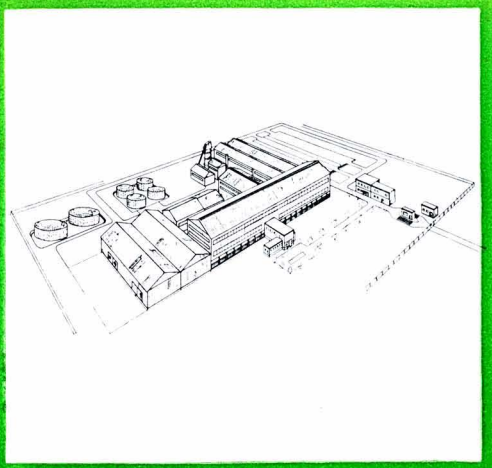
THE International Sugar Journal

FEBRUARY 1971



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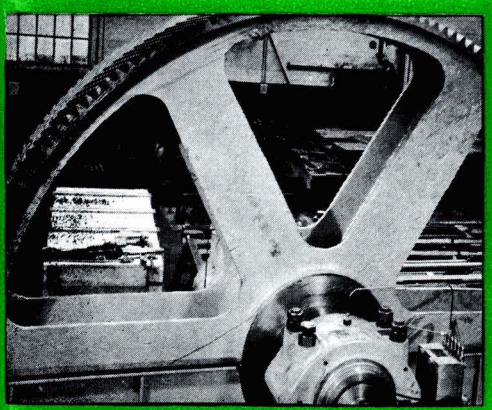

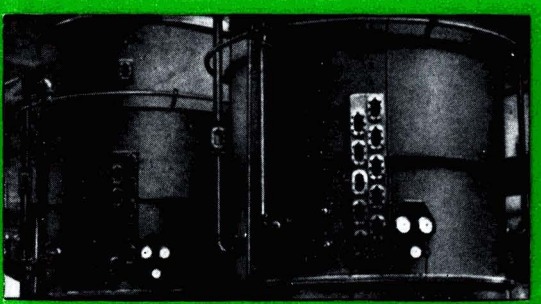

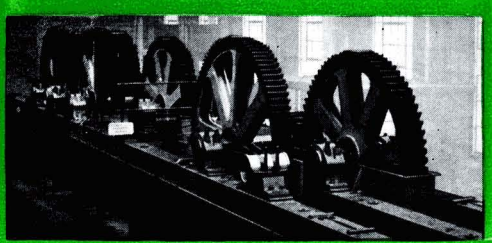

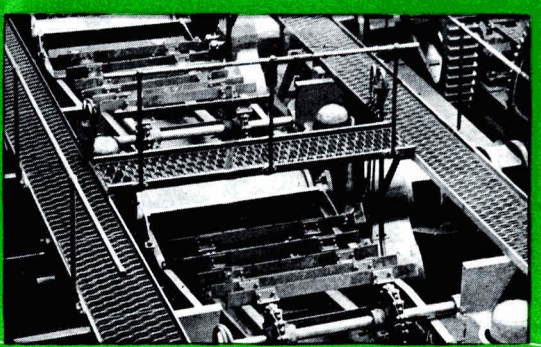

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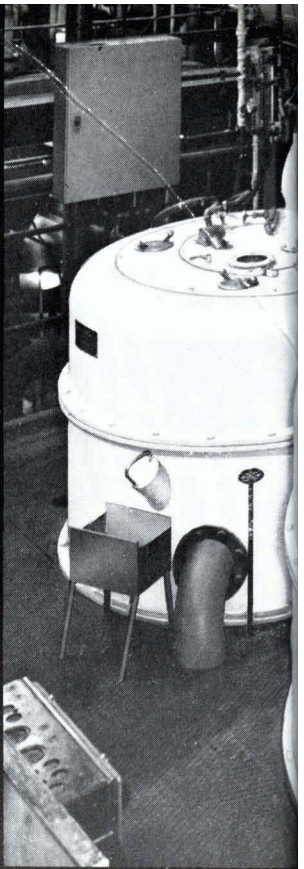

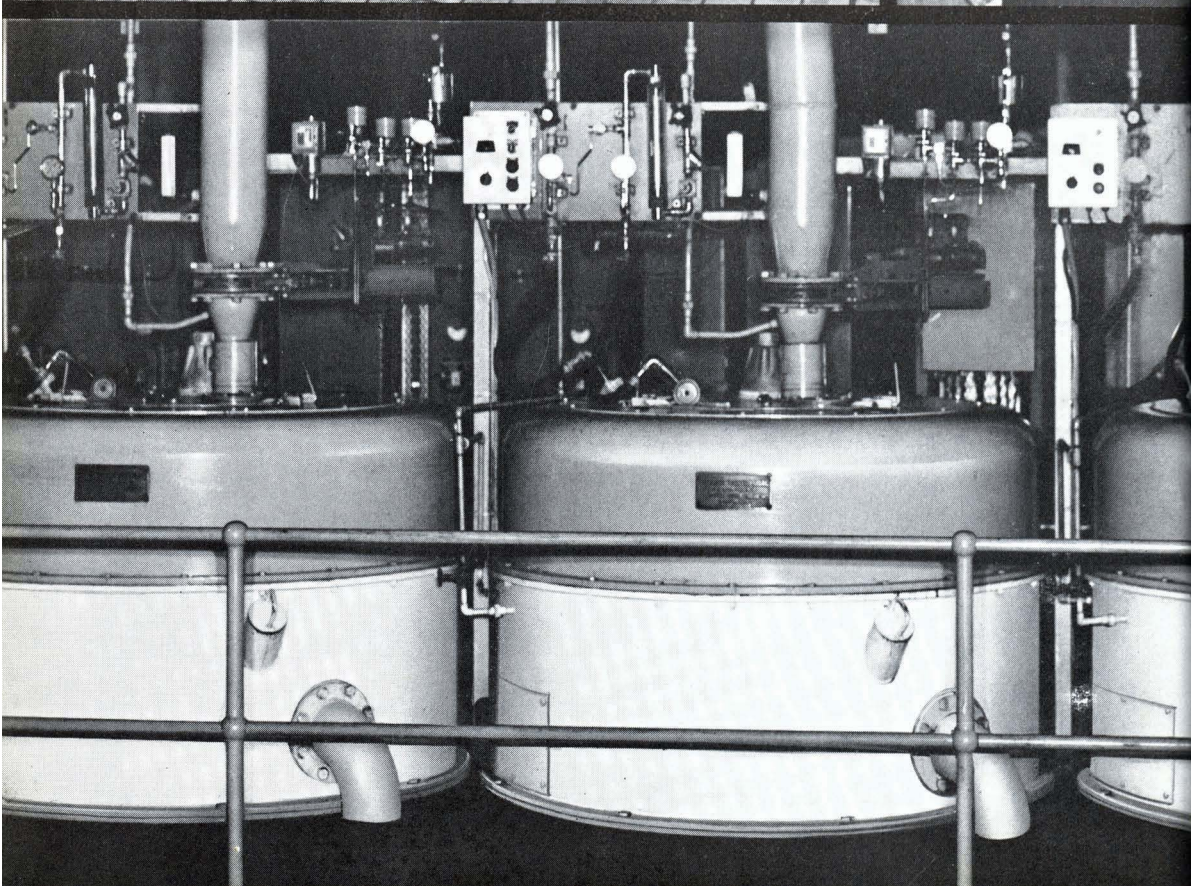

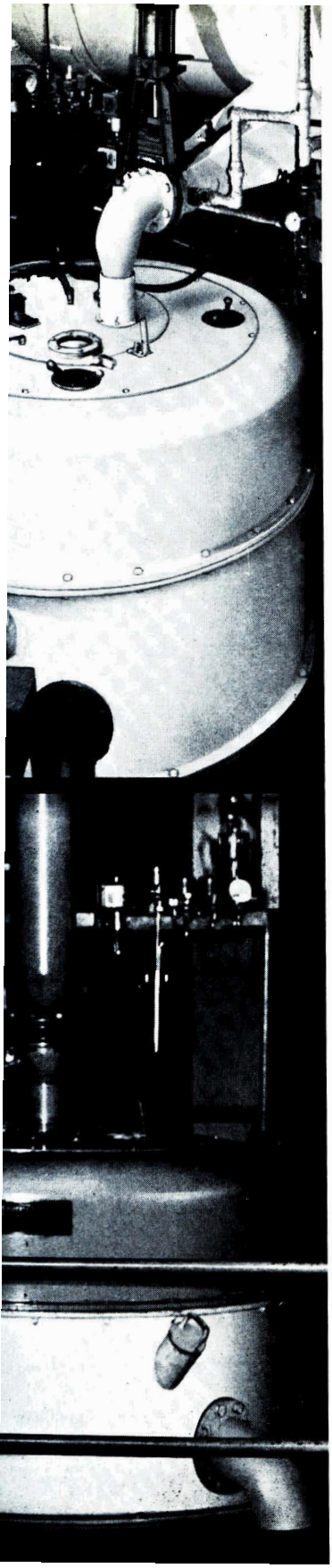

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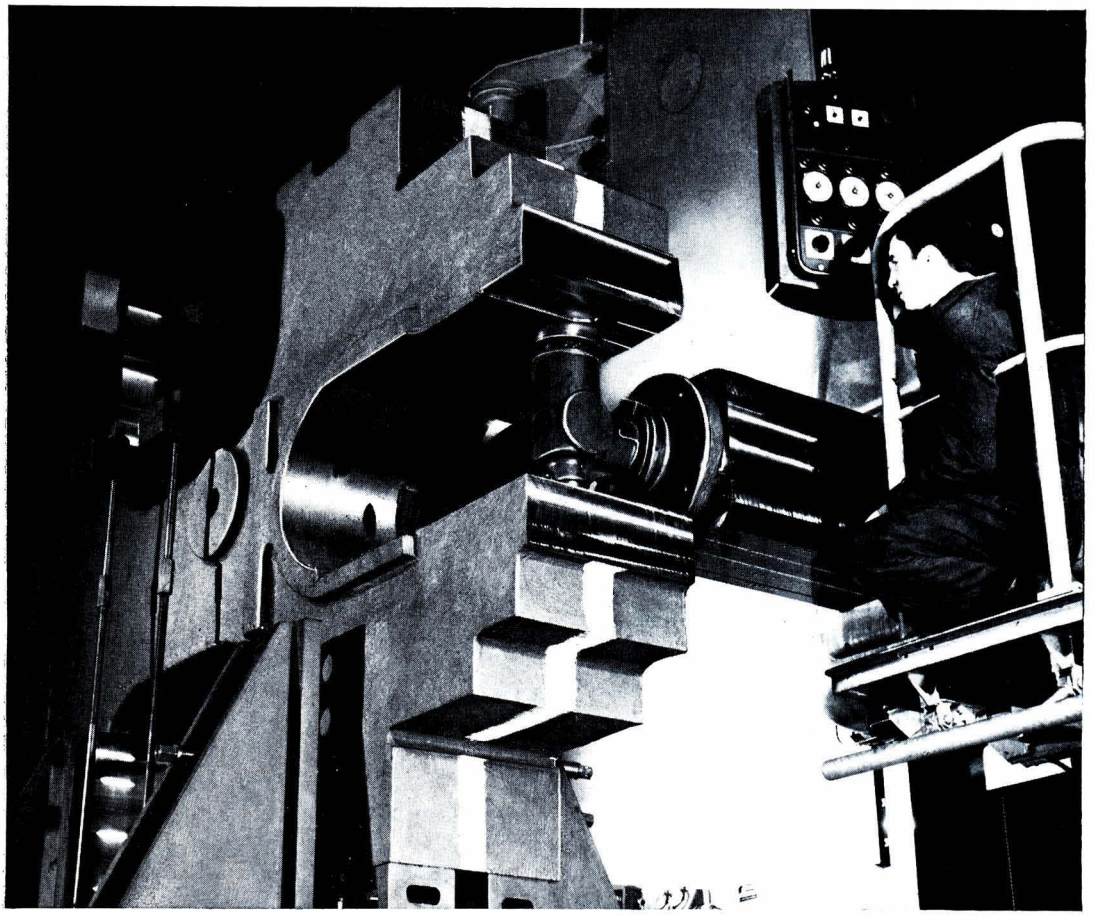

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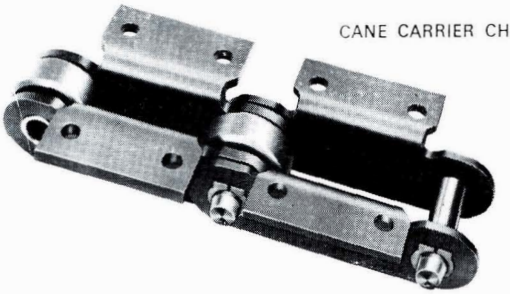

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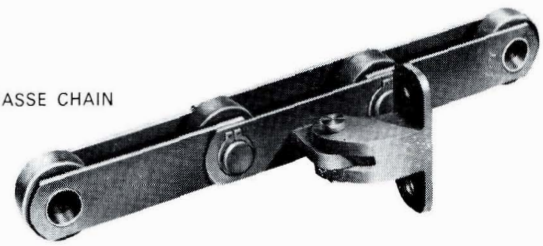

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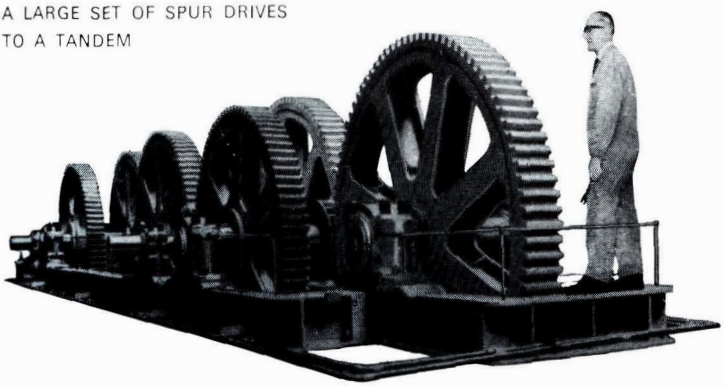

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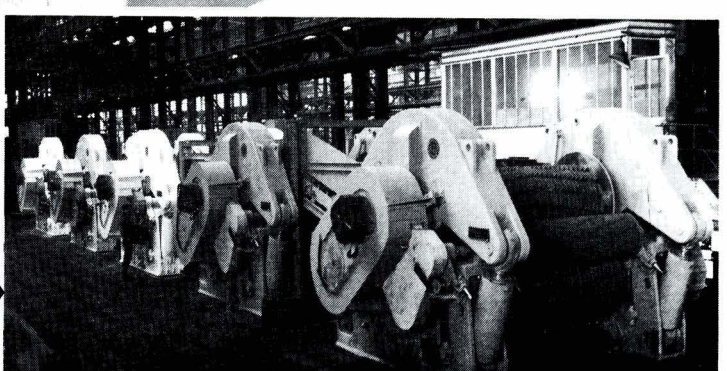

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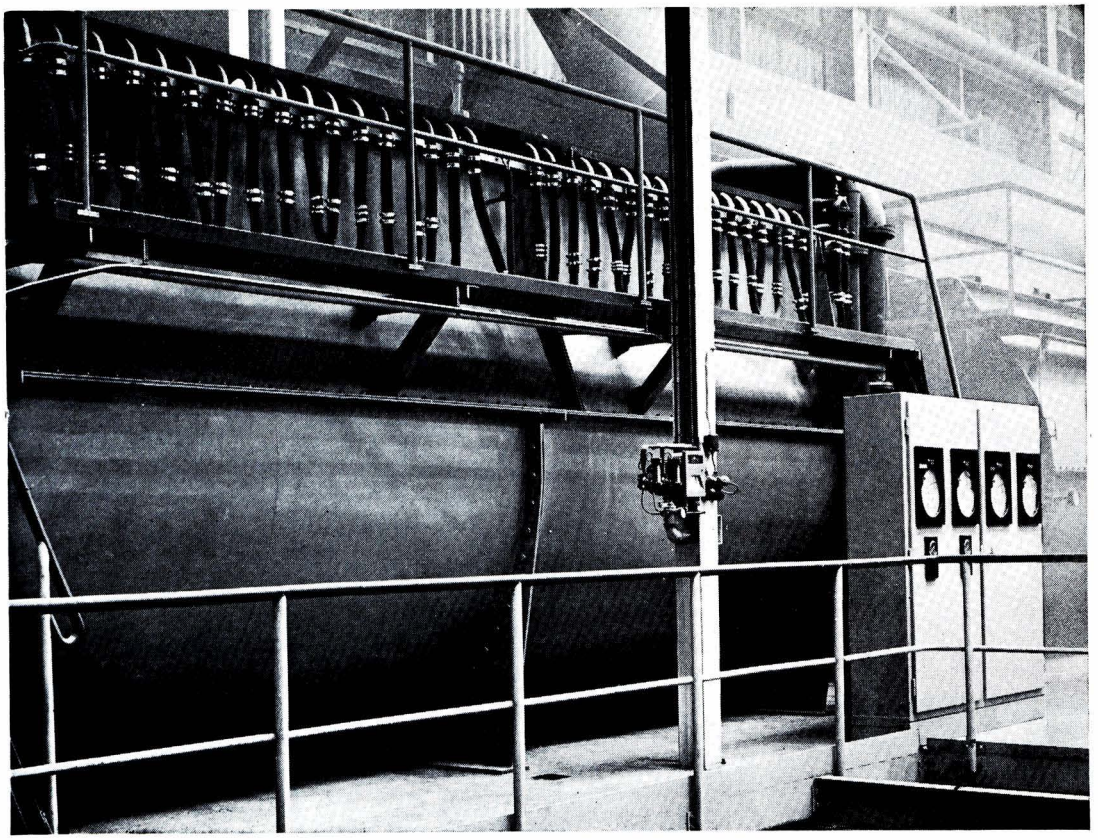

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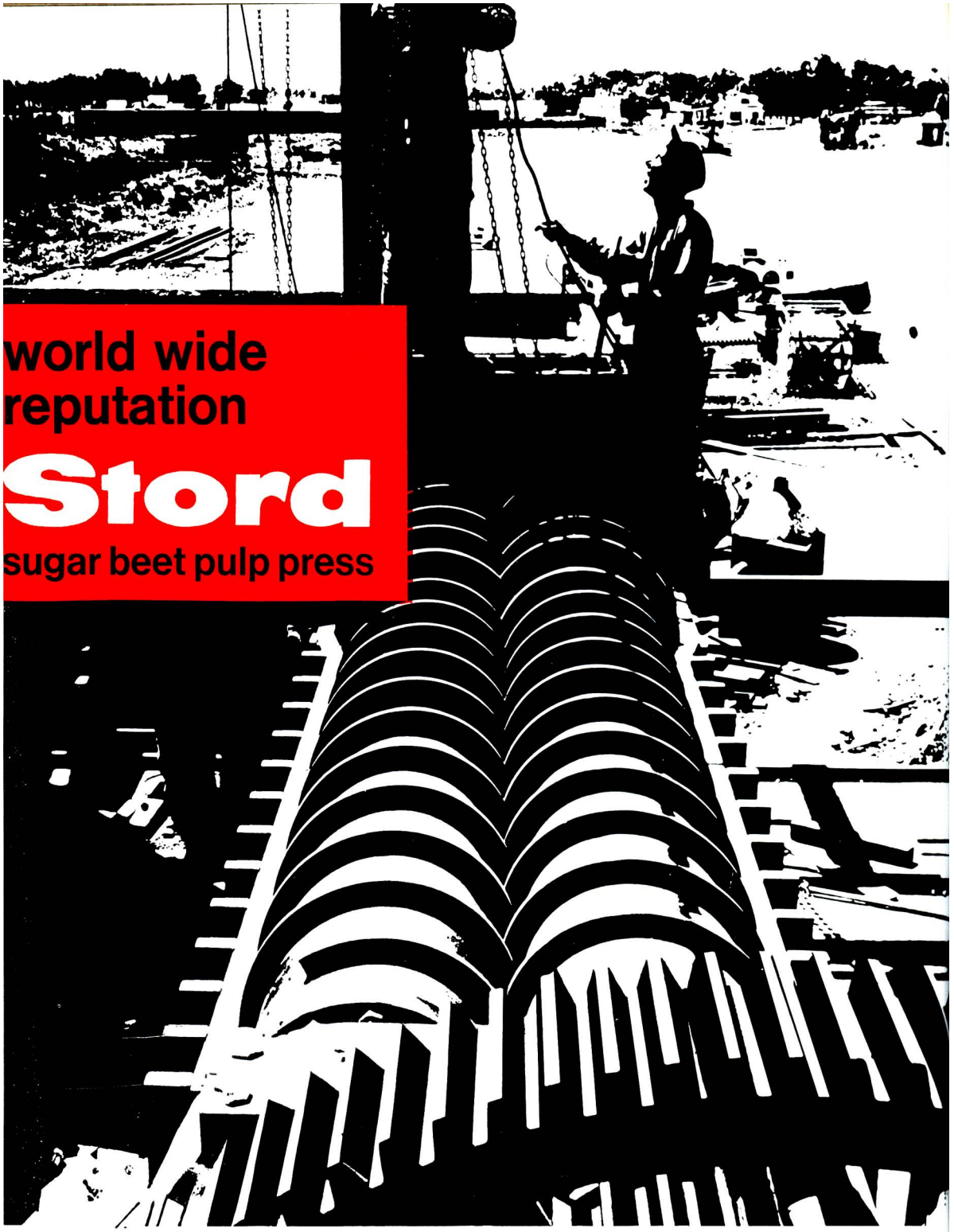

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Contents

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La signification de la formation d'inverti et de gommes dans les betteraves détériorées. 2me partie. J. F. T. OLDFIELD, J. V. DUTTON, et H. J. TEAGUE. *p.* 35–40

On a trouvé que les difficultés de filtration du jus de 2e carbonatation, produit à partir de betteraves gelées, augmentent au cours du temps après dégel par suite d'une réduction de la grosseur du cristal de $CaCO_3$. Le dextrane et le lévane ajoutés au jus ont également un effet marqué sur la grosseur et la forme des cristaux dans le précipité. L'addition de lait de chaux gênait la filtration en augmentant le nombre de petites particules de $CaCO_3$, tandis que le carbonate de calcium préformé ou l'aragonite améliorait la filtration en fournissant une base pour l'agglomération. Un floculant d'amidon modifié favorisait la conglomération mais n'améliorait guère la filtration. Du sucre interverti ajouté à du jus brut extrait de betteraves fraîches avait un effet moindre sur la formation de coloration qu'une quantité identique d'interverti ajoutée à du jus brut extrait de betteraves gelées. Les effets de l'interverti sur les sels de chaux furent semblables pour les deux types de jus.

* * *

La chaleur de cristallisation et les coefficients d'activité du saccharose dans des solutions aqueuses saturées. J. FERNÁNDEZ BERTRÁN et L. BALLESTER. *p.* 40–43

Les données disponibles sur la chaleur de cristallisation du saccharose sont revues de façon critique et de nouvelles valeurs sont calculées à partir de données récentes sur les coefficients de solubilité et d'activité dans le domaine de température de 0 à 60°C. Une nouvelle méthode pour l'extrapolation des coefficients d'activité à la région de saturation de même que les valeurs obtenues en extrapolant les données de KHARIN de 0 à 60°C sont données. La variation de la chaleur de cristallisation à 20 et 25°C est évaluée à partir de données sur la capacité calorifique et employée comme critère de sélection pour des résultats contradictoires. Une équation pour calculer la variation de la chaleur de cristallisation avec la température dans le domaine de 10 à 80°C est proposée.

* * *

Recherche sucrière à Hawaii. 1re partie. *p.* 44–46

On présente un sommaire du Rapport Annuel 1968 de la Station Expérimentale de l'Association des Planteurs de Sucre Hawaiens. La première partie décrit le travail expérimental effectué sur l'emploi de transplantations de canne, le contrôle des mauvaises herbes, l'application de fertilisants, l'irrigation, la mécanisation des opérations sur les champs de canne, les pertes causées par les insectes et le traitement des maladies de la canne.

Die Bedeutung der Bildung von Invertzucker und Polysacchariden in alterierten Rüben. Teil II. J. F. T. OLDFIELD, J. V. DUTTON und H. J. TEAGUE. *S.* 35–40

Es wirde festgestellt, dass die Schwierigkeiten bie der Filtration von Saft der 2. Carbonatation aus gefrorenen Rüben um so mehr zunehmen, je mehr Zeit nach dem Auftauen vergangen ist, da die Grösse der $CaCO_3$-Kristalle abnimmt. Ein Zusatz von Dextran und Lävan zum Saft hatte ebenfalls einen merklichen Einfluss auf die Grösse und die Form der Kristalle im Niederschlag. Die Zugabe von Kalkmilch erschwerte die Filtration durch Erhöhung der Anzahl kleiner $CaCO_3$-Partikel, während vorher gefälltes Calciumcarbonat oder Aragonit die Filtration dadurch verbesserte, dass eine Grundlage für die Agglomeration geschaffen wurde. Eine Flockungsmittel auf Stärkebasis förderte die Bildung von Konglomeraten, verbesserte aber nicht die Filtration. Der Zusatz von Invertzucker zu Rohsaft aus frischen Rüben hatte einen geringeren Einfluss auf die Farbbildung als die gleiche Invertzuckermenge im Rohsaft aus aufgetauten Rüben. Der Einfluss des Invertzuckers auf die Kalksalze was für beide Arten von Saft gleich.

* * *

Die Kristallisationswärme und die Aktivtätskoeffizienten von Saccharose in gesättigten wässrigen Lösungen. J. FERNÁNDEZ BERTRÁN und L. BALLESTER. *S.* 40–43

Die verfügbaren Werte für die Kristallisationswärme von Saccharose werden einer kritischen Betrachtung unterzogen. Aus den neuesten Daten für die Löslichkeits- und Aktivitätskoeffizienten im Temperaturbereich zwischen 0 und 60°C werden neue Werte berechnet. Ferner wird eine neue Methode zur Extrapolation der Aktivitätskoeffizienten bis in das Gebiet der Sättigung aufgezeigt, und es werden die Werte angegeben, die bei der Extrapolation der von KHARIN bei 0 bis 60°C veröffentlichten Angaben erhalten wurden. Die Aenderung der Kristallisationswärme bei 20 und 25°C wird aus den Werten für die Wärmekapazität errechnet und als Kriterium für die Auswahl aus widersprüchlichen Resultaten benutzt. Zur Berechnung der Aenderung der Kristallisationswärme mit der Temperatur im Bereich zwischen 10 und 80°C wird schliesslich eine Gleichung vorgeschlagen.

* * *

Zuckerforschung auf Hawaii. Teil 1. *S.* 44–46

Es wird zusammenfassend über den Inhalt des "Annual Report 1968" der Versuchsstation der Hawaiian Sugar Planters' Association berichtet. Der erste Teil enthält experimentelle Arbeiten über das Verpflanzen von Rohr, die Unkrautbekämpfung, die Düngung, die Bewässerung, die Mechanisierung der Arbeiten auf der Zuckerrohrplantage, die schädlichen Insekten und die Behandlung der Zuckerrohrkrankheiten, eine Aufzählung der auf Hawaii angebauten Rohrsorten und Untersuchungen über die Differenzierung des Rohrgewebes.

La significación de la formación de azúcar inertido y de goma en remolacha deteriorada. Parte 2. J. F. T. OLDFIELD, J. V. DUTTON y H. J. TEAGUE. *Pág.* 35–40

Se encontra que aprietos en filtración de jugo de 2o carbonatación producido de remolacha congelada aumentaban con creciente tiempo después de deshielo a causa de una disminución del tamaño de los cristales de $CaCO_3$. Dextrana y levana añadido al jugo también tienían un efecto notable sobre el tamaño y forma de los cristales en el precipitado. Adición de leche de cal estorbaba filtración por crecemiento del número de pequeñas partículas de $CaCO_3$, mientras carbonato de calcio pre-formado o aragonita mejoraba filtración por provisión de una base para aglomeración. Un material floculante, producido de almidón modificado, ayudaba conglomeración pero no mejoraba filtración. Azúcar invertido, añadido a jugo crudo de remolacha fresca, tenía un efecto menos importante sobre formación de colour que un contenido similar de azúcar invertido en jugo crudo de remolacha deshelada. Los efectos de azúcar invertido sobre el contenido de sales de calcio estaban similar para ambos tipos de jugo.

* * *

El calor de cristalización y coeficientes de actividad de sacarosa en soluciones acuosas saturadas. J. FERNÁNDEZ, BERTRÁN y L BALLESTER. *Pág.* 40–43

Los dados disponibles del calor de cristalización de sacarosa se reseñan criticamente y valores nuevos se calculan de dados recientes de solubilidad y de coeficientes de actividad en la gama de temperaturas 0–60°C. Un método nuevo para extrapolar coeficientes de actividad a la zona de saturación se presenta así como los valores obtenido por extrapolación de los dados de KHARIN para 0–60°C. El cambio en el calor de cristalización a 20° y 25°C se evalua de dados de capacidad de calor y se usa como criterio para selección entre resultados en pugna entre sí. Un ecuación se propone para calcular el cambio de calor de cristalización con temperatura en la gama 10–80°C.

* * *

Experimentos azucareros en Hawaii. Parte 1. *Pág.* 44–46

Se presenta un sumario del Informe Anual de 1968 de la Hawaiian Sugar Planters' Association Experiment Station. Este primer parte describe trabajo experimental sobre el uso de trasplante de caña, control de malas hierbas, aplicación de abonos, irigación, mecanización de operaciones en al campo, plagas insectas y tratamientio de enfermidades de caña.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIII FEBRUARY 1971 No. 866

Notes & Comments

International Sugar Organization.

At its meetings on the 18th–20th November 1970, the Council decided unanimously that (i) initial export quotas for 1971 Article 45 (1)(b) were to be fixed at 95% of the Basic Export Tonnages; (ii) should the prevailing price exceed 4.00 cents per pound before the end of 1970, the automatic provisions of Article 48 (2) (b) of the Agreement would not apply; and (iii) the export limit under Article 39 (2) for 1971 was to be fixed at 1,150,000 tons.

In reaching these decisions, the Council agreed that decision (ii) would not constitute a precedent for future years and would not prejudice the right of the Executive Committee to decide on such redistributions of shortfalls as it might deem necessary in order to meet the market situation before the end of the 1970 quota year.

The Council elected Mr. GUY SAUZIER (Mauritius) as its Chairman for 1971 and Mr. S. LARSON (Sweden) as its Vice-Chairman. The following were elected members of the Executive Committee for 1971: Australia, Brazil, Canada, Cuba, Finland, India, Japan, Malawi, Mauritius, Mexico, New Zealand, Poland, Sweden, USSR, and UK.

The Council also resolved to substitute with effect from 19th November 1970 the spot price under the New York Coffee and Sugar Exchange Sugar Contract No. 11 for the spot price under Contract No. 8 for the purpose of determining the price of sugar under Article 33 of the Agreement.

After a review of the recent developments in the free market, as reflected in the price levels then current, the Executive Committee of the International Sugar Organization, at its meeting on the 30th December, rescinded decision (i) above, when it (a) agreed that the automatic action referred to in Article 48(2)(b) should take its course and, as a result, that quotas in effect for 1971 should not be restrained below the basic export tonnages; and (b) further agreed to continue its close watch of the market situation and to meet whenever circumstances should so require, in order to consider in the light of all relevant factors any further action as might be necessary under the provisions of the Agreement, in particular of Articles 47 and 48.

The initial quotas for this year are therefore the basic export tonnages, as follows:

Member	*Metric tons, raw value*
Argentina	55,000
Australia	1,100,000
Bolivia	10,000
Brazil	500,000
British Honduras	22,000
Colombia	164,000
Congo (Brazzaville)	41,000
Cuba	2,150,000
Czechoslovakia	270,000
Denmark	41,000
Dominican Republic	186,000
Fiji	155,000
Guatemala	11,000
Honduras	11,000
Hungary	51,000
India	250,000
Malagasy Republic	41,000
Mauritius	175,000
Mexico	96,000
Peru	100,000
Poland	370,000
South Africa	625,000
Swaziland	55,000
Taiwan	630,000
Thailand	36,000
Uganda	39,000
West Indies (Antigua, Barbados, Guyana, Jamaica, St. Kitts, Trinidad)	200,000
	7,384,000

The reference to Article 39 (2) is in respect of the USSR; this country is a net importer and therefore does not have an export quota although it makes substantial exports. It has, however, agreed to limit shipments to the world market to a figure between 1·1 and 1·25 million tons. The quantity of 1·15 million tons agreed for 1971 is 50,000 tons higher than the figure established for 1969 and 1970.

One of the outcomes of the discussions held during the meetings was in respect of the re-export trade of net importing countries, and it was agreed by the UK that annual imports from non-ISA members would be limited, from 1971, to a total of 60,290 tons, the average amount imported from these countries during the years 1966–68. An announcement to this effect was made by the Department of Trade and Industry on the 7th December, noting that this was the first time such restrictions on imports had been imposed, and advising that imports from non-ISA members would need specific import licences allocated from within the UK quota which would itself be allocated after the 21st December.

The Executive Committee at its meeting on the 2nd December had decided that there was no justification for a further release of shortfall quota sugar to the free market; prices were not rising that steeply and were fairly stable. The applications by Thailand and the Dominican Republic for increases in their basic quotas would be kept under review.

* * *

World sugar balance.

F. O. Licht's estimate of the world sugar balance for the crop year September 1969/August 1970 has been revised[1] and the latest figures are reproduced below:

	1969/70	1968/69	1967/68
	metric tons, raw value		
Initial stocks.....	19,692,703	20,439,238	19,101,239
Production	73,427,269	68,265,561	67,899,778
Imports	23,291,267	21,444,632	21,939,635
	116,411,239	110,149,431	108,940,652
Consumption	72,131,237	69,040,282	66,565,475
Exports	23,591,828	21,416,446	21,935,939
Final stocks	20,688,174	19,692,703	20,439,238
Production increase..	5,161,708	365,783	2,258,224
„ „ (%)	7·56	0·54	3·44
Consumption increase	3,090,955	2,474,807	1,108,593
„ „ (%)	4·48	3·72	1·69

The increase in sugar production in 1969/70 compared with the previous year was largely the result of the greatly increased Cuban crop, and has resulted in an increase of almost exactly a million tons in the end-year stocks over those of 1968/69. However, rising consumption also requires rising stocks, the normal requirement of three months' supplies representing 25% of annual consumption *plus* 25% of the increase in consumption. Hence even with the higher stocks, those at end-August 1970 represent 28·68% of annual consumption in 1969/70, very little more than the 28·52% of annual consumption in 1968/69 which is the stock figure for end-August 1969.

* * *

Brazil sugar situation[2].

For several years the heavy weight of stocks in Brazil has been a troublesome feature both in that country and internationally. Statistics covering the four crop years up to May 1970, reproduced below, show that there has been a substantial reduction in the carryover at the end of each of the past two crop years, and this has occurred despite an increase in production of some 200,000 tons in 1969/70.

	1969/70	1968/69	1967/68
	metric tons, tel quel		
Initial stocks.....	1,309,560	1,539,992	1,545,183
Production	4,289,611	4,070,708	4,173,515
	5,599,171	5,610,700	5,718,698
Exports	929,214	1,021,006	1,022,135
Consumption	3,525,125	3,280,134	3,156,571
Final stocks	1,144,832	1,309,560	1,539,992

The major factor in the reduction in stocks has been the regular expansion in domestic consumption, which last season resulted in an increase of 245,000 tons, or about 7·5%. Population in Brazil is at present increasing at the rate of about 3·5% each year and it may be anticipated that a corresponding increase in sugar consumption will be registered. When one considers the vast distribution problem facing Brazil it may be doubted, however, whether much further expansion in the current annual *per caput* level of some 37 kilos can be expected for some time.

Total exports in 1969/70 amounted to 929,000 tons, compared with 1,021,000 tons in 1968/69, and with exports to the USA practically unchanged at 592,000 tons against 599,000 tons where was a substantial drop in shipments to the world market. This was not, as might be thought, a reflection on the operation of the International Sugar Agreement. Total shipments by Brazil in 1969 amounted to 450,000 tons, while the quantity currently authorized for 1970 is 512,000 tons. Even after an adjustment of about 4% is made to convert raw value to *tel quel*, it is obvious that the world market exports of 337,000 tons in 1969/70 were less than will have been effected in either of the calendar years 1969 or 1970.

Even though total exports showed a reduction, there were some new markets developed, with Algeria and Ghana each taking a cargo, while Canada reappeared on the schedule of outlets for the first time for some years. Meanwhile Japan took a much increased tonnage.

Several countries took a reduced quantity in 1969/70, while some normal outlets did not appear on the list at all. It may be of interest to note that this was the first occasion for many years on which not a single cargo was shipped to the United Kingdom.

* * *

UK sugar surcharge.

The Minister of Agriculture, Fisheries and Food has made orders under the Sugar Act, 1956, increasing the surcharge from £8 to £10 per ton from the 30th December 1970. This was the tenth change in the rate of surcharge during the year.

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[1] *International Sugar Rpt.*, 1970, **102**, (31), 1.
[2] C. Czarnikow Ltd., *Sugar Review*, 1970, (997), 202–203.

The significance of invert and gum formation in deteriorated beet

By J. F. T. OLDFIELD, J. V. DUTTON and H. J. TEAGUE
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Paper presented to the 20th Technical Conference of the British Sugar Corporation Limited

PART II

SECTION 3

THE PROCESSING OF DETERIORATED BEET

Introduction

Previous publications[5,6,7,8] have considered in detail the problems arising from processing frost-damaged beet and have proposed methods for overcoming some of the difficulties. Filtration is one of the major problems and is directly attributable to the presence of gums.

In the factories of the British Sugar Corporation polyacrylamide flocculants are employed to improve settling after 1st carbonatation when deteriorated beet are being processed and such measures have been found successful. On the other hand difficulties which occur in 2nd carbonatation filtration have not been overcome and it is this aspect which has been more closely examined in the present work on frost-damaged beet.

The problem of colour formation has also been considered to try and determine the maximum extent of beet degradation which is compatible with the manufacture of high-grade white sugar.

Methods

(a) *Production of raw juices.* Raw juice was produced in the laboratory micro-battery using at least 10 lb of cossettes for each test. The invert and sugar content of the cossettes was measured immediately before diffusion.

(b) *Production of 2nd carbonatation filtrates.* The raw juices were treated as soon as possible after production; 250 ml of raw juice was treated at 80°—85°C with 50 ml of 10% lime, the suspension was stirred for 5 min and then gassed with carbon dioxide to between pH 10·9 and 11·1. The total gassing time was normally about 5 minutes and the temperature was maintained at 80°—85°C. The floc was allowed to settle and the supernatant was filtered through a Whatman No. 2 paper on a Buchner funnel. 200 ml of the filtrate was re-heated to 80°–85°C and gassed with carbon dioxide to between pH 9·1 and pH 9·3 in 1 to 2 minutes. The suspension was filtered through a 5 μm membrane filter of 47 mm diameter at a constant vacuum of 15 inches of mercury. The filtration time was recorded.

(c) *Analysis of 2nd carbonatation filtrates.* 2nd carbonatation filtrates were analysed for invert, levan, dextran, lime salts, specific absorptive index at 520 nm, and refractometric purity.

(d) *Preparation of gum extracts.* A dried gum was prepared from frost-damaged beet by scraping the exuded gum from the surface of the beet, diluting with water, centrifuging to remove coarse residue and precipitating with 4–5 volumes of alcohol. The precipitate was taken up in water, reprecipitated, and this process repeated three times. The precipitate was finally dried at 105°C. Analysis showed the composition to be approximately 90% dextran and 10% levan. It was difficult to dissolve this gum completely in water and therefore some aqueous gum extracts were also prepared and stored in the deep freeze.

Processing frost-damaged beet

(a) *Observations on 2nd carbonatation filtration.* Fresh beet were held at —2°C for 14 days and then were allowed to thaw. The thawed beet were stored at 13—15°C and after periods of 1 to 7 days samples were withdrawn for production of 2nd carbonatation juice. Filtration at both 1st and 2nd carbonatation stages became increasingly difficult with increasing time after thawing. Each of the three 2nd carbonatation filtrates prepared in the period up to three days after thawing filtered in about 16 seconds but after thawing for 7 days this filtration was incomplete even after 25 minutes. When the juice was prepared immediately after thawing the second carbonatation precipitate was visibly particulate before filtration whereas this precipitate appeared colloidal when the juice was prepared from the deteriorated beet stored for 7 days after thawing.

Photomicrographs of the precipitates, magnified × 1000, are shown in Figs. 3 and 4. In Fig. 3 the mean crystal size is 5 to 7 μm, the crystals are sharp and the conglomerates are large whereas 7 days after thawing, as shown in Fig. 4, the crystal size is about 1 to 3 μm, the crystals are rounded and the conglomerates are small.

It seems clear that apart from any increase in viscosity caused by gums, the smaller size of the precipitate particles would make filtration more difficult.

(b) *Factors affecting size and shape of 2nd carbonatation precipitate.*— The precipitate shown in Fig. 4 was derived from a 1st carbonatation filtrate which contained 0·05 g levan and 1·0 g dextran per 100S and the original raw juice contained 0·1 g levan per 100S, 2·0 g dextran per 100S and 4·5 g invert per 100S.

[5] BECKER: *Zucker*, 1957, **10**, 215–223.
[6] SCHNEIDER: *ibid.*, 375–383, 471–478.
[7] MIJAKOWSKI: *Gaz. Cukr.*, 1966, **74**, 139–141.
[8] ANTKOWIAK: *ibid.*, 141–147.

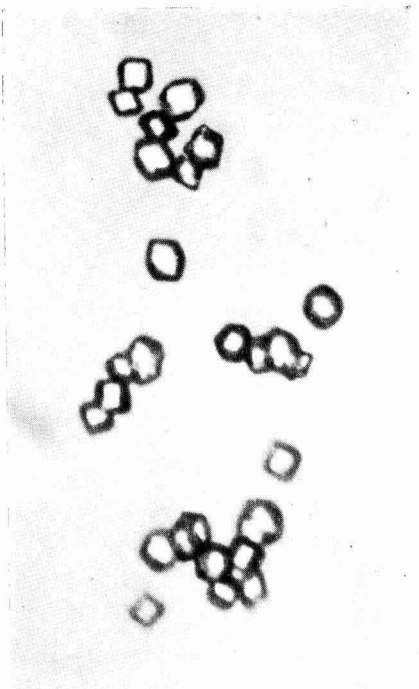

Fig. 3. Photomicrograph of 2nd carbonatation precipitate from beet immediately after thawing (× 1000)

Fig. 5 shows the 2nd carbonatation precipitate obtained from fresh raw juice to which invert sugar at 3·0 g invert per 100S was added. A rounding of the crystals can be seen but invert did not affect the rate of filtration which was complete in 16 seconds.

Fig. 6 shows the 2nd carbonatation precipitate obtained from fresh raw juice to which beet gum had been added (1·6 g dextran per 100S plus 0·2 g levan per 100S). The 1st carbonatation filtrate contained 0·8 g dextran per 100S and 0·1 g levan per 100S and it is clear that these components had a very striking effect on the size and shape of the crystals. Filtration of the 2nd carbonatation juice in this case was incomplete after 30 minutes.

A similar reduction in particle size of the 2nd carbonatation precipitate could be produced by the addition of commercial food-grade dextran (M.W. = 5 – 10 million). The results obtained with levan were not as reproducible as with dextran and at this stage of the investigations it is concluded that the major effect on particle size is produced by dextran.

(*c*) *Improvement of 2nd carbonatation filtration.*—A number of preliminary tests have been carried out in the laboratory to test the suitability of various procedures for improving 2nd carbonatation filtration in the presence of dextran.

(i) 1 ml of 10% milk of lime was added to 200 ml of 1st carbonatation filtrate which contained 0·6 g dextran per 100S. The mixture was gassed at 80 to 85°C to the 2nd carbonatation end point and would not filter through a 5 μm membrane. Examination of the precipitate showed that the particle size was of the order of 1–2 μm and these particles had only increased in number by the addition of lime. The formation of additional calcium carbonate during second carbonatation actually hindered filtration.

(ii) In contrast, some types of pre-formed calcium carbonate did have a significant effect on the filtration rate. Either aragonite (Tate and Lyle Technical Services Ltd.) or precipitated calcium carbonate (British Drug Houses Ltd.), when added at levels of 250 to 500 p.p.m. to 1st carbonatation filtrates, gave a very marked improvement in the filtration rate of the 2nd carbonatation juice.

Photomicrographs of the aragonite crystals alone and of second carbonatation precipitate produced in the presence of aragonite from dextran-containing juice are shown in Figs. 7 and 8 (magnification × 1000). The particle size of the newly formed crystals of calcium carbonate is still only about 1 μm but these small particles have agglomerated on the larger aragonite crystals.

Fig. 4. Photomicrograph of 2nd carbonatation precipitate from frost-damaged beet stored for 7 days after thawing (× 1000)

(iii) A modified starch flocculant was also tested at addition levels of 5 p.p.m. and 10 p.p.m. to 1st carbonatation filtrates prepared from frost-damaged beet. Filtration of 2nd carbonatation juices was

slower than without the flocculant. Photomicrographs of the 2nd carbonatation precipitate obtained either with no additive or in the presence of 5 p.p.m. of the starch flocculant are shown in Figs. 9 and 10. It was clear that the flocculant coagulated the precipitate but it was presumed that in contrast to the conglomerates produced by calcium carbonate additives the conglomerates produced by the flocculant are not rigid. The fact that filtration was impeded by addition of the flocculant may be associated with its high viscosity.

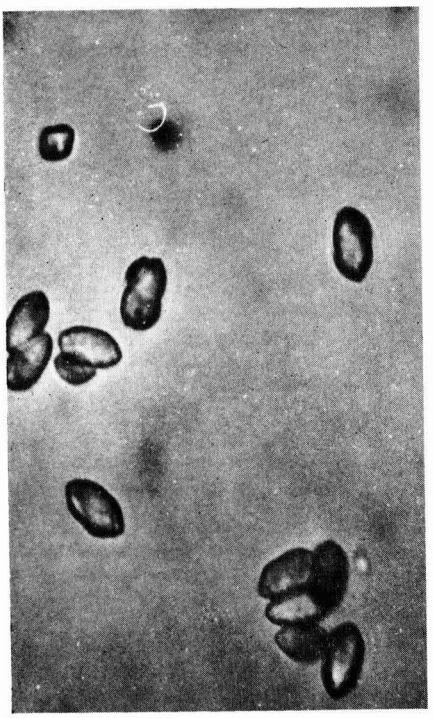

Fig. 5. Photomicrograph of 2nd carbonatation precipitate produced from fresh juice with invert added (× 1000)

In conclusion, it appears from these preliminary experiments in the laboratory that pre-formed calcium carbonate assists 2nd carbonatation filtration in providing a base for agglomeration of the calcium carbonate formed during gassing. Addition of lime hindered filtration by producing an increased number of small particles of calcium carbonate. A starch flocculant produced conglomerates, but filtration was not improved, presumably because the conglomerates were non-rigid and because the viscosity of the juice was increased.

(*d*) *Juice analysis.*—The laboratory purification system was made as simple as possible in order to obtain a general picture of the effect of different degrees and forms of deterioration on juice composition over a large number of samples. It is considered that the colour, lime salts and purities obtained in the laboratory procedure are better than could be obtained in factory processing with the longer and more variable retention times associated with continuous carbonatation and so the trends observed in the laboratory would be even more apparent in the factory.

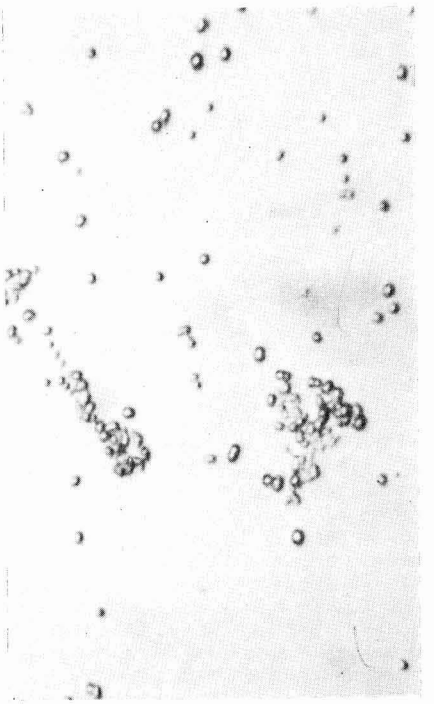

Fig. 6. Photomicrograph of 2nd carbonatation precipitate produced from fresh juice with gum added (× 1000)

Table VIII shows the analysis of juices produced from a bulk sample of beet which had been frozen

Table VIII. Analysis of frozen and thawed beet and the juices produced in the laboratory

Days of thaw	*Beet invert, g/100S*	*Raw juices*			*2nd Carbonatation filtrates*					
		Invert, g/100S	*Levan, g/100S*	*Dextran, g/100S*	*Purity*	*Invert, g/100S*	*Levan, g/100S*	*Dextran, g/100S*	*CaO, g/100S*	*Colour, 520 nm*
0	0·60	0·93	<0·05	0·1	90·5	0·16	<0·05	<0·05	0·03	263
1	0·48	0·77	0·05	<0·05	91·2	0·16	<0·05	<0·05	0·03	242
2	1·25	1·13	0·05	0·1	91·1	0·18	0·05	<0·05	0·03	276
3	2·14	2·06	0·4	0·1	89·2	0·38	0·2	<0·05	0·15	488
4	3·23	3·91	0·5	0·8	85·4	1·10	0·3	0·4	0·26	1290

at between —5 and —10°C and then stored at between 13 and 15°C for varying periods after thawing.

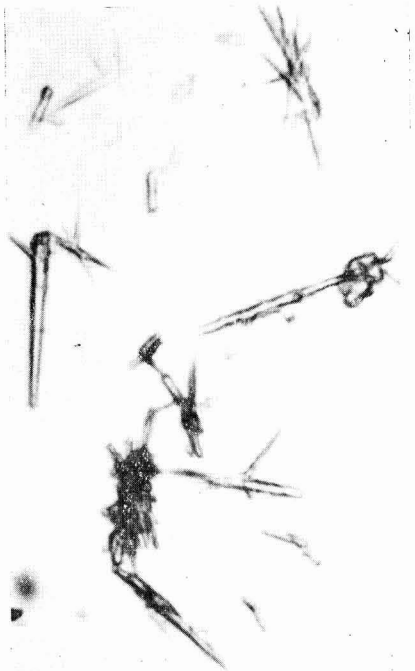

Fig. 7. Photomicrograph of crystals of aragonite (× 1000)

The invert in the beet started to rise on the second day after thawing and continued to rise, reaching 3·23 g per 100S after 4 days thawing. The levan started to rise on the 3rd day, while there was a very marked increase in dextran on the 4th day, by which time the purity of the second carbonatation juice had fallen by more than 5 units to 85·4. Filtration of the 2nd carbonatation juice could only be achieved by the addition of 500 p.p.m. calcium carbonate to the 1st carbonatation filtrate. The colour and lime salts were so high as to be completely unacceptable for the production of white sugar.

(*e*) *Effect of invert.*— Chromatographic examination of the juices from frost-damaged beet showed that the measured invert was accounted for, within experimental error, wholly by glucose and fructose. There was no evidence of significant amounts of other reducing compounds.

Invert sugar was therefore added to raw juice produced from fresh beet to determine the effect on lime salts and colour.

Table IX gives the results of such an experiment.

Table IX. Effect of invert addition to raw juice on the quality of 2nd carbonatation filtrate

	Raw juice invert,	*2nd carbonatation filtrate*		
Juice	*g/100S*	*Purity*	*CaO*, g/100*S*	*Colour*
Control	0·86	90·65	0·05	225
Invert added	3·23	89·11	0·24	836

The results obtained with invert added are mean values of three separate determinations. None of the individuals differed significantly from the mean.

The two main implications of these results are:

1. The effect of invert on colour formation was quite small compared with the effect observed with a similar level of invert in raw juice from thawed beet reported in Table VIII. This observation was confirmed by invert addition to another fresh juice to a level of 4·64 g per 100S. The colour of the 2nd carbonatation filtrate produced in this case was only 547.

2. The effect of invert on the lime salts was similar to that observed with thawed beet.

It is concluded that in thawed beet invert sugar is mainly responsible for the consequent increase in lime salts but is not directly responsible for the increase in colour, which presumably is caused by other components which are formed during beet degradation.

(*f*) *Colour formation.*—The excess colour in the 2nd carbonatation juice from the frost-damaged beet did not arise solely from the excess invert. Nevertheless, a plot of raw juice invert against colour of 2nd carbonatation juice produced in the laboratory from beet which had been frozen and thawed, showed high correlation as illustrated in Fig. 11.

Fig. 8. Photomicrograph of 2nd carbonatation precipitate produced from dextran-containing juice with aragonite additive (× 1000)

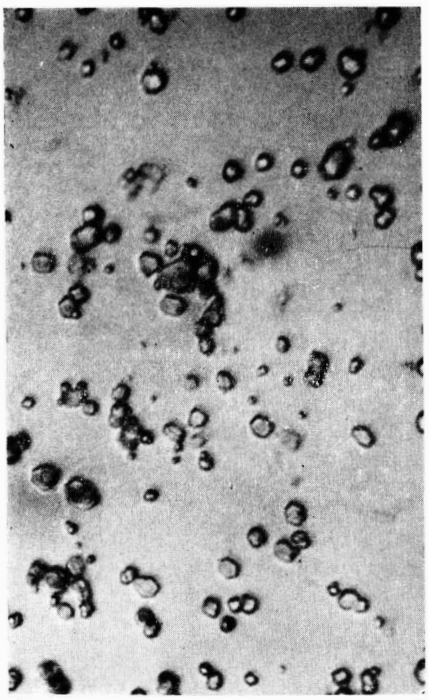

Fig. 9. Photomicrograph of 2nd carbonatation precipitate produced from frost-damaged beet with no additive (× 1000)

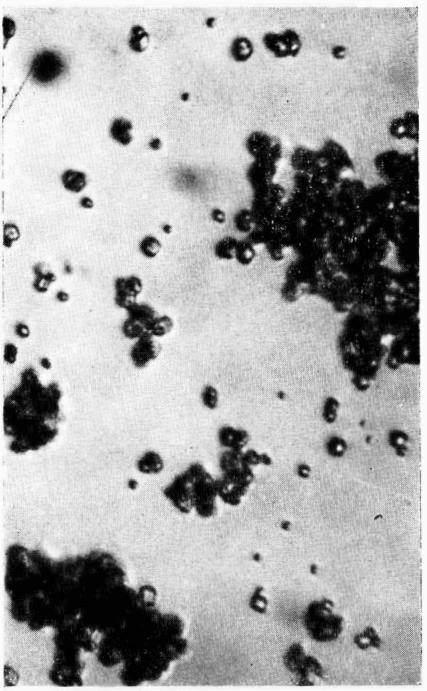

Fig. 10. Photomicrograph of 2nd carbonatation precipitate produced from frost-damaged beet with addition of starch flocculant to 1st carbonatation filtrate (× 1000)

Any increase in juice colour makes the production of high-grade sugar more difficult and the beet with the higher invert content would not be suitable for production of white sugar.

Processing other deteriorated beet

Mould-damaged samples of beet were produced by storage of beet for between 8 and 10 weeks in hessian sacks in a frost-free store. Towards the end of the storage period some wilting also occurred.

Two samples of beet which had been kept at higher than normal temperatures in laboratory respiration experiments were also processed to determine their filtration characteristics and juice quality.

There were no significant concentrations of levan or dextran in any of the samples and no difficulty was experienced in filtration. The analysis of the samples is shown in Table X.

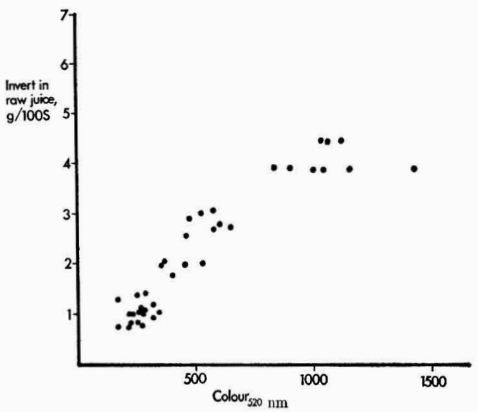

Fig. 11. Plot of raw juice invert content *vs.* colour of 2nd carbonatation juice

Table X. Analysis of mould-damaged and overheated beet and the juices produced in the laboratory

Sample	*Beet*	*Raw juice*	*2nd Carbonatation filtrate*		
	Invert, g/100S	*Invert, g/100S*	*Invert, g/100S*	*Colour, 520 nm*	*CaO, g/100S*
1. Mould-damaged, 8 week storage	1·37	2·55	0·47	566	0·08
2. Mould-damaged, 10 week storage	3·25	4·91	1·29	1735	0·60
3. 10 week storage. Sound beet cores ..	1·51	1·98	0·46	463	0·18
4. Stored 50 days at 20°C. No mould ..	3·20	3·81	0·63	608	0·20
5. Stored 60 hours at 40°C. No mould ..	**1·43**	**2·20**	0·37	480	0·35

Beet invert ranged from 1·37 to 3·25 g per 100S and raw juice invert ranged from 1·98 to 4·91 g per 100S, showing marked inversion in diffusion as was reported earlier[3] with stored beet. The colours of the 2nd carbonatation filtrates obtained from these raw juices appeared to be in keeping with the juice colours produced from frosted beet at similar levels of invert.

High lime salts in 2nd carbonatation filtrates also resulted from high levels of invert.

Sample 3 represented the visually undamaged cores from beet taken at the same time as sample 2. Analysis of these cores and of the juices produced shows that, even after removal of the obviously deteriorated exteriors, the interiors of the beet were of low quality.

(To be continued)

The heat of crystallization and activity coefficients of sucrose in saturated water solutions

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Introduction

At the 13th meeting of ICUMSA a recommendation was made to study thermodynamic properties related to the process of crystallization of sucrose from water solutions. Following this recommendation we have directed our attention to the calculation of heats of crystallization and activity coefficients of sucrose at saturation.

In spite of the research done on the subject of sucrose crystallization in the last fifty years, the heat of crystallization of sucrose remains an uncertain quantity. In the latest review by VANHOOK[1] the values at 16°C ranged from —1·05 to —1·96 kcal/mol; at 57°C, they ranged from —4·20 to —7·80 kcal/mol. In this work, we review the thermodynamic data available and also, using recent solibility data[2] and activity coefficients[3], we calculate the heat of crystallization of sucrose in the range 0–60°C.

Methods for determining the heat of crystallization

There are three main methods used for determining the heat of crystallization of sucrose.

(*a*) Direct calorimetric determination of the heat evolved during crystallization[1,4,5].

(*b*) Calculation of the differential heat of solution at saturation, using integral heats of solution or heats of dilution. The differential heat of solution, $\overline{H}_s - H_s$ is equal to minus the heat of crystallization[6,7] $H^*_s - \overline{H}_s$

(*c*) Calculation of the heat of crystallization from solubility and activity coefficients data[1,8,9,10]. Available data have been collected in Table I and Figs. 1 and 2.

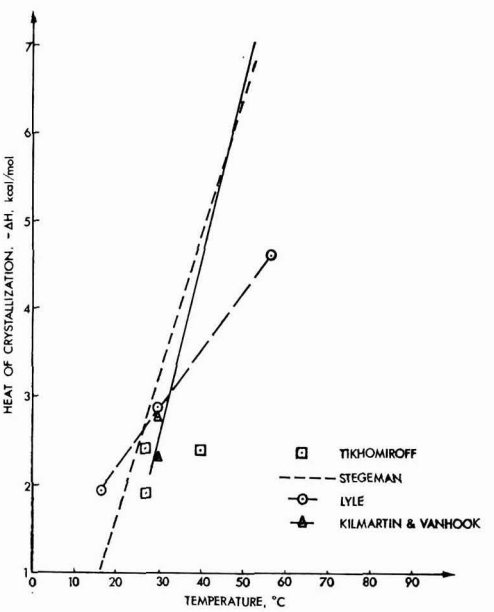

Fig. 1

CALCULATION OF RESULTS

The heat of crystallization from solubility data

If the system sucrose-water had an ideal behaviour, the heat of crystallization of sucrose could be calculated using the VAN'T HOFF isochore:

$$-\Delta H = RT^2 (d\ln N_s/dT)_{sat} \quad \ldots\ldots\ldots (1)$$

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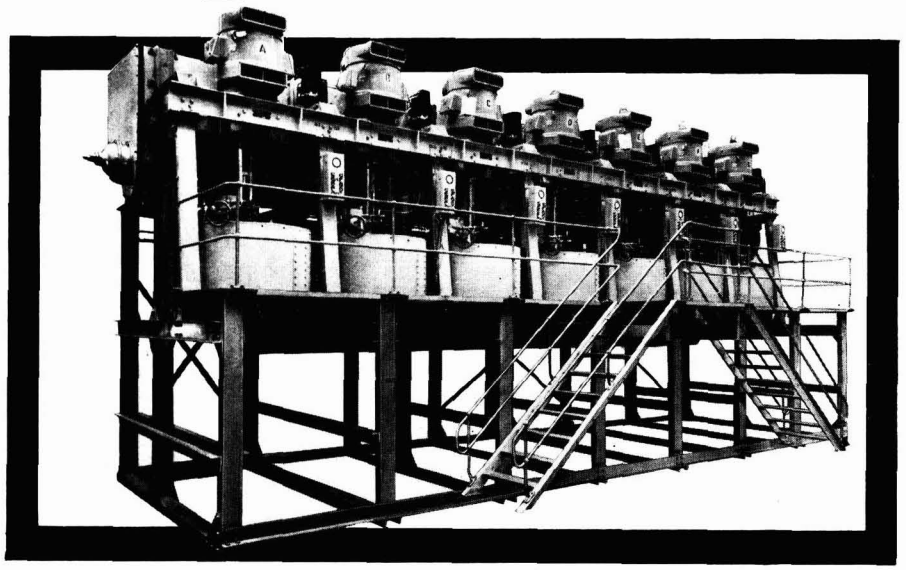

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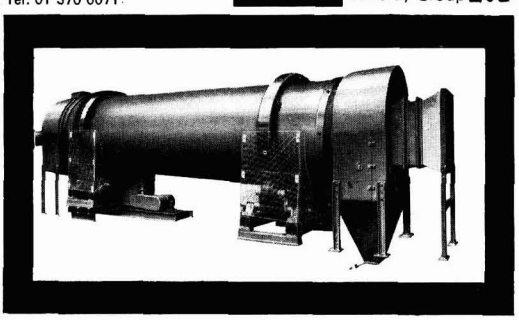

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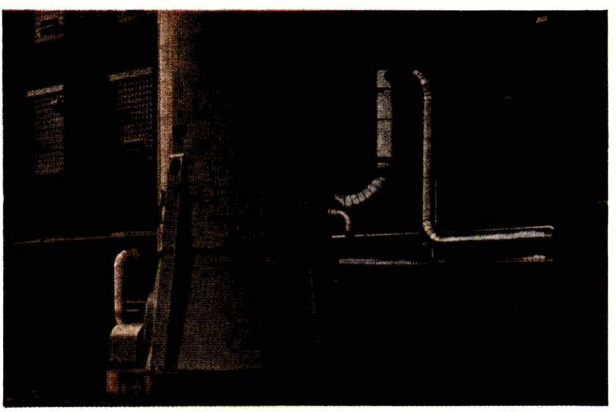

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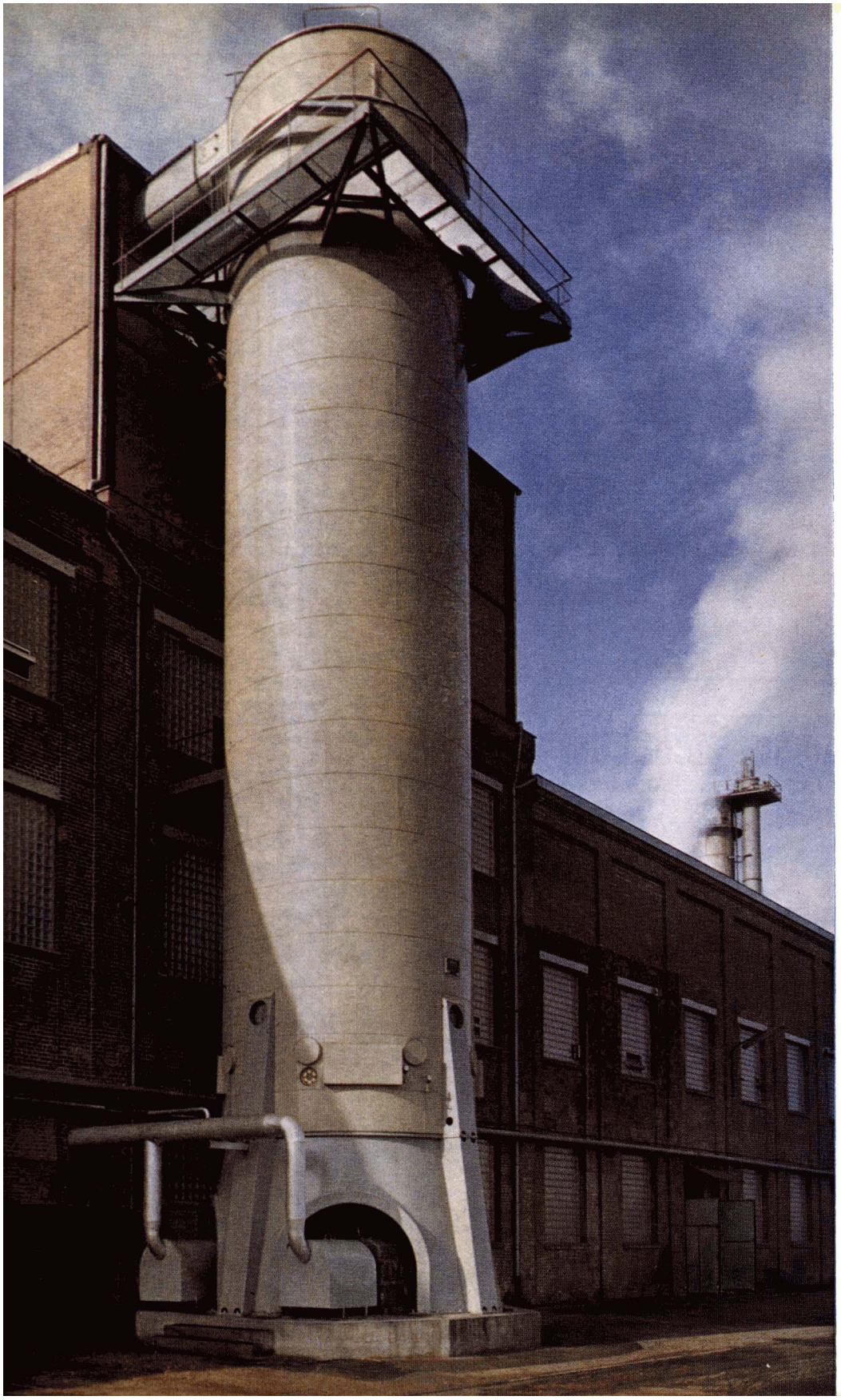

Table I. Heat of crystallization of sucrose, $-\Delta H$, in kcal/mol

0°C	16°C	25°C	27°C	30°C	40°C	50°C	57°C	60°C	90°C	*Reference*	*Method*
			1·91								
			2·43		2·38					TIKHOMIROFF[4,5]	Microcalorimetry
				2·30							
				2·80			7·80			VANHOOK[1]	Adiabatic calorimetry
	1·96			2·89			4·60			VANHOOK[1]	LYLE's Equation[6]
	1·85			3·18			7·51			VANHOOK[1]	From STEGEMAN Report[7]
	1·92			2·92			4·81			VANHOOK[1]	Solubility, activity coefficients[8]
	1·96			2·70			4·20			VANHOOK[1]	Solubility, activity coefficients[11]
		2·94						4·50	7·60	WISE and NICHOLSON[9]	Solubility, activity coefficients
1·45		2·30		2·74	3·67	4·67		5·10		This work	Solubility, activity coefficients

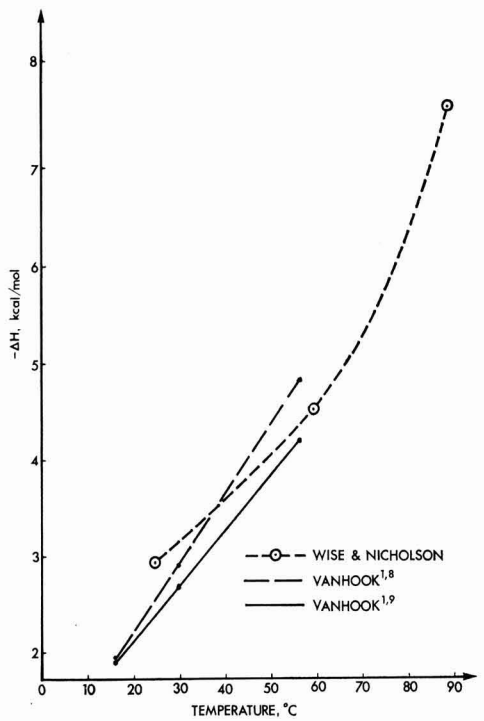

Fig. 2

However, as this system is not ideal, the results obtained are far from reality.

VANHOOK, using HERZFELD solubility data[12], has calculated heats of crystallization of —1·10 kcal/mol at 16°C, —1·29 kcal/mol at 30°C and —4·60 kcal/mol at 57°C.

In real systems, the correct formula is:

$$-\Delta H = RT^2(dN_s/dT)\,(d\ln\gamma/dN_s + 1/N_s) \quad \ldots.(2)$$

This formula is also valid in molalities m_s instead of mole fractions N_s[10]. VANHOOK, using this method, has given the values —1·92 and —1·96 kcal/mol at 16°C, —2·92 kcal/mol and —2·70 at 30°C and —4·81 and —4·2 kcal/mol at 57°C[8,9].

WISE and NICHOLSON[9] have also calculated values by this method: —2·94 kcal/mol at 25°C, —4·50 kcal/mol at 60°C and —7·60 kcal/mol at 90°C.

The success of this method depends on the correctness of the solubility data and of the activity coefficient data.

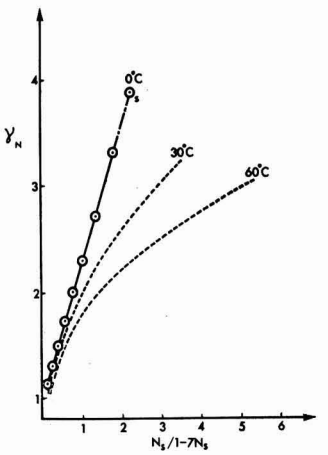

Fig. 3

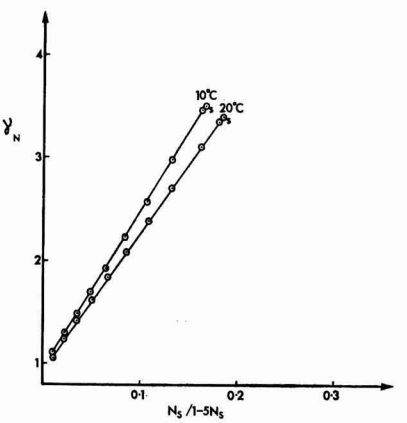

Fig. 4

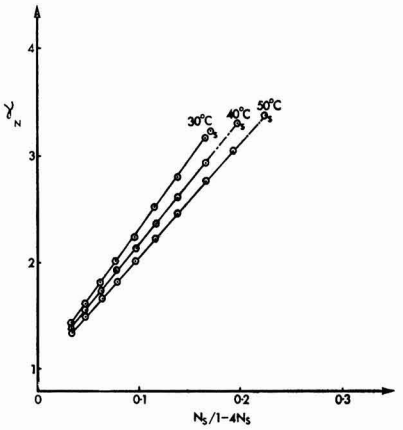

Fig. 5

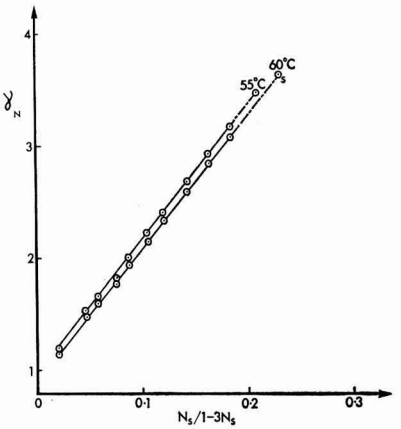

Fig. 6

We have used this method to calculate heats of crystallization in the range 0°C—60°C, using VAVRINECZ's solubility equation[2] and extrapolating in an appropriate manner to saturation concentrations, the activity coefficients given by KHARIN[3].

We have selected VAVRINECZ's solubility equation as it is an average of a large number of selected solubility data and, therefore, a reliable one. The choice of KHARIN's activity coefficient data is due to the fact that they extend into the concentrated region, minimizing the extrapolation required to saturation.

The extrapolation process is usually done by employing a plot of the logarithm of the activity coefficient *vs.* the molality. Although the plots are usually linear, the logarithmic compression of the scale gives a false sense of accuracy.

We have found an empirical treatment which gives very good results. If N_s is the mol fraction of sucrose and a is the number of water molecules bound to one sucrose molecule, then the relation $N_s/[1-(a+1)N_s]$ is the ratio of sucrose molecules to free water molecules in the solution. The parameter $a+1$ can be used as a variable adjustable parameter in such a way that a plot of the activity coefficient *vs.* $N_s/[1-(a+1)N_s]$ is linear. This parameter changes with temperature and is of a similar magnitude to the known hydration number of sucrose. Results are shown in Figs. 3–6.

A comparison of all the values of the heat of crystallization obtained from solubility data is given in Fig. 2. and in Fig. 7 are our data.

Discussion of Results

Only in the region of 30°C are there sufficient coincidences to establish a margin of agreement. A value of ΔH equal to $-2{\cdot}8 \pm 0{\cdot}3$ kcal/mol will encompass most of the calorimetric results as well as the solubility calculation values.

Below 30°C the solubility results agree with LYLE's equation, but are much higher than the rest of the calorimetric data. In this region solubility data are very reliable and the activity coefficients show less uncertainty owing to the availability of results up to saturation.

Above 30°C our results agree with values obtained from LYLE's equation[1,6]. Calorimetric data of VANHOOK and STEGEMAN give much higher values. Other solubility data give slightly lower results. This, we believe, is due to uncertainty in the activity coefficients at high temperatures caused by the need to extrapolate to saturation. Most authors have used linear plots of the type $\log \gamma = (A + B/T)\, m$, which necessarily introduce some errors at high concentra-

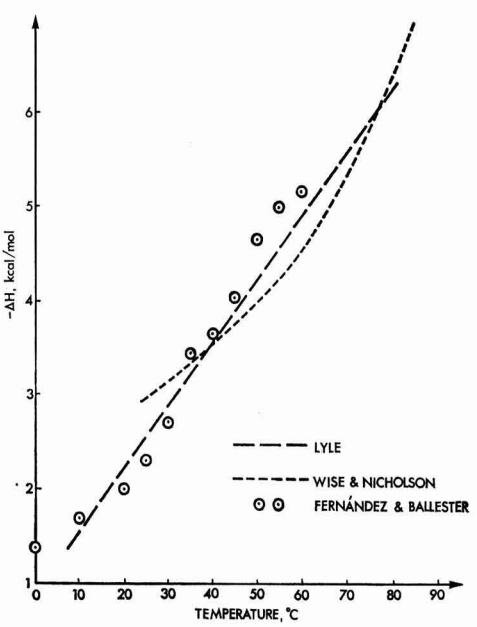

Fig. 7

tions. We have used linear plots of γ *vs.* $f(N_s)$, this function being chosen to give a straight line. See Figs. 3, 4, 5, and 6.

It is rather subjective to choose at this point which is the right answer. However, we can see that the major discrepancy between the solubility values and LYLE's equation on the one hand, and VANHOOK's and STEGEMAN's values on the other, is the slope of the curve, $(d\,\Delta H/dT)_{sat}$.

Calculation of the variation of the heat of crystallization with temperature

The variation of the heat of crystallization with temperature can be expressed by the following equation:—

$$\left(\frac{d(\Delta H)}{dT}\right)_{sat} = \left(\frac{\delta \Delta H}{\delta T}\right)_{N_s} + \left(\frac{\delta \Delta H}{\delta N_s}\right)_T \cdot \left(\frac{dN_s}{dT}\right)_{sat}$$

$$\left(\frac{d(\Delta H)}{dT}\right)_{sat} = Cp_s^* - \overline{Cp}_s + \left(\frac{\delta H_s}{\delta N_s}\right)_T \cdot \left(\frac{dN_s}{dT}\right)_{sat}$$

where Cp_s is the partial molar heat capacity of sucrose in solution and Cp_s^* is the molar heat capacity of crystalline sucrose. $(dN_s/dT)_{sat}$ can be obtained directly from the solubility curve. $(\delta H_s/\delta N_s)_T$ can be obtained from the variation of the differential heats of solution with concentration.

We have evaluated $(d\Delta H/dT)_{sat}$ at 20°C and 25°C using available heat capacity data[13] and VAVRINECZ's solubility equation[2] and calculating $(\delta H_s/\delta N_s)_T$ from differential heats of solutions. This latter term has been obtained only with an accuracy of 20%, but as it is multiplied by (dN_s/dT) which is very small, this error only influences the total result by about 1%. See Tables II and III.

Table II

Calculation of $\left(\frac{d\Delta H}{dT}\right)_{sat}$

t°C	20	25
Cp_s (kcal/degree.mol)	0·1565	0·1595
Cp_s^* (kcal/degree.mol)	0·0993	0·1018
$\left(\frac{\delta H}{\delta N_s}\right)_T$ (kcal/mol)	10 ± 2	10 ± 2
$\left(\frac{\delta N_s}{\delta T}\right)_{sat}$	$5{\cdot}6 \times 10^{-4}$	$6{\cdot}3 \times 10^{-4}$
$\left(\frac{d\Delta H}{dT}\right)_{sat}$ (kcal/degree.mol)	—0·063 ± 0·001	—0·064 ± 0·001

CONCLUSIONS

It can be seen from Table III that the slope of the curves of STEGEMAN and of the line joining VANHOOK —KILMARTIN values are too high. LYLE's equation and the results from solubility calculated by VANHOOK give slopes of the right order. Our curve changes rapidly in the 20–30°C region, having the proper value at 25°C. The slope of the WISE and NICHOLSON curve is too low.

Table III

Values of $\left(\frac{d\Delta H}{dT}\right)_{sat}$ **in kcal/mol**

	20°C	25°C
From $\overline{Cp_s} - Cp_s^*$	—0·063	—0·064
BALLESTER-FERNÁNDEZ	—0·046	—0·065
LYLE	—0·060	—0·060
WISE-NICHOLSON	—	—0·035
KILMARTIN-VANHOOK	—0·200	—0·200
STEGEMAN	—0·160	—0·160
VANHOOK	—0·070	—0·070
Solubility data	—0·056	—0·056

Recommendations

Based on the above arguments we propose the following equation, as an acceptable function of ΔH with temperature in the range 10–80°C.

$$\Delta H = -1{\cdot}00 - 0{\cdot}065\,T$$

This equation gives ΔH in kcal/mol, T being in °C. It corresponds closely to the curve obtained using LYLE's equation.

Acknowledgement

We wish to thank ELIA ORTIZ for helping in some of the calculations, and to the national referee, Eng. SANTIESTEBAN, for valuable literature information.

SUMMARY

A critical review of the available data on heat of crystallization of sucrose is made. Using recent solubility and activity coefficients data, the heat of crystallization of sucrose is calculated in the range 0°—60°C.

A new method of extrapolating activity coefficients to the region of saturation is given, as well as the values obtained by extrapolation of KHARIN's data, in the range 0°–60°C.

The change of the heat of crystallization at 20 and 25°C is evaluated from heat capacity data and used as a criterion to select from among conflicting results

An equation for the change of the heat of crystallization with temperature in the range 10°–80°C is recommended.

[1] KILMARTIN and VANHOOK: *Sugar*, 1950, **45**, (10), 34.
[2] VAVRINECZ: *Zeitsch. Zuckerind.*, 1962, **87**, 481.
[3] KHARIN and PALASH: *Izvest. Vuzov, Pishch. Tekhnol.*, 1966, (6), 82.
[4] TIKHOMIROFF: *Compt. Rend.*, 1965, **261**, (2), 334.
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[7] HIGBIE and STEGEMAN: Report to Sugar Research Foundation.
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Sugar research in Hawaii

(1968 Annual Report, Experiment Station, Hawaiian Sugar Planters' Association)

PART I

CANE RESEARCH

THIS report presents summaries of the Station's many research activities and results. The Director points out that "many of the results in the report are from research projects that represent outstanding imagination and insight on the part of staff members. But it has taken more than ideas to produce meaningful results. Experiments must be planned, installed and cared for and data must be collected and analysed. This requires not only individual effort, but the co-ordination and co-operation of many people with a variety of skills and talents". In connexion with the Station's advisory work no less than 1141 visits were paid by Station personnel to plantations or mills of members.

Transplanting versus seed cane

There is much interest in Hawaii in the use of transplants or young rooted plants or cuttings in establishing cane fields in place of the traditional setts. The costs of starting a crop by transplanting, compared with traditional plantation practice, have been carefully analysed and investigated, including the various operations that the planting material of both kinds has to go through. Analyses were conducted for two sample plantations. The cost of producing and delivering transplants (packed in polyethylene bags) includes initial cutting of the seed cane and its transport to the nursery, machine packaging of soil and seed in the bag, loading out the transplants and getting them to the field.

The conclusions reached were expressed as follows: The analyses indicate that the estimated cost of producing and delivering transplants for replanting is approximately equal to the present cost of producing and delivering seed cane. Although the operating cost for transplants is higher than for seed cane, this is offset by reduced sugar loss because the seed cane usage for transplants is only 6 to 10% of the present usage. To obtain a complete picture, costs of replanting with transplants must be compared with replanting with seed cane, and the increased crop yield with transplants must be considered. It is thought that the cost of replanting would remain at approximately the present level—thus, the gain in crop yield would be the net gain from using transplants.

Weed control

Work in this sphere included studies on the effect of herbicides on yield, the evaluation of experimental pre-emergence herbicides, varietal tolerance to "Diuron" and "Ametrine", the broadcast application of herbicides, and drift control. Four tests were installed to determine whether "Diuron" and "Ametrine", alone and in combination with "Dalapon", affect green weight of sugar cane up to the age of six months. The herbicides were applied at relatively high rates (higher than normal field practice) so that maximum effects might be observed. Applications were made at planting, at 2 months and at 4 months, yield data being taken at 2, 4 and 6 months.

There were no significant differences between treatments at 2 months, but at 4 and 6 months (after the second and third applications) significant yield reductions were observed. In the one experiment, "Diuron" alone and "Ametrine" + "Dalapon" significantly reduced the yield. In the other experiment significant reductions were measured in the "Diuron" and "Diuron" + "Dalapon" treatments. In both tests a combination of "Ametrine" and "Dalapon" caused a greater yield reduction than "Ametrine" alone, while a combination of "Diuron" and "Dalapon" did not reduce yields more than "Diuron" alone. The rates applied were considerably higher than those used on the plantations. Yield reductions due to normal herbicide application would be more difficult to measure. Even if there is a reduction in yield at six months it is likely that the damage would be overcome before harvest. Further work is planned.

Evaluation of pre-emergence herbicides was continued, 27 being tested against the three standard products—"Atrazine", "Diuron" and "Ametrine". GS-14254 continued to be the top product, with outstanding performance in unirrigated sugar cane. GS-14259 is also an excellent herbicide, with performance superior to all standards in dry irrigated fields. One newer triazine, GS-18622, shows some promise for unirrigated conditions, although it appeared less active on grass species than GS-14254.

Great differences were found in the tolerance of different varieties of cane to "Diuron" and "Ametrine". In an attempt to determine the cause of this varietal difference in herbicide tolerance the uptake, distribution and metabolism of "Diuron" was studied. "Diuron" entered the plant roots of different varieties at the same rate, over 80% of the "Diuron" in the nutrient solution being removed in nine days. The inherent differences in the varietal tolerance of sugar cane to "Diuron" are believed to be explained, at least partially, by a differential rate of "Diuron" metabolism, and a difference in toxicity of both "Diuron" and the primary metabolite. Work continues on this problem.

Fertilizing

A number of complex soil relationships are concerned in the availability of phosphorus to plants and a study was commenced of the chemical and physical factors that influence plant uptake of phosphorus. It is felt that once such factors are understood it should be possible to make more accurate and reliable fertilizer recommendations.

Experiments were carried out to evaluate the efficiency of surface and subsurface application of phosphorus. Surface-band and subsurface-band placement of two fertilizers were compared. The fertilizers were superphosphate and ammonium polyphosphate, each labelled with radioactive phosphorus. The experimental plots were located in low

humic latosols that were low in soil phosphorus. The tests included two plant crops and one ratoon. The fertilizer phosphorus uptake by the above-ground portions of the plant at three crop ages is given in a table. Preliminary results indicate that (a) uptake of fertilizer phosphorus was higher in the subsurface than in the surface placement, (b) uptake of fertilizer phosphorus was higher in the plant crop than in the ratoon, regardless of placement, (c) differences in uptake between superphosphate and polyphosphate were small and not constant. The reason for the low phosphorus uptake in the ratoon is not clear at present. Future work will include other soils and more studies on ratoons.

The evaluation of some slow-release nitrogen fertilizers is reported, plantation managers being interested in the matter, especially those with fields where nitrogen retention is poor because of high rainfall and porous, sandy or shallow soils. Sulphur-coated urea pellets and isobutylidene diurea (IBDU) from Japan were investigated. Preliminary tests indicated that both of these new materials released nitrogen at a rate slower than urea. It was concluded that a mixture of the slow-release form and ordinary urea may be more desirable than either used alone.

Trials yielding outstanding results on the beneficial results of silicon or silicate on cane in some parts of Hawaii are described. Four forms of silicate were compared—TVA slag, Hawaiian Cement Corporation's calcium silicate, U.S. Steel slag and "Cab-O-Lite" calcium silicate, these materials having shown promising results in earlier preliminary tests. Results obtained with them varied somewhat. In one silicon deficient area silicate applications gave yield increases of 2·5 to 4·2 tons pol/acre. The effects of additional silicates on ratoon crops are now being tested.

Studies on zinc, sulphur and manganese deficiency in Hawaiian sugar cane soils are reported.

Irrigation

An account is given of the trial operation of "hose-pull travelling sprinklers" in sugar cane in Hawaii. These are made by different manufacturers, four models being tested. Basically all the units consist of a large sprinkler (up to 550 gal/min) attached to a self-propelled wheel-mounted frame. The sprinkler is propelled through the field by a winch which reels up a steel cable that is laid along the lateral roadway and is anchored at the end of the field opposite the sprinkler's starting position. In one model, the winch is powered by an engine that is fuelled with liquefied petroleum gas (LPG), in another, a water hydraulic cylinder is used. Once positioned, the sprinklers run unattended—guiding themselves along the cable at speeds of from 1 to 6 ft/minute. Water is supplied through a rubberized nylon hose from a hydrant placed at the midpoint of a lateral roadway. Normal operation calls for 660 feet of 4 to 5 inch hose, allowing for a run of 1320 feet.

An account is given of fully automatic devices for surface irrigation which have been installed on four different estates. The rapid advances in full automation have been made possible by the availability of commercially manufactured components. Now available is a differential-area double-acting cylinder, along with furrow-end floats and activating valves—all made of plastic and engineered to specifications. Also readily available are the structures needed for fluidic control. It is now possible to evaluate the effects of full automation on costs and quality or irrigation and compare these with the costs and performance of semi-automatic irrigation schemes. Semi-automatic irrigation systems are now being used on approximately 20,000 acres of Hawaiian sugar cane land. Future plans are for an increasing number of acres under automation. As components are proven and become readily available, full automation will replace some semi-automatic systems as well as existing conventional systems. The rapid advances in knowledge and equipment necessary to gain plantation adoption of these new labour- and water-saving techniques are the results of the co-operative efforts of the plantations, the Experiment Station, the U.S. Department of Agriculture and equipment manufacturers.

Mechanization

The experimental single line transplanter constructed by the Station has been tested. The fluidic control appears to work satisfactorily. Removing the polyethylene bag from the root ball remains a problem, but encouraging results were obtained by using a pair of scrubber belts to grab a tab located on the bottom of the bag, thus pulling the bag from the root ball. The technique worked well with transplants grown at one substation but gave trouble in another area because of differences in soils and in root growth. It is planned to try the same principle using a side-pull rather than a bottom-pull.

Experimental work was continued on the dry-cleaning of cane and a dry-cleaner, already constructed, considerably modified. To evaluate sugar losses for both dry- and wet-cleaning the incoming recoverable pol in field cane was determined through core sampling and subtracted from this the sum of recoverable pol in bagasse and mixed juice. The difference in losses between dry and wet-cleaning is the gain attributable to dry-cleaning. Results to date show a gain for dry-cleaning of as much as 8·5% of present sugar produced, but the figure cannot be considered absolute as there have been certain discrepancies in the sampling procedures—whether or not these will detract from the estimated gain must be determined during the coming harvest. Until such testing takes place no firm conclusions can be made with regard to sugar gains through dry-cleaning with this machine. Much has been learned about the mechanics and principles of dry-cleaning cane. Trash should be extracted at every opportunity in the handling process. This, in turn, requires a full-width trash disposal conveyor under the cleaner and running parallel with it.

Insect pests

By means of mark and recapture techniques, using fluorescent dyes and lacquers of different colours, the

movements of adult beetles in the field were studied and the population size and survival rates estimated. Observations have shown that the cane beetles are active and move freely within and between fields. It is considered that adult beetle movements are relevant to the experimental design of future tests with insecticides, resistant varieties and biological control.

Interesting observations were made in regard to the nematode DD-136 being effective in killing larvae of the cane borer, *Rhabdoscelus obscurus*, in the laboratory, this being the major insect pest of sugar cane in Hawaii. The nematode DD-136 is always associated with the bacterium *Achromobacter nematophilus*, which does the actual killing of the host. The nematode penetrates the integument of the host at the intersegmental membranes. When DD-136 was placed in a petri dish with larvae or pupae of *Rhabdoscelus* the nematode was able to attack and kill the host in two days. Not only did it kill the borer larvae but, in those field-collected larvae that were parasitized by *Lixophaga* the nematode did not attack the parasite and the parasite larvae emerged normally. Small-scale field tests will be undertaken with borer infestations of known age.

Methods of rearing sugar cane borers for experimental work are discussed. It was found that the most promising artificial or quasi-artificial media for raising larvae were those that contained dehydrated coconut husks and sugar cane stalks. The husks and stalks must be coarsely shredded and and are used in combination with vitamins, Wesson oil, methyl *p*-benzoate, and non-nutrient agar.

Reference is made to the visit of a Station entomologist to New Guinea for 10 months and the task of searching for possible parasites and predators of the borer. He worked at three different altitudes in New Guinea. Three predatory *Elateridae* were discovered and a few larvae of each species brought to Hawaii for study.

Rats

What is regarded as a significant development in rodent control has been the agreement among various federal agencies as to the procedure necessary to obtain federal approval for the use of air-broadcast zinc phosphide baits in sugar cane fields. The US Department of Interior's Wildlife Damage Research Station in Hilo are to conduct the experimental field applications and evaluation in co-operation with other Departments. Zinc phosphide is regarded as the only rodenticide likely to receive federal approval in the near future. It is reasonably toxic and does not repel rats, although it is unattractive to most other animals. Most important, the residues left at harvest are expected to contain only zinc ions, a plant micronutrient. Zinc phosphide decomposes slowly in water and more rapidly in acid media, to zinc hydroxide and phosphine gas. The latter is the toxic principle generated in the rat's stomach after ingestion of the bait.

Cage experiments confirmed the fact that rats cannot survive on a diet of sugar cane alone. Experiments in feeding different varieties of cane to rats indicated that rats may exhibit selectivity for one type or condition of sugar cane over another, but that the preferences are not exclusive.

An aerial baiting programme in waste areas using 0·5% sodium fluoroacetate (Compound 1080) on oats was continued. Ten rats were caught in an area scheduled for baiting. They were tagged with transisitorized transmitters and then released in the same area immediately before the bait was applied. Two days after the 1080 bait was applied nine of the rats were motionless in the area—apparently having died the night after the drop. Of these nine, seven were recovered but two could not be found. The signal from the 10th transmitter-tagged rat could not be located. These results indicate probable success of the aerial baiting but give no indication of population or of effectiveness in preventing crop injury.

Cane diseases

Rotting of sugar cane seed pieces or cuttings, resulting in poor field germination, is caused by the pineapple disease fungus (*Ceratocystis paradoxa*). In the past only mercury fungicides have controlled this disease. More effective, less toxic, or cheaper fungicides are sought. Of several hundred fungicides screened in the laboratory, "Benlate" is the first non-mercury fungicide found to be highly effective in controlling pineapple disease. "Benlate", a Du Pont product, has lower mammalian toxicity than mercury fungicides. In field tests the germination of buds of sugar cane cuttings treated with "Benlate" was equal to, or better than, that of cuttings treated with the standard mercury fungicides.

Ratoon stunting disease (RSD) is a potential threat to all sugar cane crops in Hawaii and is at present responsible for sugar losses on some plantations. In the breeding and selection programme attempts are made to develop commercial varieties that are resistant to RSD. Since 60-6909 is immune or highly resistant, this variety is being used in crosses to develop commercial varieties. Tests show that a high percentage of seedlings from these crosses seem to be resistant to the disease. This was indicated by the lack of symptoms in an indicator (RSD-susceptible) variety which had been inoculated with juice from these seedlings previously inoculated with RSD virus.

Leaf scald disease (LSD) causes little loss in cane in Hawaii because most commercial varieties are resistant. Experiments were carried out to test the belief that under normal conditions LSD-resistant varieties may harbour the causitive agent of the disease without manifasting symptoms. Results confirmed this belief.

Other matters discussed under the heading of cane diseases are: the toxicity of culture filtrate from the eye-spot fungus, a co-operative testing programme in Fiji, a selected medium for *Pythium*, adsorption of "Cerasan L" fungicide on soils, and *Pythium acanthicum* parasitism toward fungal antagonists of *Pythium graminicola*.

(*To be continued*)

Sugar cane agriculture

Commercial varieties (in Jamaica). ANON. *Ann. Rpt. Research Dept., Sugar Manuf. Assoc. (Jamaica) Ltd.*, 1968, 69–71.—The most widely grown variety was B 4362, constituting 44% of the area under cane. Second was B 41227 with 20%. Next in importance were B 42231, grown mostly in the irrigated areas as a salt-tolerant cane, and B 49119, planted chiefly in the dry north where vigour is of first importance. The area devoted to the leading variety, B 4362, has continued to decline since 1966.

* * *

The effects of early summer application of nitrogen. L. E. GOLDEN. *Producers' Rev.*, 1970, **60,** (1), 62–63. Results of experiments on split application of nitrogen to cane in Louisiana are reported. It was concluded that splitting of nitrogen application should be considered as a regular practice in Louisiana. In at least half the experiments there was an increase in yield from split application. Normally serious nitrogen losses may be expected under Louisiana conditions. Better application of nitrogen is obtained by splitting.

* * *

Detection of sugar cane diseases by aerial or infra-red photography. G. HUGHES. *Sugarcane Pathologists Newsletter*, 1970, (4), 9.—Aerial photographs and infra-red photographs of the Pathology Farm near Brisbane are discussed. The clarity of the photographs was such that individual stools could be identified with a lens. It was disappointing that close examination did not show any significant differences in colour between diseased and healthy plants.

* * *

High temperature disinfestation of *Rhopalosiphum maidis* from sugar cane. A. W. OSBORN. *Sugarcane Pathologists Newsletter*, 1970, (4), 8.—This insect (corn leaf aphid) attacks greenhouse cane used for research work on the sugar cane leaf hopper, the vector of Fiji disease, and hinders development of the leaf hopper. It was found that aphid populations were significantly reduced after 24 hours at 40°C and completely destroyed after 48 hours without injuring the plants.

* * *

Johnson grass strain of sugar cane mosaic virus. D. S. TEAKLE. *Sugarcane Pathologists Newsletter*, 1970, (4), 4.—The maize diseases caused by strains of sugar cane mosaic virus have received several names but the most appropriate is thought to be maize dwarf mosaic. So far it has not been possible to infect sugar cane with the Johnson grass strain of sugar cane mosaic virus occurring in Queensland. A summary of a paper by the author and P. W. GROGAN is given. Seven out of eight maize inbred lines developed in Queensland from open-pollinated varieties were resistant to maize dwarf mosaic when exposed to natural infection in the field.

* * *

Sugar cane nematology in South Africa. J. DICK. *Sugarcane Pathologists Newsletter*, 1970, (4), 10–13. Recent survey work on nematodes in the soil of sugar cane fields and in cane roots in South Africa are discussed. Besides *Meloidogyne* other nematodes such as species of *Pratylenchus*, *Trichodorus*, and *Hoplolaimus* are suspected of possibly causing damage to cane. An account is given of soil fumigation tests with various chemicals.

* * *

Studies on the bacterial red stripe disease of sugar cane in Florida. B. A. BOURNE. *Sugarcane Pathologists Newsletter*, 1970, (4), 27–33.—Studies of this disease showed that there was very close agreement between the symptoms in Florida and those occurring in Java, Taiwan, Hawaii, Louisiana and Georgia. It is thought that the same organism is concerned in all these countries.

* * *

Lesser known diseases of sugar cane. II. Streak disease. G. M. THOMSON. *Sugarcane Pathologists Newsletter*, 1970, (4), 14–15.—The nature of this disease, due to a virus, is discussed. In earlier days in Natal it was of some significance, as the variety of cane then cultivated, "Uba", was very susceptible to it and the disease caused significant losses. With the breeding and release of new varieties which are all highly resistant or immune to streak, the disease has now lost its commercial significance.

* * *

The R.S.D. upsurge in North Queensland. B. T. EGAN. *Sugarcane Pathologists Newsletter*, 1970, (4), 25. Loss from ratoon stunting disease takes place in most sugar cane countries, only those countries with good, even growth throughout the year being the exception. In Queensland the degree of damage depends largely on the variety-climate interaction. It approaches 100% in highly susceptible varieties under drought conditions. In 1967 the disease caused real alarm in northern Queensland and the position has since deteriorated further. The various factors contributing to this are discussed.

Yellow wilt of sugar cane in East Africa. P. F. ROGERS. *Sugar Pathologists Newsletter*, 1970, (4), 52–54.—This disorder has caused increased concern in East Africa (Kenya, Tanzania and Uganda) and has now been reported from some adjoining countries. An experiment is reported in which cane was grown in drums in some of which an artificial water table was maintained at varying depths (6–15 in) for prolonged periods. Typical yellow wilt symptoms developed in plants with a maintained water table of 6–9 in but recovery was possible on reverting to normal conditions. The experiments are to be repeated.

* * *

The economics of fumigating sugar cane soils in Taiwan. H. T. CHU. *Sugarcane Pathologists Newsletter*, 1970, (4), 56–57.—Results are given of large-scale soil fumigation trials for the control of nematodes in sugar cane (*Meloidogyne incognita* and *M. javanica*), which are most severe in impoverished, sandy soils. Average yield increases in such soils were about 25%. Gravel soils showed good response to fumigation. Loam, sandy loam, red earth, clay and clay loam gave progressively lower responses. Profit margins from fumigation are dependent upon many factors. The Taiwan Sugar Corporation has more than 7000 ha of sandy and sandy loam soils under cane. Control of nematodes in such soils would result in greatly increased sugar yields.

* * *

Preliminary investigations on the incidence and control of plant nematodes in a new sugar cane estate in Nigeria. H. N. PARSONS. *Trop. Agric.* (Trinidad), 1970, **47,** 103–113.—A study was made of the incidence and distribution of plant nematodes in soils of a new sugar cane project in Nigeria, and the use of fumigants and molasses as methods of control were investigated. It was found that plant nematode genera are widely distributed over all soil types but their presence has led to yield losses only on the sandy soils. There were univeral responses to nematicides when applied to a sandy soil under field conditions. Heavy and organic soils did not respond to fumigants, two of which actually depressed yields of plant cane on such soils. With regard to the economics of soil fumigation it was considered that at present this may not be practical and that the nematode-prone, light, sandy soils should not be used for cane.

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Studies on the indirect effect of phosphate manuring of legumes on the succeeding crop of sugar cane. B. K. MATHUR and A. SINGH. *Indian Sugar*, 1969, **19,** 573–576, 581.—Details are given of experiments carried out at the Sugarcane Research Station, Gorakhpur, during 1965–68, using the popular variety B.O. 32. Conclusions reached were that phosphorus fertilizing of cane may well be achieved through fertilizing a leguminous or green manure crop and that smallholders accustomed to producing sugar cane in rotation with legumes may be advised to step up their cane yields to an appreciable extent through phosphate manuring of legumes.

Improving crop hygiene practices. ANON. *S. African Sugar J.*, 1970, **54,** 235.—The Experiment Station at Mount Edgecombe in Natal holds the view that the South African sugar cane industry can enjoy considerable benefits by improving field hygiene practices and has established propaganda (symposia) to assist in this. Principles of crop hygiene and methods of crop hygiene are discussed in this paper.

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Fiji disease at Bundaberg. ANON. *Producers' Rev.*, 1970, **60,** (2), 53.—Previous outbreaks of the disease, many years ago, were successfully dealt with by a long-sustained campaign of inspection, roguing, ploughing-out of badly diseased blocks and the use of only clean planting material. The disconcerting reappearance of the disease now suggests that complete eradication may not have been achieved at the time and that possibly the last remnant of the disease persisted in an abandoned portion of a block of cane or managed to survive in a resistant variety which did not show obvious symptoms.

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The end of an era. ANON. *S. African Sugar J.*, 1970, **54,** 161.—Reference is made to the firm of Reynolds Bros. Ltd. having closed its locomotive tramway system, cane to be hauled by road transport in future. Thus after nearly 100 years of operation a system which has assisted in the development of the industry gives way to a modern system which is not only more economical but also more flexible in its functioning. A portion of the system is to be preserved with locomotives and rolling stock and in time it is hoped to use a five-mile section of track, with suitable stations, as a tourist attraction. A locomotive is also to be housed in an exhibition hall planned for construction at the Sugar Terminal Reception Centre. Thus, as transport progresses future generations may wonder how the sugar cane pioneers and their successors ever managed to garner the harvest.

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Mechanical cane harvesting in Queensland during the 1969 season. L. G. VALLANCE. *Australian Sugar J.*, 1970, **61,** 559–568.—During 1969 a survey was again made of the progress, problems and trends associated with mechanical harvesting in the various districts. Of the new machines that went into operation during the season, 272 were chopper harvesters and only 4 were whole-stalk harvesters. This shows the trend. Many of the new chopper harvesters replaced whole-stalk machines, some of which were little used. Another notable feature was the influx of new models of high-capacity chopper harvesters.

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Fertilizing sugar cane. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1969, **16,** (3 & 4), 1–15.—The large amounts of N, P and K removed by a heavy crop of cane are shown and the functions of these elements explained. Other matters discussed include: soil-fertilizer relationships, sources of major plant nutrients, complete *vs.* formulated fertilizers, applying

fertilizers, full dose *vs.* split application, soil acidity and liming, trace or minor elements, and soil sampling for analysis.

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Evidence for soil transmission of sugar cane mosaic virus. W. P. POND and T. P. PIRONE. *Phytopathology*, 1970, **60,** 437–440.—Non-inoculated sorghum plants became infected with sugar cane mosaic virus when grown in containers with infected plants. Control plants grown in separate containers, but at an equal distance from the inoculated plants, did not become infected. The fact that transmission is associated with the presence of roots of healthy and infected plants in the same container, rather than the proximity of healthy and infected leaves, suggests that soil transmission, rather than transmission by aphids, or rather aerial vectors, is occurring. Examination of the soil ruled out nematodes or root aphids as potential vectors. Root contact was not necessary for transmission. The possibility of transmission by fungi or other micro-organisms could not be excluded.

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A nitrogen deficiency disease of sugar cane probably caused by repeated pesticide applications. H. D. DUBEY. *Phytopathology*, 1970, **60,** 485–487.—Stunted cane with yellowing and drying leaves of abnormally low nitrogen content in Puerto Rico is referred to. Repeated applications of the fungicides "Maneb", "Zineb" and tribasic copper to the preceding tomato crop probably changed the microbial population so much that mineralization of soil nitrogen was inhibited, resulting in nitrogen starvation of the following sugar cane crop.

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Prospects of improving germination in delayed plantings by enhancing the moisture regime of the soil. U. S. SINGH and R. SHANKAR. *Indian Sugar*, 1969, **19,** 641–645.—In Uttar Pradesh high temperatures and scanty rainfall during March, April and May account for poor germination of late spring-planted cane. This leads to reduced yields. Results are given of trials involving improved soil moisture conditions. It was proved that the disadvantages of late spring planting could be successfully overcome by applying water to fields immediately after planting.

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A new alternative for cane handling. G. R. TIMMONS. *Sugar J.*, 1970, **32,** (10), 17–22.—See *I.S.J.*, 1970, **72,** 366.

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Tractor-mounted hydraulic scale for weighing sugar cane plots in Louisiana. H. P. FANGUY. *Sugar y Azúcar*, 1970, **65,** (3), 38–40.—Details are given, with a photograph, of this recently devised mobile weighing outfit which has proved highly satisfactory.

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Developmental field studies of gibberellic acid treatment of Hawaiian sugar cane. S. R. SIEMER. *Rpts. 28th Conf. Hawaiian Sugar Tech.*, 1969, 1–5.—The known effects of gibberellic acid (GA) on sugar cane are discussed. The objects of these studies were to evaluate the effect of altitude on GA response, obtain information on the response of different cane varieties and determine the relative effects of different formulations. Combining results of present and past work it was felt that GA treatment of sugar cane in Hawaii could be of economic value.

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Automatic water-control equipment for open channels. E. E. CHAPUS and J. DUBOUCHET. *Rpts. 28th Conf. Hawaiian Sugar Tech.*, 1969, 105–109.—Several types of surface irrigation control equipment are described and illustrated such as a constant upstream level gate, a constant downstream level gate and a distributor, the last-mentioned allowing a constant and adjustable quantity of water to be drawn from a canal or reservoir regardless of variation in water levels.

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Research influences on the future of our sugar industry. L. G. NICKELL. *Rpts. 28th Conf. Hawaiian Sugar Tech.*, 1969, 110–115.—The writer makes some interesting speculations as to what the future may hold for the sugar cane industry. He deals with engineering, weed control, rat control, borer control, diseases, agronomy, milling, breeding and selection and changing the plant itself. One of the forecasts with regard to engineering is the development of portable dry-cleaning units that will operate in the cane field.

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More about phosphorus for sugar cane. M. ISOBE. *Rpts. 28th Conf. Hawaiian Sugar Tech.*, 1969, 129–135. The problems associated with phosphorus fertilizing in Hawaii (fixation) are discussed. Reference is made to the possibility of controlled release phosphorus, achieved by coating pelletized fertilizer to a specific thickness with substances such as sulphur, asphalt, resins or other materials.

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The time to mechanize is now. E. L. CLAPAROLS. *Sugarland* (Philippines), 1970, **7,** (1), 9–12, 30, 34, 50. Reasons why greater mechanization in the Philippine sugar industry is so urgent are discussed. Technological revolutions in agriculture are taking place throughout the world and the Philippines should be taking part.

* * *

Water is the life blood of sugar cane. R. P. HUMBERT. *Sugarland* (Philippines), 1970, **7,** (1), 14–16.—The sugar cane crop requires a great deal of water, more than most growers realize. In most cane areas there are periods when soil moisture is deficient and irrigation pays handsome dividends. Concrete cases are quoted. The following matters are discussed: limiting water losses, applying irrigation water, furrow irrigation, sprinkler irrigation, water development, water quality and planning field layouts.

Sugar beet agriculture

New aspects of mechanical soil cultivation with sugar beet. C. WINNER and W. R. SCHÄUFELE. *Zucker*, 1970, **23**, 122–129.—Results of trials carried out near Göttingen during 1963–68 are reported. The purpose of these was to test the possibility of replacing hand-hoeing on a soil prone to crusting or capping. It was found the task could be done in a satisfactory manner mechanically. Results of herbicide treatment ("Pyramin") are reviewed.

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Emergence and development of sugar beets as influenced by various soil mulches. D. E. MILLER. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 463–469.—Low soil temperatures that impede seed germination and danger from freezing are two of the early spring hazards for the sugar beet grower. The use of mulches can drastically change the micro-climate of the seed zone. Experiments in this connexion are reported. Asphalt mulches increased soil temperature and improved germination. Glass and water mulches (water in clear plastic bags) were effective but not practical on a field scale.

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Damage to sugar beet roots from various degrees of wilting at various temperatures. S. T. DEXTER, M. G. FRAKES and R. E. WYSE. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 480–488.—The object of the investigation reported was to ascertain the extent of the loss of extractable sugar per ton of harvested roots, when wilted at different temperatures, without freezing injury and to compare this with the injury from combined freezing, thawing and wilting in commercial piles. Samples of beets in mesh bags were analysed before and after storage. U.S. Army walk-in refrigerators were used. Wilting resulted in substantial loss of ESPT (extractable sugar per ton) compared with beets stored without wilting.

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Effect of row width, plant spacing, nitrogen rate and time of harvest on yield and sucrose content of sugar beets. J. M. NELSON. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 509–516.—When cultivation of sugar beet was commenced under the dry conditions of Arizona in the early 1900's it met with only limited success, but improvements in irrigation, cultural practices and a better choice of varieties changed the position. An account is given of experiments to ascertain the best row width, plant spacing, nitrogen rate and time of harvest on root yield sucrose content and gross sugar production. Increasing the present row width was detrimental and 10 inches was the best spacing in terms of root yield.

Relationship of date of planting and date of harvest to incidence of disease, stand survival, yield and sugar content of sugar beets at Yuma, Arizona. E. B. JACKSON and F. M. CARASSO. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 528–537.—Under the hot conditions that prevail sugar beet is grown in autumn and winter for harvest in the spring. It is processed when harvested and cannot be stored because of high temperature. In the hope of extending the period of factory operation sugar beet was sown experimentally each month. In general, summer plantings were a failure.

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Pests of sugar beet. ANON. *Hautes Etudes Betterav. Agric.*, 1970, **2**, 13–18.—Descriptions, accompanied by drawings, are given of six important sugar beet pests. Brief notes are included on nature of damage and remedial measures.

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The evolution of mechanical harvesting of sugar beet. R. BOITEAU. *Sucr. Franç.*, 1970, **111**, 131–136.—Trends that have taken place in France are considered and modern multi-row equipment now in use discussed. Shortage of hand labour for sugar beet has been the stimulus. An important consideration with the harvest obtained from intense mechanization is beet quality. This should not be ignored.

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Field emergence of monogerm seed after drilling. H. SCHAFMAYER and C. WINNER. *Zucker*, 1970, **23**, 185–189.—Trials comparing hand sowing with drilling are reported. Precision drills made by several different manufacturers were tested. With good soil or seed bed preparation and correct adjustment of the machine, emergence of monogerm seed was not significantly greater than with hand-sown seed.

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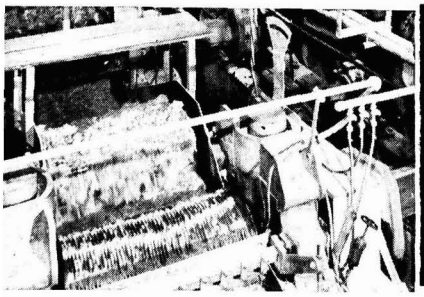
Sugar beet and soil structure. B. WILKINSON. *British Sugar Beet Rev.*, 1970, **38**, 111–114.—The basic foundation for good sugar beet production rests upon suitable soil physical conditions related to a satisfactory rooting depth, a friable, stable structure and adequate available moisture reserves. Soil structure, soil structural problems and cultivations are discussed. Soil capping, i.e. formation of a hard surface crust which prevents or impedes emergence of beet seedlings, is considered. To remedy this evil, most likely to occur on silt and sandy soils, it is important to keep surface organic matter content as high as possible.



Cane sugar manufacture

Clarification trials at Darnall. R. C. S. ROBINSON and R. P. JENNINGS. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 206–214.—Comparative tests were conducted on (i) Rabe vacuum flotation, (ii) defecation plus enzymatic hydrolysis[1], (iii) a so-called "90% split stream" process, in which the mixed juice was heated to 60°C and split into two streams, one (85–90% of the total) being limed to pH 9·0 and clarified by vacuum flotation and the other being heated to 75°C and treated by enzymatic hydrolysis, after which both streams were heated and combined. Phosphoric acid was added under pH control and the phosphated juice passed through subsiders, the mud from these and the vacuum clarifier being filtered separately to prevent re-solution of starch in the clarifier muds by the large volume of high-temperature subsider muds. The filtrates were then mixed. (iv) The Tongaat "split stream" process, in which the first stream was limed to pH 9·8 followed by vacuum flotation, while the second stream was heated to 75°C before enzymatic hydrolysis. The clear juice from the flotation stream was then mixed with all the hydrolysis stream, heated to boiling and settled in subsiders, subsequent stages being as in process (iii). A clear juice of pH 7·0–7·2 was obtained. Flow diagrams are presented for all four processes. Results showed that defecation plus enzymatic hydrolysis was the most efficient and the most economical means of starch removal, was far easier to control than vacuum flotation, and was not affected by fluctuations in juice quality. No significant benefits were derived from vacuum flotation. The costs of the chemicals used in the split stream processes were considerably lower than for vacuum flotation.

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An investigation of sugar mill effluents. S. M. H. COX. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 219–227.—Investigations of the effluents at the sugar factory of Doornkop Industries Ltd. are described. Three effluents occur: condenser water, dunder water composed of calandria condensate used for internal washing of the factory, and scum-yard drain effluent made up of water draining from a low-lying area behind the factory adjacent to the rubbish disposal area (scum yard), and which in time of rain receives leachings from spillings of filter cake being loaded into rail trucks. The dunder water had higher sugar and organic matter concentrations than did the condenser water as well as a higher concentration of Kjeldahl nitrogen. The scum-yard effluent, which flowed into the river, had a high organic matter and sugar content and contained micro-organisms usually found in untreated sewage. The condenser water is recycled and collected in a cooling pond after passing through cooling sprays. Organic matter precipitation was observed on the bottom of the pond, measurements of dissolved oxygen in the pond showing that the cooling sprays have a strong oxygenating effect on the water. The results indicate that it is the organic matter on the pond bottom rather than the oxygen dissolved and suspended in the body of the water which exerts primary effect on the dissolved oxygen status of the pond.

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Preliminary experiments in cane shredder research. M. SHAW and D. S. SHANN. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 171–180.—Tests conducted using a pilot-plant shredder provided with special instruments are discussed. Besides the instruments, used to measure all the torques, speeds, etc., a high-speed ciné camera operating at a speed of 2500 frames per sec was used, giving a 100:1 slow-down of the rotor speed when viewed at normal projector speeds and also permitting frame-by-frame analysis of hammer movement. The results are surveyed and further light thrown on the unstable behaviour of hammers.

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The performance of a heavy-duty shredder. C. D. CLARKE and R. J. MCCULLOCH. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 181–195. The performance and operating characteristics of a shredder installed at Farleigh sugar factory for the 1969 crushing season are discussed. The shredder has 87 hammers, each weighing 36 lb, with a double cutting edge, and is driven by two 700-hp motors at 960 r.p.m. (equivalent to 32 hp/ton of fibre/hr). An externally adjustable anvil bar and six detachable breaker bars cover a breaker section of about 85° of the arc swept by the hammers, the use of bars of different thicknesses allowing setting variations to be made with each breaker. Further setting variation is possible by means of pivot rods interchangeable with through rods but on different pitch circles. No serious problems have been encountered in operation apart from a serious choke when extremely heavy hammer wear was caused by high mud levels in the cane. Full details are given of tests conducted on the shredder.

[1] BRUIJN & JENNINGS: *I.S.J.*, 1970, **72**, 84.

Experiences with a heavy-duty shredder. C. D. CAMERON. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 197–205.—After the clearance between hammers and grid on a Gruendler shredder at Inkerman mill had been reduced in order to improve cane preparation, the motors tripped with overloading, indicating that the unit was underpowered. To find the reasons for this and see whether improvements could be achieved within the rated power range, investigations were carried out on the shredder operation. These, discussed in some detail, have shown that an improvement is possible by means of certain modifications.

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The Sugar Research (Institute) high-capacity subsider. D. J. HALE and E. WHAYMAN. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 243–248. On the basis of tests conducted on a pilot-scale trayless subsider[1], a full-scale subsider was built and tested during the 1969 season. The subsider has an annular feed well fed from an annular launder into which the untreated juice enters via two diametrically opposed points. The launder surrounds the feed well and has its outer edge above the liquid level while its inner edge, castellated to allow even distribution of juice around the well, forms the outer circumference of the feed well. Slots in the inner edge permit a small amount of the feed to entrain sand and heavy solids into the feed well, while rotating scrapers in the feed launder move settled solids towards these slots. The juice, moving down the well, is deflected to the wall of the subsider body by a ring-shaped baffle mounted on the rotating scraper gear. Solids build-up on the baffle is prevented by fixed ploughs attached to the bottom of the feed well. Two take-off launders, one inside and the other outside the well perimeter and concentric with the feed well, have castellated edges so arranged that the juice flow into each launder is proportional to the area from which the juice is drawn, i.e. the areas inside and outside the feed well. The lower half of the subsider is in the form of a shallow cone with a mud boot below. The mud is raked from the perimeter of the subsider to the boot by scraper blades, the depth of which increases towards the centre of the subsider to allow for a greater volume of mud towards the centre moving in a decreasing area. Clarified juice is discharged through a slightly sloping outlet pipe just below the central ring-shaped baffle. Satisfactory results were obtained with the subsider at a clarified juice throughput of 100 tons/hr, with maximum values of 140 tons/hr being achieved on occasions.

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Bagacillo for rotary vacuum filters. K. J. NIX. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 249–255.—Investigations into the effects of bagacillo on the performance of Eimco rotary vacuum filters are reported. Bagasse passed under suction through 4-mesh screens sloping at 55° to the horizontal yielded 2·8 lb of bagacillo per sq.ft./min compared with 0·45 lb/sq.ft./min using 4-mesh horizontal screens without suction. The bagacillo from both screen types was quite satisfactory as filter aid, since it did not contain excessive quantities of coarse or fine particles. Bagacillo in primary mud made up a considerable proportion of that used on the filters and contained a large quantity of fine particles. However, since most of the fine bagacillo in the filter feed was retained in the filter cake, a large amount of very fine bagacillo may not be of disadvantage.

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The single boiler unit at Pleystowe. G. D. JACKLIN and B. H. ARROWSMITH. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 257–265.—Details are given of the features and operation of a Riley Dodds boiler, believed to be the world's largest bagasse-burning unit, which has a rated steam raising capacity of 300,000 lb/hr. The bagasse is burnt in suspension in a water-cooled furnace which can be used as incinerator for surplus bagasse. Steam temperature and pressure have been found to be constant whether at maximum steam output or at a much reduced output of 100,000 lb/hr for boil-off.

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Filtrability control at Mulgrave. H. J. BYRNE. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 267–270.—Details are given of the measures adopted at Mulgrave to improve sugar filtrability. They included increasing the supply of bagacillo to the filters by providing finer cane preparation in the shredders, raising the level of mud in the subsiders to give a heavier mud and reduce recirculation of mud from the filters to the subsiders, adding a 0·2% solution of "Separan AP-273" at an adjusted rate to the juice entering the subsiders, and concentrating juice to syrup and storing this in a Bach subsider over the week-end (thus reducing sugar losses in week-end carryover juice).

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Model condenser performance. P. N. STEWART and T. C. MULVENA. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 271–280.—Features and operational results of a model rain-type condenser are reported. It was found that there was little or no difference in performance when using trays with 1-inch and $\frac{3}{8}$-in diameter holes, although it is planned to continue the tests to determine the limitations of hole size as well as condenser height. Pressure loss was negligible, indicating that the incondensable gases had free access to the top of the condenser body. An unsatisfactory fall in vacuum with increase in the quantity of vapour approaching the maximum is attributed to the vapour inlet design and is a problem considered easy to overcome.

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The rain condenser hazard. J. W. HILL. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 281–282.—Details are given of a rain-type condenser and separator design which is intended to overcome the two major problems associated with conventional rain type condensers, i.e. surging ("booming")

[1] *I.S.J.*, 1970, **72**, 52.

connected with vapour locking in the condenser body and blockage of the water-tray holes with subsequent water carry-over into the air pump which is thus severely damaged. The uncondensed vapour is withdrawn through a large number of points distributed beneath the tray by means of chimneys passing up through the tray and above the water level. The water-tray has a side wall clear of the condenser body and is placed at a level above that of the conventional tray. The annular gap created acts as a further set of chimneys and will allow any excess water to pass down in the event of tray blockage; since all injection water is permitted to pass down under its own pressure without reaching the chimney tops, no water should be carried over with the discharge vapour.

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Evaporator venting. J. W. HILL. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 283–293. Evaporator studies showed that gas accumulation can cause appreciable reduction in evaporator performance. High loss in efficiency can be caused by high gas loading relative to the inlet steam rate, a multiplicity of venting points and absence of baffling. To improve evaporator performance, it is suggested that each gas line be provided with a simple flowmeter and with a differential thermometer for measuring the incondensable content[1]. The instruments would be useful for monitoring air leakage, while further investigations could be carried out to determine the optimum gassing rate for steam economy and the possible advantage of venting each evaporator directly to the condenser.

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Possibilities for reducing scale in evaporators. D. B. BATSTONE. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 295–298.—Heat transfer data for Queensland evaporators indicate steam-side fouling of 2nd evaporator effects. Possible means of removing the deposit are listed and laboratory testing of the different procedures recommended. A number of methods of reducing liquid-side scale of heater and evaporator tubes are discussed, the most promising means in the short term being considered the application of a non-stick coating such as polyfluorocarbon, which can be easily applied by washing the tubes in a solution made up of 0·01 g polyfluorocarbon per ml of volatile solvent followed by air drying, or PTFE (polytetrafluoroethylene), which is applied in a special manner.

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Low grade (centri)fugals—continuous or batch ? B. D. SOCKHILL. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 299–303.—Factors to be considered in making a choice between batch and continuous centrifugals are discussed, including the economic aspects. Some technical disadvantages of continuous machines (including higher molasses purities than in batch machines) are indicated.

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A plant trial of a magma improvement process. P. G. WRIGHT. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 305–310.—The use of magma made up from *C*-sugar cured in continuous centrifugals as seed for high-grade boiling to produce shipment raw sugar is of disadvantage compared with that from batch machines because of the occurrence of broken crystals. Of three methods listed for overcoming the problem, the one preferred involves the use of a classification process to improve the magma quality before pan boiling. Pilot-plant tests at Racecourse, Gin Gin and Pleystowe are reported, and a scheme outlined in which the *C*-sugar is made into a magma by water addition, and the washed crystals (55% of the original) separated by filtration before being fed to the magma tank before the pans, the filtrate being returned to the *A*-molasses or syrup tanks.

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A simplified method of sampling cane juices at Proserpine mill. W. J. CHAPMAN and L. E. DAVIES. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 311–315.—The method used at Proserpine since 1969 is described. It involves a system of coloured flags for trucks at the weighbridge and a system of 3 coloured balls, corresponding to the flags, at the cane carrier. Each ball travels along a chain and thereby actuates micro-switches to bring about certain specific operations. One chain is synchronized with the movement of the cane carrier, another is synchronized with the movement of the elevating carrier, and the third is a constant time chain representing the passage of the juice and fibre sample through the mill and of the juice to the laboratory. The arrangement of the laboratory juice sampler is described with the aid of a diagram and its operation explained.

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Semi-continuous sampling at Bingera. W. R. SPOTSWOOD and L. C. KELSO. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 317–321.—Details are given of the system used at Bingera which incorporates an electronic sample tracker using uniselectors (electrically-operated rotary switches as used in automatic telephone exchanges), which carry 23 contacts representing the movement of cane on the carrier or elevator. Modifications to the original design have enabled the sampler to perform satisfactorily, with simple automatic control of the sampling rate.

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Improved canefield locomotive performance. R. A. JAMES and C. R. MURRY. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 349–351.—Of two methods considered for increasing cane locomotive speed from 10 m.p.h., the one adopted after investigations by the Sugar Research Institute at Mackay involved changing the final drive gearbox ratio. Tests showed that existing rolling stock could be operated safely at the higher speed of 16 m.p.h. attainable by the conversion.

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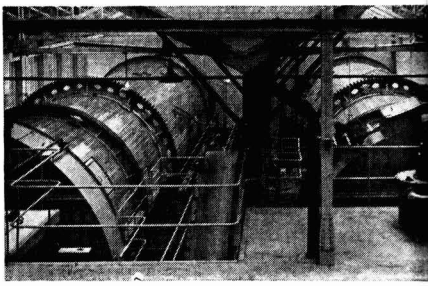
[1] HUGOT: "Handbook of cane sugar engineering" (transl. JENKINS) (Elsevier, Amsterdam), 1960, p. 382.

Beet sugar manufacture



Trends in non-sucrose constituents of Central California beets. I. Analysis of Steffen factory liquors. P. H. MILLER. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 595–606.—Details are given of the Kjeldahl-N, amino-N, nitrate-N, betaine-N, potassium, sodium, chloride, calcium and magnesium contents in diffusion juice, thin juice and carbon-treated thick juice samples taken twice a week and in Steffen molasses (composited on a weekly basis) throughout the 1964–1966 campaigns. The concentrations of 12 identified amino-acids in the three juices were also determined for one period only. The trends in the July–January and January–July parts of the year are noted and shown in graph form. The relative concentrations of individual non-sucrose constituents in beets change considerably throughout the crop year, and this greatly affects the extent of non-sugar removal by carbonatation.

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Method of evaporator descaling without sodium carbonate. V. N. SHCHEGOLEV, I. K. CHERNEGOVA, V. K. SUPRUNCHUK, A. V. AVDEEVA, I. D. VDOVENKO and D. L. SKORBUN. *Sakhar. Prom.*, 1970, **44**, (5), 16–19.—The system recommended for use in Soviet sugar factories involves boiling out with HCl solution of 5–10% concentration for 3–5 hr according to the nature and thickness of the scale after addition of 0·5–1·0% on weight of acid solution of a corrosion inhibitor such as a dialkyldimethylammonium chloride. After the solution has been discharged the evaporator is rinsed out with softened water. Details are given of a scheme for preparation and feeding of the descaling solution.

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FiLS self-discharging leaf filter V. T. RUD', YU.F. TSYUKALO, N. B. IL'CHENKO, YU. V. ANIKEEV, V. A. ZAMBROVSKII and V. M. PERTSEL'. *Sakhar. Prom.*, 1970, **44**, (5), 26–29.—Details are given of a pressure leaf filter developed by the authors in the USSR and based on the Grand-Pont design[1]. Used in tests as a thickener for 1st carbonatation juice, it gave a filtrate of 12·7°St colour (compared with 12·5°St in the original juice) containing 0·39 g turbidity/litre and a mud solids content of 540 g/litre, these values being considerably better than results obtained with clarifiers. Filtration rate, at 13·5 litres/sq.m./min at 1·4 atm feed pressure and 16·2 litres/sq.m./min at 1·7 atm, was considerably higher than with filter-presses or disc pressure filters. Used to filter 2nd carbonatation juice, the FiLS had a very much greater filtration rate, at 30 litres/sq.m./min at 0·7 atm feed pressure, than did filter-presses and disc filters. Advantages of the filter over the DGS-59 filter-thickener and over conventional Soviet clarifiers are listed. Construction of two models, having 40 and 60 sq.m. filtering area respectively, has been recommended.

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Effect of 1st carbonatation juice alkalinity on mud settling and filtering properties. M. S. ZHIGALOV. *Sakhar. Prom.*, 1970, **44**, (5), 22–24.—Factory experiments showed that, in the alkalinity range 0·06–0·10% CaO, 1st carbonatation juice alkalinity had little effect on settling rate and mud filtration rate, while no improvement in the rates was brought about by over-saturation when high- and medium-quality beets were being processed. When processing low-quality beet it is recommended to reduce alkalinity to 0·05% CaO, since this raises the settling rate significantly compared with the value obtained at 0·09–0·10% CaO, while the filtration rate is unchanged.

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Filter-thickeners. S. P. YAROSLAVSKII and G. I. DUMANETSKII. *Sakhar. Prom.*, 1970, **44**, (5), 24–25. Experience at the authors' sugar factory with Soviet DGS-59 disc-type filter-thickeners used for 1st carbonatation juice filtration has shown that they operate satisfactorily, giving a sparkling, turbidity-free juice of 8·0–9·0°St colour and a mud which is easily handled by vacuum filters. Advantages of the filter-thickener are listed. The findings are in contrast to those of KATS & OSITYANSKII[2].

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Artificial biological treatment of waste waters. Z. D. ZHURAVLEVA and K. P. GONCHAROVA. *Sakhar. Prom.*, 1970, **44**, (5), 29–31.—Algal treatment of waste water at Otradinskii sugar factory (USSR) is reported. *Chlorella* and *Scenedesmus* algae were used to treat 2 million cu.m. of effluent; the dissolved oxygen content was reduced to 6 mg/litre, the oxidizability from a minimum of 200 mg/litre O_2 to 30 mg/litre, and the BOD_5 from a minimum of 190 mg/litre O_2 to 20 mg/litre. Soil filter treatment gave only slightly better results, but involved excessive land requirements. Carp thrived in the algae-treated water in subsequent tests.

[1] *I.S.J.*, 1966, **68**, 323–326, 358–361.
[2] *ibid.*, 1970, **72**, 247.

Use of flumes for beet ventilation. A. M. ELAGIN. *Sakhar. Prom.*, 1970, **44,** (5), 38–40.—In tests during October–December on ventilation of beet piles by blowing air through an empty flume beneath the piles, the temperature was maintained at around 8·2°C during the 60-day period, whereas in the unventilated controls the temperature fluctuated between 9 and 13·5°C. Daily sugar losses and total beet weight losses were 0·010% and 0·73% in the test piles and 0·017% and 0·81% in the controls, respectively. The results showed that it was more effective at night to operate the fans intermittently with 3–3½ hour breaks rather than operate them continuously. The costs are briefly discussed.

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Application of measurements, regulations and automatic controls in the treatment of (beet) pulp. G. BIEZUNSKI. *Sucr. Franç.*, 1970, **111,** 299–302.—The problem of automatic control of beet pulp drying is discussed and details are given of a Siemens scheme in which the following are controlled: pulp feed, oil fuel feed to the furnace as a function of pulp feed, furnace air intake in proportion to the oil feed, temperature at the head of the dryer drum as a function of pulp feed and waste gas temperature, waste gas temperature, and furnace pressure. The system is claimed to have given a pulp dry solids content varying only within ± 1·5% with a feed charge variation of ± 25%.

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Guides to the design and use of boiling pans. P. FOCHESATO. *Ind. Sacc. Ital.*, 1970, **63,** 43–45.—Defects resulting from inadequate circulation in vacuum pans are discussed and the improvements which may be obtained by installation of mechanical circulators are described, especially in the case of low-grade boiling.

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Thin juice deliming with gel type cation exchange resins. C. D. FOX, L. LANGLOIS and A. PIETROLUCCI. *J. Amer. Soc. Sugar Beet Tech.*, 1970, **15,** 665–670. After installation of a thin juice deliming plant using "Imac C-12" strongly acid cation exchange resin, a number of improvements in processing at the beet sugar factory involved were obtained, mainly as a result of the drop in lime salts content. Comparison between figures for 1963 (without the deliming plant) and 1967 show a 14% increase in slicing capacity, a 50% drop in lime salts, an 8% increase in thick juice Brix, a 73% reduction in evaporator boiling-out, and a 12% reduction in steam consumption (on beet). A number of difficulties in operation of the plant have been solved and are discussed.

* * *

Respiration of sugar beets following harvest in relation to temperature, mechanical injury and selected chemical treatment. D. R. DILLEY, R. R. WOOD and P. BRIMHALL. *J. Amer. Soc. Sugar Beet Tech.*, 1970, **15,** 671–683.—Studies to determine the effect of temperature, mechanical injury and selected chemicals on respiration rate (and hence sugar loss) in storage piles are discussed. Temperature increase from 10°C to 20°C caused a marked increase in the respiration rate, although a reduction to below 10°C had little beneficial effect. None of the chemicals applied to the beets gave better results (lower losses) than did water used to treat the controls. Mechanical injury had a significant effect on respiratory loss. It is suggested that suitable artificial barriers such as waxes or synthetic materials could be used to reduce gas diffusion from damaged beet and so reduce respiration without causing fermentation.

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Effect of main liming temperature on increase in juice colour during concentration in evaporators. H. ZAORSKA and S. ZAGRODZKI. *Gaz. Cukr.*, 1970, **78,** 105–109.—See *I.S.J.*, 1970, **72,** 280.

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Purity of 3rd massecuite in the light of the economic aspects. K. WAGNEROWSKI. *Gaz. Cukr.*, 1970, **78,** 81–88, 110–115.—The question of optimum low-grade massecuite purity is discussed from both technical and economic viewpoints. According to the author, the optimum will lie somewhere in the range 77–81. The value to aim for depends on the low-grade capacity of the individual factory and the type of crystallizers used as well as on molasses sugar loss, campaign length and colour of white sugar, the last three factors determining the profit per ton of sugar produced.

* * *

The rôle and importance of thermal insulation. Z. KULIK. *Gaz. Cukr.*, 1970, **78,** 115–117.—After explaining the three types of heat transfer (conduction, convection and radiation), the author discusses the question of thermal insulation in sugar factories and presents tabulated data showing heat loss in uninsulated steel piping used to convey the more usual materials in a sugar factory. Also tabulated are heat losses in various pieces of heat exchange equipment provided with thermal insulation.

* * *

Industrial density measuring devices. M. JABŁOŃSKA. *Gaz. Cukr.*, 1970, **78,** 117–121.—Various types of density and Brix measuring instruments and systems are described and their basic operational features indicated with the aid of diagrams.

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The heat economy of a beet sugar factory. P. FREUND. *Zucker*, 1970, **23,** 373–376.—Optimization of pan vapour consumption in accordance with massecuite quantity, which in turn depends on the sugar content of the beet and raw juice purity, is discussed. The effect of recycling *A* and *B* white run-off is examined. From the heat economy viewpoint, it is preferable to recycle *A* white run-off, while *B* white run-off should be recycled instead if sugar quality is the more important factor. The effect of run-off separation on sugar yield is discussed in terms of massecuite Brix. It is recommended to fit the boiling scheme to thick juice purity.

Dissolving affined sugar in thin juice or condensate. M. BOSNJAK. *Zucker*, 1970, **23,** 376–377.—Reference is made to the statement by FREUND in an earlier article that the steam consumption is about the same when remelting washed sugar in thin juice or in condensate and that neither method has any great advantage over the other. The author of the present article describes three schemes: (1) using condensate which creates considerably more evaporator steam usage and significantly greater heating surface requirements; (2) using thin juice where less steam is consumed and a smaller heating surface requirement is created than in (1); and (3) using thin juice where the same amount of heat is consumed as in (2) but the heating surface requirements are greatly reduced.

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Continuous weighing of cossettes and pulp. J. ZIMAK and R. DENIS. *Sucr. Belge*, 1970, **89,** 297–302.—A continuous weighing system incorporated on an existing belt conveyor is described and details given of its application in the weighing of beet cossettes leaving the slicers and in the weighing of pulp on discharge from a press and/or before entering a dryer. The weigher, a Siemens product, comprises two plates below the conveyor, one located before and the other after the beam of an electronic balance provided with mechanical multiplication. In the case of cossettes, the output signal from the electronic part of the system controls the slicer speed. Comparison of calculated with true weighments shows excellent agreement.

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SPS-20-VNIISP dryer-cooler. D. S. SHEVTSOV *et al. Sakhar. Prom.*, 1970, **44,** (6), 17–20.—Details are given of a fluidized bed unit installed at Ul'yanovsk sugar factory in 1969 and which had a throughput of about 20 tons of white sugar per hr. The temperature and moisture content of the sugar on discharge are 25°C and 0·02–0·04%, respectively.

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Industrial tests on the YaVA-600 vacuum pan. L. G. BELOSTOTSKII and A. P. GORDIENKO. *Sakhar. Prom.*, 1970, **44,** (6), 21–24.—The performance of the Soviet YaVA-600 vacuum pan, in which the calandria tubes have expanded and hexagonal ends and there are no tube plates, so giving greater heating surface per unit volume, was compared with that of a conventional VATs-350 vacuum pan. Full details are given of the tests and results are tabulated.

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Experience in operation of S-17 diffusers at North Caucasian sugar factories. G. S. STEPANOV, V. A. KOLESNIKOV and O. T. MEL'NIK. *Sakhar. Prom.*, 1970, **44,** (6), 24–26.—Structural defects in Soviet S-17 screw-type beet diffusers are noted and a number of modifications described.

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Increasing the utilization of carbon dioxide gas in standard carbonatation vessels. S. K. KARTASHOV *et al. Sakhar. Prom.*, 1970, **44,** (6), 29–31.—The question of CO_2 utilization in carbonatation is discussed and the desirability expressed of raising it where necessary to 60–70% by raising the juice level and reducing the tank diameter. Even greater utilization (75–80%) is considered possible where gas-fired lime kilns are used.

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Optimum fuel consumption in limestone burning with natural gas. YU. G. GONCHAROV and B. F. KOLESNIKOV. *Sakhar. Prom.*, 1970, **44,** (6), 31–33.—The optimum fuel consumption is considered to be 7·6–7·7% on weight of limestone, which gives a carbonatation gas CO_2 content of about 27% and a carbonatation gas utilization of about 77%. A higher fuel consumption will reduce CO_2 utilization, while a lower consumption will involve changes to carbonatation vessels in order to increase CO_2 utilization.

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The production capacity of a sugar factory and optimum campaign length. A. P. KIRILYUK and L. A. KIRILYUK. *Sakhar. Prom.*, 1970, **44,** (6), 45–48.—The case of Shpikov sugar factory in the Vinnitskaya region of the USSR is cited. For this region, the optimum campaign length (as regards lowest sugar losses and minimum sugar production costs) is 110–115 days. Assuming an increase in local beet production over the next 5 years at the same rate as in the last 5 years, the author indicates the need to increase the factory slicing capacity ftom 900 to 1650–1700 tons/day, in order to be able to maintain the optimum campaign length.

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Application of Fick's law to cossette extraction. G. V. GENIE. *Zucker*, 1970, **23,** 409–412.—As an alternative to the usual Fourier series, expressions for calculation of error have been developed in a series for integration of the second Fick law, giving very simple formulae for contact times usually encountered in cell-divided diffusers. A dimensionless parameter proposed for determination of the amount of sugar extracted from cossettes is claimed to have the advantage of being practically independent of concentration and draft, and is related to time of contact, cossette thickness and convection.

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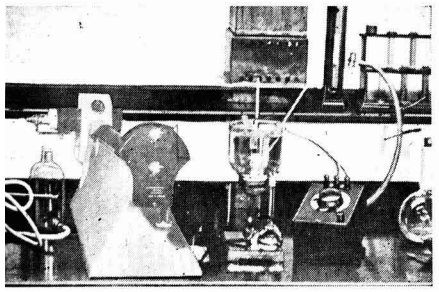
The problem of water in the sugar industry. ANON. *Sucr. Franç.*, 1970, **111,** 345–347.—It is shown that of the total "potential pollution" (solids in suspension + oxidizable material) calculated for 1969 as the amount resulting from the processing of 187,000 tons of beet per day in French sugar factories where the effluent was not treated after settling, the actual quantity was only 56%. It is further pointed out that the reduction in pollution level is obtained despite difficulties outside the control of the factory management, i.e. the quantities of dirt and other impurities introduced with the beets. Recycling of process water and treatment and subsequent re-utilization of waste water has helped reduce the water consumption per ton of sugar from 100 cu.m. where no recycling is used to 10 cu.m. and even lower in some cases.



Laboratory methods & Chemical reports

Colorimetric determination of sugars starting from methods based on the reduction of a cupric sulphate solution. T. L. LUNDER. *Ind. Alimentari*, 1970, **9**, (3), 84–92.—Variations of the original Fehling method for sugar determination are described and a new method indicated which has been applied to determination of sugars in dairy products, honey, etc. It is a colorimetric method wherein the Cu_2O precipitate obtained in the Fehling methods (of the order of 100 mg) is collected on a No. 4 sintered glass crucible and dissolved in 10 ml of 1:1 nitric acid which is gently aspirated into the flask holding the crucible, the latter washed with 10 ml of hot distilled water and the excess nitric acid in the filtrate removed by adding 1–2 g of urea. The solution is cooled, transferred to a 100-ml volumetric flask, 10 ml of conc. ammonia added to develop the strong blue colour and the solution made up to 100 ml. The colour is measured with a Hilger Spekker colorimeter with a No. 4 filter or at 480 nm using a 1-cm cell in a Beckman spectrophotometer. The colour is directly related to the Cu_2O and the sugar content can be obtained by calculation using equations which are given for lactose, sucrose, maltose and glucose.

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Measurement of sugar beet tissue conductivity. G. PÁTKAI. *Cukoripar*, 1970, **23**, 65–71.—Measurements of the electrical conductivity of beet tissue reported in the literature are compared with values obtained by the author. Conductivity is proportional to temperature and juice concentration as well as tissue permeability, so that it is a good guide to the biological state of the beet. It falls with wilting and increases sharply with freezing. In fresh, healthy beet it was about 350 μS/cm at 17°C compared with a campaign average in frozen beet samples of 923 μS/cm.

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The structure of beet sapogenin. K. SERES and P. BIACS. *Cukoripar*, 1970, **23**, 71–73.—Investigations of the infra-red spectra of raw beet saponin and of beet sapogenin obtained by hydrolysis and recrystallization are discussed.

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Economic impact of the new quality analysis established in 1967 by the American Sugar Refining Company. C. A. MARTÍNEZ. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1968, **46**, 27–29.—In addition to its polarization criterion for raw sugar payment, new criteria were introduced by the American Sugar Refining Co. for 1967; these included safety factor, ash content, grain size, filtrability and colour standards. Puerto Rican sugar shipped in 1967 and 1968 through Aguadilla terminal met all of the standards, except for the last in a number of cases, and it is proposed that the mills give attention to improving sugar colour by avoiding high contents of nitrogen and reducing sugars, by producing more uniform crystals which will allow better purging and molasses elimination and by lowering of sugar temperature before storage to avoid colour formation in the store.

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Quantitative chromatography of glucose and fructose in cane molasses. M. L. RODRÍGUEZ and I. GALANO. *CubaAzúcar*, 1968, (July/Aug.), 2–11, 46–51.—A method described earlier[1] has been further developed for quantitative analysis of glucose and fructose in molasses. Samples are chromatographed in triplicate with duplicate standards, all of 5 μl, the standards containing 5, 7·5 and 12·5 γ of the reducing sugars. After developing and fixing as before, the colour is measured using a "Chromoscan" instrument with a 620 nm filter. Analyses carried out on 27 samples are compared with chemical analyses; the chromatographic results for glucose and fructose when added were less than the chemical result for total reducing sugars. Average figures were 10·25% glucose with a typical deviation of ± 1·84%, and 10·68% fructose with a typical deviation of ± 1·81%.

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Separation, identification and quantitative analysis of the fatty acids present in Cuban sugar industry wastes by application of gas and thin-layer chromatography. D. A. NAVIA M. *CubaAzúcar*, 1968, (July/Aug.), 12–17, 52–54.—Details are given of the application of gas and thin-layer chromatographic techniques for identifying and determining the fatty acids present in the fatty fraction of wax extracted from cane muds. These were linolenic acid (7·3%), linoleic acid (38·1%), oleic acid (20·0%), stearic acid (29·2%) palmitic acid (0·93%), myristic acid (0·84%), lauric acid (2·5%), caproic acid (0·4%), capric acid (0·8%) and traces of caprilic acid, behenic acid and oxy-acids.

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Interim report on some analytical results from contract raw sugar control tests. W. W. BINKLEY. *Proc. 28th Meeting Sugar Ind. Tech.*, 1969, 163–165.—Some results obtained during the first quarter of 1969 at the New York Sugar Trade Laboratory, acting as impar-

[1] RODRÍGUEZ: *CubaAzúcar*, 1966, (July/Aug.), 24, (Sept./Dec.), 38; *I.S.J.*, 1968, **70**, 250.

tial "referees" for raw sugar quality, are presented and details are given of methods used to determine the variables.

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Thermophilic micro-organisms in sugar manufacture. I. Physiological and biochemical properties. M. A. F. ABDOU. *Zucker*, 1970, **23**, 258–265.—Some physiological and biochemical properties of 68 strains of aerobic thermophiles isolated from garden and beet soil, beet sugar factory press water, juices and white sugar and cultured in a pure state are discussed, particularly the maximum and optimum growth temperatures. Since nitrate reduction was found to occur even under aerobic conditions, nitrite is not suitable as a guide to the degree of infection in factory juices. Fifty-one references are given to the literature.

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Material transfer in the systems $CO_2/Ca(OH)_2$-H_2O and $CO_2/Ca(OH)_2$-sucrose-H_2O. H. WORM. *Zeitsch. Zuckerind.*, 1970, **95**, 172–180, 243–250.—Studies of material transfer between gaseous and liquid phases in the systems shown in the title are described, including a brief outline of the chemical conversions which take place between the reactants and a discussion of the factors affecting material transfer. The extent of the boundary surface between gas and liquid is shown to be dependent on the volume and shape of the gas bubble, which are in turn governed by the way in which the bubble is formed and particularly by the hydrodynamic forces involved in ascent of the bubble. The material transfer rate is primarily dependent on flow conditions in the liquid. The effect of chemical reaction on the transfer is also discussed, and model representations produced by various authors are examined to see if they can be used to give a mathematical description of material transfer in the systems studied. In later experiments the effects of gas flow in an empty tube and the CO_2 concentration on the material transfer rate were also investigated, and conclusions drawn from the results which could be of value in working out the most suitable conditions for carbonatation. 82 references are given to the literature.

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Determination of saturation concentrations and refractive indices of pure sucrose solutions by means of an immersion refractometer. F. A. ORLOWSKI and D. SCHLIEPHAKE. *Zucker*, 1970, **23**, 285–294.—The saturation concentrations and refractive indices of pure sucrose solutions were measured in the temperature range 20–90°C at concentrations in the range 1·25–4·15 kg sucrose/kg water (0·565–0·805 kg sucrose/kg solution), and the readings obtained plotted against concentration at different temperatures. From readings obtained for saturated solutions, saturation concentrations have been determined by means of empirical equations which are given. Comparison with the sucrose saturation concentration values obtained by CHARLES[1] showed good agreement up to 55°C, after which there was increasing deviation which was of the order of 0·5% at 80°C, although this was still within the limits imposed by temperature measuring accuracy. Refractive indices found agreed satisfactorily with the values of ROSENHAUER[2] even when extrapolated to a concentration of 0·80 kg sucrose/kg solution, provided a 5th degree polynomial is used instead of the 4th degree polynomial used by ROSENHAUER. It was found that at temperatures away from 20°C refractive indices must be corrected to allow for alteration in the r.i. of the measuring prism with temperature. Tables of values are given which have been calculated by the least squares method for refractometers of the Abbé type.

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Determination of reducing matter in sugar beet. III. M. FRIML and R. ČEJKOVÁ. *Listy Cukr.*, 1970, **86**, 66–71.—Statistical comparison of the OFNER method with the triphenyltetrazolium chloride (TTC) method for determination of reducing matter in beet press juice showed that the latter gave values closer to the true contents than the OFNER method, although the two methods were of identical accuracy. The TTC method has the advantage of greater rapidity and is easier to carry out.

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Effect of some amino-acids on sucrose crystallization. I. P. OROBINSKII and S. Z. IVANOV. *Izv. Vuzov, Pishch. Tekhnol.*, 1970, (2), 168–170.—Under identical conditions (temperature, supersaturation, concentration and time), glycine, serine, valine and lysine increased the sucrose crystallization rate K, while glutamic and aspartic acids and alanine reduced it. With increase in temperature in the range 40–60°C the order in which the amino-acids affected K remained unchanged, although the value of K was higher in each case than at the lower temperatures. Increase in the concentration of glutamic and aspartic acids caused K to fall to a value lower than with the lower amino-acid concentration. Calculated values obtained from empirical formulae relating K to glutamic and aspartic acid concentrations were in close agreement with values found experimentally.

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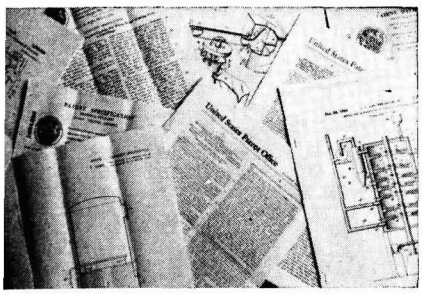
Kinetics of parallel reactions in the formation of melanoidin. R. A. KOLCHEVA, S. E. KHARIN and A. R. SAPRONOV. *Izv. Vuzov, Pishch. Tekhnol.*, 1970, (2), 206–210.—Equations for calculation of rate constants are developed for the parallel reactions occurring in melanoidin formation in a phosphate buffer solution containing glucose and α-alanine. The reactions are two 1st-order reactions (glucose and amino-acid decomposition) and one 2nd-order reaction between the glucose and alanine. Values of the three rate constants at any given pH can be used to find the reduction in sugar and amino-acids concentration and thus determine the proportion of sugar loss due to melanoidin formation.

[1] *I.S.J.*, 1960, **62**, 126–131.
[2] *Proc. 14th Session ICUMSA*, 1966, 65.



Patents

UNITED STATED

Cane harvester. C. W. HART, of Hilo, Hawaii, USA, *assr.* C. BREWER & CO. LTD. **3,492,798.** 11th September 1967; 3rd February 1970.

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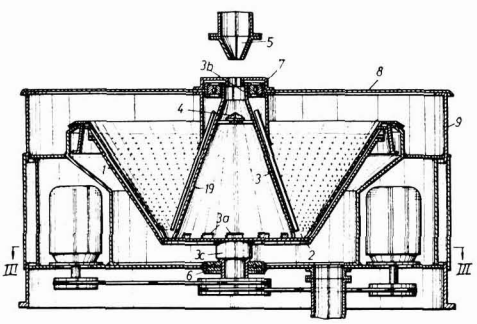
(Continuous) Centrifugal. W. L. SIEPE and H. F. SCHMIDT, *assrs.* HEIN, LEHMANN & CO. A.G., of Düsseldorf, Germany. **3,496,016.** 8th September 1965; 17th February 1970.

The centrifugal is of the continuous type with a frustroconical basket driven by a motor or motors which rotate the central shaft 3c which is supported in bearing 6. To ensure even feeding, the massecuite is admitted from nozzle 5 on to a distributing cone 4 at the top of a frustroconical body 3 within the basket and firmly connected to the plate 2 at its lower end. The massecuite is directed to the inside of the solid walls of the body 3 and passes downwards, passing through slits 3a onto the basket at its smallest diameter. The passage through the slits may be guided by means of flaps over them which are spring- or weight-loaded; alternatively, guide ribs or wedges between the slits may direct the massecuite through them.



The massecuite may be heated to reduce its viscosity by means of a concentric induction coil 19 or electrically by passing current through a central copper shaft within the conical body (which is insulated from the coaxial shaft 3c), through the massecuite to the body and so to the plate 2. By choosing materials and thicknesses appropriately the current usage will be applied mainly to heating of the massecuite.

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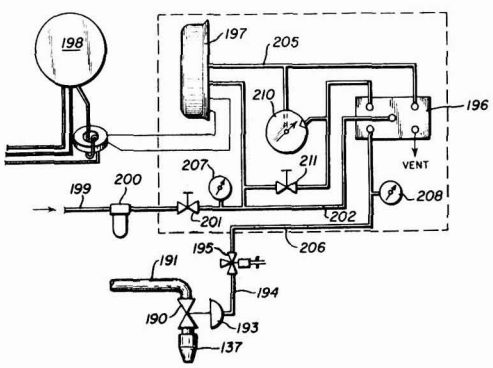
Control of massecuite input to a continuous centrifugal. C. R. STEELE and F. B. PRICE, of Denver, Colo., USA, *assrs.* CF & I ENGINEERS INC. **3,497,385.** 17th May 1965; 24th February 1970.

Feed of massecuite from supply pipe 191 to nozzle 137 is controlled by a butterfly valve 190; this is rotated by a dashpot or transducer 193 having a mechanical connexion to valve 190 and a flexible diaphragm operated by a hydraulic pressure supplied through pipe 194. The pressure supply is governed by a 3-way solenoid-operated valve 195 which is arranged to allow feed through the valve only when the centrifugal motor is supplied with power.



A current transformer in the power line of the motor 198 which measures the current and is connected to the transducer 197 actuating transcope controller 196 which regulates valve 190. Air is supplied through conduit 199, filter 200, valve 201 and line 202 to controller 196 and transducer 197. Gauges 207 and 208 measure pressures in lines 202, 206 and the pressure on the dashpot 193 and so valve 190 can

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be selectively controlled by operation of valve 211 between the two lines, this control being indicated by gauge 210.

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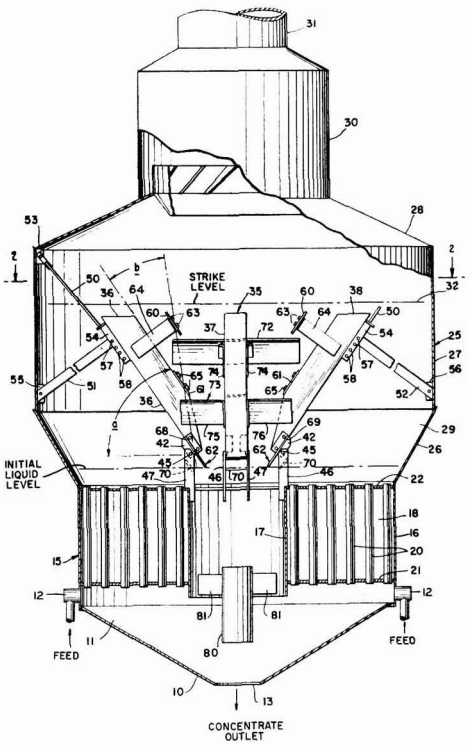
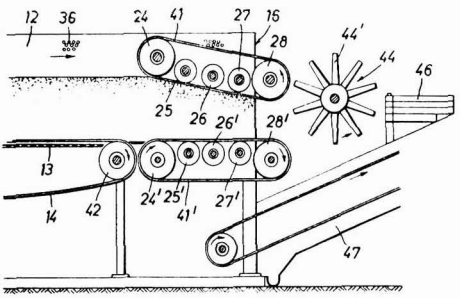
Internal circulation-inducing syrup-concentrating vacuum pan. T. M. HAMILL, of Kailua, Hawaii, USA. **3,498,357.** 22nd August 1967; 3rd March 1970.

Above the upper tube plate of the calandria pan are mounted four ducts 36, 37, 38 (and another not shown) mounted regularly about the centre axis and carrying louvres (60, 61, 62 on ducts 36, 38, and 72, 73 on duct 37 and the opposite duct). The ducts and louvres are supported firmly, but adjustably by the various brackets and shafts, and serve to guide massecuite rising from the upper tube plate outwardly. When the pan is near its strike level 32 the lighter massecuite is led by the ducts into the downtake instead of being held up above a circulating denser massecuite below. A central duct 80 held by brackets 81 in the centre of the downtake and nearly to the base of the pan directs part of the circulating stream onto this base, so preventing accumulation of a stagnant layer of heavier massecuite.



Continuous extraction of sugar from bagasse. W. KAETHER and W. DIETZEL, *assrs.* BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **3,501,345.** 14th December 1965; 17th March 1970.

Compression of the diffused bagasse (cf. UK Patent 1,145,784[1]) is obtained by a series of rollers 24, 25, 26, 27, 28 carrying an endless belt 41 such that the end roller 28 is nearer to the level of conveyor 14 of the diffuser than are the other rollers.



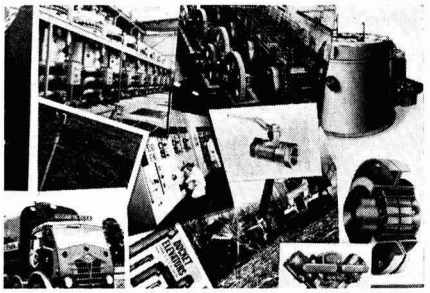
The end of the latter conveyor may also be replaced by an independent endless belt 41′ around a similar series of rollers. The compressed bagasse is broken up by the stripper arms 44′ of the revolving element 44 and discharged onto the belt 47 which takes it to the dewatering mill.

* * *

Sugar recovery from clarifier mud. R. KATZEN and A. E. HOKANSON, of Cincinnati, Ohio, USA, *assrs.* SUGAR CANE GROWERS COOPERATIVE OF FLORIDA INC. **3,501,346.** 22nd December 1966; 17th March 1970.

Clarifier mud is adjusted to pH 7–10 (7·5–9) and a temperature of 170–210°F (180–200°F) and sufficient flocculant added to obtain a content of about 1·5–5 p.p.m. (1·5–2·25 p.p.m.) on raw juice. It is then subjected to three-stage treatment in one or more solid-bowl centrifuges, the solids from the first stage being washed with an extraction liquid and the solids from the second stage being washed with water before treatment. The washings obtained from the third stage treatment is used as the extraction liquid for the second stage, while the washings from this and the juice recovered from the first stage are sent directly to the evaporator.

[1] *I.S.J.*, 1970, **72**, 59.

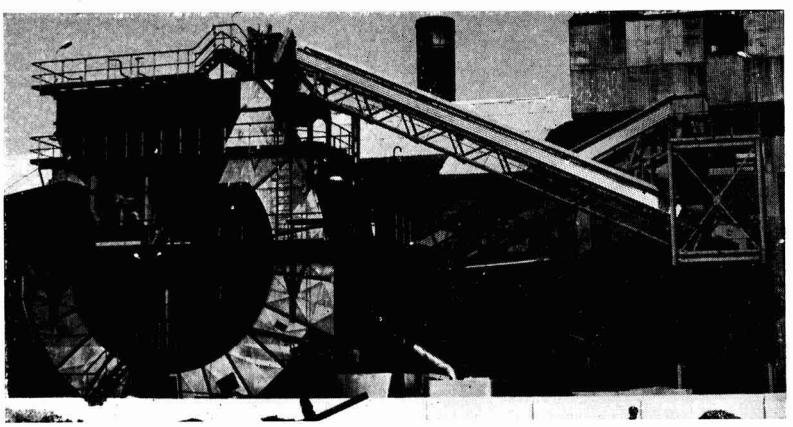


Trade notices

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

"Saturne" cane diffuser. Sucatlan Engineering, 18 Avenue Matignon, Paris 8e, France.

The illustration shows the "Saturne" cane diffuser[1] installed at Málaga, Spain, a full account of which is given in a new booklet with the text in Spanish, English and French. This unit employs maceration, i.e. total immersion of the bagasse in extraction liquid, instead of percolation and thereby achieves greater flexibility in throughput and greater tolerance in the preparation of the bagasse. Operation is under sterile conditions with protection from the effects of air. It is insulated, so reducing heat losses, and gives better extraction in a shorter time, while increasing the capacity of the factory. In addition, mud in the juice is evenly distributed and does not form an impermeable layer so that the press water need only be screened and not settled.



The diffuser employs an annular, vertical fixed container of rectangular cross-section, and of 12 m (40 ft) outside diameter, completely smooth on the inside and water-tight in the lower part which contains juice. Within the tube is a circular girder carrying radial rectangular screens which divide the interior of the container into compartments; the girder is supported and located at the top by rollers which keep it perfectly in the centre of the annulus, and it is rotated by a hydraulic jacking mechanism. Cane passes through two sets of knives and a first mill and is elevated to a Donnelly chute through which it falls to the open top of the annulus, filling a compartment which then descends into the closed section of the container as the ring rotates. Heated and limed diffusion juice is recycled onto the bagasse (using about 5 parts of juice to one of bagasse) and this adjusts its pH and temperature to desired levels (6·1 and 75°C) during a scalding time of 5 minutes.

The bagasse is carried round during a further 15 minutes against a flow of progressively more dilute liquid and enters a drainage section after which it is discharged by gravity on reaching the section of the annulus where the inside plate is omitted, leaving the compartment bottomless. The bagasse falls to a pressure extractor in the form of two cylinders having a clearance of 20 cm and rotating slowly under hydraulic pressure. The lower, larger cylinder has a perforated surface and allows expressed juice to pass into it whence it is drained off, while the bagasse then passes to a dewatering mill. The combined press water is screened, limed, heated and returned to the diffuser and flows down through the rinsing bagasse, becoming progressively richer in sucrose. As diffusion juice it is withdrawn from near the bottom of the diffuser, part recycled as scalding juice, and the remainder sent to process.

It was not possible to build a pilot plant in miniature because of the time of contact necessary, while a plant of adequate diameter would have a width of only 20 cm for a cane throughput of 100–200 t.c.d.; this would have been disproportionately expensive and so a full-scale 1000 t.c.d. unit was built and installed at Málaga, within easy reach of Paris, where the owners of the 1150 t.c.d. factory wished to raise its capacity to 1800 tons. The unit was operated with very heterogeneous cane because of poor knife and shredder work, and the dewatering mill was not properly grooved to handle the diffused bagasse. Nevertheless the diffuser achieved good extraction (0·426 ratio of sucrose % diffuser bagasse to sucrose % diffusion juice, which compares favourably with

[1] *I.S.J.*, 1970, **72**, 147.

the figure of 0·483 quoted by HUGOT and 0·444 quoted by GRAHAM). Power consumption was only 10 h.p. for a throughput of 1100–1200 t.c.d., and as a result there were no signs of wear and tear at the end of the season. The pressure extractor only consumed 20 h.p. and also showed no wear.

* * *

Refinery computer installation. Hewlett-Packard Ltd., 224 Bath Road, Slough, Bucks., England.

The Thames refinery of Tate & Lyle Refineries Ltd. has been equipped with a Hewlett-Packard computer as part of a control system to improve reliability of sugar throughput and to reduce fuel consumption. The system, designed by Tate & Lyle engineers, will enable the plant to handle an extra five tons of sugar per hour when necessary and, in addition to reducing steam consumption by 3–5%, is expected to minimize sugar loss resulting from heat effects. Certain sections of the main sugar liquor stream will be controlled solely by signals generated by the computer which is connected to sensors in the process plant. Supervisory advice will be provided at some manually-operated sections for the guidance of operators. In addition to minimizing engineering maintenance problems by eliminating misuse and overloading of plant, it is expected that maintenance specifically geared to plant needs will be a long-term result. This on-line computer installation is the first of its kind in the UK sugar industry.

* * *

PUBLICATIONS RECEIVED

BMA INFORMATION. Braunschweigische Maschinenbauanstalt, 33 Braunschweig, Postfach 295, Germany.

The latest issue (No. 9) of this magazine is devoted to sugar by-products and discusses many materials which may be obtained from molasses and bagasse, including animal fodder, alcohol, yeast, ether, acetaldehyde, acetic acid, etc., and refers to BMA equipment and expertise available in the establishment of plants for their manufacture. A section of news items refers to the new BMA beet sugar factory at Eghlid in Iran, an order for centrifugals for Indonesia, new sugar factories in Morocco and the Philippines, pulp dryers for Süddeutsche Zucker AG, etc.

* * *

SMITH-MIRRLEES SUGAR BULLETIN. A. & W. Smith & Co. Ltd.; Mirrlees Watson Co. Ltd., No. 1 Cosmos House, Bromley Common, Bromley BR2 9NA, England.

Issue No. 12 of this magazine is devoted to the Mirrlees fully-automatic batch centrifugal which is designed to incorporate not only the makers' ideas but also practical features suggested by experienced operators. It features box-section framework giving rigidity and ample strength but also clean lines, and also carries its own fluorescent light fittings. The suspension head is provided with a spherical-seat bearing housing with a greatly enlarged surface area. The flexible coupling has accurately-machined teeth and ample proportions to transmit motor torque and provide silent running. The emergency brake is a disc type unit with easy access; normal braking is, of course, fully regenerative. The discharge valve is a dropping cone type to give efficient discharge and clear inside of the basket for ploughing. The new mixer valve is a unique ball type of infinitely variable opening but offering rapid opening and shutting and completely clean massecuite cut-off. The monitor casing is of split construction for easy erection and dismantling, and incorporates built-in lighting. The redesigned plough is on a nitrided steel shaft to ensure long life and is pneumatically operated with safety interlocks. A separate panel of pneumatic controls is provided, which also includes signal lamps to indicate faults which may develop during running. A manual control box is provided for overriding manual control of the various stages of operation. The centrifugal is driven by a multiple-speed, pole-changing three-phase vertical induction motor with a special squirrel-cage rotor, carrying a tacho-generator which delivers the linear voltage necessary for the speed-dependent control of the machine. Temperature detectors give full thermal protection. Machines are available for all types of massecuite, 1000 or 1200 r.p.m. (1200 or 1500 r.p.m. for C-massecuites), and all have 15·0 cu.ft. baskets 48 in dia. and 30 in deep.

* * *

BGMA BUYERS' GUIDE. British Gear Manufacturers Association, P.O. Box 121, 301 Glossop Road, Sheffield, S10 2HN England.

This booklet comprises a list of the members of the Association with their addresses and types of gear products, and it also provides lists of makers of a number of general use gears and gear units.

* * *

TRAVELLING BRIDGE SLUDGE COLLECTORS. Rex Chainbelt Inc., P.O. Box 2022, Milwaukee, Wisconsin, 53201 USA.

Rex Chainbelt announce the introduction of a line of travelling bridge sludge collectors designed to remove settled solids and/or floating material from rectangular clarification tanks in water and waste water treatment applications. The units incorporate a sludge scraper blade carried by a wheel-mounted bridge spanning the tank width and travelling on rails. The collectors are available in three series covering tank widths up to 125 ft. Bulletin 315-6B1 gives full details.

* * *

D.G.I. AS Dansk Gaerings-Industri (Danish Fermentation Industry Ltd.), Fabriksparken 58, DK-2600 Glostrup, Copenhagen, Denmark.

A well-produced booklet gives information on D.G.I., a company established in 1918 to carry out control and advisory work for Danish and other yeast and alcohol plants and to conduct research work in fermentation and related fields. D.G.I. were responsible for the Z-method of yeast manufacture, which made possible the manufacture of compressed yeast without simultaneous alcohol production and which found world-wide acceptance. The brochure describes how D.G.I. can help with any problems associated with fermentation.

* * *

WEIGHERS. Autopack Ltd., Malvern Link, Worcs., England.

Numerous types of weighing, filling and packaging equipment manufactured by Autopack Ltd. are featured in a recent brochure. The weighers include the Autopack 272 electronic weighers and the Autopack 172 vibratory feed weigher, details of which are also to be found in separate leaflets as also in the case of the "Dialafil" auger filter (Leaflet 124) and the Model 165 polyethylene bag making and feeding machine (Leaflet 165). Amongst users of Autopack equipment are Tate & Lyle Ltd. in the UK, as well as other sugar refiners.

* * *

Iran sugar factory expansions.—Kermanshah sugar factory, erected by Salzgitter Maschinen AG in 1963, has been expanded from the original capacity of 1500 tons of beet per day to 3000 tons/day. The extended factory started operations in October 1970. In addition, Salzgitter Maschinen AG are carrying out extensions to Kavar sugar factory and are negotiating for the expansion of another Iranian sugar factory.

* * *

Westburn sugar refinery storage expansion.—A new £200,000 extension to the storage system at Westburn Sugar Refineries Ltd., Greenock, Scotland, is to be completed soon. It has been design by IDC (Scotland) Ltd., of Edinburgh and includes new warehousing to hold approximately 3000 tons of refined sugar in bags stacked on pallets. A specially designed conveyor system is included to move bags from the refinery to the warehouses at the rate of 25 tons/hour.

Brevities

Filtration equipment exhibition. Filtech/71, the International Filtration and Separation Exhibition, is to be held at Olympia, London during the 28th September–1st October 1971. Almost every British manufacturer of filters will be exhibiting while there will be stands with equipment from Belgium, France, Germany, Holland, Ireland, Japan, Sweden, the USSR and USA. All kinds of filters from thimble-sized to giants weighing 15 tons and more will be exhibited and the Filtration Society is to hold a concurrent conference with the theme of "Filtration in process plant design and development". Authors should send four copies of titles and synopses as soon as possible to the Hon. Secretary, The Filtration Society, 1 Katherine Street, Croydon CR3 1LB, England, from which address can also be obtained further information regarding the exhibition.

* * *

Caroni Ltd. 1969/70 report.—The Company incurred the most substantial loss in its history during the year ended 30th June 1970. Although a near-record crop was reaped in Trinidad, 11·84 tons of cane were required to make a ton of sugar compared with a figure of 10·25 tons in 1969 and 10·14 in 1968. Production, at 196,668 tons of sugar, was at least 31,000 tons less than would have been the case with normal yields, and compares with 213,444 tons in 1968/69. The phenomenon of the low yield of sugar from cane (the lowest for more than 30 years) has been experienced throughout the sugar industries of the Caribbean and as a result sugar production has been abnormally low. The Government of Trinidad and Tobago has purchased a controlling interest in the Company, so putting the destiny of the industry in local hands and under local control.

* * *

Computer installation for Australian sugar factory[1].—The first computer installation in an Australian sugar factory is to be installed at Mossman Central Mill early this year. It is to be an IBM 1800 process control system and will be used in the areas of cane reception, sampling and payment, cane crushing and plant operation. Installation will be a start towards closed-loop control by computer of the process of sugar production.

* * *

Spanish sugar industry rationalization[2].—A national reorganization programme for the sugar industry of Spain has the following objects for the period 1970–78: the average slicing capacity is to be raised to more than 3000 metric tons of beet per day in place of the current 1670 tons; all the factories are to be equipped with analytical laboratories, mechanical loading of beets, continuous diffusers and automatic installations for sugar and pulp storage; 12 sugar factories with slicing capacities between 700 and 1400 tons of beet per day will be permanently closed, while 8 new ones will be built and 3 existing factories enlarged.

* * *

Ivory Coast sugar project[3].—The Ivory Coast Government is to establish a joint project with Lonrho Ltd., valued at £14,000,000, which will make the Ivory Coast independent of sugar imports. The project includes a sugar refinery and cubing plant. It is planned that by the end of 1973 production will be 50,000 tons of sugar per annum.

* * *

Egypt sugar expansion[4].—About £E 75,000,000 is to be invested by the Egyptian sugar industry in an expansion programme to raise production from its present 546,000 tons/year to 750,000 tons/year by 1975. During the same five-year period, the cane area in Upper Egypt is to be increased from 130,000 to 200,000 feddans.

Indian sugar situation[5].—Production in the 1969/70 crop totalled 4,260,005 metric tons, compared with 3,559,004 tons in the previous crop. Exports were higher at 212,000 tons compared with 74,000 tons, and consumption increased markedly from 2,678,479 tons in 1968/69 to 3,476,028 tons in 1969/70. In neither year, however, were consumption and exports greatly enough increased to account for the increases in production, and stocks rose from 448,524 tons at the beginning of the 1968/69 crop to 1,225,049 tons by its end, and to 2,088,123 tons by the end of September 1970. The vast distribution problem which prevails in India makes it advantageous to hold substantial supplies to meet domestic needs, nevertheless this level would appear to be far too high; the SEN Commission suggested that stocks should be of the order of 800,000 tons and forecast a consumption in 1970/71 of 3,760,000 tons. Current indications are that 1970/71 production will be a little below that of 1969/70 and, when India's export entitlement under the ISA and US Sugar Act are taken into account, it may be that the level of stocks will be held in check, with a possible reduction in the following year.

* * *

Süddeutsche Zucker A.G. rationalization[6].—Suddeutsche Zucker A.G. of Mannheim, West Germany, is planning to concentrate sugar production in a few factories; its plant at Gross-Gerau is to be extended to a slicing capacity of 5800–6000 tons of beet per day by the middle-seventies, while the sugar factory at Worms is to be closed after the 1974/75 campaign. A new sugar factory with a daily capacity of 6000 tons is presently under construction at Offenau, near Heilbronn, which will replace the existing factories at Heilbronn, Stuttgart and Züttlingen. The Waghäusel sugar factory is to be modernized and considerably extended to be ready, like the new Offenau factory, for the 1971/72 campaign. Production of the company's ten currently-working factories is more than 500,000 tons of sugar from 3,900,000 tons of beets; after the rationalization equal production will be achieved by seven plants.

* * *

Taiwan sugar production target, 1971[7].—Taiwan's sugar production is to reach 780,000 metric tons in 1971, an increase of 100,000 tons on that of 1970. An effort is to be made to obtain a higher quota for exports to the USA.

* * *

West Germany sugar beet crop, 1970[8].—The 1970 West German beet crop totalled 13,278,879 metric tons, compared with 13,214,763 tons in 1969, according to the West German Sugar Association. The average sugar content of the beet was 16·04% against 16·28% the previous year. The Association puts final sugar production at 1,850,000 tons, white value, as against 1,907,000 tons in 1969.

* * *

Colombia sugar exports reduction[9].—Colombia is to reduce its sugar exports to the world market by 30,000 tons, representing an exchange loss of $2,500,000, so as to ensure that the home market is adequately supplied.

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[1] *Producers' Review*, 1970, **60**, (9), 63.
[2] *Sucr. Franc.*, 1970, **111**, 503.
[3] *The Times*, 30th November 1970.
[4] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (32), 8.
[5] C. Czarnikow Ltd., *Sugar Review*, 1970, (999), 209–210.
[6] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (30), 5.
[7] *The Times*, 28th November 1970.
[8] *Public Ledger*, 9th January 1971.
[9] *Bank of London & S. America Review*, 1970, **4**, 633.

Sugar Technological Forecast programme.—The International Sugar Research Foundation decided at its meeting in October 1970 to implement a Technological Forecast covering all ramifications of the sugar industry in the next decade. An outside consultant will examine pertinent phases of social, medical, technological and economic aspects of world cultures as each could pertain to the marketing of sugar in 1975 and 1980. The output of the study will be used in selecting goals for the Foundation's research programme. The first stage of the forecast, covering the North American continent, will be completed by September 1971.

* * *

British Honduras sugar production, 1969/70[1].—Sugar outturn from the 1969/70 crop in British Honduras totalled 66,785 tons, produced from 676,176 tons of cane, while 26,397 tons of molasses was also produced. In the previous crop, 528,720 tons of cane yielded 52,138 tons of sugar and 18,686 tons of molasses. Of the 1969/70 total, 38,905 tons were manufactured at Libertad factory in the Corozal district, while the remaining 27,880 tons were produced at the Tower Hill factory.

* * *

Ceylon sugar imports 1969[2].—Imports of sugar into Ceylon totalled 313,379 metric tons, refined value, in 1969, compared with 222,583 tons in 1968. Suppliers included Yugoslavia with 102,186 tons, Cuba with 63,595 tons, USSR (44,692 tons), East Germany (30,768 tons), Poland (30,209 tons), Rumania (28,708 tons), Czechoslovakia (11,219 tons), and Hungary (2002 tons).

* * *

Colombia sugar expansion plan[3].—Colombia plans to increase sugar production and to invest $8,500,000 to meet growing international and domestic demand. The scheme includes the construction of a mill at Virginia, south-east of Bogotá, to process 3000 tons of cane per day and produce about 60,000 tons of sugar per year. Operations are expected to start in about March 1972.

* * *

India sugar industry nationalization study[4].—The Indian Government has appointed a Commission to inquire into the working of the sugar industry and to report by August 1971. This has resulted from a call by the Government of Uttar Pradesh for nationalization of the entire industry by the Central Government on the grounds that nationalization by the State Government of the UP industry would be unconstitutional; the Attorney-General's view is that the State Government is competent to take over mills within its boundaries. With formation of the Commission, however, the matter is shelved for a year, and the Government will be provided with a survey on the working of the industry in the whole country, including the causes of "sick mills", and a report on the pattern of reorganization in the context of demand for nationalization.

* * *

New Indonesian sugar factory[5].—Indonesia's newest sugar factory was inaugurated in September 1970. The factory, built with Polish aid at Tjot Girek, in Atjeh Province, in the northern tip of Sumatra, has a daily processing capacity of 2500 tons of cane.

* * *

Jamaica sugar production, 1970[6].—Sugar production in Jamaica in 1970 totalled 368,337 tons, according to the Sugar Manufacturers' Association. This is 8162 tons more than the 1969 crop.

* * *

New USSR sugar factories[7].—Two new sugar factories have been completed in the Soviet Union, both with a slicing capacity of 3000 tons/day. One is located at Gyrbov in the Moldavian Republic and the other, built by a Polish supplier, at Cherkask in the Ukraine. The capacity of the latter factory is to be increased in 1971 to 5000 tons of beet per day.

* * *

Cameroun sugar crop, 1969/70[8].—Production for the 1969/70 crop was 12,330 tons, two-thirds of which was extracted from the local cane crop of 110,000 tons, the remainder being imported from Congo (Brazzaville).

New Moroccan sugar factory[9].—Agreement has been signed between the Moroccan Government and private companies for the erection of an eighth sugar factory. This will be the first in the country to be designed for both beet and cane processing. The first stage will be for a daily beet slice of 3000 tons, while the second phase will involve the installation of plant for a crushing capacity of 4000 tons of cane/day. The factory, to be located in the Berkana region, is planned to start operations in 1972 and will raise the Moroccan sugar production capacity to 280,000 tons per annum. The sixth factory, at Doukkala, 200 km south-west of Casablanca, in the province of El Jadida, was inaugurated in July 1970[10]. It has a slicing capacity of 2400 tons of beet per day and was built by Soc. Fives Lille-Cail.

* * *

New Malaysian sugar factory plans[11].—The Government of Negri Sembilan plans a joint enterprise with Phaltan Sugar Works Ltd. of India for establishment of a sugar cane plantation of 25,000 acres as well as the building of a sugar factory. The costs are expected to total 40 million Malaysian dollars and sugar production is expected to reach 20,000 tons per year.

* * *

Barbados sugar crop 1970.—The sugar crop in 1970 was reduced by cane fires and this caused a loss by factories of 18% of their grinding time. In consequence the sugar production reached only 153,923 tons which, although better than the 138,521 tons reached in 1969, is 12,000 tons less than the previous three-year average.

* * *

St. Kitts sugar crop, 1970.—The sugar crop in St. Kitts ended in October with 324,662 tons of cane crushed to yield 27,163 tons of sugar, giving a cane:sugar ratio of 11·95:1. Over 58,000 tons of cane were left unreaped in the fields[12]. Heavy rains (up to 14 inches in 7 hours at one period) caused damage and poor juice in the cane. There was a shortage of cane cutters and the St. Kitts Government agreed to the importation of mechanical harvesters and the recruitment of cane cutters from outside the island; unfortunately the imported mechanical harvesters did not function properly under the local conditions and were returned. Experiments on cane by-products have continued, involving bagasse building board and animal feed. A new cane price agreement, to extend until 1973, allows for payment on the basis of cane sugar content instead of weight alone.

* * *

Thailand sugar factory conversion to refinery[13].—According to an announcement by the Ministry of Industry, the Supanburi sugar factory is to be reconstructed as a sugar refinery which will be the first in Thailand. At present none of the existing factories in the country can produce refined sugar, but refineries are planned for other areas.

* * *

Indian sugar factory project[14].—A cooperative sugar factory is proposed for the former Portuguese territory of Goa, and it is hoped to complete the plant by Goa Liberation Day, 19th December 1972. The factory, which will be known as the Sanjivani Sahakari Sakhar Karkhana, will be located at Usgaon Tisk, Tilliyem, Ponda Taluka and will have a capacity of 1250 metric tons of cane per day. The factory will cost Rs. 14,500,000 (over £800,000).

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[1] *W. Indies Chron.*, 1970, **85,** 509.
[2] *Lamborn.* 1970, **48,** 162.
[3] *Reuter's Sugar Rpt.*, 16th September 1970.
[4] *Financial Times*, 29th September 1970.
[5] *Reuter's Sugar Rpt.*, 21st September 1970.
[6] *Public Ledger*, 17th October 1970.
[7] F. O. Licht, *International Sugar Rpt.*, 1970, **102,** (28), 5.
[8] *Barclays Overseas Review*, December 1970, 18.
[9] *Zeitsch. Zuckerind.*, 1970, **95,** 501.
[10] *Agence France-Presse*, 25th July 1970.
[11] F. O. Licht, *International Sugar Rpt.*, 1970, **102,** (33), 6.
[12] *Barclays Overseas Review*, December 1970, 56.
[13] F. O. Licht, *International Sugar Rpt.*, 1970, **102,** (33), 6.
[14] *Sugar News* (India), 1970, **2,** (4), 3–4.

Courtesy of Hawaiian Sugar Planters Association

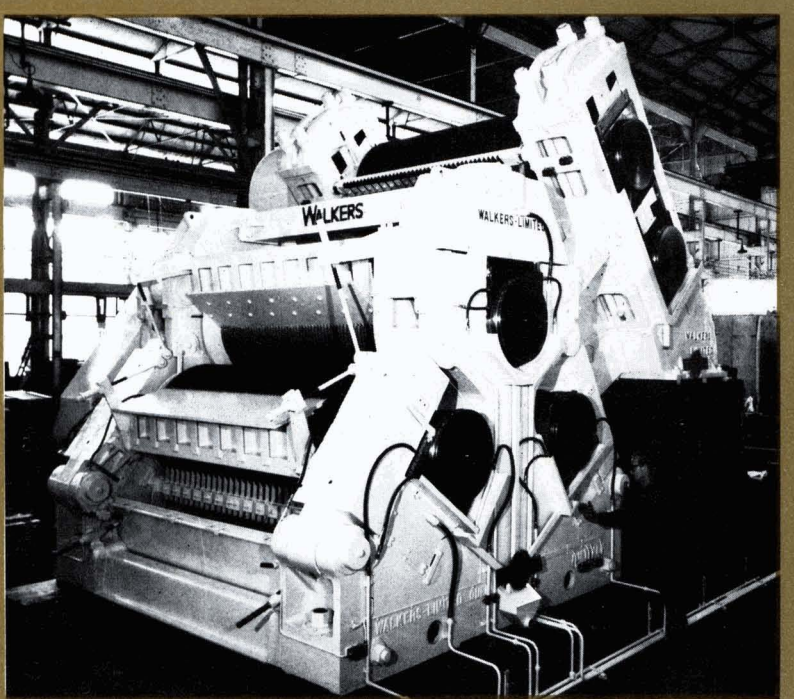
This ancient sugar mill stands in the grounds of the Experiment Station of the H.S.P.A. in Honolulu.

It has rollers made of granite 3 ft. in diameter and 2 ft. high. As can be seen, wooden cogs were morticed into the roller to form the gearing between them.

The roller shafts were of wood about 6 in. diameter but were not continuous, each shaft end being driven into an octagonal hole cut into the roller ends. The bearing surfaces were protected with iron bands.

Such mills were imported to the islands from China and were fairly common in the early part of the 19th century, and there exists a record of one being imported in 1821. The driving power was manual, through the branch of a tree, also imported with the rollers.

It may be truthfully said that these mills were the first to be used in Hawaii, and WALKERS LTD. believe that the latest and most modern mill in Hawaii is the five roll dewatering mill installed at the Paia factory of The Hawaiian Commercial Sugar Co. of Maui. It is shown here.



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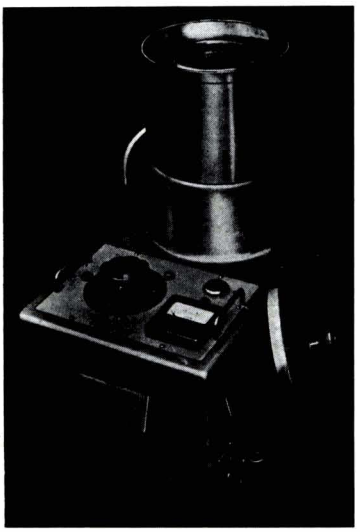

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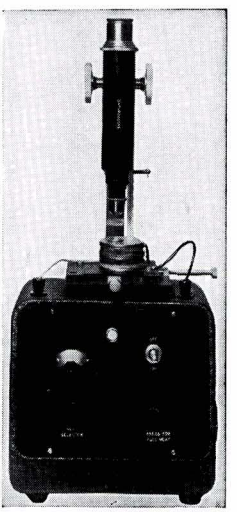

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