Mr. SMART does.

He suggests that new factories should give "serious consideration" to such a tandem. With this suggestion one can agree, but in such a consideration due weight should be given to the fact that as yet inadequate information is available about the performance of screw presses in the first, second and perhaps third place of the tandem.

If there is sufficient evidence to assume that a screw press is a better extraction apparatus than a three-roller mill a further study of its performance is justified. Such an examination should include the practical side of the problem.

Mr. SMART's suggestion to install a fourth press "so that, in the event of a break-down, the press tandem operation would be changed from four to three presses with only a relatively small loss in extraction" is little suited to provoke much confidence in their uninterrupted operation.

Yours faithfully,

K. DOUWES DEKKER,
El Atabal, Málaga, Spain.

Sugar cane agriculture

Sugar cane diseases in Kenya. C. K. BUNGEY. *Sugarcane Pathologists Newsletter*, 1972, (9), 18.—Trials have produced strong evidence of ratoon stunting disease in cane fields in Kenya, although a method of discovering the causal agent is needed before confirmation. Eye spot has occurred in cane fields subject to lower temperatures and higher rainfall.

* * *

Mechanical transmission of sugar cane mosaic virus. K. K. N. NAMBIAR. *Sugarcane Pathologists Newsletter*, 1972, (9), 19–20.—Tests were conducted on addition of chemicals to sap from mosaic-infected leaves with the aim of increasing infection of cane cuttings by inoculation with mosaic virus during a screening tests. Results indicated that cysteine hydrochloride added to the phosphate buffer solution increased infection from 20% (with the buffer solution alone) to 46·67%, while sodium sulphite + phosphate caused 40% infection. In all other cases infection remained unchanged or was reduced, EDTA and $CaCl_2$ completely inhibiting infection.

* * *

Roguing and its effects on yield and smut of sugar cane. G. L. JAMES and J. BURTON. *Sugarcane Pathologists Newsletter*, 1972, (9), 20–21.—While roguing of smut-infected plant, first and second ratoon cane had no marked effect on millable cane population at harvest, it considerably increased cane and sugar yield per hectare. Of two methods of roguing tested, whip removal reduced smut incidence to a greater extent than did stool removal, but the latter method increased cane and sugar yield to a greater degree.

* * *

Leaf scald in Mozambique. M. E. PINTO. *Sugarcane Pathologists Newsletter*, 1972, (9), 22.—Symptoms of the disease, caused by *Xanthomonas albilineans*, are described and the cane varieties infected in Mozambique reported.

* * *

Leaf spot of sugar cane incited by *Colletotrichum falcatum* Went. S. SINGH and S. M. P. KHURANA. *Sugarcane Pathologists Newsletter*, 1972, (9), 23. Investigations at Coimbatore indicated that the strain of *C. falcatum* causing leaf spot on cane of 28 NG 223 variety (part of a collection obtained in New Guinea in 1928) was very weak, but infected cane which already showed symptoms of mosaic or other disease, as demonstrated by inoculation of cane from other varieties.

A source of maize dwarf mosaic virus susceptibility in sugar cane. A. G. GILLASPIE and H. KOIKE. *Sugarcane Pathologists Newsletter*, 1972, (9), 24.—While all but one (US 56-15-8) of 16 parental cane varieties were were found to be susceptible to cane mosaic virus strain H, only one, *S. sinense* Chunnee, showed symptoms of maize dwarf mosaic virus (MDMV) after inoculation. This variety is to be found in the ancestry of all commercial varieties grown in Louisiana, and must be regarded as a source of MDMV susceptibility in them, although not all hybrids containing *S. sinense* Chunnee in their lineage are susceptible.

* * *

Alternative hosts of sugar cane diseases. C. G. HUGHES. *Sugarcane Pathologists Newsletter*, 1972, (9), 24. Additions and corrections are made to the list of alternative hosts of cane diseases[1], the additions referring to leaf scald hosts. It is suggested that it should be indicated whether the hosts recorded in the list are proven alternative hosts in the field or whether they have exhibited symptoms of a disease only after inoculation.

* * *

Sugar cane diseases in Afghanistan. S. B. LAL. *Sugarcane Pathologists Newsletter*, 1972, (9), 25.—In The province of Jalalabad, red rot (*Physalospora tucumanensis*), smut (*Ustilago scitaminea*) and leaf sheath red spot (caused by *Cercospora vaginae*) have been reported, the first two each infecting about 20% of the cane.

* * *

An alternative host for sugar cane mosaic. N. RISHI. *Sugarcane Pathologists Newsletter*, 1972, (9), 25.—In India, *Pennisetum typhoides* has been found to be a new alternative host of cane mosaic virus.

* * *

Smut in Brazil. F. M. VEIGA. *Sugarcane Pathologists Newsletter*, 1972, (9), 25.—CB 45-3 cane, found in South Africa to be resistant to smut[2], has been found to be infected with the disease in the state of Rio de Janeiro, where the variety is grown on nearly 80% of the total cane area. It is suggested that the difference in the reactions in South Africa and Brazil is due to different strains of *Ustilago scitaminea*. Control measures being adopted in Brazil against the disease are described.

[1] HUTCHINSON: *I.S.J.*, 1973, **75**, 313.
[2] THOMSON: *ibid.*, 144.

1972 sugar cane variety census for Florida. L. P. HEBERT. *Sugar J.*, 1972, **35**, (5), 22–24.—Details are given from the 9th of the annual surveys made on varieties grown in Florida. The predominant variety is still Cl 41-223 but its use has declined from 59·3% in 1971 to 49·6% in 1972 (it occupied 87·0% in 1962). New varieties of increasing importance are CP 63-588 (up from 6·4% in 1971 to 13·9%) and CP 56-59 (up from 5·9 to 6·7%).

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Tweed River experiment foreshadows new cane transport system. ANON. *Producers' Rev.*, 1972, **62**, (9), 61. An illustrated description is given of a pilot scheme under trial in New South Wales in which chopped cane is loaded into a 20-ton bin from conventional infield cane transport and the filled bin winched onto a special trailer which carries it to the mill.

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Effects of methods of planting, seed rates and spacing of sugar cane. K. SINGH and R. RAGHAV. *Sugar News* (India), 1972, **4**, (3), 9–10, 28.—Experiments over two crops compared germination, number of millable canes and yield of cane per hectare for cane planted flat and in trenches, with different seed rates and spacing. Results are tabulated and the highest cane yield found with cane planted in trenches at a row distance of 90 cm with 74,100 two-budded setts per hectare.

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"Scheonite", a new indigenous potassic fertilizer. R. S. PATIL and G. K. ZENDE. *Sugar News* (India), 1972, **4**, (4), 9–10.—Trials comparing K_2SO_4 and "Scheonite" (a K_2SO_4,$MgSO_4$,$6H_2O$ double salt produced as a by-product from the extraction of common salt from sea-water) as a potassium fertilizer for cane showed that they gave equally high increases in yield over the unfertilized control

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Sugar cane culture in Puerto Rico and Louisiana. R. S. KANWAR. *Sugar News* (India), 1972, **4**, (4), 14–16.—See *I.S.J.*, 1973, **75**, 379.

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Water in the production of sugar cane. H. B. SOUTINHO. *Brasil Açuc.*, 1972, **80**, 416–418.—The prime importance of water in controlling the yield of cane is demonstrated by a table of rainfall data during the period January–June in 1971 and 1972; the period in the former year was dry and the cane crop low by comparison with the latter. Agricultural planning should include provision for irrigation to counter lack of rainfall.

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CB 45-3: extraordinary variety. F. VEIGA. *Brasil Açuc.*, 1972, **80**, 419–421.—An account is given of this variety, bred in 1947 as a cross between Co 290 and Co 331. It is extremely vigorous and gives both high yield (205 tons/ha has been recorded) and high sucrose content (about 14·5%). It has been planted in various regions of Brazil and also in Zaire and South Africa.

Cane ripening—point of maturity. L. M. J. BRAS. *Brasil Açuc.*, 1972, **80**, 434–440.—Measurement of a coefficient of maturity (C.M.), defined as pol:reducing sugars, during the growth of a cane provides an indication of yield potential and hence indicates the time when the cane has reached its optimum ripeness. Curves obtained with a number of varieties are reproduced.

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Quantitative equation for predicting success or failure of pre-emergence herbicide application to sugar cane. L. M. ARCEO. *Sugarland* (Philippines), 1972, **9**, (6/7), 12, 34.—Six factors contribute to the success or failure of pre-emergence herbicide application, viz. spray operator's skill, soil texture, soil preparation, organic matter, soil moisture, and rain after spraying. The author assigns numerical values to degrees of these factors and by assessment of the values for different instances predicts from the total the likelihood of successful weed control.

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How can an agronomist pursue sugar cane development work in a factory zone? A. AZIZ. *Sugarland* (Philippines), 1972, **9**, (6/7), 23–26.—The activities of an agronomist are discussed. The knowledge he requires of local conditions are set out as are aspects of the extension work he should do among local farmers—distribution of seed cane and supervision of a seed nursery, and provision of advice regarding fertilization and cultural practices, assessment and control of pest damage, irrigation and mechanization. He should also ensure that publicity is given to agricultural matters and should establish good relations with farmers, as well as ensuring that advantage is taken of the Government and other funds available for construction of roads, bridges, etc.

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Side-tipping bins. L. G. VALLANCE. *Australian Sugar J.*, 1972, **64**, 345–346.—Three photographs illustrate the rapidity of emptying a 4-ton bin of cane by a hydraulic side-tipper into a rail bin for transport to the sugar factory; a conventional derrick unloader has hardly commenced its transfer during the time taken by the side-loader to complete its work while the driver does not leave his seat.

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The ups and downs of harvesting. L. G. VALLANCE. *Australian Sugar J.*, 1972, **64**, 346.—Modern cane harvesters can cope with both upright and lodged cane with little effect on speed; with lodged cane, however, the topping mechanism does not come into action and the tops are included in the cane that is sent to the factory. Since this is not desirable, there is still good reason to search for varieties which will grow erect under a wide variety of conditions.

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Ways to reduce labour costs. R. C. HODSON. *Sugar Bull.*, 1972, **51**, (4), 6.—Labour costs can be reduced by a number of steps suggested which include: increase use of mechanical planters, perform only

necessary cultivations, use multi-row and higher capacity equipment, apply chemicals, etc., from the air, reduce cane transport waiting time at the factory and cross-hauling by cooperation between grower and processor, hire temporary labour for certain jobs, eliminate extra year-round labour, employ only productive workers, pool labour with other growers for certain jobs, and maintain a good working relationship with employees to obtain more productivity.

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Sugar cane variety outfield experiments in Louisiana during 1971. H. P. FANGUY. *Sugar Bull.*, 1972, **51,** (4), 8–12.—Outfield testing, the stage after experimental plots, showed L 65-69 to be resistant to mosaic but, while stalk breakage through hurricane winds was low, the variety lodged and machine harvesting proved difficult. CP 65-357 is susceptible to mosaic but is erect and gives high cane and sugar yields. It did not suffer extensive stalk breakage as a result of the hurricane and harvested well. It is more tolerant to cold than L 65-69.

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Laboratory evaluation of insecticides against *Aeneolamia varia saccharina* (Homoptera: Cercopidae) in Trinidad. D. E. EVANS. *Trop. Agric.* (Trinidad), 1973, **50,** 25–33.—A range of 56 insecticides were tested against "Carbaryl" and "Malathion" for froghopper control. "Aminocarb", "Azinphos-methyl", "Methiocarb", "Monocrotophos", "Omethoate" and "Propoxur" are more effective than or similar to "Carbaryl". "Dioxacarb", "Dursban", "Mecarbam", "Methidathion", "Phosmet" and "Vamidothion" are superior to or similar in initial effect but less residual than "Carbaryl"; "Carbofuran" and "Thiocarboxime" ("Talcord") are highly effective but are considered too toxic in Trinidad. Ultra-low volume formulations of "Diazinon", "Fenitrothion", "Fenthion" and possibly "Phoxim" show promise as potential alternatives to "Malathion".

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Evaluation of chemical ripeners for sugar cane having constant nitrogen and water régimes. I. Growth, quality and enzymic responses of nine potential ripeners. A. G. ALEXANDER and R. MONTALVO Z. *Trop. Agric.* (Trinidad), 1973, **50,** 35–44.—Nine chemicals were tested by application to cane propagated in glasshouses to eliminate the effects of field variables. Growth and quality measurements were made, as were observations on activity trends for acid invertase, β-amylase, phosphatase and ATP-ase as evidence of chemical penetration and activity. "Chlormequat chloride" and 60-CS-16 gave evidence of ripening potential sufficient to justify testing in field plots while marginal responses to "Alar-85" and 2-chloroethylphosphonic acid warranted further glasshouse evaluation. "Dicamba" showed a leaf sheath loosening property having possible value in canopy penetration or defoliation studies. Seven compounds gave evidence of penetration and physiological activity but none significantly repressed growth.

Effect of saline water irrigation on N:Co 310 and H 50-7209 cultivars of sugar cane. II. Chemical composition of plants. M. M. SYED and S. A. EL-SWAIFY. *Trop. Agric.* (Trinidad), 1973, **50,** 45–51. Irrigation with solutions of NaCl and Na_2SO_4 and with sea-water all increased the Na content of both varieties. The K content decreased with Na_2SO_4 but was unchanged by the NaCl solution and sea-water. The Ca content was reduced by all treatments, but more so by Na_2SO_4. The Mg content increased slightly, the greatest effect being obtained with sea-water. The Cl content increased significantly with NaCl and sea-water irrigation but fell sharply with Na_2SO_4 treatment; the converse was true of the SO_4^{--} content. N contents were reduced under all treatments while the P content increased significantly with H 50-7209 but remained essentially unchanged in N:Co 310.

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Sugar cane—control of tiririca (*Cyperus rotundus* L.). J. FERNANDES. *Brasil Açuc.*, 1972, **80,** 520–528. Colour photographs show the effects achieved by treatment with 2,4-D amine of purple nutsedge or "tiririca". The herbicide was applied when the weed was fully developed and rates of 1·44, 2·16 and 2·88 kg a.e. per hectare were employed. The tubers were killed by translocation of the 2,4-D after absorption by the leaves. Late post-emergence application is advisable because of the variability of germination of the weed and the need for for herbicide to contact all developing plants. The highest rate applied had a more pronounced initial effect but the final results were identical for all three.

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Sucrose losses in the field through high cutting. J. G. L. DE ARROXELAS and B. C. DIAS. *Brasil Açuc.*, 1972, **80,** 553–562.—On the basis of sampling of fields and laboratory analysis, the losses of sugar in cane stumps left in the field have been calculated and correspond to about 35,000 tons of sugar for the whole of Alagoas. While such losses probably cannot be eliminated, they should be reduced as much as possible by care in harvesting.

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Investigations on sugar cane growth in relation to soil moisture. U. S. SINGH. *Indian Sugar*, 1972, **22,** 425–427.—Investigation of soil moisture effects on cane growth and the depth of soil to be considered in this respect is reported. The upper 22·5 cm depth of soil proved most important and a moisture content of 10–12% appeared optimum for satisfactory growth.

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Reaction of cane varieties to red rot in the western tract of Uttar Pradesh. K. KAR, G. P. SINGH and R. R. SINGH. *Indian Sugar*, 1972, **22,** 429–430.—A considerable number of cane varieties of the Co and CoS series have been tested for resistance to red rot. Co 1148 is graded resistant, and of the moderately resistant group Co 1336, Co 6425 and CoS 561 are considered suitable for growing in areas where the disease is a hazard. Other varieties are under test.

Defoliation studies in sugar cane. M. S. VAIDYA and S. SINGH. *Indian Sugar*, 1972, **22**, 431–434.—Removal of the top leaves of cane, as a means of controlling flowering, increased cane yield and quality. Nitrogen fertilizer was more effectively used when the cane leaves were removed although the higher fertilizer usage depressed juice purity slightly.

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Relative efficiency of herbicides in sugar cane. G. K. PATRO and G. C. TOSH. *Indian Sugar*, 1972, **22**, 435–439.—Trials were carried out with pre-emergence application to plant and first ratoon cane of "NaTa" (TCA) alone and with "Fernoxone" (2,4-D) and of "Tafazine 50-W" ("Simazine") supplemented with one hoeing and earthing as was the control. No harmful effects were found on germination or ratoon shoot generation. Best weed control and maximum cane yield were achieved in both crops with the "Tafazine" treatment.

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Improving sugar cane yields in Northern India. S. BHAN. *Indian Sugar*, 1972, **22**, 485–502.—The average cane yield in Northern India is 35 metric tons per hectare, against 80 tons in South India. The yield could be raised to 70 tons if the latest techniques in cane cultivation were employed, and a survey is presented of measures needed to achieve higher yields. 103 references are made to the literature.

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Co 1336—a sugar cane variety especially suitable for gur production in Western U.P. D. N. GUPTA. *Indian Sugar*, 1972, **22**, 503–505.—The variety is a Co 1148 × G 8860 cross produced by the Sugarcane Breeding Institute at Coimbatore. It has a high sugar content early in the season and gives satisfactory yield, as well as giving superior quality gur.

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Co 1336—a promising sugar cane variety for sugar as well as gur production in U.P. D. N. GUPTA. *Sugar News* (India), 1972, **6**, (4), 11–13.—See preceding abstract.

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Intercropping in autumn-planted sugar cane in North Bihar and the economics involved. P. K. BOSE and H. ASHRAF. *Indian Sugar*, 1972, **22**, 507–513.—Trials were conducted at Pusa on intercropping of sugar cane with maize, wheat, peas, potato and mustard. Potatoes slightly increased the yield of cane which was significantly depressed by the other intercrops. Juice quality was not affected. The economics of the practice are calculated from the extra costs involved and the returns from the cane and intercrop yields; use of potato as an intercrop gave the highest net profit while wheat was also a significantly profitable intercrop. The other crops did not give a significantly improved profit over that of cane alone.

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Recent studies in controlling grassy shoot disease of sugar cane in Uttar Pradesh. K. KAR, G. P. SINGH and D. C. KUREEL. *Indian Sugar*, 1972, **22**, 565–574. Seed cane selection did not completely eliminate grassy shoot disease in the new crop although spread of the disease was checked when affected stools were rogued in the seed nursery. Apparently healthy canes of affected stools were found to be the main source of carry-over and multiplication of the disease. Planting season had little effect. The disease was controlled effectively, however, by hot water treatment of seed cane at 52°C for 1½ hours, which did not affect germination appreciably. Some "escapes" occurred but did not appear when the affected stools in the previous crop were rogued.

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Apanteles flavipes **Cameron, a promising parasite of sugar cane borers.** D. K. BUTANI. *Indian Sugar*, 1972, **22**, 577–578.—Information on this borer parasite, which occurs in India, is recorded with many references to the literature. Aspects covered include systematics, distribution, host range, extent of parasitization, morphology, biology and hyperparasitism. It is recommended that the possibility of its use for borer control be explored.

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Brazilian whole-stick harvester for South Africa. ANON. *S. African Sugar J.*, 1972, **56**, 599.—An account is given of the Santal CTE whole-stick cane harvester, an example of which has been imported by South Africa for experimental trials. The machine cuts both burnt and green cane but it must be erect. It handles cane grown at spacings of 140–160 cm and on ridges up to 10 cm high. It gathers, tops, base-cuts and conveys the cane stalks along a guide-arm, laying up to five lines in one windrow where the green cane is burnt before being loaded. It is designed for a crop of 40–100 tons per hectare and can cut 250–300 tons per 8-hour day.

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Sugar losses from canes damaged by rats. P. H. PORQUEZ and F. I. LEDESMA. *Sugarland* (Philippines), 1972, **9**, (8/9), 14, 16, 32.—The literature on cane damage by rats is surveyed and the results reported of a study on six farms of the Victorias mill district where analysis was carried out of damaged cane samples and adjacent undamaged cane. By calculating the loss resulting from rat damage of the sample and estimation of the proportion of rat-damaged cane in the fields, the loss caused could be calculated. The average field damage was 15·3% and the average sugar loss % cane was 5·08%.

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Recent development on application of leaf diagnosis for fertilizer recommendations at TSC plantations. C. T. A. YOUNG and H. C. FU. *Taiwan Sugar*, 1972, **19**, 165–167.—Application of foliar diagnosis for assay of soil N-P-K status has increased in Taiwan and in the 1971/72 crop was employed on 20 plantations. Leaf samples are taken after 6–7 months and 9–10 months of growth, and on the basis of data recorded over the years since initial work in 1952 the analyses can be correlated with the need for application of fertilizer. Recommendations for using and improving the technique are presented.

Biological control of sugar cane borers. H. T. TSENG. *Taiwan Sugar*, 1972, **19**, 168–169.—A report is presented on the growing application of biological control of the six borer species found in Taiwan by means of controlled releases of *Trichogramma australicum*. From the first full-scale trials in 1956 the practice has spread and in 1973/74 is expected to cover 20,000 hectares. Nodal damage is reduced by about 42%.

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The development of downy mildew in Taiwan. T. S. LI. *Taiwan Sugar*, 1972, **19**, 170–171.—After discontinuation of cultivation of POJ 2875 and PT 43-52 varieties in Taiwan, downy mildew was not a problem until a new corn variety, Tainan No. 5, came into wide cultivation. This corn is highly susceptible to downy mildew and has infected cane growing as an intercrop or in adjacent fields. It is being replaced by another corn variety, however, and other control measures are in operation to reduce the infection of cane.

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Zinc phosphide—a new rat control agent recommended by TSC. H. T. TSENG. *Taiwan Sugar*, 1972, **19**, 172. In large-scale trials since the 1970/71 season it has been shown that zinc phosphide is a rapid rat poison producing an average 62·4% control effectiveness at a cost only one-third of that of "Warfarin".

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The performance of large self-propelled harvesters in Taiwan. C. Y. FENG. *Taiwan Sugar*, 1972, **19**, 173–174.—A Toft harvester was demonstrated at a Shiaokang plantation in 1971 and notes are presented on its specification and changes which would be desirable to meet conditions applying in Taiwan.

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Effect of the salivary secretions of *Mogannia hebes* (cicada) nymphs on germination of sugar cane ratoon. Y. S. PAN. *Taiwan Sugar*, 1972, **19**, 175–178.—Invertase, amylase and maltase were detected in the salivary glands of both sexes of *M. hebes* nymphs but lactase occurred only in the females. Salivary proteases, pepsin, trypsin and erepsin were absent. The contents of the salivary glands of both sexes of different strains of nymphs equally inhibited tri-indoleacetic acid. Growth of young plants of N:Co 310 cane was also retarded by infestation by either female or male nymphs, and the prominent presence of amylase in the salivary glands seems to play an important rôle in inducing phytotoxic effects during its feeding process.

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Soil micro-organisms in relation to yield decline of ratoon cane in Taiwan. M. M. H. WU, M. H. CHIANG and J. S. F. CHOU. *Taiwan Sugar*, 1972, **19**, 179–186. Examination of soil microflora from samples taken in areas where ratoon growth of cane had deteriorated demonstrated that *Ceratosystis* sp. T_{40}-S_5 could be one of the causal agents of poor germination, although other micro-organisms could be additionally responsible. The experimental work is described in detail.

All-out war on Fiji disease. ANON. *Producers' Rev.*, 1972, **62**, (11), 5–6.—At a symposium held in Bundaberg in November 1972 plans were announced for eradication of Fiji disease in the affected areas of Queensland. Planting of infected cane is to stop immediately and cane ploughed-out if more than five infected stools are found per acre; if less, the diseased cane can be rogued. Only cane from approved sources will be planted, Q 70 and Q 71 will be removed from the list of approved varieties, and, in the long term, N:Co 310 will be replaced with a variety of equal productivity but lower susceptibility to the disease.

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Can leaf hopper be controlled ? R. M. BULL. *Producers' Rev.*, 1972, **62**, (11), 8.—Probably because of alteration in a population-limiting factor, the incidence of leaf hopper has increased greatly in Queensland since the 1930's. In order to achieve control, comprehensive knowledge is required on the life cycle, ecology and behaviour patterns of the pest and work is required on the possible effects of chemical and biological control. The author considers that biological control with the mirid bug *Tytthus* sp. offers greatest potential and discusses the problems involved.

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Silicates as fertilizers. ANON. *Producers' Rev.*, 1972, **62**, (11), 9.—The use of silicate as a fertilizer in Hawaii and Australia is reviewed; considerable and profitable yield increases have been achieved but the mechanism of silicate action is not yet known and research is needed to establish conditions under which its use would be economical.

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The economics of spray irrigation. ANON. *Producers' Rev.*, 1972, **62**, (11), 53–55.—A guide is presented to the costs involved in the use of overhead spray irrigation.

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New idea in cane transport in Nambour. ANON. *Australian Sugar J.*, 1972, **64**, 385.—A loader-transporter for cane, designed by Mr. KEITH ROLFE, a Nambour cane farmer, is described and illustrated. It embodies two fork-lift tines which are hydraulically operated from a tractor seat; they go under a laden tram truck and lift it onto a frame built onto the tractor. At the mill the action is reversed.

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Multiple-blade topper at Babinda. L. G. VALLANCE. *Australian Sugar J.*, 1972, **64**, 399.—An illustrated topper with multiple blades, fitted to a Massey-Ferguson 201 harvester, minces the tops, obviating the need to rake and burn, and permits their immediate incorporation in the soil by discing or the use of a rotary hoe.

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Automated furrow irrigation in the Burdekin district. L. G. VALLANCE. *Australian Sugar J.*, 1972, **64**, 393–397.—A system is described where water is distributed through flumes made of non-rigid material carrying outlet pipes at intervals. Lengths of the

flume can be joined to each other or to mains, elbows, T-pieces, etc., by simple circlips or clamps and flow can be blocked at any point required by scissors clamps. The system permits unattended night-time furrow irrigation at low cost.

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The use of sugar cane molasses as an economical substitute for sugar in the extraction of nematodes from soil by the flotation-sieving technique. R. RODRÍGUEZ K. and P. S. KING. *Plant Disease Reporter*, 1972, **56**, 1093–1096.—In tests with over 100 different soil samples, cane molasses diluted 1:3 with tap water and containing a preservative and flocculating agent yielded equal or higher nematode numbers than the standard molar sucrose solution.

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Research on various physico-mechanical properties of sugar cane. V. A. ABLIKOV and J. A. SILVEIRA R. *CubaAzúcar*, 1972, (July/Sept.), 31–41.—In order to provide data for design studies on cane harvesters, research has been carried out on physico-mechanical properties of cane and the relationship between internode diameter and cutting effort was determined for eight varieties, as well as the relationship between cutting effort at the node and in the internode. The experiments were made under static and dynamic conditions and it is concluded that the optimum rate of cutting the cane stalks is 4–5 $m.sec^{-1}$.

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Preliminary studies on gibberellin-type substances in sugar cane apices and their relation with photoperiodic induction. N. CORREA, E. PÉREZ A. and H. ANTONI. *Rev. Ind. Agríc. Tucumán*, 1972, **49**, (1), 1–11.—Samples were taken from sugar cane apices in different stages before and after floral initiation and gibberellin-type substances separated by paper chromatography and measured biologically by a test involving liberation of reducing sugars. During and after induction a lower content was observed than in apices which remained vegetative. While there is no concrete evidence as to the rôle of these substances in floral induction, their reduction during the process of flowering suggests that they are involved.

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Influence of different levels of avoilable moisture on the growth and yield of sugar cane. F. A. FOGLIATA. *Rev. Ind. Agríc. Tucumán*, 1972, **49**, (1), 39–56.—Field experiments on irrigation of NA 56-30 cane variety using gypsum blocks and applying different available moisture levels permitted establishing that from the statistical and economic point of view it is suitable to irrigate when 60% of the useful water in the soil has been consumed. This practice helped to increase production and lower the cost per ton of cane. The relation between values of moisture tension at a soil depth of 40 cm and the rate of stalk elongation of variety NA 56-79 indicates that the optimum moment of irrigation would be between 1·00 and 1·70 atmospheres, with a critical level of 2·50 atm. In all cases where moisture tension was higher than this, the growth rate was reduced by up to 50%. When rainfall equalled evapotranspiration of the cane, especially in the summer months, the effect of irrigation was of little significance.

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Repeatability estimations and associations among characters of five hybrid sugar cane populations. J. A. MARIOTTI. *Rev. Agron. Noroeste Argentino*, 1972, **9**, 255–266.—Two problems in selection are studied, viz. the best way of selection of different characters and the problem of interactions between characters. The studies were made by means of correlation analysis among characters between two selection stages which are the first two in the local cane breeding programme. Data were taken from five hybrid cane populations derived from five 1966-series crosses at the Tucumán Experiment Station. The highest repeatability was estimated for stalk diameter and moderate repeatability estimates obtained for height and weight per stalk. It is considered that reliability can be placed on selection for these characters in the first selection stage; selection for juice purity, erectness and moisture in bagasse (associated with fibre) should not be made at this stage. In respect of number of stalks and juice pol content it is better to discard the worst rather than select for the best in the first stage.

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Cane field engineering. R. T. SYMES. *Sugar y Azúcar*, 1972, **67**, (12), 7–8.—The need is emphasized for economic assessment of the justifiability of field modifications to improve cane yield and their adoption if justified. Since field inefficiency often permits considerable improvement by loss reduction, careful attention should be paid to the effects of variation in field size and shape, headlands, water control, cultivation, and the cane transport road network. These factors influence the efficiency of operation of mechanical equipment used in the cane.

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Sugar cane planting in Louisiana. D. T. LOUPE. *Sugar y Azúcar*, 1972, **67**, (12), 12, 14.—In Louisiana whole stalks of cane, not setts, are planted in ridges built up to 12 inches high, 6 feet apart, using 3–5 tons of seed cane per acre. The planting season extends from late August to mid-October, and the cane grows actively for about seven months (April to October) and is harvested by the end of December or early January. Details are given of the seed bed preparation and planting techniques. Current research on achieving higher plant populations, in order to give higher yields, is discussed.

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Cultivation and fertilization—chemically. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1972, **67**, (12), 20–24. New ideas in cane cultivation are briefly surveyed; these include: fertilizer placement by trickle irrigation, from the air and in the form of controlled-release fertilizers; transplanting of nursery-raised cane plants; and the use of gibberellic acid and of cane ripening chemicals.

Sugar beet agriculture

Nematodes. M. RITTER and J. B. BERGE. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (16), 7–13.—A general survey is presented of nematodes, including their taxonomy, morphology and plant hosts. More specific information is given on parasitic nematode attack on beet and the types of damage inflicted. Included are *Ditylenchus dipsaci*, *Heterodera schachtii*, *Meloidogyne* spp. and *Pratylenchus* spp. The action of such ectoparasites as *Trichodorus* spp. and *Longidorus* spp. in transmitting soil-borne viruses and causing Docking disorder is also described with the aid of photographs.

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Problems of trace elements in calcareous soils. P. DUTIL. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (16), 17–19.—The problem of trace element deficiency in lime soils is reviewed generally.

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Water requirements and sugar beet irrigation under the Mediterranean conditions of Haut Cheliff (Algeria). J. C. LEGOUPIL. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (16), 29–38.—Details are given of beet irrigation and evapotranspiration studies at the El-Khemis-Miliana Experiment Station of INRAA in a region of rainy winters and very dry summers (with an annual rainfall of 470 mm). The aim was to find the economic optimum quantity of supplementary water to apply, above which the irrigation costs outweigh the value of increase in yield, and to establish whether the lysimeter studies under- or over-estimated the water requirements of beet grown in the field.

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Sugar from sugar beet. K. JOTHI. *Indian Sugar*, 1972, **22,** 155–156.—Aspects of beet cultivation in India are reviewed, including suitable locations, varieties, sowing and crop period, disease control, processing in cane sugar factories, and by-products utilization.

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Results and aspects of sugar beet cultivation without soil preparation. K. BAEUMER and G. PAPE. *Zucker*, 1972, **25,** 711–718.—While omission of ploughing and conventional seed bed preparation on a soil of low clay content caused a significant increase in beet and sugar yield and a decrease in leaf yield compared with results from conventional beet growing, considerable falls in yield occurred when the beet were grown on untilled soil of high clay content. On the low-clay soil increase in N fertilizer application had no adverse effect on sugar yield, while on the high-clay soil increase in N had no beneficial effect. Omission of tillage increased the soil bearing capacity and decreased mudding-up, although the beet were always fangy. Compactness of the unprepared soil was discounted as a limiting factor in beet growth.

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From herbicides to weed control system. J. M. BELIEN, J. F. SALEMBIER and L. DETROUX. *Pub. Trimest. Inst. Belge Amél. Betterave*, 1972, 79–105.—Studies over a three-year period are reported in which control of weeds which grow in sugar beet was effected using pre-sowing treatment of experimental plots with "Diallate" alone, "Cycloate" alone, "Diallate" + "Lenacil" or "Cycloate" + "Lenacil", followed by a pre-treatment with "Pyrazon" or post-emergence treatment with "Phenmedipham". The reference system consisted of a "Diallate" treatment followed by pre- and post-emergence treatment. The results are discussed and presented in diagrammatic form for comparison. While it is emphasized that they cannot be directly transposed to practical beet cultivation, they indicate that the reference system gives the most complete control but involves difficulties under certain conditions. With some soil types "Lenacil" causes damage and the systems omitting this are best. In other conditions the combined systems are suitable. The time of sowing is an important factor, and weather conditions affecting weed growth are decisive in regard to the necessity for post-emergence application of herbicides.

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The growth, pests and diseases of sugar beet in Belgium in 1971. L. VAN STEYVOORT. *Pub. Trimest. Inst. Belge. Amél. Betterave*, 1972, 107–124.—The high temperatures, sunshine and lack of rainfall except from mid-May to end-June were highly favourable for beet growing in 1971 and resulted in record crops of about 55 metric tons/ha with a sugar content of 16·75%. The dryness hindered attack by seedling pests, minimizing beet damage, while heavy rains in May/June resulted in little loss from mangold fly. Virus yellows intensity was lower than during the four previous years, entailing a theoretical sugar loss of only 5% as against 9·3% in 1970.

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Reflections on the selection of sugar beet. J. DENEUCHE. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (17), 7–11. During the period of surplus sugar production, beet selection was directed to reducing labour requirements by production of monogerm varieties. Currently, research is directed towards higher sugar productivity

and juice purity, improved germination, etc. The time factor in beet breeding is discussed and steady progress anticipated rather than spectacular leaps.

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Great Western Sugar Beet Expo—'72. P. B. SMITH. *Sugar J.*, 1972, **35,** (6), 9–13.—An account is given of an exhibition in August 1972 which included the latest equipment for beet growing from planting to harvesting and including cultivation, mechanical weeding, mechanical blocking, electronic thinning and chemicals application from the ground and from the air for pest and disease control, as well as several forms of irrigation.

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Influence of spacing on sugar beet weight and quality with varying plant distribution. C. WINNER and I. FEYERABEND. *Zucker*, 1973, **26,** 2–11.—Two-years' trials are reported in which single and double beet plants (individual plants spaced 0–8 cm apart) were spaced 25 and 50 cm apart and the inter-row spacing also varied. It was found that the beets had a high capacity for closing gaps in the stand and utilizing water and nutrients from neighbouring rows even with considerable inter-row spacing and despite relatively high competition from closely spaced beets in the same row. Hence, variations in spacing can be tolerated within quite wide limits provided the planting density per hectare does not fall below a required level and provided close spacing does not cause quality loss through inefficient topping and cleaning. Double beet are better able to compensate for gaps than are individual beet. Despite the above findings, regular spacing was still found to be desirable and should be the aim, even where it is difficult to achieve.

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Bolting in early-sown beet. L. A. WILLEY. *British Sugar Beet Rev.*, 1972, **40,** 259–260.—Fine weather in early March 1972 permitted early sowing but the beet emerged to face cold weather and the resultant bolting was the most extensive since 1967, at 6% compared with the usual 4%. Sharpe's Klein E showed the most marked resistance to bolting.

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Diseases of crops in the Khuzestan Province of south-western Iran. J. ALTMAN, A. K. ESLAMI and A. VAZIRI. *Plant Disease Reporter*, 1972, **56,** 1067–1069. Diseases observed in sugar beet included *Cercospora* leaf spot, *Phoma* leaf spot and powdery mildew, as well as mosaic.

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Experiments with the vetch *Vicia narbonensis*. Y. BILGIN. *Seker*, 1973, **11,** (86), 18–27.—Trials have been made in respect of seed rate, plant spacing, sowing time, irrigation and fertilizer suitable for growing this vetch as a green manure for sugar beet.

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Calibration of the available soil phosphorus values found by the modified Hellige-Truog method with the phosphorus requirement of sugar beets. I. Determination of the phosphorus fertilizer application rates to obtain selected yield levels. S. BARKER. *Seker*, 1973, **11,** (86), 7–17.—The relationship between beet yield and available soil and fertilizer P was determined and the effects examined of soil, weather and length of the growing period. Of these, only the soil analysis caused significant variation in yield, the factors involved being $CaCO_3$ and available P_2O_5 content.

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Saline and sodic soil and improvement methods. N. VANLI. *Seker*, 1973, **11,** (86), 28–33.—Soils may become saline and alkaline through improper irrigation methods. They can often become fertile, however, when the salt and alkali are removed and this has been done by use of drainage and washing, with application of organic matter and planting of salt-resistant plants.

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Mechanical sugar beet harvesting in West Germany. E. KESTEN. *Zucker*, 1973, **26,** 145–152.—Data on mechanical beet harvesting in West Germany are summarized in tables.

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Replacement of "Heptachlor". Disinfection of the seed bed in beet cultivation. J. F. MORIN. *Hautes Etudes Betterav. Agric.*, 1973, **5,** (19), 7–11.—Because of trace residues of this insecticide in beet pulp, over the limit permissible if it is to be used for animal feeding, it is necessary to find other means of pest control. Permitted insecticides include non-systemic insecticides (which are however useless against foliage-attacking pests), including "Lindane" (an organo-chlorine compound) and "Parathion" (an organo-phosphorus compound), and systemic insecticides, including "Phorate" (an organo-phosphorus compound) and the carbamates "Aldicarb" and "Carbofuran". Recommendations are made for the use of these compounds under various conditions.

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Methods of combating *Cercospora*. M. LEBRUN. *Hautes Etudes Betterav. Agric.*, 1973, **5,** (19), 15–19. Comparative studies have shown that for preventive treatment, triphenyl tin acetate gave best results, copper oxychloride the poorest and "Thiabendazole" intermediate results. "Thiabendazole" was the only effective product for curative action, and a combination of triphenyl tin acetate and "Thiabendazole", combining both actions, was an excellent means of combating the disease. Other chemicals are under development and study; these include "Benomyl" and "Methyl thiophanate".

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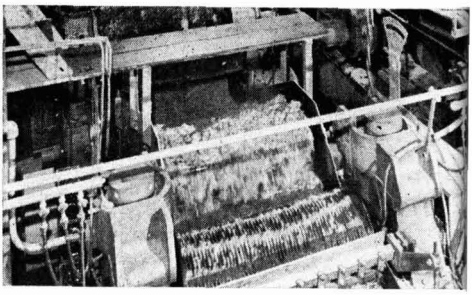
Continuing changes in sugar beet varieties. G. E. COE. *Sugar Beet J.*, 1973, **36,** (2), 6–9.—The production of varieties suited to local conditions is explained and it is forecast that varieties will appear with greater resistance to leaf blight and black rot caused by *Aphanomyces* fungus. They should have fair resistance to crown rot (*Rhizoctonia*) and to nematodes, and will probably be bred for closer spacing, lack of lateral root branches and earlier ripening.

Cane sugar manufacture



Aerobic treatment of sugar mill effluent with the addition of nutrients. D. E. SIMPSON, J. HEMENS and S. M. H. COX. *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 40–53.—Activated sludge treatment of waste water is feasible but since the N and P content is low, their addition can increase the overall reaction rate and is needed to produce a sludge floc which will settle. At a temperature of 25°C the optimum load factor is in the region of 0·6 g COD per g MLSS (mixed liquor suspended solids) per day; a good quality effluent is produced with an average settled COD and BOD of 97 and 13 mg per litre, respectively. The excess sludge produced may be successfully dewatered on drying beds over a period of 12 days.

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Diffuser performance appraisal—a new approach. A. D. FERGUSON, R. P. JENNINGS, P. W. REIN, G. T. SCHUMANN and A. VAN HENGEL. *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 54–63.—A new approach to the evaluation of the performance of diffusers is presented. It is assumed that part of the juice in bagasse is easily extracted, by mill or diffuser, and attention is therefore focused on the remaining tightly-held or bound juice. This "difficult juice" is defined according to an analytical method. Preliminary results on the performance of diffusers, based on the extraction of "difficult juice", are presented. The need for further development of experimental techniques is emphasized. Attention is drawn to the utility of this approach in furnishing a means of evaluating the performance of a diffuser in isolation, as opposed to the performance of a complete extraction unit containing a diffuser as well as primary and dewatering mills.

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Air pollution control for bagasse-fired boilers. G. N. ALLAN and J. R. FITZGERALD. *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 79–91.—In order to implement the Atmospheric Pollution Act 1965, the South African Sugar Millers Association formed a Smoke Study Group consisting of representatives from the Sugar Milling Research Institute and factory engineers. Emission levels, dust gradings and fall-out rates within 500 m of the mill stacks were measured and a survey is reported of existing boiler and smut collection plant.

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The dry smut collector at Sezela. D. W. CAMDEN-SMITH. *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 92–99.—Sezela sugar factory has eight boilers, three without any dust collection equipment, two with multi-vortex, and three which have been provided with a Howden "Centicell" unit. This comprises a nest of 150 small cyclones in a casing, solids from which fall into four hoppers from which they are removed by rotary valves. Operating experience with the unit is described, including an account of difficulties encountered and measured to overcome these. An efficiency test run in November 1971 showed that the inlet dust, amounting to 5·674 tons/day, was reduced to 0·415 tons/day at the outlet, i.e. 92·67% removal.

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Shipping in bulk. M. PASTOR. *Bol. Azuc. Mex.*, 1972, (269), 14–16.—Aspects of bulk shipping of sugar in relation to the establishment of the Veracruz terminal are discussed, including economic benefits through savings of labour and reduced losses, cooperation of the trade unions concerned, amortization of the plant installed, etc.

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Clarification of cane juices. E. C. VIGNES. *Zeitsch. Zuckerind.*, 1972, **97,** 629–638.—Cane juice clarification is surveyed in the light of the author's experiences in Mauritius and a number of points are listed, attention to which will permit satisfactory treatment of even the most refractory juice.

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Milling in small factories. C. BAYMA. *Brasil Açuc.*, 1972, **80,** 343–346, 425–430.—Factors of importance in the operation of small-scale cottage industry plants to achieve efficient operation are discussed. These include: cane quality; raw juice handling and liming; production of raw sugar; centrifugal types, their installation and advantages; and variation of yields with the season.

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Cane leveller reversal. G. K. CHETTY. *Sugar News* (India), 1972, **4**, (5), 16–17.—Reversing the direction of the cane leveller as well as the cane knives was tested at Walchandnagar; after modifications to overcome initial problems with chokes and excessive power consumption the preparation was improved materially as demonstrated by measurements of bulk density of the prepared cane.

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On the selection of a bagging scale. C. PORTER. *Sugar y Azúcar*, 1972, **67,** (10), 24, 26.—The requirements of a bagging station, in regard to material to be handled (raw sugar, brown sugar, powdered sugar, granulated sugar), throughput, etc. govern the type

of weigher suitable for the application which will be a source of profit and not a source of loss. Suitable types of weighers are described in an effort to indicate how a proper choice can be made.

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Good evaporator design. P. L. DREHER. *Sugar J.*, 1973, **35,** (6), 25–29.—Aspects of evaporator design to promote good heat transmission are discussed; they include steam distribution outside the calandria tubes, removal of non-condensable gases, condensate drains and handling, juice feeding and circulation, entrainment prevention, steam and vapour pipe sizes, materials of construction, equipment and accessories.

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Performance of a milling plant. K. V. N. RAO. *Indian Sugar*, 1972, **22,** 421–424, 434.—Factors affecting mill performance are discussed, including cane preparation, mill settings, mill maintenance and operation. Observations in regard to juice filtration are also presented.

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An additive for improving the colour of sugar. S. NATH and R. P. SINGHAL. *Indian Sugar*, 1972, **22,** 483–484. White sugar massecuite is spun in a centrifugal, washed with water, treated with a solution of an additive identified only as "Nathsol", and spinning continued to dry the sugar before discharge. Use of the additive improves the reflectance of the sugar.

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From the notes of a sugar technologist. VI. M. ANANAD. *Sugar News* (India), 1972, **4,** (6), 6–10. Non-conventional milling equipment is briefly described, including the Fives Lille-Cail self-setting mill and the French screw press.

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Cane leveller reversal. G. K. CHETTY. *Indian Sugar*, 1972, **22,** 563–564.—See *I.S.J.*, 1974, **76,** 22.

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The sugar economy in South Africa. H. HIRSCHMÜLLER and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1973, **98,** 17–22.—An illustrated survey is presented of the South African cane sugar industry, with information on cane agriculture and factory processing and an outline map showing factory locations.

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Controlling air pollution in sugar mills. W. P. BOULET. *Sugar J.*, 1972, **35,** (7), 13–14.—Factors involved in the prevention of air pollution, as a result of legislation, by installation of collectors for solids borne by stack gases from cane sugar factory boilers are discussed and examples given for guidance in such cases.

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Problems in the disposal of sugar mill effluents. D. BEVAN. *Producers' Rev.*, 1972, **62,** (11), 25–36. Research on pollution abatement at the Sugar Research Institute since 1967 was subject to a number of problems in regard to analytical methods, measurement of effluent volumes, sampling and sample deterioration, solids collection and monitoring of other parameters. Various pilot plants were established to investigate the different components embodied in effluent treatment plant for e.g. measuring the loadings of effluent sent to the plant, for removing of inert suspended material, for removal of organic pollution by microbial action, etc. Existing equipment was then assessed and characteristics of required plant calculated for dealing with problems not satisfactorily handled.

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Diffusion in sugar cane. Determination of some thermodynamic properties in evidence. S. K. D. AGARWAL and B. K. GUPTA. *Zeitsch. Zuckerind.*, 1973, **98,** 78–81.—Laboratory experiments are reported which were aimed at determining cane diffusion kinetic parameters for cane pieces of 1–1·5 cm extracted with water at 50–60°C. From the rate constant of 7×10^{-4} sec^{-1} the distance d between a molecule of solute and one of solvent in equilibrium, i.e. the distance through which a molecule of solute is transported in each "jump" from one equilibrium position to the next, is found to be 0·1 cm.

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Preliminary evaluation of the "Re-al-cal" system of automation in the Pablo Noriega experimental unit. J. M. ALONSO. *CubaAzúcar*, 1972, (July/Sept.), 42–45.—The system, developed by the Industrial Automation Organization in Cuba, governs the steam pressure by operation of the reducing valves (REductoras), controls juice alkalinity by measuring the pH and using the signal to govern the lime dosing (ALkalización), and maintains the required juice temperature by automatically regulating the steam feed to the heaters (CALentadores). Operation at the Pablo Noriega experimental factory has demonstrated that, compared with manual operation, the system provides longer cycles between heater and evaporator cleaning stops, easier cleaning, better control of clear juice pH, better control of heated juice temperature and of clarifier work, and stability in exhaust steam pressure with consequent improvement in boiling house work.

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Selection of machinery for the boiling house. G. D. AGARWAL. *Sugar News* (India), 1972, **4,** (7), 15–19. Guidance is given on the correct approach to ordering and supplying cane sugar factory equipment, since it is pointed out that in a large number of cases in India there are important omissions from both the purchasing and the supplying end. Specific pieces of equipment are dealt with in turn.

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Improved reliability through equipment selection. J. W. KHANNA and S. K. GHOSH. *Sugar News* (India), 1972, **4,** (7), 20–25.—Selection of electrical equipment for a cane sugar factory is, according to the authors, often made after the design, layout and construction of the rest of the plant have been considered, whereas

it should be carried out at the same time as the other plans and the electrical equipment not just fitted into whatever space is left available. Electrical equipment selection for cane unloading cranes, mills, boilers, boiling house equipment and the centrifugal station is discussed in detail.

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Receiving and cleaning cane at Central Coloso. A. RIOLLANO and F. BADRENA. *Sugar y Azúcar*, 1972, **67**, (12), 28–31.—The new wet cane cleaning station at Central Coloso (Puerto Rico), supplied by Jeffrey Mfg. Co., is designed to remove 4000 tons of dirt, rocks and trash per day from the cane supply and is thought to be the largest such installation in the world. A chain net system is used for unloading trucks to a stock-pile from which cane is brought to the cleaning station by a grapple on a large jib crane. The cleaning station includes a large sloping table on which the cane is washed by jets of water before delivery to the carrier.

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Extraction. J. R. GUNN and B. S. C. MOOR. *The Condenser*, January 1973, 37–38.—Developments in milling plant design over the past 50 years are briefly surveyed, with mention of a new design of shredder developed at Tongaat, and the place of the diffusion system discussed.

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The sugar industry in Hawaii. D. P. KULKARNI. *Sugar News* (India), 1972, **4**, (8), 9–12.—Agricultural information is presented and a description given of factory operations at Pioneer Mill Co. and Oahu Sugar Co.

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Deposits and chemicals of sugar factory boilers. A. C. CHATTERJEE and S. R. KALASWAD. *Sugar News* (India), 1972, **4**, (8), 18–23.—Factors responsible for deposition of scale in boilers are discussed as are the nature of and removal of such deposits. Chemical cleaning is preferred to mechanical cleaning and methods used are surveyed. At Walchandnagar the boilers are cleaned with a 3% solution of commercial HCl containing "Rodine 213" as inhibitor which is recirculated at a temperature of up to 75°C until the loss of acidity indicates that the scale has all been dissolved (18–24 hours). The boiler must then be washed to remove the acid, and alkali circulated (usually sodium carbonate solution).

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The "Saturne" diffuser. ANON. *Sugar News* (Philippines), 1972, **48**, 479–483.—The "Saturne" cane diffuser is described and illustrated by the manufacturers, Sucatlan Engineering, and its design, control, performance, erection and advantages discussed.

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Studies on the deliming of clear juice with ion exchange resins. I. GALBÁN. *CubaAzúcar*, 1972, (Oct./Dec.), 24–32.—Cane juice after clarification with lime still contains insoluble and colloidal materials which foul ion exchange resins, decreasing their capacity and causing pressure losses in the filters; this is one reason for not using the method in the cane sugar industry. Experiments have been made on ion exchange treatment after preliminary filtration of the juice through a sand filter. Over 23 trials the insolubles were reduced by an average of 46·6% and the juice diluted from 16·97 to 16·87°Bx. The filtrate was treated by ion exchange and the Ca content, originally 19·50–34·00 meq/litre, was reduced to 0–13·30 meq/litre. The soluble solids content was reduced on average from 16·07 to 16·06°Bx while the average pol was unchanged at 13·52. The trials were conducted at a juice temperature of 91–92°C and the cycle duration was mostly 5–6 hours with extremes of 4 and 8 hours. The resins were regenerated with brine and it was found that the use of a higher concentration (150 $kg.m^{-3}$ *vs.* 60 and 120 $kg.m^{-3}$) gave a higher Ca concentration in the effluent and a greater Ca removal per equivalent of NaCl. Industrial-scale trials are recommended.

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Criteria for evaluation of investments in the sugar industry. J. HERNÁNDEZ. *CubaAzúcar*, 1972, (Oct./Dec.), 33–40.—Evaluation of investments is discussed and a number of indicators noted which may be used for such analysis; these include work productivity, production:investment ratio, equipment investment per worker, amortization period (both total and for individual parts), etc.

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Influence of the design of juice and syrup feed on the general efficiency of evaporators and vacuum pans. E. P. DÍAZ G., I. CALA and A. MARISTANY A. *Cuba-Azúcar*, 1972, (Oct./Dec.), 41–56.—The juice feeds of various evaporators have been studied and modifications made which have improved the efficiency of operation of the plant. Similar work has been done in regard to the syrup feeding of vacuum pans and the importance of good feed design is shown by comparative figures for pan performance before and after modification.

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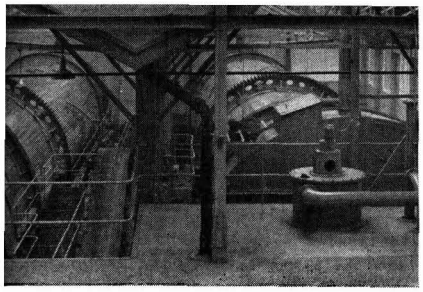
The HSPA mini-factory. L. J. RHODES, G. E. SLOANE, T. MORITSUGU, K. ONNA and H. W. HILTON. *Hawaiian Planters' Record*, 1972, **58**, (19), 265–281.—In order to examine residues of e.g. pesticides in sugar factory products following small-scale trials, equipment was assembled in which 10–20 lb samples of cane can be treated. Such samples are prepared by means of a "Jeffco" cutter-grinder and juice extracted by use of a 100-ton "Enerpac" hydraulic press. The juice is clarified using a 4-gal reaction tank and four 4-gal batch settling tanks; it is then evaporated under vacuum in one or two vertical tube evaporators of 0·018 ft^3 capacity and 2·32 ft^2 heating surface. Six pan crystallizers are provided, four of 0·06 ft^3 total capacity for normal sample runs and two of 0·265 ft^3 capacity for larger strike volumes. Two small laboratory centrifugals are used for separating the crystals and *A*-molasses. Operation of the equipment is described.



Beet sugar manufacture

Operation of units for interbody processing of thick juice. V. A. KOLESNIKOV. *Sakhar. Prom.*, 1972, (11), 24–26.—It has been found in Soviet factories that for satisfactory filtration of thick juice and standard liquor the Brix should be no higher than 57–59°. Since this is below the Brix of the thick juice leaving the 4th effect of a quadruple-effect evaporator, at a number of factories the thick juice is withdrawn from the 3rd effect at 52–55°Bx, mixed with low-grade remelt liquor and subjected to sulphitation and filtration, after which the filtrate is concentrated in the 4th evaporator effect. The main advantage of the scheme is a higher filtration rate. The use of precoat in the disc filters used increases the rate still further.

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The immersion conductivity cell. V. VALTER and S. BOUČEK. *Listy Cukr.*, 1972, **88**, 271–278.—Experiments with various types of immersion conductivity cells for use in pan boiling control are described. The most suitable proved to be a cell provided with rod electrodes, one of which is located in the vertical axis of the cell while a second is a ring made up of three rods rising above the central electrode.

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Precoat filters and filter-thickeners. M. CZIRFUSZ. *Cukoripar*, 1972, **25**, 171–178, 213–220.—A survey is presented of precoat filters and filter-thickeners of various well-known types as well as Hungarian models.

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Ion exchange processes in the sugar industry. V. GRYLLUS. *Cukoripar*, 1972, **25**, 179–184, 220–227. Ion exchange processes are surveyed under three basic groups: those which act as aids to processing, such as thin juice deliming, diffusion water treatment and juice pH control; decolorizing processes; and means used to obtain extra sugar, such as in the Quentin process. Production of liquid sugar is also discussed and the possibility of manufacturing it in Hungary examined. Properties of the Hungarian "Varion" range of ion exchange resins are tabulated.

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The use of compressed air in sugar factories. L. L. NIELSEN. *Sugar y Azúcar*, 1972, **67**, (10), 18, 20. The wide range of uses for compressed air in various parts of a sugar factory often leads to the use of a separate compressor for each application. This results in low efficiency and other problems, e.g. arising from the different air cleanliness required for pumping beet water mixtures and for pneumatic instruments. A central system requires compressors, after-coolers and an air filter. Reduction of the dew point of the compressed air is discussed.

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Thick juice clarification: filtration or centrifugation. P. DEVILLERS, J. BOYER, R. CANREDON and M. S. GUERIN. *Sucr. Franç.*, 1972, **113**, 566–579; 1973, **114**, 39–47.—Comparative laboratory and industrial tests have been made for the removal of fine insolubles (calcium oxalate precipitate, bacteria, colloids, etc.) from thick juice using filtration through a bed of kieselguhr, with and without addition of further kieselguhr to the thick juice to be filtered, and also using a centrifuge. From the results it is clear that, in order to produce white sugar which will give a solution needing little or no filtration before use, the material to be treated should be the standard liquor, i.e. the material fed to the pans. Centrifugation removes solids which are visible to the naked eye and is suitable for treatment where the product does not have to be melted to a clear liquid. But for products which are to be used for soft drink manufacture, etc., one or two filtrations are required although preliminary centrifugation may be used to remove the larger particles. A number of suitable filters are listed and the technique to be employed is described.

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Investigations on the boiling process and its improvements. F. SCHNEIDER, D. SCHLIEPHAKE and G. WITTE. *Zucker*, 1973, **26**, 12–20.—Laboratory and factory experiments in pans provided with massecuite stirrers are reported in which a fraction containing crystals measuring 0·075 mm was used for seeding. (It had earlier been found that 31 kg of this fraction, having a total area of 1700 m², would give 25 tons of crystal sugar.) During crushing to obtain the seed crystals, crystal fragments were produced which had many non-uniform surfaces. During boiling, however, it was found that this gave rise to a rapid "mending" effect which was of advantage in that the seed crystals provided a high crystallization rate in the critical initial phase where higher supersaturation can occur. While there was little difference in the final crystal size distribution between the 0·075 mm seed fraction and a slurry of 0·0055 mm crystals, the larger, freshly crushed crystal fraction is considered preferable where the boiling time is to be reduced through increased evaporation rate or a higher feed concentration. A description is given of a system for preparation of the seed and its incorporation in standard liquor to produce a magma of about 40% crystal content.

Experiences in the use of a viscosity-consistency transmitter. W. BÖHM. *Zucker*, 1973, **26**, 21–24. The device described comprises a rotary body driven at constant speed by means of a hollow axis housing an inner spindle attached to the axis by springs. The unit is fixed to the side of a vacuum pan, and with increase in massecuite viscosity and, according to the seeding point, increase in massecuite consistency, the torsion angle between the inner and outer axes increases. By means of a slotted disc and photo-electric cells this angle is converted to an electric signal which is related to supersaturation. Comparative tests with a Haake viscometer showed that the units are of comparable accuracy. Application of the new unit to 1st white sugar boiling is reported, demonstrating its value in automatic boiling.

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The significance of calcium carbonate addition to raw juice before liming. J. VAŠÁTKO and A. DANDÁR. *Zucker*, 1973, **26**, 25–31.—See *I.S.J.*, 1972, **74**, 85.

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Utah-Idaho Sugar Company holds colour to under 20 RBU with diatomaceous earth filter aid. ANON. *Sugar y Azúcar*, 1972, **67**, (11), 12, 14.—The slicing capacity of the Moses Lake sugar factory has been raised continually from its initial 2000 tons per day in 1953 and has now reached 11,500 tons per day. Beets are sliced during a 5-month campaign and part of the thick juice produced is stored for post-campaign boiling. The purification system yields a juice of 99·8 purity and this is filtered in a station of seven pressure leaf filters using "Kenite 700" filter aid as precoat. The automatic cleaning cycle operates once in about 4 hours and is controlled by the refracto-metric Brix.

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Means of increasing sugar production by modifying the beet processing technology. S. RIZESCU. *Ind. Alimentara*, 1972, **23**, 36, 43; through *Abs. Rom. Sci. Tech. Lit.*, 1972, **8**, 978.—A method was developed on the laboratory scale for treatment of stored beet whereby sugar extraction could be increased. It has yet to be tested industrially.

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Possibility of reducing sugar losses in diffusion by limiting the action of enzymes. I. JANUSZEWICZ. *Gaz. Cukr.*, 1972, **80**, 297–301.—Losses in diffusion caused by the action of beet invertase, and dependent on beet condition and bacterial population, can be reduced, it is shown, by increasing the diffusion temperature to 70°C, disinfecting with formalin and shortening the route taken by raw juice from diffusion to preliming.

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Conditions and parameters of flume water liming as a means of stabilizing it. K. SKALSKI. *Gaz. Cukr.*, 1972, **80**, 301–306.—Campaign results of liming flume water are discussed. Addition of 0·2% CaO on beet had the desired effect of precipitating suspended solids and inhibiting bacterial development as well as a number of other positive effects. The use of a closed circuit for the flume water was found to be advisable.

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The 60,000-ton white sugar silo at Wanze sugar factory, Belgium. ANON. *Zeitsch. Zuckerind.*, 1973, **98**, 22–23. Information is given on the silo at Wanze which has a nominal charging rate of 55 tons of sugar per hour. The sugar is stored at a constant temperature of 25°C.

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Corrosion in evaporators. W. WERNER. *Zeitsch. Zuckerind.*, 1973, **98**, 24–25.—Two case histories of evaporator corrosion, one in a Near East beet sugar factory and the other in a Balkans beet sugar factory, are reported. In the first case the corrosion was attributed to local overheating of juice and consequent sucrose decomposition at various points on the tube plate; in the second case, the cause was found to be pumping of water or condensate into the evaporator to compensate for a lack of thin juice during post-campaign processing, so that the Brix in the 3rd and 4th effects was unusually low. In both cases the juice pH was low and the thick juice purity lower than that of the thin juice. Addition of sodium carbonate helped to solve the problems.

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Mathematical and mechanical relationships in the measurement of rheological properties of syrup and syrup-crystal mixtures using a rheometer true value transmitter. H. KEMTER. *Zeitsch. Zuckerind.*, 1973, **98**, 27–32.—Details are given of what the author describes as an essential part of the "Rheomat" control system used for pan boiling at, e.g., the Euskirchen sugar factory of Pfeifer & Langen (West Germany). The component in question is the rheometer true value transmitter which measures the massecuite viscosity in terms of torque and transmits a corresponding signal to central control.

* * *

Nitrogen fertilization and its effects on the technological quality of sugar beet. L. WIENINGER and N. KUBADINOW. *Zucker*, 1973, **26**, 65–70.—Experiments over a period of 3 years in Austria have shown that increase in N application in the range 0–280 kg/ha caused a fall in beet processing quality and in juice purity, natural alkalinity and white sugar rendement (as a proportion of sugar in beet), while there was an increase in reducing sugar content.

* * *

The quality of the beet crown. U. BEISS. *Zucker*, 1973, **26**, 71–78.—Investigations have confirmed the findings of a number of other authors, namely that beet crowns are of poorer quality than roots and therefore should not be processed together with them. However, it is suggested that inadequately topped beet could be accepted for processing but the payment reduced to cover the higher processing costs. It is also pointed out that in view of the demand for mechanical harvesting, poorer topping can occur and that factories should do all that they can to process such beet as efficiently as possible.

Dependence of saturation coefficient on non-sugars concentration. E. SVOBODA. *Listy Cukr.*, 1973, **89**, 15–22.—It is shown how knowledge of the saturation coefficient as a function of the non-sugars concentration in sugar solution and in standard molasses can be used to solve a number of processing problems using a computer, including the calculation of heat and processing parameters throughout a factory.

* * *

Fluidized-bed drying, cooling and de-dusting of crystal sugar. Z. HRUŠKA. *Czech. Heavy Ind.*, 1973, (2), 13–21.—Equipment produced at the Hradec Králové Engineering Works for fluidized-bed drying, cooling and dust removal from white sugar is described and illustrated.

* * *

Sugar crystal agglomerates. S. GAWRYCH. *Gaz. Cukr.*, 1973, **81**, 4–6.—The formation of conglomerates during boiling and how to avoid it are briefly discussed, and guidance given on how to determine their content in sugar, using a photomicrograph.

* * *

Selection of optimum conditions for juice sulphitation. V. Z. SEMENENKO *et al. Sakhar. Prom.*, 1973, (1), 18–21.—When identical quantities of SO_2 were added to carbonatation juice from different sugar factories, the fall in pH differed as did the effect of the molar ratio between reducing sugars and SO_2 on colour formation prevention. Hence, the non-sugars composition is of significance in sulphitation, and for greatest effect on coloration the quantity of bound SO_2 (forming hydroxysulphonic acids with aldehyde and ketone groups and preventing their reaction with amino-acids) should be maximum. This involves adding at least 0·01% SO_2 (on beet weight) to liberate a minimum of 0·001% free sulphite ions. While addition of sulphurous acid provided greater colour prevention and more bound SO_2 than did sodium sulphite, it also gave a greater pH reduction, resulting in more sucrose decomposition, whereas the pH did not change or even rose when sodium sulphite was added.

* * *

Increase in yield and rise in sugar quality. V. A. KOLESNIKOV and D. M. LEIBOVICH. *Sakhar. Prom.*, 1973, (1), 21–27.—Difficulties encountered at a number of Krasnodar factories, where the thick juice pH (at 80°C) was lower than optimum, are reported. The main cause was found to be too short a liming period for juice of high reducing matter content. Experiments indicated that, of various liming techniques tested, liming at 50°C for 15 minutes followed by juice exposure to 85°C for 3–5 minutes was optimum for juice thermal stability and thick juice colour. An optimum thick juice pH_{80} of 7·7–7·8, at which losses were minimal, was obtained by 2nd carbonatation to a higher alkalinity (0·034% CaO) than the normal optimum, the juice first being heated to a temperature no higher than 88–89°C. The overall effect was increase in sugar yield and quality, lower molasses yield and a reduction in the amount of bled vapour used to heat the juice before 2nd carbonatation.

* * *

New juice purification scheme and heat scheme for sugar factories. B. F. KOLESNIKOV, V. A. MAKSYUTOV, L. N. DOBROVOL'SKAYA and N. I. ZHARINOV. *Sakhar. Prom.*, 1973, (1), 27–31.—Preliming for 3–5 minutes at 60°C followed by liming at 55°C for 15 minutes and then at 85°C for a further 15 minutes are the basic features of the carbonatation system described for use in North Caucasian sugar factories. To reduce overall fuel consumption (to 5·58% on beet weight), a number of measures, including evaporation modifications, are recommended on the basis of the heat economy at Leningrad sugar factory.

* * *

Invertase activity in a frozen state. M. Z. KHELEMSKII, M. L. PEL'TS and V. A. KNYAZEV. *Sakhar. Prom.*, 1973, (1), 48–49.—Experiments showed that invertase activity (expressed as reducing matter) was only very slightly enhanced by freezing stored beet to a temperature in the range between —10°and —20°C, provided the freezing took place over a short period (8–15 days). A longer period of freezing (lasting some months) caused a rise in invertase activity and hence in sugar losses, which were also considerably higher at temperatures above —10°C.

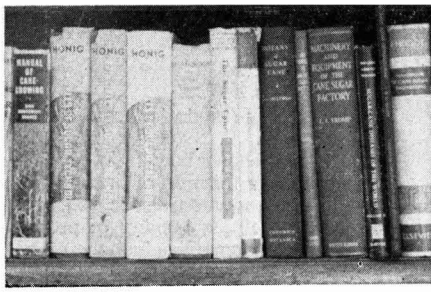
* * *

Some suggestions of efficiency experts at Gindeshtskii sugar factory. L. P. SOFRONYUK. *Sakhar. Prom.*, (1), 52–54.—A beet flume trash catcher is described which has operated for 12 years without failure. It comprises a series of iron plates with a forward serrated edge mounted by pivot on the perimeter of a drum. As the drum rotates, the impurities in the water impinge on the teeth of the plates which now hang vertically. The plates pivot freely back to an almost horizontal position with further rotation of the drum, and after having passed through an angle of about 280° from the pint of impingement, they strike a stay which releases the impurities. Also mentioned is carbonatation of condenser water before its use for raw sugar melting instead of filtering it, which has proved inadequate for removal of suspended particles, and an improved method of weighing raw sugar going to process.

* * *

Guidelines for the introduction of sulphitation in juice purification. K. VUKOV. *Cukoripar*, 1973, **26**, 23–25. The subject is briefly examined in regard to SO_2 preparation and feeding, and the relative costs in Hungary of various forms of raw material for its preparation, including sodium metabisulphite, sodium bisulphite and sodium sulphite, as well as their chemical properties and yields.

New books



Sugarcane physiology. A. G. ALEXANDER. 752 pp; 16 × 24·5 cm. (Elsevier Scientific Publishing Co., Amsterdam, Holland.) 1973. Price 197 florins.

The author, Plant Physiologist at the University of Puerto Rico, has written a book of the sort he would have liked to read in 1962 when he first became involved as a member of a group of investigators working to reverse the decline in the island's sugar industry. His comprehensive reference work is intended to give a rapid and correct perspective to the cane plant as a "source-to-sink" system, for the benefit of plantation managers or cane growers whose college training has been left behind, or students of plant physiology and of plant scientists engaged for the first time on research on cane.

His introduction deals with the origin of the unique system of the cane plant in its massive sunlight utilization in synthesis of sugar and its translocation and storage. The literature on prehistoric development and movement of *Saccharum* species is quoted and a survey presented of these and allied genera. The next three chapters are concerned with aspects of photosynthesis, while two chapters follow on polysaccharide and specifically sucrose biosynthesis. The second part of the book discusses sugar translocation and storage—paths, rate, and storage regulation—while the third part discusses aspects of *Saccharum* sink physiology including natural and chemically-induced ripening of cane, chemical desiccation, flowering and the physiology of post-harvest deterioration, as well as cell and tissue physiology. No less than 1622 references are given to the literature and cover up to end-1971. Author and subject indices are included.

The book is extremely valuable in presenting an up-to-date account of knowledge on the subject of cane physiology, with particular attention to new techniques, both of research and cultural practice, which are likely to be of increasing importance in years to come. A book for specialists, this is nevertheless likely to be the standard work for many years to come.

* * *

IAA relatório 72. 28 pp; 29 × 22 cm. (Instituto do Açúcar e do Alcool, Praça 15 de Novembro, 42, Rio de Janeiro, Brazil.) 1973.

This booklet is a survey of the activities of the Institute in 1972 and carries tables and photographs in illustration. Sugar and alcohol production are covered, as is the domestic market and external trade in sugar molasses and alcohol. Development plans are summarized with a note on the finance involved, on agronomic research, land reclamation and social assistance.

* * *

Sugar beet nutrition. A. P. DRAYCOTT. 250 pp; 14·5 × 23 cm. (Applied Science Publishers Ltd., Ripple Rd., Barking, Essex, England.) 1972. Price: £6.00.

Information on all aspects of beet nutrient requirements and associated subjects (irrigation, pests, diseases, soil, crop rotation, plant density and beet juice purity and storage properties) is contained in this work. Hitherto results of investigations have been scattered among published and unpublished reports as well as in numerous publications not eadily accessible to those people who could make best use of them, but now this evidence is collected in one book. Much of the work is based on experience in the UK, particularly on the subject of the residual effects of fertilizers on beet, but where information on a particular topic is lacking in the UK, the author has drawn on foreign, particularly US, evidence.

The text is divided into 14 chapters plus an appendix of conversion factors and a short terminology appendix. A list of references in alphabetical order of the authors and a subject index complete the book, which also contains 29 illustrations and 100 tables. Chapters 2–6 deal with specific nutrients (nitrogen, phosphorus and sulphur, potassium and sodium, calcium and magnesium), while chapter 7 concerns trace elements. In each case the author examines all aspects of concentration, uptake, deficiency symptoms, residual value in the soil and methods of predicting nutrient requirements by plant and soil analysis. The value of organic manures and green manuring is also considered.

Although the scope of the book is wide, the individual aspects are dealt with concisely and the many findings are summarized in a clear manner. Layout of the material is good and clarity of the print excellent. Considering the importance of the subject, the fact that this book is probably the first of its kind in the English language, and the manner in which the information is presented, there is no doubt that the work represents good value for money.

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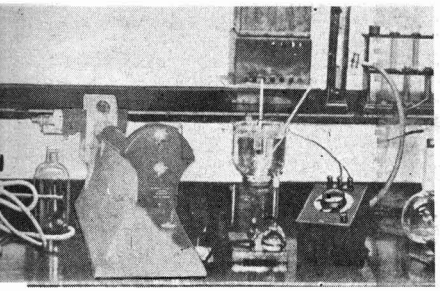


Laboratory methods & Chemical reports

Movement of nitrogenous substances through a beet sugar factory. S. S. MIROSHNICHENKO, G. P. VOLOSHANENKO, K. D. ZHURA and I. S. CHERKAS. *Sakhar. Prom.*, 1972, (11), 22–24.—Tables are given showing the contents of nitrogenous substances, particularly peptide N and amino-acid N (capable of forming melanoidins), in products from raw juice to final molasses at two Soviet sugar factories.

* * *

Results of investigations on the physico-mechanical properties of sugar beet tissue. M. Z. KHELEMSKII and I. A. EROSHENKO. *Sakhar. Prom.*, 1972, (11), 47–51. Studies are reported which showed that the passage of ultrasonic vibrations through frozen and thawed beet was much faster than in the case of fresh beet, a finding which could be used as basis for a method of measuring the degree of freezing of beet received and stored at a factory. Determination of the degree of withering of beet was based on measurement of yield of a sample subjected to instant elastic deformation under a given load stress.

* * *

Chromatographic, spectroscopic and thermal analytical examination of sugar beet lipids. P. BIACS and K. SÖRÖS. *Cukoripar*, 1972, **25**, 210–212.—Crude fat isolated from sugar beet was found to contain triglycerides of fatty acids with 18 C atoms, 90% of them being unsaturated fatty acids; oleic acid and one of its isomers made up 10% of these, while linoleic acid was the most important component at 35%. Thermal analysis indicated three stages in the temperature range 400–700°C which are characteristic for thermal degradation of fats.

* * *

American Crystal completing laboratory for tare and sugar analyses. S. BASS. *Sugar y Azúcar*, 1962, **67**, (10), 7–14.—A description is given of the facilities offered by the new laboratory being built at East Grand Forks, Minn., by American Crystal Sugar Co. To be ready for the 1973/74 campaign, it will assure faster and more accurate analysis and provide support data. Procedures are described for delivery, sampling, and automatic analysis for dirt tare, topping and sugar analysis.

* * *

Comparative tests on gravimetric looped density meters at sugar factories. I. M. GLYBIN and N. P. BAIDAKOV. *Sakhar. Prom.*, 1972, (12), 29–32.—Tests are reported, involving a number of Soviet density meters as well as a French and a UK model, in which the units were applied to measurement and recording of sugar solution densities.

* * *

Boiling point elevation and supersaturation of sugar solutions. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1973, **98**, 10–17.—See *I.S.J.*, 1973, **75**, 153.

* * *

Determination of nitrogen in beet juice by the semi-micro Kjeldahl method of Konrad. A. DANDÁR, J. DUBRAVNICKÝ and E. MÓROVÁ. *Listy Cukr.*, 1973, **89**, 11–14.—Comparative tests were conducted on N determination in beet factory products, e.g. raw juice and molasses, using the KJELDAHL method and a semi-micro modification of it developed by KONRAD, details of which are given. In all cases the semi-micro method gave more accurate results, although the differences were statistically not significant. However, the new method has a number of advantages including a reduction in time, materials and space requirements.

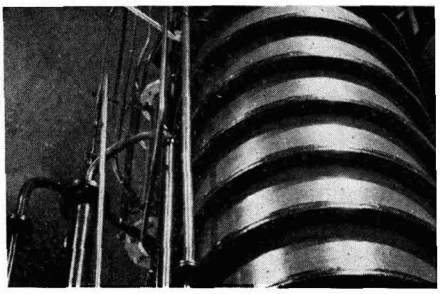
* * *

Raw sugar microflora. V. Z. NAKHODKINA. *Sakhar. Prom.*, 1973, (1), 45–47.—A raw sugar sample stored in bulk for 6 months (February–August) in an unheated warehouse at 75–90% relative humidity was analysed microbiologically every 2 months. Details are given of the counts of various groups of bacteria associated with stored sugar. Although in general all counts were lower at the end of the storage period than at the start, exceptions to this were slime-forming mesophiles on the surface of the pile and osmophilic yeasts to a depth of 1 metre in the pile. However, sugar losses were negligible. Techniques of microbiological control are briefly examined.

* * *

Automation of calculations in a sugar laboratory (Lab. 201 system). D. VALDÉS C. *CubaAzúcar*, 1972, (July/Sept.), 7–12.—A pilot trial has been made at Central Camilo Cienfuegos (formerly Hershey) in Havana Province of a system developed at the electronic data processing centre of the Ministry of the Sugar Industry. Production data are fed to the computer and process control calculations made automatically with printed-out reports produced by the computer. Input includes three blocks, the first comprising details of raw material, mill train performance and juice, the second process calculations, and the third product sample analyses. The basic programmes are interrelated as to input/output, so maintaining the system's integrity.

By-products



Laboratory and manufacturing notes. IV. Final molasses. C. BAYMA. *Brasil Açuc.*, 1972, **80**, 44–49. The nature of molasses and its utilization to recover the value of its constituents are discussed, especially its use as a constituent in animal fodder. The molasses ("mel-de-duro") produced by small non-centrifugal sugar factories is of much higher sugar content and is a suitable material for fermentation to produce alcohol, and a number of calculations are given concerning tank capacities, molasses volume and weight, solids, sucrose and non-sugar contents, etc.

* * *

Method of determining the urea content in a mixture of beet pulp and "amido" molasses. M. G. PARFENOPULO and N. E. KARAULOV. *Sakhar. Prom.*, 1972, (9), 38–41.—Details are given of a method, and experiments leading to it, for determining urea in molasses-pulp-urea mixtures with a view to controlling the drying and briquetting processes in terms of the dielectric properties of the fodder.

* * *

Fish meal and NPN conversion to bacterial protein in molasses/urea diets. A. RAMÍREZ. *Rev. Cubana Cienc. Agríc.*, 1972, **6**, 195–202.—Analysis of duodenal fluid from bulls fed under experimental conditions with molasses/urea diets with and without supplemental protein in the form of fish meal demonstrated higher nitrogen contents in the former but which did not appear to affect bacterial synthesis effectiveness.

* * *

Protein levels for growing turkeys fed high-test molasses. S. VALAREZO and R. PÉREZ. *Rev. Cubana Cienc. Agríc.*, 1972, **6**, 223–233.—Comparison of six protein levels and two housing systems for turkeys fed on molasses-based diets showed that the most economical level of protein was 25% on dry matter and housing in wire cages was preferable to dry lot housing.

* * *

Bagasse structural board—our hope? M. F. GLORIA. *Sugarland* (Philippines), 1972, **9**, (6/7), 14, 16, 22, 27, 28.—With forest reserves in the Philippines falling and timber usage increasing, it is suggested that attention should be paid to the utilization of bagasse for the manufacture of particle boards and structural boards. Characteristics of such products are described and tabulated and reference is made to the necessity of retaining fibre length while removing pith from bagasse to give a suitable raw material. Brief descriptions are given of the dry and wet processes for board manufacture.

Use of coconut meal and molasses as supplements to grazing for dairy cows in Fiji. K. H. MCINTYRE. *Trop. Agric.* (Trinidad), 1973, **50**, 17–23.—Feeding trials showed that cononut meal and molasses as supplementary feeds both produced increases in milk and butterfat yield. Although the coconut meal gave better results for butterfat production, it was uneconomical whereas the molasses addition was economical. Both were economical for whole milk production.

* * *

Composition of sugar factory and distillery wastes during the cane harvest. N. A. DA GLORIA, A. G. SANTA ANA and H. MONTEIRO. *Brasil Açuc.*, 1972, **80**, 542–548.—Samples of vinasse, filter cake and sugar factory waste water—all used as fertilizer—were collected and analysed over a period of four months. Dry matter, readily oxidized organic matter (expressed as carbon), Ca, Mg, N, K, P and pH were determined as was filter cake water content. The results show that the samples varied widely; the vinasse was the best source of K, while N and Ca were the main nutrients in the filter cake. Waste water was poor in all nutrients. Mixing of all three wastes provided a better N-P-K balance and is probably the most economical means of using them as fertilizer.

* * *

New unit for dried beet pulp pelleting. K. P. ZAKHAROV *et al. Sakhar. Prom.*, 1972, (12), 20–22.—Details are given of a unit (E8-PGA/1) for producing pulp pellets (measuring 9·7, 12·7 or 19 mm) at a throughput of 3·5–5 tons/hr and cooling it from 75°C to a temperature no more than 10°C above ambient. A mixer for applying steam or water to the pulp before pressing is also incorporated.

* * *

Physico-mechanical properties of a beet pulp-molasses-urea mixture. M. G. PARFENOPULO and N. E. KARAULOV. *Sakhar. Prom.*, 1972, (12), 22–25.—Experimental data have been obtained on volumetric mass, angle of repose, coefficient of internal and external friction, initial shear resistance and other parameters of pulp-molasses-urea mixtures with the aim of designing a briquetting press.

* * *

Dried beet pulp and the dairy herd. E. K. RODENHURST. *British Sugar Beet Rev.*, 1972, **40**, 279–280.—An account is given of a dairy herd and its management by a farmer in Shropshire who includes beet pulp in the balanced ration fed to the milking cows and feeds the calves with a ration containing 30% dried pulp.

ICUMSA

16th Session, 1974

It is confirmed that the 16th Session of the International Commission for Uniform Methods of Sugar Analysis will be held in the Turkish Standards Institute, Ankara, Turkey in June 1974, by kind invitation of Mr. O. BOZOK, Chairman of the Turkish National Committee of ICUMSA and Türkiye Seker Fabrikalari AS.

Registration will take place on Sunday, 2nd June and working sessions will be held on Monday, 3rd June to Friday, 7th June, both dates inclusive. A separate programme will be arranged during this period for delegates' ladies.

There will be an optional excursion to Kayseri and Göreme for delegates and their ladies, leaving Ankara at 08.30 on Saturday, 8th June and returning to Ankara at about 13.00 on Sunday, 9th June; the cost of this excursion, including accommodation and food, is likely to be about $20.

In view of the seasonal shortage of suitable accommodation in Ankara, it is important that prospective delegates should inform, as soon as possible, both the organizer, Mr. O. BOZOK, Seker Enstitüsü Müdürü, Etimesgut, Ankara, Turkey and the General Secretary of ICUMSA, Mr. D. HIBBERT, British Sugar Corporation Ltd., P.O. Box 35, Wharf Road, Peterborough, PE2 9PU, England.

Lime kiln orders.—After the successful commissioning of a lime kiln at the Brugelette sugar factory of Raffinose Tirlemontoise S.A., West's (Manchester) Ltd. have received orders for the supply of a further two lime kilns to Belgian sugar factories, viz. those of N.V. Suikerfabriek Van Veurne and S.A. Sucrerie-Raffinerie de Donstiennes. Another lime kiln has been ordered from West's by the Irish Sugar Co. Ltd. for installation at Carlow sugar factory.

* * *

Nepal sugar factory expansion.—The cane sugar factory erected by Technoexport at Birganj in Nepal in 1965 is to be expanded from 1000 t.c.d. to 1500 t.c.d. under the terms of a contract given to the Czechoslovakian organization. The work is to be carried out during April-November 1975 between the two cane seasons, and will involve, among other things, the installation of new machinery such as a bagasse-fired furnace, a cane mill, lime kiln, two ARO 700 automatic centrifugals, a vacuum pan, etc.

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Erratum.—In our November 1973 issue we carried a note on the new BMA tower diffuser to be installed at Vierverlaten sugar factory in Holland. We apologise for our error in giving the capacity as 65 tons/day instead of 6500 tons/day.

* * *

Brazil sugar expansion plans[1].—Brazil intends to double its sugar production to 12 million metric tons by 1980. One-half of the total quantity is to be earmarked for export and the other half for covering the growing domestic sugar requirements. To reach this objective it is intended to improve the infrastructure and to enlarge the ports at Santos and Maceio.

* * *

Zambia distillery project[2].—Feasibility studies into the possibility of setting up a local distillery plant to produce industrial and consumer alcohol from the molasses produced by the Zambia Sugar Co. Ltd. have established the project as economically viable and it is likely that a distillery will be built by 1975. At the moment Zambia imports all her requirements of alcohol.

US sugar supply quotas 1973

	Initial quotas	*Increases/ Shortfalls/ Redistributions*	*Quotas in effect at 15th November 1973*
	(*short tons, raw value*)		
Domestic Beet	3,500,000	—	3,500,000
Mainland Cane	1,608,333	17,334	1,625,667
Texas Cane	5,000	—	5,000
Hawaii	1,143,000	—	1,143,000
Puerto Rico	90,000	—	90,000
Philippines	1,440,052	22,611	1,462,663
Argentina	85,459	—	85,459
Australia	245,193	10,159*	255,352
Belize	43,727	1,788	45,515
Bolivia	7,261	215	7,476
Brazil	616,641	18,216	634,857
Colombia	75,963	—	75,963
Costa Rica	96,110	4,539	100,649
Dominican Republic	732,456	21,120	753,576
Ecuador	91,046	2,689	93,735
Fiji	44,705	—	44,705
Guatemala	69,267	—	69,267
Haiti	15,295	—	15,295
Honduras	0	—	0
India	81,688	—	81,688
Ireland	5,351	—	5,351
Malagasy Republic	12,192	—	12,192
Malawi	15,037	676	15,713
Mauritius	44,618	—	44,618
Mexico	632,280	—	632,280
Nicaragua	75,723	—	75,723
Panama	52,500	—	52,500
Paraguay	7,155	529	7,684
Peru	426,245	—	426,245
Salvador	50,484	1,491	51,975
South Africa	60,643	14,347	74,990
Swaziland	30,338	1,082	31,420
Taiwan	84,939	3,204	88,143
Thailand	19,190	—	19,190
Venezuela	31,902	—	31,902
West Indies	60,207	—20,000	40,207
	11,600,000	100,000	11,700,000

* Net amount from 19,992 deficit and 30,151 tons new additional quota

Paraguay refinery plans[3].—It is planned to erect a sugar refinery at Asunción in Paraguay, to be completed in two years at a cost of $20,000,000.

* * *

Indian state sugar factory enterprise[4].—The Government of the state have set up West Bengal Sugar Industries Development Corporation Ltd. which has taken over the National Sugar Mills at Ahmedpur in the district of Birgbhum. This factory requires a complete overhaul which, it is intended, will make it operative from the next crushing season. The Corporation is also to set up further sugar mills in the cane growing area of West Bengal and to undertake a survey on present cultivation methods and cane area, and prospects of extension.

* * *

Philippines sugar production 1972/73[5].—Sugar production in the 1972/73 season in the Philippines reached 2,474,530 short tons, tel quel, equivalent to 2,244,399 metric tons. This was obtained by processing a total of 35,492,400 short tons (32,191,606 metric tons) of cane.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (30), 8.
[2] *Standard Bank Review*, November 1973, 20.
[3] *Zucker*, 1973, **26**, 574.
[4] *Indian Sugar*, 1973, **23**, 184–185.
[5] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (28), 8.

Brevities

Jamaican Government sugar industry participation[1].—A new body, the Jamaica Sugar Manufacturing Corporation, has been formed in which the Government will participate with private sugar interests in the running of the industry. An agreement has been signed between the Government and the Sugar Manufacturers' Association of Jamaica. The Corporation has been set up to establish a central body for the effective operation of the industry; the Government is planning the rationalization and modernization of the industry and the new body will be the mechanism for so doing. Wide-ranging powers are being given to the Corporation, including control over the operation of factories, closure of those deemed inefficient or redundant, and related matters.

* * *

US new beet sugar factory[2].—In addition to Red River Valley Cooperative factory near Hillsboro, N.D., and the Minn-Dak Farmers' Cooperative factory near Wahpeton, N.D., a third project is under way. It will be owned by the Southern Minnesota Beet Sugar Cooperative and will be located near Renville, Minn., but will be operated by American Crystal Sugar Co. The factory should be in operation for the 1974/75 campaign.

* * *

New Polish sugar factories[3].—Erection of a new sugar factory, to be the largest in Poland, is to start in the spring of 1974. It will have a slicing capacity of 5300 tons of beet per day and will cost 1·3 million zloty. The factory will be built in the Krasnystaw district of the eastern Polish province of Lublin. Another large factory is to be built in the Krasnik district of Lublin province but no date has been set for the start of construction.

* * *

Bagasse board investigation in Swaziland[4].—A timber expert is visiting the National Industrial Development Corporation at Mbabane, Swaziland to study markets in Southern Africa and other African countries for wood and bagasse-based products. He is to investigate the possibility of setting up a bagasse board factory. One process under consideration is a new German process producing "Mende" board, a particle board 2·6 mm (0·1 inch) thick, as against the 18·22 mm (0·72 inch) thick board produced in conventional plants; this might be used as a substitute for hardboard in low-cost housing.

* * *

Honduras crop forecast[5].—After normal rainfall for the first time in three years, the 1973/74 crop in Honduras is expected to rise to about 80,000 short tons or some 23% more than the 65,000 tons of the 1972/73 crop. Last year, Honduras had to buy 11,000 tons from Cuba for delivery in October and this is expected to be sufficient to last until new crop sugar becomes available. Honduras was unable to meet all its 1973 US quota but sugar companies hope to have sufficient supplies to meet its quota in 1974; however, because of the tightness of the supply position, the Honduras Government might prohibit exports.

* * *

South African sugar development[6].—In cooperation with the South African Sugar Association, the Minister of Economic Affairs has appointed a special committee to undertake the economic, financial and technical investigation of any sugar projects. After an investigation, lasting nearly three years, into the production, markets and price structure of the industry, a limited expansion in South Africa is already under way to meet the growing demands of local and export markets. The expansion programme implemented was in accordance with the recommendations of the Commission of Inquiry into the Sugar Industry (1970) that it would be more economical—and in the national interest—to utilize the maximum capacity of the existing sugar factories. The committee appointed by the Minister, however, is likely to investigate the opening-up of new areas.

US sugar supply quotas 1974

	(*short tons, raw value*)
Domestic Beet	3,300,000
Mainland Cane	1,643,000
Texas Cane	100,000
Hawaii	1,110,000
Puerto Rico	155,000
Philippines	1,526,445
Argentina	90,860
Australia	209,048
Belize	40,382
Bolivia	7,719
Brazil	655,611
Colombia	80,764
Costa Rica	81,952
Dominican Republic	760,127
Ecuador	96,798
Fiji	45,808
Guatemala	70,075
Haiti	36,818
Honduras	14,253
India	83,701
Ireland	5,351
Malagasy Republic	12,493
Malawi	15,408
Mauritius	30,816
Mexico	672,239
Nicaragua	76,605
Panama	76,605
Paraguay	7,719
Peru	433,020
Salvador	51,070
South Africa	59,132
Swaziland	30,816
Taiwan	87,034
Thailand	19,156
Venezuela	60,983
West Indies	53,192
	11,800,000

Australian milling equipment for Thailand.—Walkers Ltd., of Maryborough, Queensland, have received orders to the value of about A$4,000,000 for pressure feeders, individual mills and complete milling tandems to be supplied to Thailand.

* * *

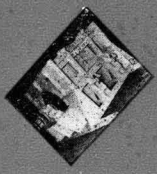
Philippines sugar expansion programme[7].—The Philippine National Bank is to raise 395·5 million pesos as production loans to sugar mills for a programme to increase the country's sugar export earnings. The finance, to be sought from a US banking consortium, consists of additional time loans of 47·6 million pesos, crop loans of 265·8 million pesos and operational loans of 82·1 million pesos. The programme is intended to permit filling of the US sugar quota and produce a surplus for world market exports. It covers improvement of mill capacity and efficiency, and expansion of plantation outputs. The latter would be achieved through increased cane area, provision of fertilizers, acquisition of agricultural tractors and equipment, extension of irrigation facilities and construction of feeder and access roads.

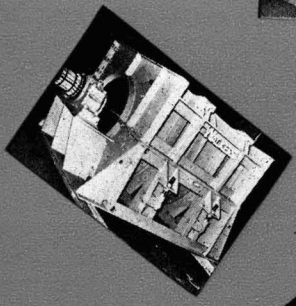
* * *

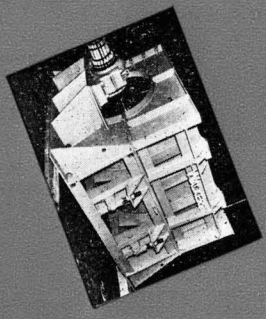
Mexico sugar production, 1972/73[8].—Production of sugar in 1972/73 reached a record level of 2,590,000 tons, compared with 2,350,000 tons in 1971/72, an increase of 9·8%.

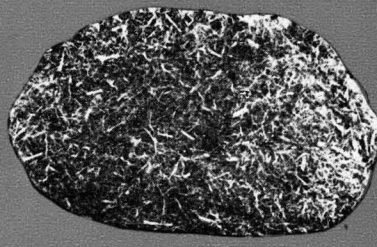
[1] *W. Indies Chron.*, 1973, **88**, 413.
[2] *Sugar J.*, 1973, **36**, (3), 23.
[3] *Zucker*, 1973, **26**, 574.
[4] *Barclays International Review*, October 1973, 40.
[5] *Public Ledger*, 6th October 1973.
[6] *S. African Sugar J.*, 1973, **57**, 429.
[7] *Reuters Sugar Rpt.*, 25th July 1973.
[8] *Bolsa Review*, 1973, **7**, 566.

THE DAY IT RAINED SHREDDERS









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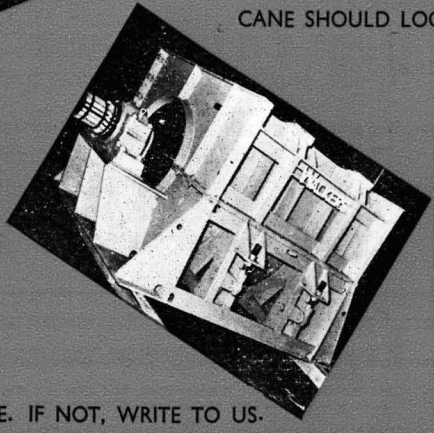

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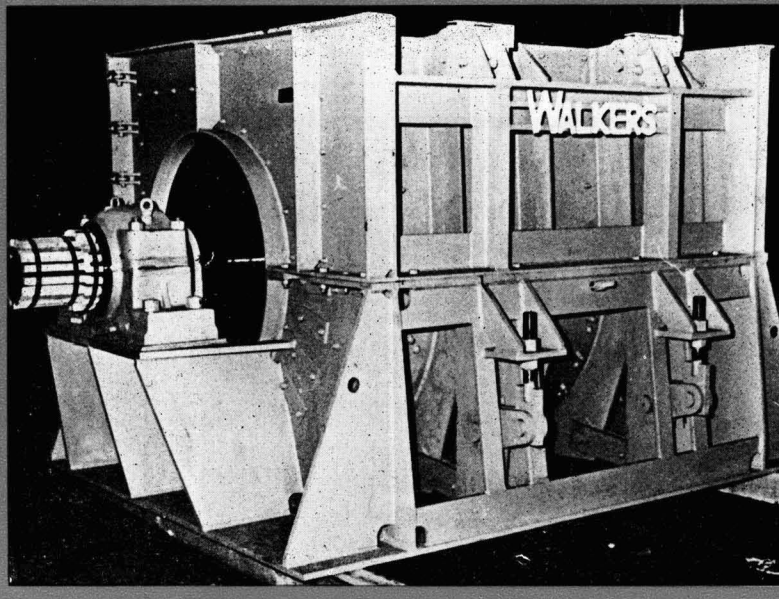

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