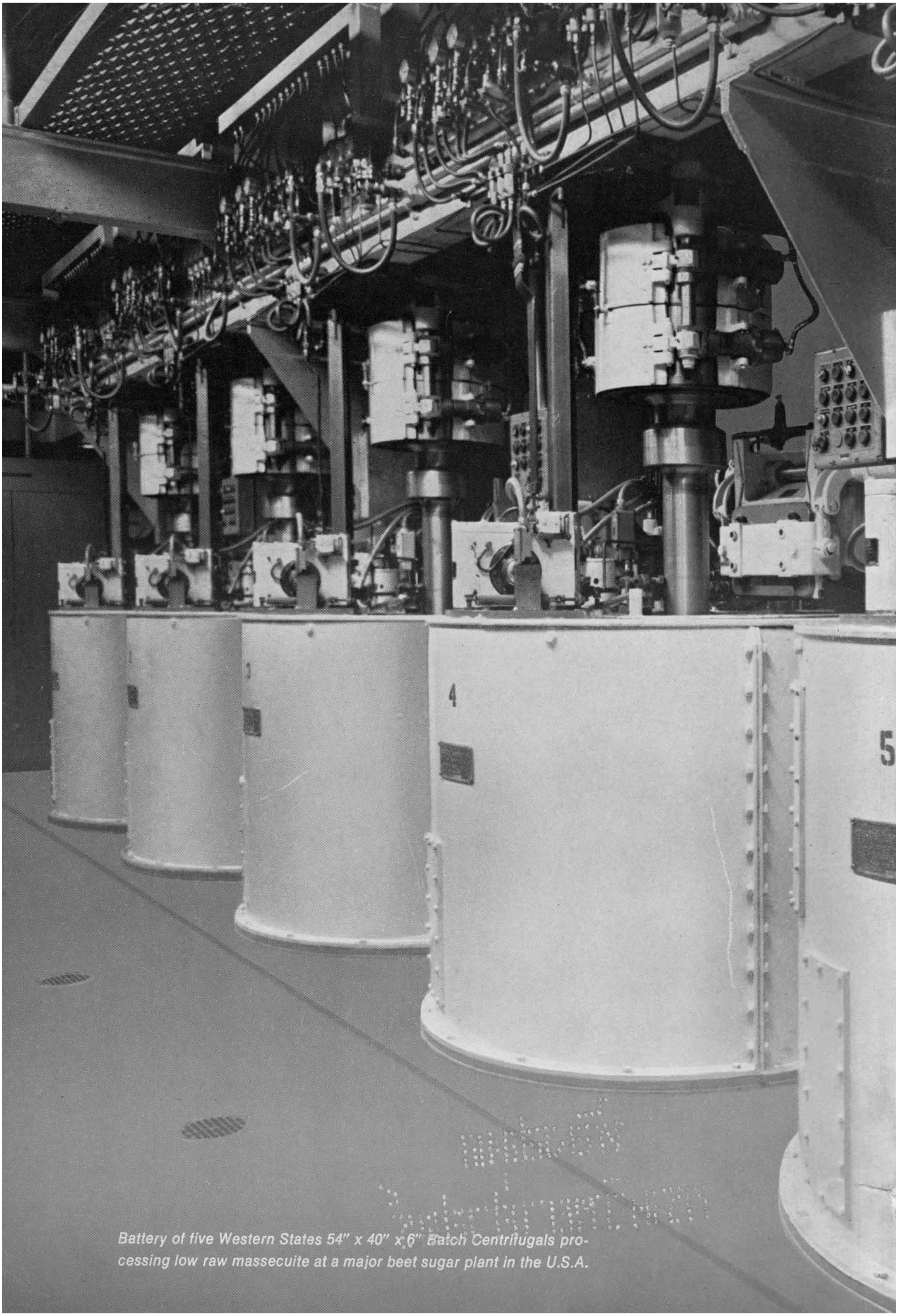
THE **International Sugar Journal**

JANUARY 1970



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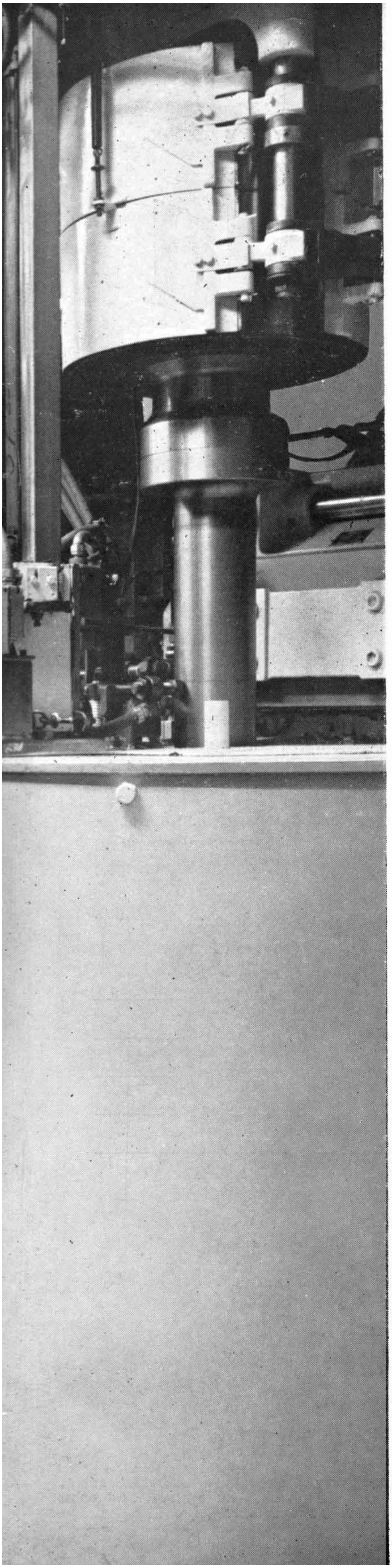

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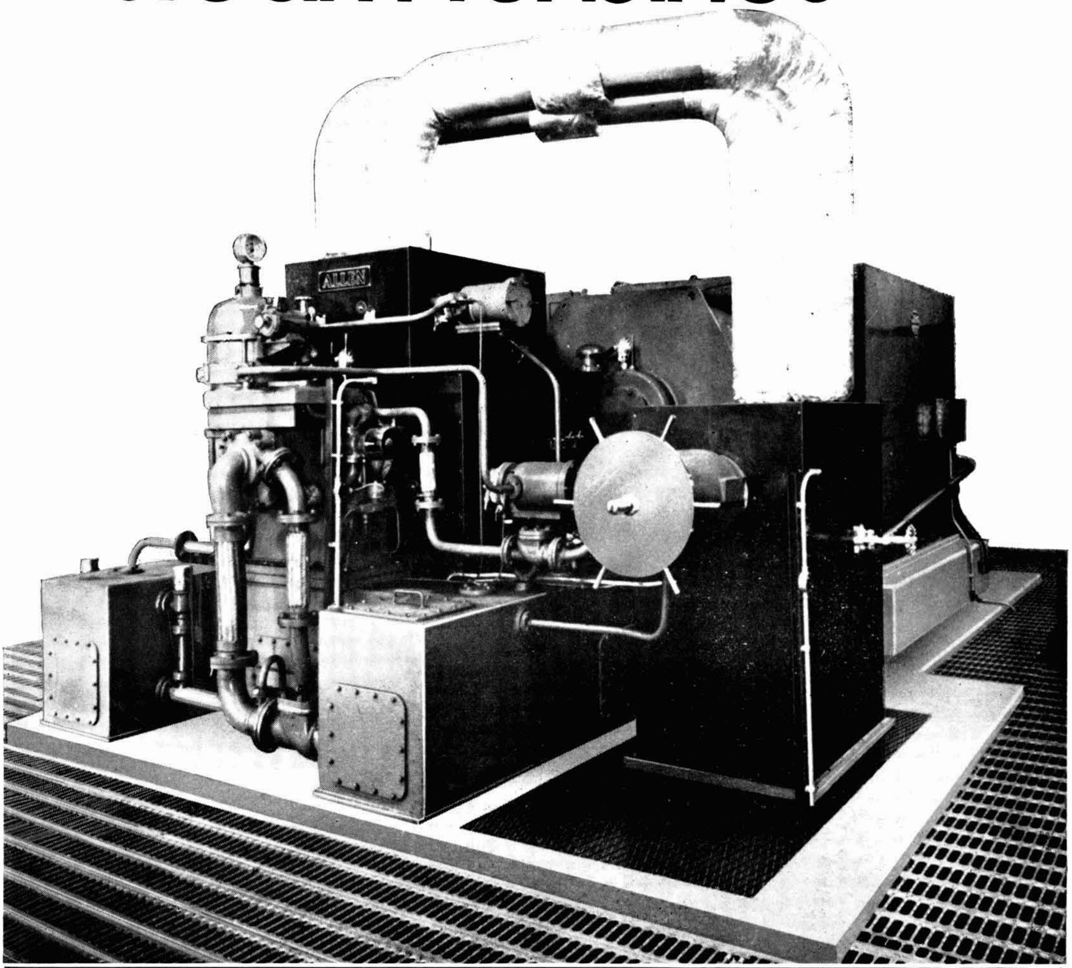
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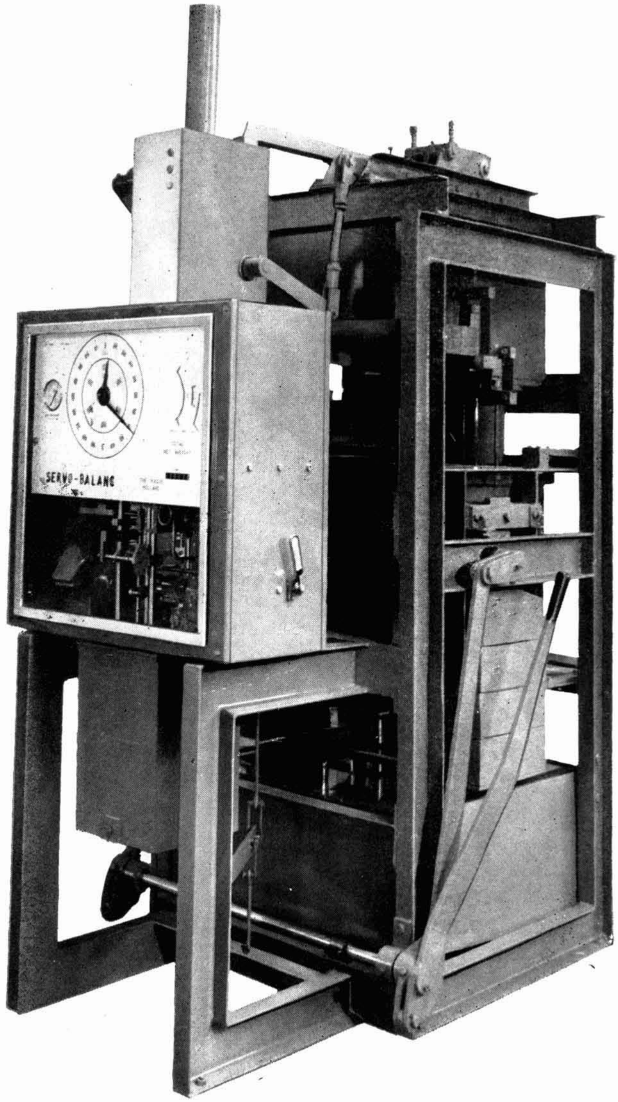

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Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

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Annual Subscription: 50s 0d or $8.00 post free
Single Copies: 6s 0d or $1 post free

January 1970

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Une méthode de routine pour l'analyse de l'acide lactique est décrite. Elle consiste en la séparation de l'acide lactique des sucres et des éléments cationiques par échange ionique, l'oxydation par une solution de sulfate cérique et la récolte, après distillation, de l'acétaldéhyde formé dans une solution tamponnée de semi-carbazide. Par la mesure à 224 nm de la densité optique de l'acétaldéhyde semi-carbazone, on peut déterminer la teneur en acide lactique (par référence à une courbe standard).

* * *

Le sort de quelques-uns des principaux acides aminés du jus de canne lors de la formation de mélasses. IVe partie. Estimation de la vitesse de fixation des acides aminés constitutifs du jus de canne par des polymères "modèles" finaux responsables du processus de brunissement dans les mélasses en utilisant des acides aminés marqués au carbone-14. W. W. BINKLEY. *p.* 5–7

Dans les tests décrits, les acides aminés du jus de canne se présentaient de la manière suivante par ordre décroissant pour ce qui est de la vitesse de fixation par les polymères "modèles" responsables du processus de brunissement dans les mélasses: acide γ-aminobutyrique, acide glutamique, proline, asparagine, acide aspartique et alanine. On en déduit que les polymères résultants sont constitués en majeure partie des polymères de "brunissement" a base d'asparagine en raison de l'abondance d'asparagine dans le jus de canne, son niveau de fixation élevé au début de la réaction par les produits de "brunissement" et son taux de participation modéré dans les étapes ultérieures de la polymérisation.

* * *

Raffinage du sucre—Notes sur les opérations unitaires. Ve Partie. Station de récupération et appauvrissement des mélasses. F. M. CHAPMAN. *p.* 7–13

L'auteur passe en revue les différents processus mis en oeuvre dans la station de récupération dans les raffineries, c.-à-d. au cours de la cuisson, du refroidissement et du réchauffage de la masse-cuite et au cours du clairçage dans les centrifuges. Il se base sur les travaux d'autres chercheurs ainsi que sur sa propre expérience acquise chez Tate & Lyle Ltd.

Die Bestimmung der Milchsäure bei der Rübenzuckerherstellung. Teil I. J. F. T. OLDFIELD und M. SHORE. *S.* 3–4

Es wird eine Schnellmethode zur Milchsäurebestimmung beschrieben, bei der die Milchsäure von den Zuckern und den als Kationen vorliegenden Substanzen mit Hilfe von Ionenaustauschern abgetrennt und mit Cer(IV)-Salz-Lösung oxydiert wird. Der entstehende Acetaldehyd wird abdestilliert und in gepufferter Semicarbazidlösung aufgefangen. Die Milchsäure wird dann aus der optischen Dichte des Acetaldehyd-semicarbazons bestimmt, die bei 224 nm durch Vergleich mit einer Standardkurve ermittelt wird.

* * *

Ueber das Verhalten einiger wichtiger Aminosäuren des Zuckerrohrsaftes bei der Melassebildung. Teil IV. Untersuchungen über das Ausmass des Einbaus der im Zuckerrohrsaft vorkommenden Aminosäuren in die Bräunungsprodukte von Modellmelassen mit Hilfe von ^{14}C-markierten Aminosäuren. W. W. BINKLEY. *S.* 5–7

In den beschriebenen Versuchen zeigte sich, dass das Ausmass des Einbaus der im Zuckerrohrsaft vorkommenden Aminosäuren in die Bräunungsprodukte von Modellmelassen in folgender Reihe abnahm: γ-Aminobuttersäure, Glutaminsäure, Prolin, Asparagin, Asparaginsäure und Alanin. Es wird der Schluss gezogen, dass am Aufbau der Bräunungsprodukte im wesentlichen das Asparagin teilnimmt, und zwar aus folgenden Gründen: Asparagin kommt im Zuckerrohrsaft in grösserer Menge vor, es wird im frühen Stadium der Reaktion in hohem Masse in die Bräunungsprodukte eingebaut, und schliesslich wird es auch noch in den späteren Verlauf der Bräunungsreaktion einbezogen, wenn auch nicht mehr in gleichem Ausmass.

* * *

Zuckerraffination—Bemerkungen über Grundoperationen. Teil V. Zuckergewinnung und Melasseerschöpfung. F. M. CHAPMAN. *S.* 7–13

Der Verfasser gibt einen Ueberblick über die Einzeloperationen, in welche die Zuckergewinnung in Raffinerien zerfällt, nämlich Kochprozess, Abkühlen und Erwärmen der Füllmasse sowie Schleudern in den Zentrifugen. Er bezieht sich dabei auf die Arbeiten von anderen Autoren sowie auf seine eigenen Erfahrungen bei der Tate & Lyle Ltd.

La medida de ácido láctico en la elaboración de azúcar de remolacha. Parte I. J. F. T. OLDFIELD y M. SHORE. *Pág.* 3–4

Un método rutino para la determinación de ácido láctico se describe, en el cual el ácido láctico se separa de azúcares y material catiónico por medio de una técnica de cambio de iones. El ácido se oxida con solución de sulfato cerico, y el acetaldehido resultante se destila y se acumula en una solución tamponado de semicarbazido. Se determina el ácido láctico de la densidad óptica de la semicarbazona de acetaldehido, medida a 224 nm por referencia a una curva normal.

* * *

El destino de algunos de los principales amino-acidos de jugo de caña durante la formación de melaza. Parte IV. Estimación de la velocidad de entrada de los amino-acidos constitutivos de jugo de caña en modelos polímeres apardantes de melaza final de caña, utilizando amino-ácidos rotulados con carbón-14. W. W. BINKLEY. *Pág.* 5–7

En los ensayos que se describen, los amino-ácidos de jugo de caña se encontran en el ordén séquito de velocidades disminuciendos de entrada en modelos polímeres apardantes de melaza: ácido γ-aminobutírico, ácido glutámico, prolina, aspáragina, ácido aspártico y alanina. El autor deduce que los polímeres resultantes son esencialmente polímeres apardantes basado sobre aspáragina a causa de la plenitud de aspáragina en jugo de caña, su alta nivel de entrada en los productos apardentes a las etapas tempranas de la reacción, y a causa de su persistente velocidad moderada de participación en las etapas más tardes de polimerización.

* * *

Refinación de azúcar—Notas sobre procesos unitarios. Parte V. Trabajo de recuperación y agotamiento de melaza. F. M. CHAPMAN. *Pág.* 7–13

El autor examina los procesos individuales que se envolven en el trabajo de recuperación en refinarias, como cocción en tachos, enfriamiento y recalefacción de masa cocida, y separación en centrífugas. Refiere al trabajo de otros así como su propria experiencia a Tate & Lyle Ltd.

THE INTERNATIONAL SUGAR JOURNAL

VOL. LXXII | JANUARY 1970 | No. 853

Notes & Comments

International Sugar Council.

Members of the International Sugar Council met in London during the 17th–21st November and were able to dispose of half of their agenda very quickly so that the Chairman, Sr. ADRIAN LAJOUS of Mexico, was able to issue a statement on the first day, as follows:

"The Council accepted an estimate of total free market import demand for 1970 of 8·6 million tons prepared by the Statistics Committee and adopted by the Executive Committee, noting that this estimate did not include any allowances for the effects of the recent prohibitions by a number of countries of the use of cyclamates for human consumption purposes. In this regard, the Council noted the tentative view of the Statistics Committee that, with the important exception of Japan, these prohibitions would have very limited impact on total net import demand from the free market. Nevertheless, because of the significance of Japan in the world free market and the special factors applying to the former usage of cyclamates in Japan, the Council recognised that this factor could ultimately have an important effect on free market demand in 1970.

"The Council also accepted that supplies from non-Members in 1970 could be of the order of 1·2 million tons, but noted the very large uncertainties involved in making any such estimate at this stage.

"The Council accepted that it was not possible at this time to derive any reliable estimate of the aggregate level of shortfalls likely from Members in 1970, but considered that some shortfalls were inevitable and recognised that this factor might exert an import influence on the market—as, indeed, it did in 1969.

"On the other hand, the Council noted that export entitlements of some Members in 1970 could be increased via allocations from the Hardship Relief Fund.

"Taking all these factors into account, the Council unanimously decided that it was appropriate to set initial quotas in effect for 1970 at 90% of Basic Export Tonnages. The Council also heard a statement by the USSR delegation, that under present circumstances they would agree to a limitation on the exports by the USSR to the free market in 1970 remaining at 1·1 million tons. The Council was pleased to accept this statement.

"In making these decisions the council was conscious of the need to keep the market situation under continuous review throughout 1970, when it would be possible to progressively refine estimates of the likely level of supplies from non-Members, possible shortfalls by Members, etc."

The item concerning the USSR was welcome news since fears had been expressed that the free market might be faced with a substantial amount of white sugar from East European countries to whom Cuba had supplied raw sugar.

On the 21st November a further statement was issued: "The Council of the ISO concluded its deliberations at noon today. In addition to fixing initial export quotas for 1970 at 90% of the basic export tonnages of Members concerned and making the administrative and financial arrangements necessary for the coming year, the Council elected Mr. R. E. LATIMER (Canada) as Chairman and Mr. A. LAJOUS (Mexico) as its Vice-Chairman for 1970. The Council appointed the Executive, Credentials, Supply Commitment and Hardship Relief Committees for 1970. The Rules dealing with Supply commitment[1] were considered by the Council and were referred back to the Executive Committee for consideration in the light of such comments as might be made in their connexion by Members before 15th January 1970 and they will be considered first by the Executive Committee and then by the Council early next year. The Rules as would then be approved by the Executive Committee would be deemed to have been temporarily adopted, but would be subject to formal adoption by the Council at its next session in March 1970. Arrangements were also made to ensure that the principles included in the draft Rules under Article 30 would be appropriately reflected in commercial contracts between the Members concerned."

[1] See *I.S.J.*, 1969, **71**, 353.

European sugar production 1969/70.

At the end of October the International Association for Sugar Statistics published the results of their inquiry into the beet tonnages and sugar crops expected by the officials of the various member countries of the Association. These have been reproduced by F. O. Licht K.G.,[1] together with his latest estimates for the four non-member countries, Greece, Ireland, Italy and Yugoslavia, and are reproduced below:

BEET TONNAGE

	Estimate 1969/70	1968/69
	(*metric tons*)	
Austria	2,133,000	1,935,791
Belgium	4,400,000	4,450,000
Denmark	1,970,000	2,243,000
Finland	403,000	441,087
France	16,800,000	15,565,000
Germany, West	13,350,000	13,951,140
Greece*	1,037,000	662,811
Holland	5,000,000	5,241,352
Ireland*	900,000	1,093,050
Italy*	10,200,000	11,100,000
Spain	4,900,000	4,700,000
Sweden	1,573,000	1,981,543
Switzerland	430,000	453,075
Turkey	3,615,000	4,715,578
UK	6,400,000	7,118,206
Yugoslavia*	3,626,000	2,781,830
	76,737,000	78,433,463

SUGAR OUTPUT

	(*metric tons, raw value*)	
Austria	344,000	299,234
Belgium	650,000	588,000
Denmark	310,000	347,777
Finland	52,000	50,087
France	2,611,000	2,433,289
Germany, West	2,046,000	2,019,365
Greece*	146,000	97,919
Holland	750,000	734,806
Ireland*	147,000	160,944
Italy*	1,390,000	1,322,000
Spain	745,000	707,916
Sweden	236,000	303,551
Switzerland	64,000	69,310
Turkey	562,000	721,613
UK	950,000	997,305
Yugoslavia*	524,000	398,691
	11,527,000	11,251,707

* F. O. Licht estimates.

The unusually warm dry weather in October is reflected in the estimates which are higher than would have been anticipated some weeks earlier, and which result from higher sucrose contents. Thus, the total sugar output for 1969/70 is set at 11,527,000 metric tons, compared with Licht's estimate of 11,334,000 tons made a month before. A measure of the higher sugar content of the beets is given by the forecast 275,293 tons of sugar (2·45%) more than last year in face of the fall of 1,696,463 tons (2·17%) in the anticipated beet crop.

* * *

World sugar production 1969/70.

Estimates of world sugar production during the current crop year have recently been published by C. Czarnikow Ltd.[2], F. O. Licht K.G.[3] and the US Dept. of Agriculture. There is close agreement in most cases but there is a considerable difference in the crops expected for Cuba and the USSR between the USDA's and the other estimates; the USDA expects 8,000,000 short tons (7,260,000 metric tons) to be produced during the current Cuban campaign while Czarnikow and Licht, admitting that there are variations in the estimates of various observers, have set their figures lower at 6,750,000 long tons (6,858,000 metric tons) and 6,500,000 metric tons, respectively.

Corresponding estimates for the USSR are: USDA 11,000,000 short tons (9,979,000 metric tons), Czarnikow 8,875,000 long tons (9,017,000 metric tons) and Licht 9,500,000 metric tons. Thus the overall total expected by the USDA at 79,362,000 short tons (71,997,000 metric tons) is higher than the totals of Czarnikow—69,183,000 long tons (70,293,000 metric tons) and Licht—71,272,500 metric tons. The variations between the estimates for the USSR reflect the reliance placed on the reports from that country of the substantial reduction—up to 20%—resulting from bad weather and late sowings.

Again while Cuba is making a great effort in view of its well-publicized target of 10 million tons—even to including the small harvest of July-August which would normally have been included as part of 1969 production—opinions differ not as to whether but by how much the new crop will exceed the 4,650,000–4,700,000 tons of 1968/69. Even the lowest of the three estimates for Cuba—that of Licht— allows for a 40% increase on last year, and only time will tell whether or not this has been an under-estimate.

A further point to be noted is that, although the totals represent record levels, they still represent less than the anticipated consumption during the period so that stocks are likely to fall further during the year from their level of just over the "normal" of 25% of annual consumption at the end of the 1968/69 crop year. Such a reduction below "normal" stock levels augurs higher sugar prices during 1970.

* * *

Caroni Ltd. 1968/69 report.

Although it had been hoped that production for 1969 would show an increase over 1968, a drought held down yields so that the final figure of 213,444 tons was almost identical with that of 1968 (213,380 tons). All factories had uninterrupted production runs and in the field the extension of mechanical harvesting again contributed to the containment of reaping costs. 520,000 tons of cane were mechanically loaded and 120,000 tons reaped by combine harvesters; the corresponding figures for 1968 were 400,000 tons and 100,000 tons, respectively. Wherever fields in flat lands are being replanted, the opportunity is taken to ensure that their layout permits of mechanical harvesting.

[1] *International Sugar Rpt.*, 1969, **101**, (30), 1–3.
[2] *Sugar Review*, 1969, (945), 206.
[3] *International Sugar Rpt.*, 1969, **101**, (33), 1–4.

The measurement of lactic acid in beet sugar processing

Part I. A routine high precision method for the determination of lactic acid

By J. F. T. OLDFIELD and M. SHORE
(British Sugar Corporation Ltd., Research Laboratories, Colney, Norwich.

Introduction

MEASUREMENTS of the lactic acid content of molasses and beet sugar process juices have been carried out for many years using the *p,p'*-dihydroxy diphenyl colorimetric procedure of BARKER and SUMMERSON[1] applied to an eluate from an ion exchange column. The eluate is usually obtained from an anion exchanger in the carbonate[2] or hydroxyl[3] form after separation of the lactic acid from cationic material and sugars.

To obtain consistent results using this colorimetric procedure some modification of the water content of the sulphuric acid reagent is required[3]. Moreover some batches of Analytical Reagent-grade sulphuric acid yield little or no colour even at the 15 μg/ml level, possibly owing to traces of oxides of nitrogen[3]. The standard curve is not reproducible with this method and the total possible number of determinations which may be carried out in a day is limited by having to run a set of standards concurrently with each determination.

The use of strongly basic anion resin in the hydroxyl form can lead to the formation of lactic acid from reducing sugars[4,5,6], necessitating a procedure which minimizes or eliminates this source of error.

Nitric acid may be present in the hydrochloric acid eluates from hydroxyl form resins and in ammonium carbonate eluates from carbonate form resins. The presence of nitric acid will lead to low recoveries using the procedure of BARKER and SUMMERSON. Fractionation of the eluted acids followed by paper chromatographic identification to eliminate this interference is time-consuming and unpractical for routine determinations.

The present method which utilizes a colorimetric procedure carried out in a Conway diffusion unit[7], after elution of lactic acid from an anion exchanger with sodium chloride solution, has been in general use in the British Sugar Corporation Research Laboratories for some years and has proved to be more consistent and trouble-free in operation than previous methods.

After removal of cations by treatment with a strongly acidic ion exchange resin, all anions present in the juice are absorbed onto a strongly basic ion exchange resin in the carbonate form. After washing the resin free from sugars the lactic acid is eluted with sodium chloride solution.

The lactic acid in an aliquot of the eluate is oxidized to acetaldehyde using acidified ceric sulphate solution in a Conway micro-diffusion unit; the acetaldehyde is then absorbed in a buffered semicarbazide solution) The lactic acid is determined from the optical density of the acetaldehyde semicarbazone measured at 224 nm, by reference to the linear standard curve obtained with standard solutions of lactic acid.

Ion Exchange Procedure

Reagents

N Hydrochloric acid
N Sodium hydroxide solution
0·5M Sodium carbonate solution
0·1M Sodium chloride solution

Preparation of resins

The ion exchange columns contain only 10 ml of resin and, for routine determinations, it is more convenient to regenerate the resin in bulk than to regenerate the individual column.

The stock quantity of 1 to 5 litres of "Deacidite FF" resin, (52–100 mesh, 7–9% DVB), is converted to the carbonate form in a large glass column. Used resin is first treated with 2 bed volumes of N hydrochloric acid to ensure complete conversion to the chloride form before regeneration. The resin is then washed until free from acid and regenerated by successive treatments with 2 bed volumes of N sodium hydroxide solution, 3 bed volumes of water and 3 bed volumes of 0·5 M sodium carbonate solution. The sodium carbonate solution is applied until the output pH is the same as the input pH. The quantity used may be reduced by gassing the effluent with carbon dioxide to pH 11·0 and recycling it to the input. The resin is finally washed with 3 bed volumes of water.

The stock "Zeo-karb 225" resin (14–52 mesh, 8% DVB) is converted to the hydrogen form by regeneration in a large glass column using 2 bed volumes of N hydrochloric acid. Before use the column is washed acid-free with water.

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[1] *J. Biol. Chem.*, 1941, **138**, 535.
[2] STARK *et al.*: *J. Agric. Food Chem.*, 1953, **1**, 564.
[3] SHORE: *Compt. Rend. X Ass. Comm. Int. Tech. Sucr.*, 1957, 196; *I.S.J.*, 1958, **60**, 24.
[4] HULME: *Nature*, 1953, **171**, 610.
[5] PHILLIPS and POLLARD: *ibid.*, 41.
[6] CAROLAN: *Compt. Rend. X Ass. Comm. Int. Tech. Sucr.*, 1957, 227; *I.S.J.*, 1957, **59**, 350.
[7] RYAN: *Analyst*, 1958, **83**, 528.

Separation of lactic acid from beet process juices

The sample of juice, containing a total of not more than 20 mg of lactic acid, is diluted to 100 ml with water and applied to 10 ml of "Zeo-karb 225" resin in the H^+ form contained in a 160 mm × 12·5 mm diameter column followed in series by a similar 10 ml column of "De-acidite FF" resin in the carbonate form. The acid effluent from the cation exchanger passes directly on to the anion exchanger.

Amounts of 20 to 60 ml of raw juice, thin juice and diluted thick juice at 15°Bx, or up to 1 g of molasses dissolved in 100 ml of water, are applied. The sample is applied at a maximum rate of 3 ml/min (about 1 drop/second). About 1·5 litres of distilled water is applied to the column until the washings are sugar-free as shown by the Molisch test.

The lactic acid content of white sugar is determined by application of a solution of 500 g of white sugar in 3 litres of water at a rate of 15 ml/min.

Lactic acid is eluted from the anion exchanger at a rate of 3 ml/min with 100 ml of 0·1M sodium chloride solution.

Colorimetric Procedure[7]

Reagents

Zinc lactate trihydrate: 0·1653 g of this reagent is dissolved in the minimum of dilute sulphuric acid and then diluted to 1 litre with water to give a standard solution containing 100 μg/ml of lactic acid.

Phosphate buffer at pH 7·0: This buffer is prepared by mixing 500 ml of 0·14M disodium hydrogen phosphate solution with 500 ml of 0·06M sodium dihydrogen phosphate solution.

Semicarbazide solution: 0·747 g of semicarbazide hydrochloride is dissolved in the phosphate buffer to give 1 litre of 0·0067M solution.

Saturated solution of ceric sulphate in 6N sulphuric acid: This reagent should be freshly-prepared daily.

Conway unit fixative: This contains 3 parts of petroleum jelly plus 1 part paraffin wax. The fixative is applied by lightly touching the surface of a portion melted in a Petri dish with an inverted Conway unit. This method applies an even coating of sufficient fixative to ensure adequate sealing of the unit.

Spectrophotometric determination

An aliquot of the anion exchange eluate, containing not more than 200 μg lactic acid, is pipetted into the outer chamber of a No. 1 Conway unit[8] and the total volume made up to 2 ml with distilled water.

A 2 ml portion of the semicarbazide solution is placed in the centre well of the unit and finally 0·4 ml of saturated ceric sulphate solution is placed in the outer chamber. The unit is rocked gently to mix the contents of the outer chamber, sealed with an etched glass plate and placed in an incubator at 37°C ± 3°C.

After two hours' incubation the units are removed and opened. A 1 ml aliquot taken from the centre well is diluted to 10 ml with distilled water, mixed, and then placed in a 1 cm silica spectrophotometer cell.

The optical density is measured at 224 nm by comparison with a blank sample taken through the above procedure.

Standard curve

0·5, 1·0, 1·5 and 2·0 ml aliquots of the 100 μg/ml lactic acid standard solution are oxidized in the Conway units and the optical density of the product acetaldehyde semicarbazone is determined. A linear standard curve is obtained which is reproducible if all conditions are strictly adhered to. It is considered better to run standards with each batch of determinations. Up to 24 Conway units can conveniently be incubated together.

Ion exchange eluate

The sodium chloride is adjusted to 100 ml and 0·5, 1·0 and 2·0 ml aliquots are oxidized in the Conway units and the lactic acid content calculated from the standard curve. The results for the different aliquots do not normally differ by more than 5%.

Interference from other acids

Of the acids present in beet process juice only glycollic, malic and citric acids may possibly cause interference.

No peak absorption has been detected, against a blank determination containing water only, for solutions of these acids, made up to the maximum concentration at which each is likely to occur in the anion exchange eluate. Lactic acid added to a mixture of these acids was recovered to the extent of 99–100%.

Experimental Results

Complete duplicate determinations using the same beet process juice, molasses or white sugar, are reproducible to 2·5 μg/ml in the anion exchange eluate (i.e. 2·5% of the amount of the highest standard).

The results of recovery experiments ranged from 97 to 103%.

Summary

A routine method, of relatively high precision, for the determination of lactic acid is described.

Lactic acid, separated from sugars and cationic material by an ion exchange procedure, is oxidized with ceric sulphate solution to give acetaldehyde which is distilled off and collected in a buffered semicarbazide solution. The procedure is simplified by carrying out the oxidation and distillation in a Conway micro-diffusion unit.

The lactic acid is determined from the optical density of the acetaldehyde semicarbazone measured at 224 nm, by reference to the linear standard curve obtained with standard solutions of lactic acid.

[8] No. 1 Conway Units supplied by A. Gallenkamp & Co. Ltd., Christopher St., London E.C.2, England.

The fate of some of the principal amino-acids of cane juice during molasses formation

IV. Estimation of the rate of intake of cane juice constituent amino-acids into model final molasses browning polymers utilizing carbon-14 labelled amino-acids

By W. W. BINKLEY

(New York Sugar Trade Laboratory, 37 Warren Street, New York, N.Y., 10007 USA)

Paper presented before the Division of Carbohydrate Chemistry at the 157th National Meeting of the American Chemical Society, 1969.

OUR researches on the cane final molasses "browning" products have shown that useful polymers can be obtained from heated cane juice[1]. Utilizing cane juice with added carbon-14 and tritium-labelled amino-acids, the distribution of the principal amino-acid residues in these model polymers was found to be 52–53 asparagine, 5 γ-aminobutyric acid, 2-3 proline, 2 aspartic acid, 2 glutamic acid, 2 alanine and 1 valine residues in polymer units containing 66–68 amino-acid residues[2]. In the present study we have examined, with the aid of carbon-14 labelled amino-acids, the patterns of participation of the principal cane juice constituent amino-acids in the formation of model final molasses polymers and report our findings herein.

EXPERIMENTAL

The cane juice used in this work was reconstituted from Louisiana lyophilized clarified cane juice. The juice was clarified and lyophilized in the pilot plant facilities of the United States Department of Agriculture at the Audubon Sugar Factory, Louisiana State University, Baton Rouge, La., USA.

Preparation of model final molasses browning polymers

Eighteen grams of lyophilized cane juice solids were dissolved in sufficient distilled water to produce 150 g of solution of pH 6·18 at 20°C. The labelled amino-acids were added (the amount, form and location of the radioactivity in the added amino-acids are shown in the appropriate Table) and aliquots (1 ml each) of the juice were taken for lyophilization and radioassay. The polymers were produced by heating the juice at 95°C for 27 hours. The pH of the juice after heating was 4·86–4·89. The polymers were isolated as described previously[2]. The radioactivities of the cane juice solids and the polymers were determined by the New England Nuclear Assay Corp., Boston, Mass., USA.

RESULTS AND DISCUSSION

The "browning" polymers used in this study were prepared from cane juice in the same manner as the cane final molasses model polymers already described[2]. However, the duration of the reaction was shortened

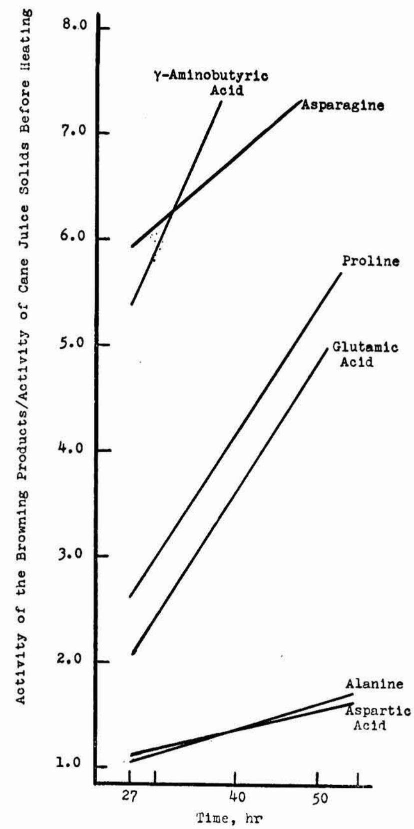


Fig. 1

[1] BINKLEY: *I.S.J.*, 1962, **61,** (a) 39; (b) 203.
[2] *idem ibid.*, 1969, **71,** 359-361.

Table I. Determination of the participation of the principal constituent amino-acids in the formation of browning products from cane juice heated 27 hours at 95°C

Added amino-acids	Activities, μc/g: Cane juice solids (A)	Activities, μc/g: Browning products (B)	Ratios of C-14 Activities: (C) B*/A	Ratios of C-14 Activities: (D) C/1·07
DL-Asparagine-3-C-14†	2·90, 2·92	17·1, 17·4	5·93	5·54
DL-Aspartic-3-C-14 Acid‡	2·13, 2·17	2·40	1·12	1·05
DL-Alanine-3-C-14‡	3·3, 3·4	3·42, 3·65	1·07	1·00
DL-Glutamic-3,4-C-14 Acid‡	2·72, 2·72	5·59	2·06	1·93
γ-Aminobutyric-2-C-14 Acid†	2·65, 2·66	14·2, 14·3	5·37	5·02
DL-Valine-4-C-14§	2·88, 2·88	6·36, 6·67	2·26	2·11
DL-Proline-5-C-14**	1·92, 1·95	5·05, 5·08	2·62	2·45

* Averages used. † Dhom Products Ltd., North Hollywood, Calif., USA.
‡ Nuclear Equipment Chemical Corp., Farmingdale, N.Y., USA.
§ Amersham/Searle Corp., Des Plaines, Ill., USA. ** New England Nuclear Corp., Boston, Mass., USA.

to 27 hours, the minimum time required to produce sufficient polymer(s) for radioassays and elemental analyses. Only one of each of the principal constituent cane juice amino-acids labelled with carbon-14 was added to the juice in each polymer preparation; these activities are given in Table I. Alanine and aspartic acid were least active during the 27-hour reaction period; the participation of glutamic acid, valine and proline in this polymerization was about twice as great. γ-Aminobutyric acid and asparagine were most reactive in the cane juice "browning", 5·02 and 5·54 times, respectively, that of the reference amino-acid, alanine. The estimated relative amounts of these amino-acids in the 27-hour polymers, based on their available quantities in the cane juice, are shown in Table II, Column D. Asparagine residues make up, by weight, 85·55% of these amino-acid residues; their distribution as molecular units is presented in Table II, Column F. A unit of the 27-hour polymer possessing 56 to 59 amino-acid residues would contain 48–49 asparagine, 1–2 aspartic acid, 1 alanine, 1 glutamic acid, 3–4 γ-aminobutyric acid, 1 valine and 1 proline residues.

Utilizing the data from Table I, Column D and the corresponding data for the model cane final molasses "browning" polymers reported previously[2], the relative rates of intake of the principal cane juice amino-acids into these polymers can be estimated (based on the slopes of the plots in Fig. 1). During this reaction period, 27 hours until the model molasses polymer was obtained, the relative rates of intake of these amino-acids into the polymers were as follows: (with alanine = 1) γ-aminobutyric acid, 7·54; glutamic acid, 5·05; proline, 5·01; asparagine, 2·87; aspartic acid, 0·74. The model cane final molasses "browning" polymers are essentially asparagine "browning" polymers arising from (1) the abundant availability of asparagine in cane juice, (2), the high level of intake of asparagine into the polymers during the early stages of the reaction, and (3) the continued moderate rate of asparagine participation in the later stages of the polymerization.

Hydrogenolysis regenerated from cane final molasses browning products four amino-acids in trace quantities, namely, glycine, alanine, valine and leucine (or isoleucine)[3]. Studies with model polymers made from cane juice with added alanine, specifically labelled 1-C-14 and 2-C-14, showed that this amino-acid underwent 41% decarboxylation during polymerization[1b]. In a parallel experiment with cane juice utilizing DL-asparagine-3-C-14 and L-asparagine (uniformly labelled with C-14), asparagine was found to decompose to the extent of 22·5–23·8% (see Table III). Since decarboxylation of the reactant amino-acid is typical in the "browning" reaction[4], it is probable

[3] *idem ibid.*, 1957, **59**, 64.
[4] MAILLARD: *Compt. rend.*, 1912, **154**, 66; *Ann. chim.*, 1916, **5**, (9), 258.

Table II. Distribution of the cane juice principal amino-acids in the browning products from cane juice heated 27 hours at 95°C

Cane juice amino-acids (A)	Cane juice solids: %A (B)	Cane juice solids: A relative to Alanine (C) B/0·04	Cane juice browning products: Relative concentration of A* (D) C × D†	Relative number of amino-acid residues (E) D × 1000/MW‡	Relative number of amino-acid residues (F) E/11·22
Asparagine	0·52	13·00	72·02	545·2	48·59
Aspartic Acid	0·09	2·25	2·36	17·73	1·58
Alanine	0·04	1·00	1·00	11·22	1·00
Glutamic Acid	0·04	1·00	2·06	14·00	1·25
γ-Aminobutyric Acid	0·03	0·75	4·03	39·09	3·48
Valine	0·03	0·75	1·70	14·51	1·29
Proline	0·02	0·50	1·31	11·38	1·01

* Based on availability in cane juice, ROBERTS & MARTIN: *Sugar*, 1956, **51**, (1), 32. † Column D of Table I.
‡ Molecular weight of respective amino-acid.

Table III. Radioactivities of the browning products obtained from heated cane juice with added carbon-14 labelled asparagine

	Activities, μc/g			
Added amino-acid	*Cane juice solids*	*Browning products*	*Decomposition, %*	*Probable decarboxylation, %*
L-Asparagine-C-14(U)*	2·80, 2·81	4·98, 5·00‡	23·8**	95·3‡‡
DL-Asparagine-3-C-14†	2·90, 2·92	6·55‡		
L-Asparagine-C-14(U)*	2·80, 2·80	15·07, 15·31§	22·5††	90·0‡‡
DL-Asparagine-3-C-14†	2·84, 2·88	19·5, 19·7§		

*Amersham/Searle Corp., Des Plaines, Ill., USA. †Dhom Products Ltd., North Hollywood, Calif., USA.

‡ 27-hour reaction products. § Model final molasses polymers, Ref. 2. ** $\frac{6{\cdot}55 - 4{\cdot}99}{6{\cdot}55} \times 100\%$.

†† $\frac{19{\cdot}6 - 15{\cdot}2}{19{\cdot}6} \times 100\%$. ‡‡ Based on the uniform distribution of the activity among the four carbons of L-asparagine-C-14(U), i.e. $\frac{23{\cdot}8}{25} \times 100\%$ and $\frac{22{\cdot}5}{25} \times 100\%$.

that this decomposition represents the almost complete decarboxylation of this four-carbon amino-acid. This extensive change in structure would explain for the most part the absence of intact asparagine in the products from the hydrogenolysis of the cane final molasses polymers.

Summary

Utilizing carbon-14 labelled amino-acids, the order of decreasing rate of intake of the constituent cane juice amino-acids into model molasses polymers was found to be γ-aminobutyric acid, glutamic acid, proline, asparagine, aspartic acid and alanine. The resulting polymers were deduced to be essentially asparagine "browning" polymers because of the abundance of asparagine in cane juice, its high level of intake into the "browning" products early in the reaction and its continued moderate rate of participation in the later stages of the polymerization.

Acknowledgments

The writer wishes to thank Dr. L. F. Martin of the United States Department of Agriculture and Dr. F. G. Carpenter of the Cane Sugar Refining Research Project for the lyophilized cane juice used in this work and Mr. W. F. Altenburg of this Laboratory for his assistance in a portion of the experimental work.

Sugar refining-Notes on unit processes

Part V. Recovery work and molasses exhaustion

By F. M. CHAPMAN (Chapman & Associates, Vancouver, B.C., Canada)

Recovery is a rather expensive process which could, in theory, be eliminated. It provides scope for one of the larger economies for refiners. Apart from starch, the most objectionable impurities in raw sugar are ash and colour, and there is a strong case for leaving as much as possible of these in the country of origin, where there are neither duties nor levies and all costs, except for equipment, are lower than in refining areas. The lower cost of "conventional" recovery—by boiling—in the raw sugar areas must also affect one's attitude to alternative processes such as desaccharification.

It is pertinent to review what is achieved by this recovery process. At Plaistow Wharf refinery, the 1st crop massecuite comprised

Green syrup from refinery strikes	1·4% on refined solids output
Affination syrup	11·7%
Evaporator sweet water	2·0%
2nd and 3rd crop sugar as seed	6·7%
	21·8%

Of the net input of solids, i.e. 21·8 — 6·7% = 15·1%, the 1st crop sugar produced amounted to approx. 12·0% on refined solids output and molasses 3·1%. Despite the high cost of recovering 1st crop sugar, it is much inferior to washed raw sugar, its invert content in particular being high, e.g. 0·15% as against 0·10% for a washed raw sugar, as well as ash (0·19% *vs.* 0·14%), and colour (1860 Telo units *vs.* 1160). Obviously, the purity of the run-off is also lower, e.g. 76·0 *vs.* 87·0.

Recovery Pan Work

Graining

It is well known that the lower the purity of the graining charge, the cleaner, but also the smaller, will be the grain. Conversely, the higher the purity, the greater is the danger of forming complexes and conglomerates which always have a worse analysis than clean grain. According to one author, ash in the conglomerate fraction of a strike averaged 0·26% while that in the non-conglomerate fraction was only 0·21%. He added: "the only disadvantage of blend graining is increased viscosity, but it has reduced conglomerates in the Mackay district from 80% down to 10%".

Graining low-grade massecuites on syrup of 70–80 purity has been generally accepted, as has fondant seeding. At one refinery the charge of 70 purity green syrup is concentrated at 5 in absolute pressure, seeded, and the pressure raised to 9 in during 15 minutes. It is held at this level for 20 min and then reduced over the next 20 min to 5 in again, after which feed is admitted at 6 in absolute pressure. During a boiling time of 8 hours the skip is built up to 1400 cu.ft. and dropped at 160°F and 65 purity. It is cooled to 120° during 8 hours and held at 120° for 10–15 hours before curing.

Slow boiling

With low-grade massecuite, the recommended grain size is 0·25–0·35 mm × 0·1–0·15 mm. Elongation, with the width remaining at only 0·05 mm, occurs chiefly as a result of sour cane, and such grain is slow in growing and is fragile so that massecuites have to be dropped light and molasses purity is abnormally high[1]. Slow boiling is also caused by over-liming, as was found at Koloa in Hawaii where it was found in *A*-pans when the strike was well-advanced and occurred in the *B*-pans as soon as the *A*-molasses was introduced. Koloa had been heavily over-liming the settlings before filtration, and mixed the filtered juice, of pH over 9·5, with the mixed juice. Over-liming was stopped and the filtered juice pH reduced to 8·0–8·3; immediately boiling times improved[2].

In Peru, where factories work the year round, massecuites in Autumn (February–May) can be very sticky, so that boiling times can be three times the normal. J. C. P. Chen[3] has described trials with surface-active agents to remedy this slow boiling; he found that two such materials reduced boiling time by 11·5 and 27·5%, respectively, while the purging efficiency of a BMA K.1000 and a Western States continuous centrifugal was raised from 90·5 to 91·3 and 91·9%, respectively. At 90% purging efficiency, the capacity of the centrifugals was increased by 30–70%. Raw sugar ash was reduced from 4·26 to 3·84% in one set of trials and from 3·48 to 3·23% in another. Generally the value of surface-active agents is greatest when massecuites have abnormal viscosity.

Steam requirements

In Table I appear steam requirements, calculated as percentages on refined solids output.

Table I

	Feed heating	*Evaporation*	*Total*
1st crop	0·7	3·2	3·9
2nd crop	0·1	1·1	1·2
3rd crop	0·3	2·1	2·4
Totals	1·1	6·4	7·5

Massecuite mobility

In 1937, Spengler & Horn published data on measurements of power needed for stirring massecuites of different crystal contents at different temperatures[4]. These data are indicated in Fig. 1 and show both the marked influence of temperature and the rapid increase in power required with more than 45% crystal.

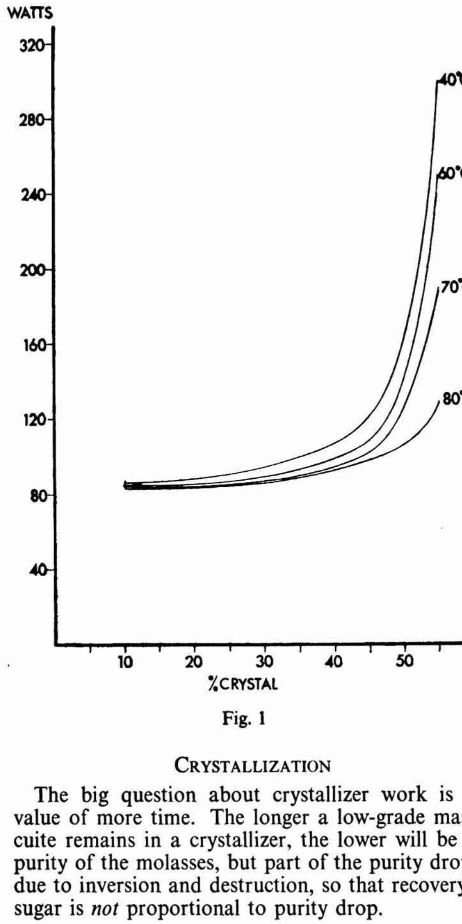


Fig. 1

Crystallization

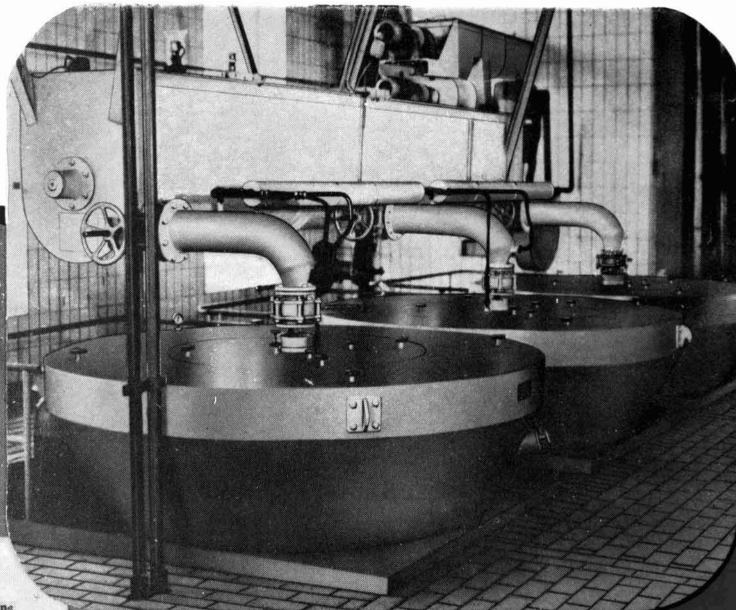
The big question about crystallizer work is the value of more time. The longer a low-grade massecuite remains in a crystallizer, the lower will be the purity of the molasses, but part of the purity drop is due to inversion and destruction, so that recovery of sugar is *not* proportional to purity drop.

In 1947 it was found at Plaistow Wharf refinery that the effect of air cooling a massecuite was to produce a decrease in sucrose on solids in mother syrup of 3·6%. Of this, however, 0·4% was due to inversion and 0·7% due to sucrose destruction and the sucrose rise in spinning was 0·6%. Again, in 1949, it was concluded from further trials that, (i) with 72 hours air cooling, 50% of the drop in total sugars could be due to a chemical loss of sucrose and invert, while (ii) of the drop in total sugars, due to crystallization, half could be lost during spinning. These results indicate, not that crystallizers are bad tools, but only that purity drop does not give a proportionate

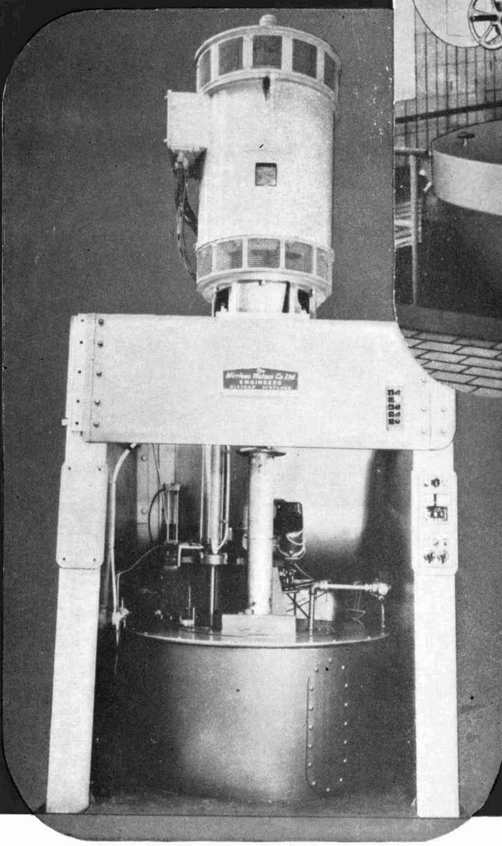
[1] McCleery: *I.S.J.*, 1946, **48**, 23.
[2] Wickey: *ibid.*, 1930, **34**, 594.
[3] *Paper presented to the* 13*th Congr. ISSCT.*, 1968.
[4] *I.S.J.*, 1937, **39**, 397.

SMITH

'Mirrlees' sugar centrifugals



SUGAR FACTORY AND REFINING ENGINEERS



Continuous

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Thin-layer principle

The continuous separation of molasses is only possible according to the thin-layer principle, i. e. a thin massecuite layer must slide over the centrifugal screen in order to permit good separation of the molasses in a short time. The thickness of the layer is determined by quantity and viscosity of the massecuite and by the basket speed.

Batch Type

The modern lines of Mirrlees Centrifugals are illustrated in the above photograph of one machine of a battery of 13—48″ x 30″ Fully Automatic Re-cycling Centrifugals being erected in our works. Note the complete and uncluttered accessibility of the working front; the control console incorporating a mimic diagram of the cycle stages and the fault annunciator on the pelmet.

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increase in extraction, and this factor must be allowed for in calculating the return on investment.

For any specific molasses, the principal factor in exhaustion is concentration which can most usefully be expressed in terms of the impurity:water ratio, I/W, because this is unaffected by after-crystallization. In addition, I/W may be determined directly from the massecuite, without any need to filter off the molasses. The dependence of molasses purity on the I/W ratio is illustrated in Fig. 2, based on data of PRINSEN GEERLIGS.

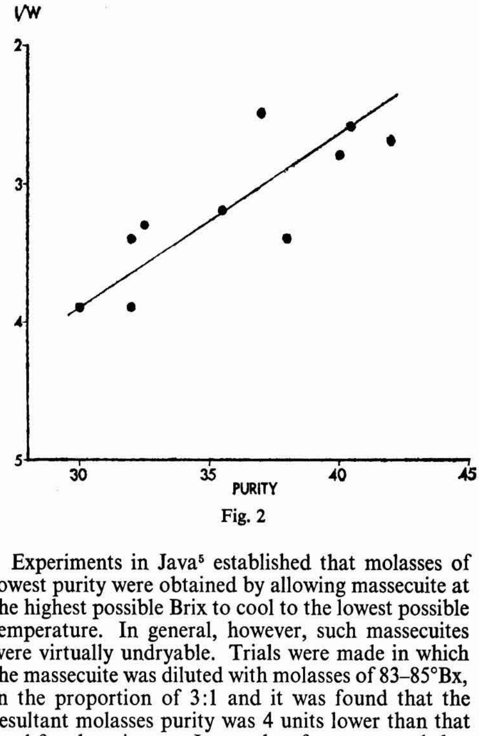

Fig. 2

Experiments in Java[5] established that molasses of lowest purity were obtained by allowing massecuite at the highest possible Brix to cool to the lowest possible temperature. In general, however, such massecuites were virtually undryable. Trials were made in which the massecuite was diluted with molasses of 83–85°Bx, in the proportion of 3:1 and it was found that the resultant molasses purity was 4 units lower than that used for the mixture. It was therefore suggested that massecuites should be boiled to such a Brix that they were just movable after cooling, and molasses then added before spinning. It was found that the time of spinning was about normal, and the molasses purity was 1·9 units lower than the average.

MICHELI[6] was concerned with a direct measurement of exhaustibility. As under factory conditions sufficient time is not available for the molasses and crystal in a low-grade massecuite to reach equilibrium, no attempt was made to investigate exhaustion by phase-rule methods; instead, he concentrated attention on the development of a practical crystallization test. That chosen was to run one gallon of the concentrated molasses into the crystallizer which had been heated to 75°C. Hot caster sugar was added to make a magma of 33% crystal and this was cooled at the rate of 1°C per hour to 45°C and stirred at 45°C for 15–18 hours. The molasses was then separated through silk of 180-mesh in a pressure filter at 600–700 p.s.i.

Several factors were varied, and it was found that grain size, purity of the magma, efficiency of stirring, etc., had very little direct effect on the final purity although varied over quite wide limits. The final temperature was found to have very little effect when reduced below 45°C, for the rate of crystallization at 45°C had already become very low. With any given material, the concentration, expressed as I/W, appeared to be the only factor which had any considerable effect on the final purity.

In the discussion following presentation of this work to the ISSCT, HONIG said that, obviously, the practical limiting factor, given good grain, was viscosity; a purity of 22 had been obtained in the laboratory, but the massecuite could not be spun. He had found, in all molasses at a given temperature, that the logarithm of the viscosity in poises was a function of the molasses dry solids, so that, for a given crystal size (0·3–0·5 mm) and a given sugar purity, the required viscosity could be calculated.

From the above it is evident that we can never achieve an absolutely exhausted cane molasses. We can only say that molasses is exhaused at a definite I/W ratio at a definite temperature, both I/W ratio and temperature being limited by the ability to separate the crystal from the molasses with reasonable efficiency. But since the latter is affected by viscosity, and viscosity is influenced not only by temperature but non-sugar composition, it is worth while to attempt to vary non-sugar composition by, for example, diminishing lime salts.

MCCLEERY, working with low-grade massecuites in Hawaii, confirmed that high-density massecuites were necessary for maximum results[7]. He found that large purity drops in the pan appear to be more important in securing maximum final results than good crystallizer work alone. The crystallizer used was water-cooled and insulated with bagasse board, permitting close temperature control. High-density massecuite could be handled with less liability of breakage of equipment, and the time in process could be greatly reduced, 36/48 hours being required to obtain practically maximum results.

Other investigations indicate that this period may be reduced still further to 30 hours; MCCLEERY was in favour of cooling only to 51°C and maintaining this with water at 50°. He found that crystallization proceeded rapidly, while there was no danger from breakage of equipment which might result from excessive viscosity at a lower temperature. After the saturation temperature reached the optimum, the massecuite was brought to 56° with water at about 58°; this small temperature difference is essential, and requires a large heating surface. With cooling

[5] VAN DER LINDEN: *I.S.J.*, 1923, **25**, 531.
[6] *ibid.*, 19 6, **38**, 460; *Proc. 5th Congr. ISSCT*, 1936, 229.
[7] *ibid.*, 1940, **42**, 332; 1941, **43**, 352.

coils in the crystallizers, the total time in process, exclusive of reheating, could be reduced to not more than 48 hours, which was a 50–75% saving compared with air-cooled crystallizers.

Heat transfer rates in crystallizers

The rate of heat transfer in units with moving cooling coils varies with the relative speed between the cooling surface and massecuite, as indicated in Table II based on data of HONIG (molasses viscosity 140 poises at 40°). The effect of temperature and viscosity on heat transfer rate is also very large, as indicated in Table III.

Table II

Relative speed		*Heat transfer rate*	
cm/sec	*f.p.m.*	*Cal/sq.m./hr/°C*	*C.H.U./sq.ft./hr/°C*
0	0	13	2·6
3·3	6·6	40	8·0
6·7	13·4	53	10·6
10·0	20·0	63	12·6
13·3	26·6	70	14·0

Table III

Temperature	*Viscosity*	*Observed variations in heat transfer rate*	
°C	*poises*	*Cal/sq.m./hr/°C*	*C.H.U./sq.ft./hr/°C*
60	40–150	110–20	22–4
50	100–300	75–20	15–4
40	150–800	60–25	12–5
35	200–1500	30–10	6–2

Air-agitated crystallizers

Vertical crystallizers, their contents agitated by air, are cheap to construct and their agitators are unbreakable. Such vessels, nested below pans, require only a perforated pipe and an air timing valve. They can be pressurized to supply reheaters and feeding troughs and, if connected in series, the last of a group can be used as a montejus. MUNSON[8] patented such a device in 1934 with gas agitation through a central telescopic pipe with automatic level adjustment and a ring of vertical water cooling pipes fed from a bottom champer. Advantages claimed for it included acceleration of the process of mixing and crystallizing, and oxidation of gummy non-sugar constituents with, if necessary, air enriched with oxygen.

Thames and Liverpool refineries both had batteries of vertical air-agitated crystallizers but it is doubtful if the advantages of these units were fully realized. They were not adopted when the recovery house at Plaistow Wharf was rebuilt because of anxieties about the possibilities of losses of which CO_2 in the air leaving the massecuite was a symptom. However, it is probable that any low-grade massecuite gives off CO_2 and other gases.

Continuous crystallizers

As a result of an investigation in 1968, the author is lukewarm to this development which has formidable disadvantages. Massecuites tend to lose their identity so that it is less easy to place responsibility for good and bad strikes. The crystallizers have to be liquidated for maintenance, etc.

REHEATING

The viscosity of molasses is a controlling factor in centrifugalling. By the late 1930's, the work of BEHNE, McCLEERY and others had shown conclusively that, as a means of reducing the viscosity before spinning, reheating was much preferable to dilution (Fig. 3).

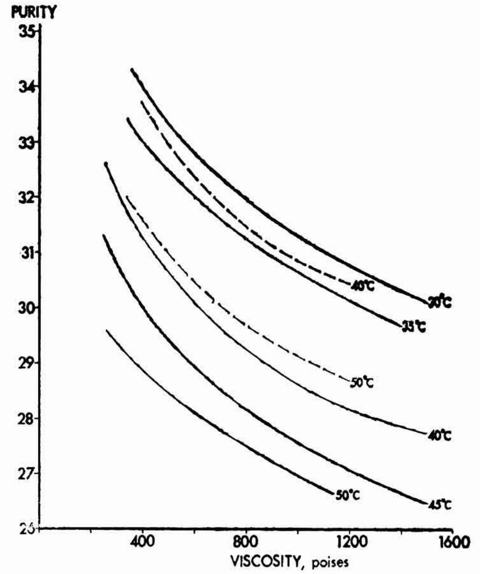

Fig. 3. Gravity purity *vs.* viscosity at different saturation temperatures: ——— same molasses; — — — average of 14 molasses

A rise of 6°C halves the viscosity of high Brix molasses, and the residual molasses on the crystal appears to vary with the square root of the viscosity (Fig. 4). There is thus a great incentive to reheat the massecuite right up to saturation temperature and also to maintain this temperature both in the feed trough and in the centrifugals.

At the same time one should avoid local overheating of the massecuite, and these considerations require a large heating surface and a small temperature difference at the hot end of the reheater. In Hawaii, experiments have been made with old juice heaters and it is reported that to reheat a massecuite with reasonable celerity and efficiency requires 9 sq.ft. of moving heating surface or 12 sq.ft. of fixed heating surface per cu. ft. of massecuite per hour.

In Australia it was reported in 1938 that, using a double coil (right-hand and left-hand) heater with coils of 2 in dia. and 6 in pitch, turning at 12 r.p.m., with water at 140°F and massecuite at 115°F, a heat transfer rate of 6–7 B.Th.U./sq.ft./hr/°F was attained and sugar purity raised by about 4 points, i.e. reheating halved the amount of molasses retained by the crystal.

[8] US Patent 1,983,805.

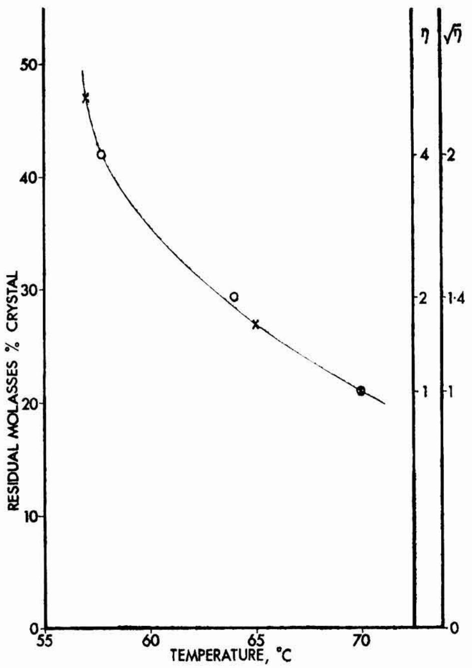

Fig. 4. Effect of temperature of purging on: × elimination of molasses, and o molasses viscosity (η)

In Hawaii, in 1947, one installation for massecuite reheating used a 4000 sq.ft. heater with 1½ in tubes for massecuite, the temperature of which was raised from 106° to 134°F using water at 140°F. Such massecuite tubes seem small but give a mean heat path of ½ in. An economizer-type reheater has a mean heat path of about ¼ in and, because of its grid construction, is less liable to choke than is a "sieve plate".

Economizer reheaters

The economizer reheater provides a large secondary heating surface to permit rapid heat exchange without local overheating through using a heating temperature excessively higher than the saturation temperature. To the writer's knowledge, the first of this type was designed by D. Tonner and himself in the Glebe refinery in Scotland, in about 1942.

An account has been given by James and Lawrence[9] of the use of Green-Smith economizer reheaters for *C*-massecuites at Moneymusk and Brechin Castle sugar factories.

Under normal conditions an economizer-reheater at Plaistow Wharf handled 11 tons/hr (280 cu.ft./hr) of solids, heating it from about 50° to about 62°C, with water entering at 67° and leaving at 64°C. This represented a heat transfer rate of 4·8 B.Th.U./sq.ft./hr/°F, and spot tests have given rates of 6·5 and even 10 B.Th.U./sq.ft./hr/°F. The heat transfer rate varies with both viscosity and the relative velocity between massecuite and heating surface, but fear of excessive resistance on start-up has led us to avoid making economizer reheaters too deep. There is need for more data on the maximum head loss across such reheaters so as to avoid structural problems in their design.

There is need for an evaluation of economizer reheaters in comparison with reheaters fitted with Stevens coils. The latter give twice the heat transfer rate but at the expense of power requirement, higher maintenance, higher temperature difference and (possibly) higher capital cost. It would be useful to know how serious is the loss of sugar by dissolution and in frothing as a result of overheating.

At Toronto refinery in 1959 the heat transfer rate in a 3rd crop massecuite reheater fitted with Stevens coils was found to be 15·5 B.Th.U./sq.ft./hr/°F, 4000 lb/hr of massecuite being raised from 48° to 65°C with water which entered at 71° and left at 70°C. Residence time of the massecuite was 235 minutes. The thermal conductivity of such 3rd crop massecuite was found at Ravensbourne to be 0·24 C.H.U./ft/hr/°C. Results from another installation in Hawaii correspond to a heat transfer rate of 14 B.Th.U./sq.ft./hr/°F[10].

Centrifugal Work

Temperature maintenance

A centrifugal is a crude fan and, if left unsealed, will pump great volumes of warm and sticky air into the building, simultaneously cooling the charge and decreasing the efficiency of purging. Three means of alleviating this condition are: (a) to fit covers, (b) to

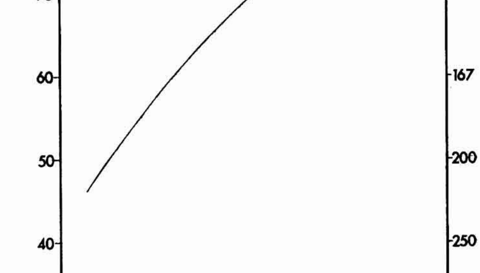

Fig. 5

[9] *I.S.J.*, 1965, **67**, 271, 298.
[10] Hughes: *ibid.*, 1949, **51**, 77–80.

seal the outlet pipes by submerging the ends in 3 or 4 inches of molasses, and (c) to blow a little low-pressure steam into the monitor casings. Fig. 5 shows the important effect of spinning temperature on purging efficiency and its reciprocal Q, the amount of massecuite which must be spun to yield a unit quantity of molasses solids.

Sugar loss

In all the Tate & Lyle Refineries low-grade centrifugal stations a considerable amount of sugar is lost. Comparison of total sugar in mother syrup, obtained by expression from a massecuite, with that in the corresponding molasses, showed that the latter was 0·55% higher at Plaistow Wharf, 0·85% higher at Thames and 0·70% higher at Liverpool. This indicates that, of the crystals entering the basket, more than 2% is lost by over-charging or passing through the screen. The loss could perhaps be reduced by a better centrifugal cloth.

Several tests have shown that, with top and bottom covers closed and no steam on, the temperature inside the casing of a low-grade centrifugal, spinning at 2200 r.p.m. (with a peripheral speed of 260 m.p.h.), will rise to as much as 20°C above the saturation temperature of the massecuite. This is naturally reflected in the molasses purities, as indicated by tests recorded in Table IV.

Table IV

	Time of spinning (minutes)	*Molasses purity*
Test 1	5	30·6
	10	30·6
	15	30·9
	20	31·3
Test 2	15	30·1
	30	31·3
	45	32·8
	60	34·1

An experiment using a basket with only a quarter of the usual number of holes showed just as good results as with a normal basket, and it is to be noted that in 1968 the number of perforations in Buckau-Wolf 3rd crop baskets have been greatly reduced.

Continuous centrifugals

A serious gap in our knowledge is the true comparative performance of continuous *vs.* fully automatic batch centrifugals for 3rd crop massecuites. Some users claim that there need be no difference in molasses purity and the continuous machine needs only to be fed with a rather tougher massecuite. During a visit to Louisiana in 1968 the writer enquired about performance and maintenance of continuous machines for low-grade massecuite. There were no complaints about bearings, while in one case the basket had to be re-balanced. Gramercy refinery had abandoned stainless steel baskets and had changed to monel. Cloth life varied from 12 to 40 weeks, being influenced by wear of perforations and leakage of grain. Capacities ranged from 50 to 100 c.f.h. and purging efficiency was calculated as 80–90%. All machines needed steam or water or both.

For a true evaluation we need to know:

(a) the nett output of molasses per unit of basket area per hour,

(b) the effect of feed rate on sugar purity,

(c) the comparative cost of maintaining screens and bearings,

(d) the first cost of centrifugals, motors and switchgear,

(e) the cost of power surges with batch machines, and

(f) the cost of labour. (The view has been expressed by one user that continuous machines need more attention than do automatic batch machines as a failure in the water/steam supply can send a "snake" of massecuite into the monitor casing.)

It must be recognized that evaluations of continuous *vs.* batch machines have not compared like with like. All continuous machines, in effect, employ a "displacement" wash of steam and/or water. But, as in 2nd crop work, a "displacement" wash on a batch machine will improve considerably the purity of 3rd crop sugar. This is shown in Fig. 6 which records

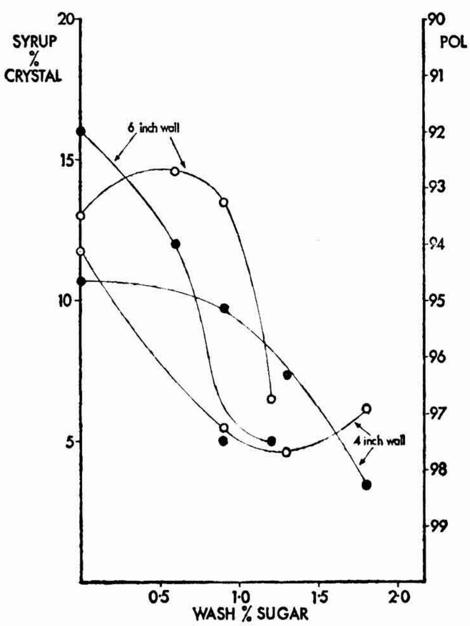

Fig. 6. Effect of displacement wash on ● pol of washed sugar and O residual syrup

that, e.g. application of 1·2% water, producing about 5% clairce, will reduce residual syrup per 100 crystal from about 13% to about 6·5% and increase pol from 92 to 97·5; the clairce will remain in the washed sugar.

continued on p. 13

Sugar cane agriculture

Preliminary studies on a strain of ratoon stunting disease virus of sugar cane. C. S. Wang. *Taiwan Sugar*, 1968, **15,** (6), 18–19, 13.—Reasons are given why it is believed that two different strains of ratoon stunting disease exist in Taiwan.

* * *

Studies on a strain of sugar cane mosaic virus causing severe mosaic disease on Co 527 cane at Nellikuppam. M. L. Seth. *Indian Phytopathology*, 1967, **20,** 54–56. A new strain of sugar cane mosaic, located at Nellikuppam in Madras State, is described and the results of experiments and studies made with it given. It is designated a sub-strain of the strain "Y" of sugar cane mosaic.

* * *

Spread of red rot in the leaves of the sugar cane plant. G. R. Singh. *Indian Phytopathology*, 1967, **20,** 220–225.—Extensive laboratory and experimental work is described. It is claimed that a relationship between leaf sheath infection and the development of lesions in the midribs has been established for the first time. It is considered that spores migrate in the transpiration stream. Some irregular or unexpected behaviour of spores is described. When leaf sheaths without injury were inoculated by spore suspension sheath symptoms appeared in 48 hours and lesions on midribs developed in 6 days. With injury by pricking with a fine needle sheath symptoms appeared in 24 hours and lesions on the midrib developed in 2 days or more.

* * *

Irrigated sugar cane in Rhodesia. Anon. *Rhodesia Agric. J.*, 1968, **65,** 130–137.—Intensive production of sugar cane is in the south-eastern lowveld (Chiredzi area). The extensive irrigation now practised is described and the methods of cultivation and management that are adopted in connexion with it. The question of drainage is important in some areas and the need to avoid over-irrigation and raising the water table unduly is discussed.

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continued from p. 12

The expanded top of the continuous centrifugal provides an air brake on the crystals discharged from the basket, and so reduces damage resulting from impact on the monitor. But the volumetric requirements become 9 ft dia. × 10 ft, compared with 5 ft dia. × 6 ft for the batch machine. In the present state of knowledge, the author is not convinced of the superiority of the continuous centrifugal in the recovery house, except perhaps for 2nd crop sugars.

Sugar cane smut (*Ustilago scitaminea*) **in Kenya. I. Epidemiology.** J. M. Walker. *J. British Mycol. Soc.*, 1969, **52,** (1), 139–151.—Observation and experiment confirms the belief that the disease is particularly favoured under conditions of surface irrigation in hot areas. Removal of diseased plants early in the crop cycle and the protection of young ratoon crops from infection are most important in checking the initial stages of the epidemic. The period from infection to whip production was found to be about 6 months under field conditions. The terminal smut whip, produced by modified activity of the apical meristems of diseased canes, releases inoculum over a period of about 3 months. The maximum rate of release of spores occurs in the middle of that period. Infection in the field is chiefly restricted to young tiller buds as they emerge through the soil.

* * *

Factors affecting shoot borer in sugar cane. P. N. Avasthy, T. N. Krishnamurthy and K. Ananthanarayana. *World Crops*, 1969, **21,** (1), 39–40.—The various factors affecting attack by shoot borer (*Chilotraea infuscatellus*) are discussed. These include stage of growth, seed rate or planting density, shoot population and varietal characters (in the cane). It was found that stage of attack, shoot population and genetic make-up of the cane variety were important in this order. Three months of age for the cane was the most critical time for attack.

* * *

Control of emerged weeds in Florida sugar cane with pre-emergence herbicides. J. R. Orsenigo. *Abs. Meet. Weed Soc. America*, 1967, 1–2; through *Weed Abs.*, 1969, **18,** (1), 31.—Repeat applications of mixtures of "Atrazine", "Diuron" or "Chlorfenac", usually considered pre-emergence compounds, with 2,4-D and/or surfactant gave good control of annual grasses and broadleaved weeds in sugar cane for the entire season. The first treatment must be applied before the grasses reach the 3-leaf stage, exceed 3 inches in height or tiller.

* * *

Stomatal movement in relation to drought resistance in sugar cane. K. M. Naidu and K. V. Bhagyalakshmi. *Curr. Sci.* (India), 1967, **36,** (20), 555–556; through *Biol. Abs.*, 1968, **49,** 10763.—The drought-resistant variety Co 312, by closure of the stomata, effectively controls loss of water by transpiration and hence is able to withstand soil moisture stress. The stomata open soon after watering.

Johnson grass life-cycle implications for improving cultural control practices. R. J. HULL. *Res. Prog. Rpt.* (Purdue Univ. Agric. Exp. Sta.), 1968, (330), 5 pp; through *Field Crop Abs.*, 1969, **22,** (1), 93. Rhizomes of Johnson grass (*Sorghum halepense*) were harvested throughout the year and their life history studied under controlled conditions. They failed to become winter-hardy, demonstrating the advantage of winter ploughing. Germination of rhizome buds has a high temperature requirement. Fragmentation by early season cultivation stimulates germination. Early growth should be controlled with herbicides before the 5-leaf stage is reached.

* * *

Effects of nitrogen on the growth and yield of three clones of sugar cane. 1. Plant cane. C. N. YOON and C. A. KOK. *Malay. Agric. J.*, 1968, **46,** 270-285; through *Plant Breeding Abs.*, 1969, **39,** (1), 138.—The varieties N:Co 310 and F134 gave significantly higher yields of cane and sugar than "T.kuning". The latter was the shortest cane but gave the highest proportion of millable cane. It appeared to be more susceptible to borer (*Chilotraea auricilia*) and fungus diseases.

* * *

Cytology of South Pacific sugar cane and related grasses with special reference to Fiji. S. PRICE and J. DANIELS. *J. Heredity*, 1968, **59,** 141–145; through *Plant Breeding Abs.*, 1969, **39,** (1), 139.—Tabulated data are included showing the chromosome number, origin and source of clones of *Saccharum officinarum* and 5 other related species.

* * *

Internode formation in sugar cane—its nature and rate. C. EKAMBARAM. *Madras Agric. J.*, 1968, **55,** 55–66; through *Plant Breeding Abs.*, 1969, **39,** (1), 140.—It was found that the number of internodes formed and rate of internode formation were the same for varieties differing in length and thickness of internodes, also under different levels of manure or irrigation. Length and girth of cane are important factors in selecting for increase of yield.

* * *

Climatic factors promoting the accumulation of sucrose in sugar cane. A. GONZÁLEZ G. *Bol. Azuc. Mex.*, 1968, (227), 15–16.—Time and duration of rainfall and of drought can be important in affecting sucrose content. Temperature is another important factor. These factors are discussed in relation to specific years.

* * *

Growth behaviour, root extension and juice characters of sugar cane in relation to nutrient deficiency and drought resistance. K. N. LAL, O. N. MEHROTRA and J. N. TANDON. *Indian J. Agric. Sci.*, 1968, **38,** 790–804. This paper deals with the effects of nutrient deficiency on such characters as height, shoot number, green leaf number, dry weight, root extension and juice characters. These variations are discussed in relation to the general problems of age and resistance to drought. For this work single-budded, germinated setts were grown in sand-nutrient cultures.

Study on the effects of different doses of nitrogen and systems of planting on plant cane and the subsequent effect on the ratoon crop. B. K. MATHUR, V. S. BHADAURIA and A. SINGH. *Indian Sugar*, 1968, **18,** 611-619.—It is considered that greater care and attention should be paid to the ratoon crop as a means of increasing total production. Results of a wide range of fertilizer experiments are recorded, including the effects of N fertilizing of plant cane on the ratoon crop.

* * *

A rational approach to the problem of organic *vs.* inorganic manuring of sugar cane. G. N. MISRA. *Indian Sugar*, 1968, **18,** 621–627.—Experiments conducted in Uttar Pradesh during the last 30 years on this subject are analysed and discussed. It is concluded that there is insufficient farmyard manure, oil-seed cake, compost or other organic matter available and that total dependence on inorganic fertilizer may not be conducive to the maintenance of high yields in the long run. The desirability of the cane grower using both organic and inorganic manures or fertilizers is pointed out.

* * *

Occurrence of sugar cane Hispa in pest form. V. G. RAJANI, R. K. KATIYAR and B. R. JAISWAL. *Indian Sugar*, 1968, **18,** 629–631.—Sugar cane Hispa or leaf-miner (*Asamangulia cuspidata*) is a pest which damages the crop during hot weather. Often its incidence is not high but in 1966 it caused severe damage at the Muzaffarnagar Sugarcane Research Station. Results of close observation on the behaviour of the insect and on control measures are given.

* * *

On the response of sugar cane to urea. P. S. GILL. *Indian Sugar*, 1968, **18,** 679–682.—The advantages of urea as a nitrogen fertilizer for sugar cane are discussed and it is compared with ammonium sulphate. The effect of the method of application and the effect on juice quality are also considered. If volatilization losses are prevented urea gives as good a yield of cane as ammonium sulphate and shows better juice quality.

* * *

Heat treatment of sugar cane seed material. K. V. SRINIVASAN and J. T. RAO. *Indian Sugar*, 1968, **18,** 683–690.—The use of heat treatment for controlling virus diseases in general in cultivated plants is discussed, as is control of certain cane diseases such as "sereh", chlorotic streak and ratoon stunting disease. Hot water treatment of cane setts is compared with hot air treatment, especially in regard to costs.

* * *

On deterioration of cane varieties. M. R. KELKAR. *Indian Sugar*, 1968, **18,** 695–697.—Changes which have taken place in cane varieties cultivated in northern India in recent years are discussed. Difficulties that the cane breeder has to face in producing improved disease-resistant varieties suited to local conditions are considered. Reference is made to the increased difficulties imposed by the development or evolution of new strains of certain cane diseases.

* * *

On some aspects of sugar cane irrigation. R. R. CHAUDURY. *Indian Sugar*, 1968, **18,** 699–700.—The essential need for irrigation in cane growing in most parts of the Indian Subcontinent is pointed out and the usual practices in regard to irrigation discussed.

* * *

New wild canes to be used. L. L. LAUDEN. *Sugar Bull.*, 1968, **47,** (5), 4.—Reference is made to the large collection of wild cane that has been built up in the United States. Some 71 wild canes tested and repreatedly artificially inoculated have resisted mosaic disease and 13 have already been used in crosses and back crosses. It is hoped to combine this disease resistance and cold tolerance with the desirable features of commercial canes.

* * *

Control of grasshoppers. ANON. *Victorias Milling Co. Exp. Sta. Bull.*, 1968, **15,** (7/8), 4.—Reference is made to infection of cane by grasshoppers (frcm a near by neglected, grassy field) leading to severe damage. Aerial spraying, using 1 kg BHC plus 1¼ litres "Diazinon" in 18 gallons of water, gave most effective control.

* * *

Control of army worms. ANON. *Victorias Milling Co. Exp. Sta. Bull.*, 1968, **15,** (7/8), 2–3.—Severe local outbreaks of army worm (*Cirphis* sp. and *Spodoptera* sp.) causing damage to cane, after drought, are referred to. Successful control was achieved by spraying, using 2 kg BHC (26% DP) and 1 litre of "Folidol" in 100 gallons of water per hectare.

* * *

A breakthrough in the emancipation of the sacada. Z. V. DE LA CRUZ. *Sugarland*, 1968, **5,** (10), 24, 28, 35.—The unfortunate lot of the "sacada", a labourer imported from one island to another in the Philippines for the cane harvest, is here described. A plea is put forward for better treatment and improvement of the sacada's economic and social position.

* * *

A study on trucks. ANON. *Sugarland*, 1968, **5,** (10), 25–27.—There is greater use of road transport for transporting cane from field to factory in the Philippines and diminishing use of the light railway. Details are given, in tabular form, of the various makes of truck or motor lorry used for cane and their capabilities.

* * *

Distribution of sugar cane varieties in Louisiana. R. J. MATHERNE. *Sugar Bull.*, 1969, **47,** (7), 4–6.—Distribution over the years is discussed and represented by means of a chart. The present emphasis on resistance to mosaic disease is stressed. Selection work has resulted in several new, high-yielding, moderately resistant varieties being in various stages of evaluation. It is urged that every effort should be made to keep mosaic infection to the minimum until high yielding resistant commercial varieties are available.

* * *

The monovarietal versus the polyvarietal concept. S. J. P. CHILTON and R. J. STEIB. *Sugar Bull.*, 1969, **47,** (8), 4–5.—This paper gives what is considered to be the polyvarietal viewpoint and the reasons for it. With this concept it is argued that a relatively large number of varieties should be released, since the criteria used for evaluation do not always take in the unknown factors such as type of operator of a farm or plantation, a disease or diseases not yet known to be present in the industry, but which could be introduced into Louisiana, and such extremes of environment as early freezes, heavy freezes, etc. The threat of leaf scald to the Louisiana industry is referred to, for this disease is already present in Florida.

* * *

Lifting and transplanting sugar cane ratoon stools. T. W. CASSELMAN and F. LE GRAND. *Sugar y Azúcar*, 1968, **63,** (12), 18–19, 32.—In Florida cane stools are sometimes damaged or destroyed by cold and replanting becomes necessary. A machine designed for this purpose is described.

* * *

Effects of an early freeze on Louisiana sugar cane. J. E. IRVINE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1967, **14,** 10–15.—Early freezes are usually more moderate in their effects on the sugar cane crop than late severe freezes. The effects on cane of an abnormally severe freeze on November 2, 1966 are described. Most fields of standing cane went completely brown and no undamaged terminal buds were found in commercial fields. Recorded data up to 3 months after freezing are given. Cane with completely frozen leaves, but with little stalk damage, may be of acceptable quality 3 months after freezing.

* * *

Use of multi-row equipment. E. H. GRAUGNARD. *Proc. Amer. Soc. Sugar Cane Tech.*, 1967, **14,** 16–19.—The advantages of multi-row equipment in sugar cane cultivation are discussed and disadvantages, under some conditions, mentioned. The improvement in 75–90 h.p. tractors has aided the use of multi-row equipment, but the main incentive is to reduce labour costs. Figures are quoted showing how a large tractor, capable of three times the work of a small tractor, has less than twice the operating costs.

* * *

The reduction of field labour requirements through land grading. C. H. BURLEIGH. *Proc. Amer. Soc. Sugar Cane Tech.*, 1967, **14,** 20–26.—The advantages to be derived from precision grading of cane fields in Louisiana, admittedly expensive, are discussed. They include: reduced ditch and maintenance costs, reduced Johnson grass control costs, improved efficiency of all mechanical operations, lower equipment maintenance and increased yields.

One way to reduce field labour requirements for Louisiana sugar cane by the use of airplane application of herbicides during the period January through July. D. C. MATTINGLY. *Proc. Amer. Soc. Sugar Cane Tech.*, 1967, **14,** 27–32.—With labour conditions becoming more and more difficult in Louisiana it is thought that farmers will have to switch to multi-row equipment, improved field lay-outs, minimum tillage and aerial application of chemicals. Figures are given showing costs of aerial application of herbicides as compared with ground application. On balance aerial application proved cheaper at $1.16 per acre against $1.27 for ground application. Aerial application usually uses 10% more chemicals because of ditch banks and headlands.

* * *

Sugar cane fertilizer trials in the U.S. Virgin Islands. A. J. OAKES and O. SKOV. *Sugar y Azúcar*, 1969, **64,** (1), 28–31.—The cultivation of sugar cane (practised for over two centuries) is briefly described, as are recent field trials to determine further the nutrient requirements of the St. Croix sugar cane soils, in an effort to increase production. The yield differences of cane and sucrose between the standard fertilizer practice and unfertilized cane were significant. Cane and sucrose yields resulting from annual applications of complete fertilizer were superior to those where only nitrogen was applied to the ratoon crop.

* * *

Cane needs sulphur in its diet. ANON. *Producers' Rev.*, 1969, **59,** (1), 49.—Changing fertilizer practices such as reduced use of sulphur-containing compounds like ammonium sulphate and superphosphate in favour of ammonium phosphate, urea and ammonium hydroxide, containing no sulphur, are leading to sulphur deficiency in some areas. Ways and means of rectifying any such deficiency are discussed.

* * *

Chopped cane deterioration research continues. ANON. *Australian Sugar J.*, 1969, **60,** 529–531.—Reference is made to the large amount of money that is being devoted to this avenue of research. It has not proved practical to prevent bacterial infection in cut or chopped cane, but there are extensive programmes of work in other spheres, such as cane transport systems, scheduling techniques to get the cane into the carrier more quickly so as to reduce the fall in c.c.s. and increase in dextrans associated with the deterioration.

* * *

A practical guide to the chemical control of weeds. ANON. *Suppl. Betterav. Franç.*, 1969, (197), 16 pp. The mode of action of different types of modern herbicides used for sugar beet are explained in simple terms, and the best methods of using them described. Colour photographs of 24 common weeds of sugar beet in the seedling stage are reproduced to enable the grower to identify his weeds and so use the guide more intelligently.

Intensive sugar cane cultivation in South Bihar. V. S. BHIDE. *Crops in India*, 1968, **1,** 27–31.—Details are given of steps taken by the State, since 1963, to improve the standard of cane cultivation and production among peasant cultivators. In trial plots the methods adopted have resulted in increasing production by 30–34%. The steps taken include the use of improved varieties, deep ploughing, sett treatment, better fertilizing and pest and disease control, and co-operative financing and marketing.

* * *

Insecticides for soldier fly, Bundaberg, 1969. R. B. MOLLER. *Cane Growers' Quarterly Bull.*, 1969, **32,** 78–79.—Results of field trials with BHC and "Dieldrin" are given, the latter proving superior. Where grub damage also occurs BHC is necessary. A combination treatment is recommended in soldier fly and grub infested fields.

* * *

Syndicated farm drainage—a positive answer. C. L. TOOHEY. *Cane Growers' Quarterly Bull.*, 1969, **32,** 80–82.—The extension of mechanical harvesting in southern Queensland has emphasized the need for improved land drainage of sites subject to weather delays. The advantages of carrying out drainage on a communal basis, where possible, are explained, especially in the provision of joint main drains between properties.

* * *

Unusual pig damage. C. M. MCALEESE. *Cane Growers' Quarterly Bull.*, 1969, **32,** 84.—Wild pigs have destroyed some cane in Queensland ever since cane was first cultivated. Where two varieties were grown, Q 78 and Q 83, pigs ate and severely damaged Q 78 but did not damage any of the Q 83.

* * *

Ground pearls—margarodids. G. WILSON. *Cane Growers' Quarterly Bull.*, 1969, **32,** 93–95.—Ground pearls are only a serious pest of cane in certain situations in Queensland. There are four different species. These are described. They are related to woolly aphis and have many peculiar characteristics, one being the ability to remain in a dormant state for as long as four years.

* * *

Relative effects of commonly used nitrogenous fertilizers. J. WRIGHT. *Cane Growers' Quarterly Bull.*, 1969, **32,** 96–98.—An outline is given of the manufacture of sulphate of ammonia, ammonium hydroxide and urea and of their reactions in the soil. The establishment of recent further trials with these fertilizers in the Mackay district, in all the major soil types in which cane is grown, is referred to.

* * *

The ratooning of Q 85 is satisfactory. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1969, **32,** 105–106.—Results of ratoon trials involving this variety are given. Its performance proved to be satisfactory.

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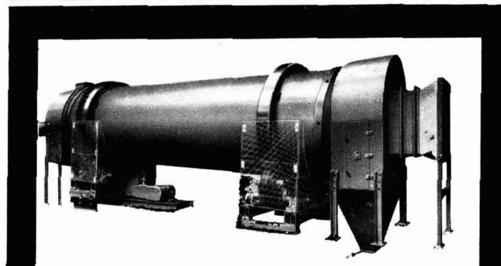

Mossman growers beware! A new grass. L. G. W. TILLEY. *Cane Growers' Quarterly Bull.*, 1969, **32,** 76. A new grass weed, an annual grass called "Habana oat grass" or "grader grass" (*Themeda quadrivalvis*) has appeared in cane in the Mossman area of Queensland in the last two years and has spread rapidly. A photograph shows first ratoon cane badly infested. Precautions and suggestions for chemical control are made. [This grass is widespread in India, a garden weed, and in the Middle East. The culms or flowering stems may reach a height of 3–4 feet.—*Ed.*]

* * *

The truth about the sacadas. E. L. CLAPAROLS. *Sugarland* (Philippines), 1968, **5,** (11), 34–35.—The "sacada" is the name given in the Philippines to the seasonal sugar cane labourer who goes from his own island to another for the sugar cane harvest. In this article the writer contends that the sacadas are well treated on the sugar cane plantations and not exploited as has recently been made out.

* * *

Studies on the metabolic changes associated with grassy shoot disease. S. J. JAISWAL and I. S. BHATIA. *Sugar y Azúcar*, 1969, **64,** (2), 29.—In Maharashtra State this disease, at first thought to be of little consequence, has developed to the extent of being a major threat. An infected stool bears a mass of stunted, crowded shoots with leaves unlike normal cane leaves. As little is known regarding the biological changes that take place in infected cane this study was undertaken. It is concerned mainly with changes in the free and protein-bound amino-acid and organic acid contents.

* * *

Investigations on the growth and ripening of sugar cane in Tucumân. ANON. *La Ind. Azuc.*, 1968, **74,** (901), 337.—An account is given of investigations or observations carried out in Tucumán with the sugar cane variety NA 56-30. The two most important factors influencing the growth of sugar cane in Tucumán are considered to be temperature and humidity.

* * *

Recommendations for the control of mosaic disease in sugar cane in Louisiana, 1969. ANON. *Sugar Bull.*, **47,** (11), 13.—The need for keeping seed plots free of the disease and the value of roguing is stressed. Where N:Co 310 is grown and is badly infected its cultivation should be discontinued and replaced by another or other varieties. Mosaic spreads more rapidly in N:Co 310 than in any other commercial variety in Louisiana. Nine different recommendations for reducing the incidence of the disease are made.

* * *

Borer infestation and loss in the 1968 Louisiana sugar cane crop. L. J. CHARPENTIER, R. MATHES and W. J. MCCORMICK. *Sugar Bull.*, 1969, **47,** (12), 5.—The 1968 borer survey (*Diatraea saccharalis*) consisted of two examinations of 100 stalks each at 22 representative mills. Details of the survey are given. Mill averages ranged from 7 to 18% with an estimated average of 11% for the 22 mills. Compared with 1967 infestation was higher (1–14%).

* * *

Leaf scald disease confirmed. ANON. *S. African Sugar J.*, 1969, **53,** 161–163.—This bacterial disease of sugar cane (*Xanthomonas albilineans*), previously unknown in southern Africa, has now been recorded from the eastern Transvaal, Pongola and the Mtunzini Field Station. It has been found attacking at least 5 varieties of sugar cane. In most instances the disease was located only in isolated stools and appropriate remedial measures were taken. Information is given under the headings of symptoms of the disease, transmission, economic importance and control.

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Characteristics of sugar cane damage caused by rodents in Hawaii. ANON. *Sugar J.*, 1969, **31,** (9), 22–24. The Polynesian rat, black rat and Norway rat all eat and damage cane in Hawaii, the total amount of damage being very large. Characteristics of stalk damage were studied to find out whether the kind of damage could be correlated with any particular species of rat. This was found not to be so. For identification rind chips left by rats provided better clues than stalk injuries. Some expertise is needed to make use of these and examinations must be made while the chips are fresh.

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Enquiry into the health of sugar cane in various parts of Africa. H. BARAT. *Agron. Trop.*, 1969, **24,** 505–522. The countries dealt with include RCA (République Centrafricaine), Dahomey, Togo, Niger, Upper Volta, Ivory Coast and Sénégal. Diseases and pests that occur and their significance are discussed. The need to apply quarantine regulations in the introduction of new varieties is emphasized.

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An analysis of labour demand and supply in the sugar cane industry of Puerto Rico. R. CALEIRO, P. CHOUDBURY and F. PRINGLE. *J. Agric.* (Univ. Puerto Rico), 1969, **53,** 28–32.—During the 15 year period, 1950–51 to 1965–66, cane field workers declined in number from 109,000 to 45,000. During this time the average field wage increased from $2.96 to $4.86. During the same period the sugar cane acreage fell from 423,123 to 306,900. Other factors concerned with the labour problem are discussed.

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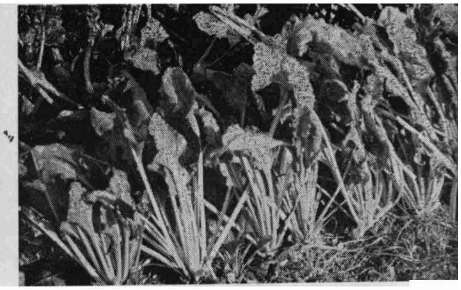
Comparison of growth and development of sugar cane borer larvae from Puerto Rico and Louisiana. S. D. HENSLEY and L. F. MARTORELL. *J. Agric.* (Univ. Puerto Rico), 1969, **53,** 147–148.—A basic wheat-germ diet used successfully in the United States in rearing the sugar cane borer, *Diatraea saccharalis*, in the laboratory proved unsuccessful in Puerto Rico. It was concluded that strains of the borer, differing in their nutritional requirements, occur in Louisiana and Puerto Rico.

Sugar beet agriculture



Beet without hard labour: varied methods compared. ANON. *British Sugar Beet Rev.*, 1968, **37**, (1), 27–30, 35–36.—An account is given of a spring demonstration at Thriplow, near Cambridge, drill performance being examined in detail.

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Effect of soil physical condition and fertility on yield of sugar beets on a Brookston clay soil. E. F. BOLTON and J. W. AYLESWORTH. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **14**, 664–670.—Improvement of the physical condition of the soil was effected by means of a soil conditioner ("Vama"). At both high and low fertility levels this resulted in higher root and sugar yields. Effects of physical improvement and fertility were additive.

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Resistance of sugar beets to sugar beet root aphids (*Pemphigus populivenae*). R. L. WALLIS and J. E. TURNER. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **14**, 671–673.—Results of growing 31 varieties of sugar beet exposed to infection by the sugar beet root aphis (a troublesome pest in some areas) are discussed and tabulated. There was much variation in the degree of infection. The opinion was reached that breeding for greater resistance to the sugar beet root aphis would be feasible.

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Potassium fertilization of sugar beets in central Washington. D. W. JAMES, D. C. KIDMAN, W. H. WEAVER and R. L. REEDER. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **14**, 682–694.—Results are presented of field experiments made in 1966 with K on sugar beets. Various rates of K fertilizer were applied to a soil low in available K. It was applied both in banded treatments and foliar sprays. Results indicated that either method increased K in the plant and reduced Na. Percentage sucrose at harvest and root yield were significantly increased, giving an increase of 0·44 tons sugar per acre.

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Field trials with "Dexon" for detecting latent damage in sugar beets caused by root-invading fungi. C. WINNER and W. R. SCHÄUFELE. *Zucker*, 1968, **21**, 583–588.—Damage not readily visible may be caused to lateral roots of sugar beet by the root-infecting fungus, *Aphanomyces* sp. By partial soil disinfection with the fungicide "Dexon" (*p*-dimethylaminobenzene-diazosodium sulphonate) root damage by the fungus may be detected and its actual effect on the growth of the plants recognized. Field trials are discussed. Damage from the fungus is most likely to occur in fields where sugar beet is frequently cultivated or when grown in successive years, i.e. faulty rotation.

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Harvester maintenance. R. FOGG and J. J. NIEDERER. *Sugar Beet J.*, 1968, **32**, (1), 4–5.—The need to have a sugar beet harvester in first-rate condition at the commencement of the season to avoid what may be costly delays is emphasized. Some hints of maintenance, with illustrations, are given.

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Plan your harvest. F. B. RUSSELL. *Sugar Beet J.*, 1968, **32**, (1), 6–7.—The need to plan sugar beet harvesting ahead, right from planting time, is stressed. Rows must be straight and uniform and evenly spaced if maximum benefit is to be obtained from modern harvesting machinery. Good even stands result in better topping. Loading vehicles should be checked in advance.

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Studies of "Gametocide FW 450" (sodium 2, 3-dichloro-isobutyrate) effects upon the percentage of triploid seeds obtained by treatment of diploid or tetraploid plants. H. AMAND, F. BRONCKERS and F. STAINIER. *Publ. Trimest. Inst. Belge pour l'Amél. Betterave*, 1968, (2), 33–50.—Results of experiments during 3 seasons (1965–1967) on the possibility of utilizing FW 450 to increase production of triploid seed in crosses between tetraploid sugar beet are discussed. Aqueous solutions of different concentrations were used as sprays at intervals. The most efficient treatment was found to consist of two sprayings at 0·5% concentration. Production and viability of seed were not seriously affected. Percentage of triploid hybrids was 72 when diploid plants were treated and 90 in the case of tetraploid plants.

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The production of sugar beet seed in Austria with special reference to genetic monogerm seed. H. ISÁK. *Zeitsch. Zuckerind.*, 1968, **93**, 597–599.—Developments in the production of sugar beet seed in Austria since 1948 are outlined. Present-day production of monogerm seed, which has increased very rapidly in recent years in Austria, is discussed. Owing to favourable climatic and edaphic conditions, seed of very high quality is produced, some of it now exported.

Protection of sugar beet stecklings against aphids and viruses by cover crops and aluminium foil. G. D. HEATHCOTE. *Plant Pathology*, 1968, **17**, 158–161. Sugar beet seedlings or stecklings were grown without cover, between rows of mustard or barley, or with strips of aluminium foil between the rows. Very few sugar beet plants under the cover crops contracted virus yellows, as the cover crops discouraged the aphids from alighting on the sugar beet. Aluminium foil had the same effect but to a less extent. The sugar beet grown under cover was less well developed than that in the open beds. The efficiency of the aluminium foil decreased as the reflecting surface weathered and it is considered unlikely that it would have commercial use in this way.

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Graft transmission of male sterility in sugar beet. G. J. CURTIS. *Euphytica*, 1967, **16**, 419–424; through *Biolog. Abs.*, 1968, **49**, 9714.—Male sterility in sugar beet was successfully transmitted across the union when male sterile plants were reciprocally grafted. Details of the experimental work are given.

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Investigations made into male sterile beets. H. A. CORTESSI. *Euphytica*, 1967, **16**, 425–432; through *Biolog. Abs.*, 1968, **49**, 9714.—It was found that environmental conditions influence the expression of male sterility. Different strains reacted differently. Pre-treatment of material had an influence on the expression of male sterility.

* * *

"Pyramin" and "Venzar" for the control of weeds in sugar beet. G. COVARELLI. *Ind. Sacc. Ital.*, 1968, **61**, 288–295.—Field trials carried out in central Italy during the years 1965–68 with "Pyramin" and "Venzar" are reported. The effects on some 16 troublesome weeds are given in tabular form. Both herbicides effectively destroyed weeds, "Pyramin" proving to be rather more efficient that "Venzar".

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Improvement of emergence and growth of sugar beets by soil covering. A. VON MÜLLER and C. WINNER. *Zucker*, 1968, **21**, 646–651.—Results are discussed of field trials over 5 years in covering newly sown sugar beet seed with a thin layer of bitumen sprayed on the seed row to act as a mulch. Meteorological conditions and soil temperatures were recorded. With the exception of one out of five trials, field emergence, early growth and yields were improved by the treatment. It was felt that high cost and difficulties of application would at present prevent this treatment from becoming general field practice.

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Sex attractant of sugar beet wireworm: identification and biological activity. M. JACOBSON, C. E. LILLY and C. HARDING. *Science* (New York), 1968, **159**, 208–210; through *J. Sci. Food Agric. Abs.*, 1968, **19**, ii–217.—The sex attractant, produced by adult females [*Limonius californicus* (Mannerheim)] has been isolated and identified as valeric acid. In the laboratory the males are repelled by the pure attractant but in the field they are lured by a dilute solution from a distance of 12 m in 10 sec. The pheromone occurs in unusually large amounts in the female's body. Its stability, volatility and availability make it an ideal bait trap for population control.

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Bolting in early-sown sugar beet. L. A. WILLEY. *British Sugar Beet Rev.*, 1968, **37**, 71–72.—It is pointed out that bolting in beet is a complex physiological process as yet imperfectly understood, temperature, up to the six-leaf stage, being very important. Tables are given showing average percentage of bolters for the 1966–68 seasons, with all the leading varieties. The variety Sharpe's Klein E gave the lowest number of bolters for 1968. Growers should pay close attention to bolting resistance when choosing varieties for early sowing.

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Three new harvesters at Scottish event. ANON. *British Sugar Beet Rev.*, 1968, **37**, 75.—Reference is made to Scotland's 15th sugar beet harvesting demonstrations held at Balcathie, Arbroath, on 7th November, 1968. Nine harvesters were at work. Three, the Armer, Standen Rapside tanker and Catchpole Twin Row, were at their first demonstration. For the first time more tankers than side delivery models were present.

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The distribution of sugar beet yellowing viruses in East Anglia from 1965 to 1968. G. E. RUSSELL. *British Sugar Beet Rev.*, 1968, **37**, 77–84.—The important differences between the two kinds of virus yellows of sugar beet, beet yellows virus (BYV) and beet mild yellowing virus (BMYV) are explained. The results of 4 surveys from 1965 to 1968 are summarized. Photographs of the filamentous particles of both diseases taken with an electron microscope (at magnifications of $\times 45,000$ and $\times 25,000$) are shown, as well as colour photographs of the leaves of some weeds infected by either of the two diseases.

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Current practice in the Bardney beet-growing area. G. PARKINSON. *British Sugar Beet Rev.*, 1968, **37**, 85–88.—In this area (near the Wash) farming interests and soil types vary greatly and many different methods of husbandry are employed in producing sugar beet. These are described under such headings as seed bed preparation, drilling, monogerm seed, herbicides and yields.

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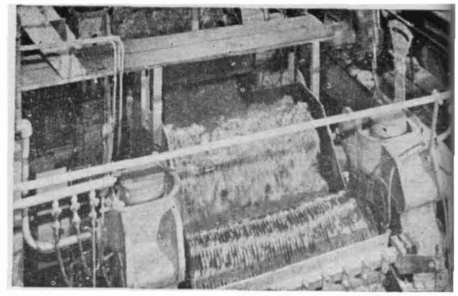
A review of an experiment on the manufacture of sugar from sugar beet. V. S. SUD. *Indian Sugar*, 1968, **18**, 433–439.—See *I.S.J.*, 1969, **71**, 170–172.

Cane sugar manufacture



Improved cane handling system at Okeelanta. A. Kirstein and P. A. Carreno. *Sugar y Azúcar*, 1969, **64**, (3), 46–47.—Details are given of the system used at the Okeelanta sugar factory of the South Puerto Rico Sugar Co., whereby the mill receives 9000 t.c.d. while having no storage facilities in the yard.

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Design of integral vapour dome and entrainment catcher with new deflector-type elements. S. L. Saxena and L. Sanyal. *Sharkara*, 1968, **10**, 54–58.—In the integral entrainment separator described, channelling and short-circuiting of the vapour is prevented by arranging the deflector elements vertically in a staggered arrangement. Good separation has been obtained at a vapour velocity of 80–100 ft/sec.

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Full pan seeding of low-grade strikes: a brief review. T. R. Ray. *Sugar J.*, 1969, **31**, (10), 17–23.—After an explanation of supersaturation, the author describes the three major methods of graining low-grade massecuites, i.e. the waiting method, the shock seeding method and the full seeding method. The last of these is discussed in much greater detail, advice being given on the technique and quantities recommended for given conditions, the extra equipment needed, and availability of commercial seed fondant. The advantages of full seeding are considered.

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Handling mud with the "Eimcobelt" filter. J. R. Stembridge. *Sugar J.*, 1969, **31**, (10), 27–35.—Operation of the "Eimcobelt" filter for clarifier muds is described and advice is given on how to obtain optimum results. Among the major factors discussed are clarifier operation, mud temperature, addition of bagacillo and the use of flocculants to prepare mud of suitable condition for filtration.

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Burning bagasse. V. Baillet. *Sugar J.*, 1969, **31**, (10), 36–37.—Factors affecting the burning of bagasse in furnaces and possibilities in improving furnace performance are discussed in the light of experience in Louisiana.

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The Suchem "Auto Diffuser". P. P. Strich. *Sugar J.*, 1969, **31**, (10), 47–49.—Results obtained with a Suchem "Auto Diffuser"[1] in Louisiana indicate an average of 1·5° less pol in bagasse than was obtained with milling, while bagasse moisture was about the same in both cases.

Evaluating evaporator maintenance in Barbados. R. Maloney. *Sugar y Azúcar*, 1969, **64**, (4), 23–24, 38.—See *I.S.J.*, 1969, **71**, 202–205.

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Major growth in Colombia's sugar industry. Anon. *Sugar y Azúcar*, 1969, **64**, (4), 30.—A brief survey is given of the Colombian sugar industry, the exports from which have risen rapidly in recent years to 200,000 tons of raws in 1967, whereas in 1958 the country was still an importer.

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Effectiveness of coarse groovings. G. K. Chetty. *Indian Sugar*, 1969, **18**, 749–751, 763.—See *I.S.J.*, 1969, **71**, 242.

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Molasses viscosity—its limiting effects on low-grade massecuite treatment. J. C. Chou. *Taiwan Sugar*, 1969, **14**, (1), 7–11.—Results are given of tests in which it was found that during treatment in a water-cooled crystallizer the mother liquor (molasses) purity fell at a decreasing rate while its viscosity rose at an increasing rate. For reasonable exhaustion of the molasses, it is considered sufficient to cool the massecuite to 40–35°C and reheat it to about 50°C before curing.

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A simple method for preparation of seed slurry for sugar boiling. S. C. Gupta and S. K. D. Agarwal. *Sharkara*, 1969, **10**, 94–98—See *I.S.J.*, 1968, **70**, 233.

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Various aspects of instrumentation in Mauritius. F. le Guen. *Rev. Agric. Sucr.* (Mauritius), 1968, **47**, 279–290.—The maintenance and repair of certain types and makes of sugar factory laboratory instruments used in Mauritius are discussed.

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Prevention of entrainment from the last body of a quadruple. K. S. Shah. *Indian Sugar*, 1969, **18**, 807–808.—At the author's sugar factory, installation of a helmet-type entrainment separator designed at the National Sugar Institute in India reduced entrainment in the last effect of a quadruple-effect evaporator almost to zero.

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Clarification and filtration trouble with Co 1148 variety cane juice during the season 1967-68. D. P. Sanjana, H. H. N. Saxena, P. N. Malik and K. R. Sakhuja. *Indian Sugar*, 1969, **18**, 809–810, 850. Difficulties experienced at the authors' sugar factory were overcome by adding 2·5% 20°Bé milk-of-lime (on mud volume) to the muddy juice from the Dorr clarifier, giving a juice pH of about 7·6.

[1] *I.S.J.*, 1968, **70**, 203–205.

Deterioration of chopped cane. D. H. Foster. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 21–28.—Investigations on stored cane showed that sucrose losses in burnt cane (5–10% of the original content) were far higher than those in green cane over the same period. The dextran content in the green cane was also considerably lower than in the burnt cane. Freshly cut cane was found to contain varying quantities of dextran, the content being higher in diseased cane, although some of the apparently healthy cane samples showed high levels (500–1500 p.p.m.). However, the possibility that polysaccharides other than dextran are involved is suggested.

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Continuous centrifugals. L. K. Kirby. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 77–84. Comparative tests on the BMA K.1000 and the Buckau-Wolf 1100 V continuous centrifugals for low-grade work showed that the Buckau-Wolf machine was superior to the BMA centrifugal at identical feed rates (higher sugar purity and lower molasses purity) but was somewhat less efficient than the BMA machine at maximum throughput, averaging 3·4 tons/hr compared with 2·0 tons/hr in the BMA centrifugal. Crystal breakage was about the same in both machines. "Teflon" deflector plates on the inner housing on the Buckau-Wolf machine to reduce crystal breakage quickly became fouled with adhering sugar.

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Effet condenser performance. P. N. Stewart and T. C. Mulvena. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 89–95.—Details are given of the performances of condensers connected to the evaporators at Babinda[1], Mourilyan and Plane Creek sugar mills in Queensland, and some conclusions are drawn.

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Calandria pan studies. J. W. Hill. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 97–110. Details are given of a design for a 12,000-gal low-head calandria pan with multiple (18) downtakes. The main design features are compared with a similar design but having only a single central downtake and with a Walkers Ltd. floating-calandria, "centre stream" pan, showing the advantages of the proposed design as regards lower footing volume required (27% of the total capacity) and shorter maximum horizontal flow path (2–3 rows of tubes).

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Performance of floating calandria pans at Racecourse mill. E. McDougall. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 111–116.—A centre-stream floating-calandria pan was modified to a fixed-calandria pan with a central downtake after boiling difficulties were encountered in the form of constant growth of new grain during the strike. Details are given of the original and modified designs. The altered design permitted shorter boiling times, and 2nd massecuites could be boiled as well as 1st massecuites without "dirty" graining. Sugar grist was much better than the Queensland average.

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Sequencing of vacuum pan operation. R. N. Johnson. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 117–129.—Details are given of the features of a sequential control system applied to a Walkers Ltd. No. 1 pan at Pioneer mill. Although the pan has operated 300 cycles with the controls, a number of difficulties have prevented proper evaluation of performance, although a 7% decrease in cycle time is already possible.

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Eddy current testing of brass tubes in sugar mill vessels. S. R. Durrell. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 161–169.—The technique described is based on the magnetic field set up by eddy currents induced in the test material. The magnetic field opposes the primary magnetic field, so inhibiting the flow of current in the energizing coil. If the material within the coil contains cracks, the eddy current will be restricted, the opposing magnetic field reduced and the current flow in the energizing coil increased. The use of this phenomenon to measure tube flaws and the type of instrument used are described and tests undertaken by Metal Manufactures Ltd. on evaporator tubes at Fairymead sugar mill are discussed. The results have indicated the value of annual testing of heat exchanger tubes, although some limitations of the technique are noted.

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Tube expanding. S. Houghton. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 170–176. Types of expanders, measurement of expansion, the expanding operation itself and preparatory work are among the items discussed. Explosive tube expanding, as carried out in the USA, is also noted.

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Design of sugar mill gears. P. W. Jones. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 177–181.—Gear design and construction for sugar factory equipment is discussed and the basic difference between the standard set by the British Standards Institute and the American Gear Manufacturers' Association, viz. the higher reliability factor applied by the latter, is noted.

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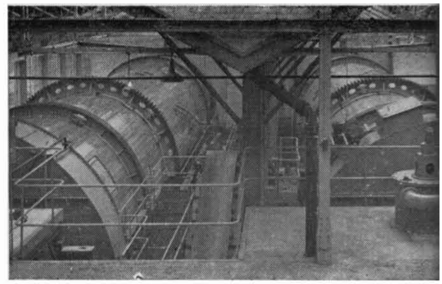
Experiences in high-grade graining at Marian mill. D. M. Stevenson. *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 205–212.—Boiling of *A*- and *B*-massecuites using seed slurry for graining and remelting all *C*-sugar at Marian mill had the advantages over the use of magma of increasing pan and high-grade centrifugal capacities and reducing labour and centrifugal maintenance costs and capital expenditure, but had only a slight effect on sugar quality improvement. However, the system is advocated for Australian sugar mills.

[1] *See I.S.J.*, 1968, **70**, 53.

Beet sugar manufacture



Investigation of a juice purification scheme with removal of pre-carbonatation mud. R. G. Zhizhina, A. K. Kartashov, V. A. Nagornaya and L. I. Onishko. *Sakhar. Prom.*, 1969, **43,** 25–29.—Factory tests showed that subjecting raw juice to pre-defecosaturation, with simultaneous liming and gassing, followed by vacuum filtration of the mud and return of the filtrate and clear juice to main liming, improved the filtration and settling properties of 1st carbonatation juice as well as reducing its colour, lime salts and reducing matter content compared with 1st carbonatation juice obtained in a conventional system. Less than 1% CaO (0·4–0·6%) on juice volume is added at pre-carbonatation.

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Dosing of small quantities of milk-of-lime. V. V. Zlaman. *Sakhar. Prom.*, 1969, **43,** (3), 36–37.—For automatic dosing of milk-of-lime to carbonatation, a trough with a sloping bottom is provided with a slide valve near the discharge port. Milk-of-lime falls into the other end of the trough from a metering tank. By using two slide valves, it is possible to separate the milk-of-lime into two streams, one for preliming and the other for carbonatation.

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Forced ventilation—a reliable means of improving raw material quality. I. A. M. Elagin and A. E. Gelunov. *Sakhar. Prom.*, 1969, **43,** (3), 42–45. **II.** V. Semenenko and A. Solov'ev. *ibid.*, 46–47.

I. Comparison is made between the results of beet storage with and without forced ventilation, from which it is concluded that under Kuban' conditions the capital costs of ventilation equipment would be recouped in one campaign, assuming a storage period of 70 days and using automatic temperature control.

II. Forced ventilation of beet piles of various dimensions ranging from 4·7 m high × 96 m long × 36 m wide to 6·0 m high × 156 m long × 22 m wide has been tested over 3 years. The beet processing properties were good and the advantages of piling high are briefly discussed.

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The profitability of electrical power generation for a sugar factory to be built. H. Huber and W. Stolz. *Zucker*, 1969, **22,** 179–184.—Four systems of power supply for a new sugar factory are compared for their economics: (1) where all of the electricity needed is generated at the factory, (2) and (3) where up to 3·4 kWh and 4·5 kWh per zentner of beet, respectively, is generated at the factory, and (4) where all the electricity is obtained from the grid. All the cost factors involved are investigated.

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Survey of methods for determining invertose (invert sugar). F. Tödt and J. G. Abraham. *Zeitsch. Zuckerind.*, 1968, **93,** 289–296.—A survey is presented of the literature (202 references) on methods of determining invert sugar in the presence of sucrose. The advantages and disadvantages of the various categories of techniques are discussed.

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Control of beet pile ventilation. V. Hrdlička and V. Valter. *Listy Cukr.*, 1969, **85,** 76–77.—Details are given of a control scheme for forced ventilation of beet piles which has been tested in an experimental beet yard and in which the signal to the fan controller corresponds to the difference between the pile and ambient temperatures. The difference should be 2–3°C.

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Use of an i,d-diagram for selection of optimum air conditions during white sugar storage in silos. D. S. Shevtsov, A. F. Zaborsin, L. K. Sereda and V. N. Golubenkov. *Sakhar. Prom.*, 1969, **43,** (4), 13–16. Optimum air conditions in a white sugar silo are discussed and an i,d-diagram reproduced in which the region of optimum air temperature and relative humidity is indicated.

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Induction slip coupling for the electric drive of suspended centrifugals. G. A. Kaminskii, A. M. Savenkov and A. P. Yan'shin. *Sakhar. Prom.*, 1969, **43,** (4), 29–34. Details are given of tests with a Soviet-designed vertical induction slip coupling for centrifugal drives.

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Aperture proportioning meter for raw juice. V. V. Zlaman. *Sakhar. Prom.*, 1969, **43,** (4), 34–36.—Raw juice is pumped up into a compensator tank, to reduce foaming and turbulence, whence it flows into the proportioning chamber, passing through an aperture in a dimensioned weir and down through a discharge port to pre-liming.

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Operational safety of modern high-capacity centrifugals. G. Schneider. *Zucker*, 1969, **22,** 216–219. Among causes of accidents involving centrifugals that are surveyed is operation of the discharge plough at too high a basket speed, resulting from error in the electrical controls or failure of the clutch between the motor and the shaft, so that the motor speed alone governs the basket speed. Since the safety factor for basket calculations is now lower than previously, the importance of losses in strength caused by corrosion is much greater, so that more thorough and regular checks are necessary. Examples of basket corrosion are shown as well as illustrations of centrifugal damage.

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The sugar industry and ergonomics. R. VEROEVEREN. *Sucr. Belge*, 1969, **88,** 187–197.—After an introduction to ergonomics ("fitting the job to the worker"), examples are given of improvements in efficiency and personal comfort brought about at Tirlemont refinery in Belgium on recommendations made by the Commission d'Ergonomie.

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Sugar factory with all-year-round operation. M. ŠKRÁBAL. *Czechoslovak Heavy Ind.*, 1969, (4), 2–18. Details are given of the design layout of a beet sugar factory and refinery processing 4000 tons of beet per day and stored thick juice during the off-season. Reference is made to tests on stored thick juice in Czechoslovakia[1] and a flow diagram is given of a liquor storage plant. Steam requirements for the factory and storage plant are calculated and the costs of equipment and building costs are compared for a modified existing factory and for a completely new factory, showing the advantages of building to the proposed new specifications.

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Sugar beet growing and the sugar industry in Holland. C. F. ROOSENSCHOON. *Sucr. Franç.*, 1969, **110,** 161–165.—A brief survey is given of beet growing, showing the increase in beet area, including the sandy regions, and the history of the Dutch sugar factories and their cooperatives is briefly retold. The transport (by barge in many cases) and reception of beet is examined, as are the farmer-factory relations and relations between the private and cooperative sectors. Beet price, sugar storage, consumption and the future of the industry within the framework of the EEC are also dealt with.

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The present state of science and technology in the piling and storage of sugar beet. M. Z. KHELEMSKII. *Zeitsch. Zuckerind.*, 1969, **94,** 201–209.—The whole subject of beet storage is dealt with in the light of experience in the USSR and experimental work being carried out under the guidance of the all-Union Sugar Industry Research Institute (VNIISP) in Kiev, where the author is a professor. Beet damage and respiration, the use of antibiotics to combat microbiological processes in the pile, beet sprouting, and the effects of various factors on beet cultivation and harvesting are among the subjects of research considered. Reception, evaluation, classification and preparation of the beet for piling, pile protection and the effect of forced ventilation are also discussed and recommendations on optimum conditions for processing of stored beet are given.

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Recent developments in hyperfiltration. G. VERNOIS. *Zeitsch. Zuckerind.*, 1969, **94,** 214–218.—The reverse osmosis technique for desalting seas and brackish water and for concentrating sugar-containing juices such as grape must and cider is described and its possible applications in other fields, including the purification of factory effluent, briefly mentioned.

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Sugar crystallization with the rheometer boiling control. H. THIELE and A. LANGEN. *Zeitsch. Zuckerind.*, 1968, **93,** 469–474, 544–547, 656–661; 1969, **94,** 218–223. The use of a rheometer, which measures flow in terms of viscosity and crystal content, as basis for boiling control is discussed in great detail and a description is given of a unit developed and installed in a number of Pfeifer & Langen sugar factories in West Germany. The results obtained by use of the system and its advantages over manual boiling control are discussed.

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Device for washing of entrainment separators having Raschig rings and for foam dispersion in evaporators. H. GELEN. *Zeitsch. Zuckerind.*, 1969, **94,** 224–225. An overhead spray device installed above the Raschig rings in the entrainment separators of a quintuple-effect evaporator at Adapazari sugar factory in Turkey has proved successful in keeping the rings clean after 165 days' operation and preventing foam formation. Warm water is sprayed onto the rings after the effects have been boiled-out with sodium carbonate solution and acid.

* * *

Hopper weighers for the sugar industry. E. R. ERDMANN. *Zeitsch. Zuckerind.*, 1969, **94,** 225–227.—In the system described, liquid falls from a tank to a weighing hopper below and then into a third tank below the hopper. From the last tank it flows continuously to process. Application of the system to sugar is discussed. Advantages claimed include high precision and reliability. Calibration and control equipment is described.

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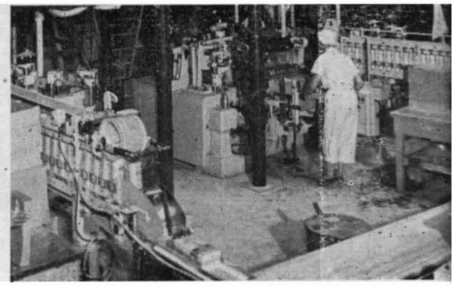
Optimization of beet syrup purification by electrodialysis. I. F. ZELIKMAN, D. M. LEIBOVICH and E. V. REPINA. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (1), 66–68.—In electrodialysis tests with 60°Bx syrup and 3% NaCl electrolyte solution, the optimum throughput in terms of current usage was 70% at 10 mA/sq.cm. current density and 20–24% deionization. The pH of the syrup, which was recirculated, fell from 8·3 to about 7.

* * *

Fundamentals of automatic control. III. J. PULACZEWSKI and S. MICJALOWICZ. *Gaz. Cukr.*, 1969, **77,** 53–57.—The design and operation of modern pneumatic converters, which measure in terms of compensating forces, are explained.

[1] SÁZAVSKÝ: *I.S.J.*, 1968, **70,** 373.

Sugar refining



Purity of refined sugar obtained with the use of AV-16G anion exchange resin. T. A. KLOCHKOVA and T. A. BALASHOVA. *Sakhar. Prom.*, 1968, **42,** (12), 18–19. Tests showed that no chlorine was present in refined sugar after syrup treatment with AV-16G anion exchange resin, which contains epichlorhydrin. Although syrup could become contaminated with polyethylenepolyamines, also present in the resin, it was found that most of the PEPA would remain in the molasses; even where the surface of the sugar crystal became contaminated, the PEPA could be removed with water.

* * *

Use of fibre glass-reinforced plastic in sugar refineries. N. ROSENBERG. *Zeitsch. Zuckerind.*, 1969, **94,** 34–36. See *I.S.J.*, 1969, **71,** 376.

* * *

Consideration of sugar cooling by means of (a) fluidized bed cooler. S. TAKAHASHI and S. SUZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1968, **20,** 1–7.—A fluidized bed cooler was modified on the basis of correlation between cooling efficiency and the air:sugar ratio. By this means sugar was cooled from about 57–67°C to about 36–43°C, although the temperature difference between sugar on discharge and the inflowing air never fell below 7–8°C. Further improvements in cooling efficiency would necessitate larger equipment and lower cooling air temperatures.

* * *

Pressure drop due to viscous flow through beds of bone char. S. KUDO and K. AMAKO. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1968, **20,** 8–15. The KOZENY-CARMAN equation for calculation of pressure drop due to viscous flow through beds of granular solids has been found in laboratory tests with water to be fully applicable to beds of bone char. A value of 2200 was found for K [$K = 18k(1-\varepsilon)^2/\varepsilon^3\varphi_s^2$, where k is a dimensionless constant, ε is the fractional void volume, and φ_s is the shape factor of the packing solid, which is given by (area of a sphere equivalent to the particle volume)/actual particle surface] for closest char bed packing, whereas the recommended value for bone char filters is 2000.

* * *

"Reverse two bed" system demineralization of sugar liquor with ion exchange resin. Y. ITO, Y. OWADA and S. SHINADA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1968, **20,** 39–52.—Raw sugar liquor of about 62°Bx and 98 purity, previously decolorized with "Diaion SA11A" strongly basic anion exchange resin in Cl^- form, was passed at pH 6·5–7·0 through two columns in parallel containing "Amberlite IRA 402" anion exchanger, after which it was passed through a column of "Amberlite IRC-75" cation exchanger. The purity rise of 0·3–0·4 was 0·1 unit lower and the demineralization efficiency of 73% was 20% lower than with monobed (mixed bed) treatment. Total sugar loss (sucrose + invert) in the reverse process was 0·46%, of which 30% was invert loss. Tests on elimination of excessive amine odour from the anion exchanger sweet water showed that passing it though the cation exchanger during sweetening-off was the most effective method, giving a sweet water of sufficiently high quality as to make it suitable for use in high-grade boiling.

* * *

Studies on the clarification of affination syrup by means of polyphosphate treatment. II. Discussion of (the) physical nature of (the) reaction products. S. IWASHINA and M. ABE. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1968, **20,** 66–73.—Studies were made of the settling rate of impurities in affined syrup treated with polyphosphates[1]. Optimum conditions were: an agitation rate during polyphosphate treatment as low as possible, a sugar concentration of 40–45°Bx, and, in the case of centrifuging to remove the precipitate, a force of >5000 *g* for 10 min. pH was best adjusted with $Ca(OH)_2$ and the most suitable coagulant was "Aron Vis F" at 5 p.p.m. Sodium tetrapolyphosphate was the best of the polyphosphates investigated.

* * *

Studies on the clarification of affination syrup by means of polyphosphate treatment. III. Discussions on the clarification effects. S. IWASHINA, M. ABE, T. NAGASAKA, A. HIROSE and Y. EGASHIRA. *Proc. Research Soc. Japan. Sugar Refineries Tech.*, 1968, **20,** 74–81. NaOH, $Ca(OH)_2$ and NH_4OH used individually for adjusting the pH of the affination syrup treated with polyphosphate (see preceding abstract) were tested with 40°Bx syrup having an initial pH of 9·0. In all cases, excellent clarification was generally obtained with the reagents, and 80% of the micro-organisms present in the syrup were removed; more than 97% of the sodium tetrapolyphosphate was recoverable. Although NH_4OH was more effective than the other two alkaline reagents, difficulties such as toxicity, corrosiveness, etc. necessitate further studies before it can be recommended for use on a factory scale.

* * *

C & H improves packaging for granulated sugar. ANON. *Sugar y Azúcar*, 1968, **63,** (12), 23.—Details are given of the packaging plant at Crockett refinery, which includes five fully-automatic Hesser packaging machines and three Drohmann bundling machines.

[1] *I.S.J.*, 1969, **71,** 279.

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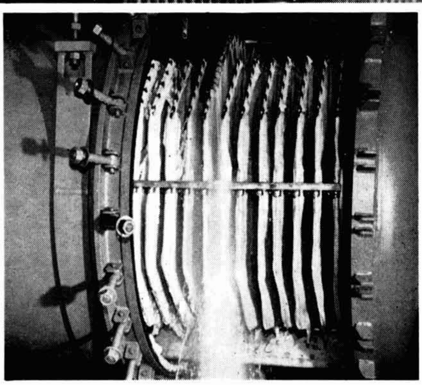

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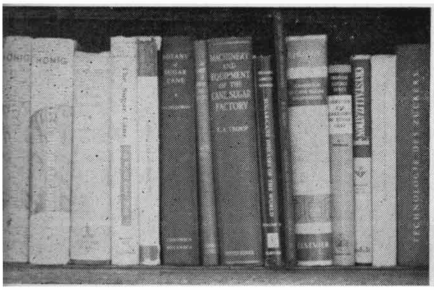


New books

US sugar and molasses trade, 1963-1967.—Summaries of trade and tariff information, Schedule 1, Vol. 9. (US Tariff Commission, Washington, D.C., USA.) 1969.

This volume, TC Publication 288, provides information on imports, exports, and production sugar, molasses, cocoa, confectionery, coffee, tea and spices, and is the eleventh of a series of fourteen to be published on animal and vegetable products covered by Schedule 1 of the Tariff Schedules of the United States.

The Summaries are designed to meet the needs of wide and varied interests, including the Congress, courts, Government agencies, importers, domestic producers, research organizations and many others, and contain accurate descriptions in terms of the tariff schedules, of the products imported into the US, methods of production, world supplies and importance in trade and in the US economy. Basic factors affecting trends in consumption, production and trade, and those bearing on the competitive position and economic health of domestic industries are also covered.

The current volume is published in too limited an edition for general distribution but copies will be available in the 42 field offices of the Dept. of Commerce and in selected public and university libraries.

* * *

Dictionary of chemical engineering. Vol. I. Chemical engineering and laboratory equipment. 617 pp; 6 × 9 in. **Vol. II. Chemical engineering; processes and products.** 570 pp; 6 × 9 in. W. E. Clason. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1968. Price: 165s 0d per volume.

Each of these two volumes is a six-language dictionary (English/American, French, Spanish, Italian, Dutch, German) in which the English/American term is given alphabetically in capital letters and beneath it the equivalent term in each of the other five languages, each group being numbered. The non-English terms are themselves listed alphabetically in separate thumb-tabbed indexes, one for each language, the group number being recorded for each word. Thus, for instance, to find the Dutch equivalent of an Italian word, the group number appropriate to that Italian word is looked up in the first section where the equivalents in all the other languages are listed, including the Dutch term. Each group, in addition, is assigned an abbreviation indicating the branch of chemical engineering in which the term is used.

Volume I, containing 5973 groups, covers apparatus and components used in chemical laboratories and in the chemical and allied industries, as well as chemical installations. Volume II, which has 5900 groups, deals with processes and methods used in chemical engineering, raw materials and their treatment, as well as the finished products. Commonly known chemicals are not included.

This is an ingenious system and might have produced a useful aid to the sugar man attempting to read work in a language foreign to him; however, to judge from the terms denoted as being employed in the sugar industry, the compilers have not carried out their work thoroughly enough and have not checked the terms against those actually used. In many cases terms have been included which are not used in the sugar industry, others have been mistranslated, and other important terms have been omitted. We hope that in the preparation of a new edition, the compilers would seek from workers in the various industries lists of important terms *in their mother-tongue* and correlate these. In this way a reliable multi-language dictionary would result; the present volumes we would not rely upon.

* * *

By-products of the cane sugar industry. J. M. Paturau. 274 pp; $8\frac{1}{4} \times 11\frac{3}{4}$ in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1969. Price: 200s 0d.

This new book provides a remarkably comprehensive survey of the range of products which have been obtained from the materials produced by the cane sugar factory—including sugar itself when the price obtainable is low enough to make industrial utilization economically desirable. After an introduction to the raw sugar factory process, the amounts of bagasse, molasses, filter mud, electricity, etc. which are available are summarized and a diagram used to illustrate the range of by-products obtained.

After a chapter reviewing the use of sugar for sucrochemical production and as a fodder, the text is divided into parts concerned with the utilization of bagasse, filter mud and cane wax, molasses, and miscellaneous by-products, respectively. Each section describes the characteristics of the material and then its utilization, giving a historical summary, the chemical and industrial principles involved, economics, references to actual utilization operations, an indication of future prospects, as well as a bibliography.

The extensive nature of the latter indicates the author's wide reading on the subject and while it may be said that the information comprising the bulk of the book is already available in the literature, this is the first time that it has been assembled in a single volume covering the by-products of the cane sugar industry. The book should be of interest to any sugar technologist or industrialist concerned with improving his company's profitability by utilization of these by-products and the author is to be congratulated on producing such a useful and informative work.

* * *

F. O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1969. (International sugar economic yearbook and directory.). H. AHLFELD. xlviii + 410 + 65 pp.; $8\frac{1}{2} \times 11\frac{1}{2}$ in. (F. O. Licht K.-G., 2418 Ratzeburg/Lbg., P.O. Box 90, Germany.) 1969. Price: £4 18s 6d.

This has become such a well-known publication that the reviewer is almost tempted to say to the reader "Please refer to our review of the 1968 edition". This is not to say that the information has not been updated, but the general layout remains unchanged and is quite satisfactory. For readers who do not know the book, it can be described as the best directory to the world sugar industry that is available. It contains information on EEC sugar marketing regulations, German and other sugar organizations, sugar importers and exporters, reports from sugar machinery manufacturers, a Buyers' Guide, an English-German glossary of sugar machinery terms, details of a number of sugar publications with their publishers' addresses, scientific institutes, and miscellaneous material on yeast and molasses producers and users. Apart from three special articles ("Beet agriculture without singling" by O. NEEB, "Drying and cooling in the sugar industry" by H. J. DELAVIER, and "Sugar trading within the EEC and with a third country") and a 65-page statistical supplement on world sugar, the rest of the book is devoted to details of the world's sugar factories and refineries, separated into beet and cane. Some of the details are incorrect, through no fault of the publishers but because of lack of information from the country in question, and there will inevitably be the occasional closure and new factory completion which has taken place since the book was put to press, but generally the contents are of great value to anyone seeking the type of information to be found in its pages, and the presentation is unquestionably of the highest standard.

* * *

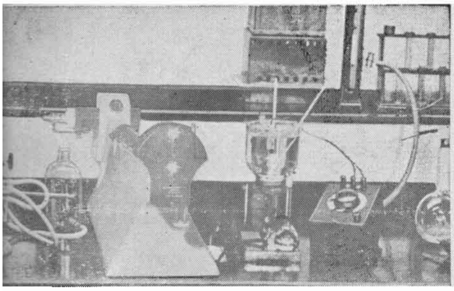
Tekhnologiya sakhara (Sugar technology). P. M. SILIN. 624 pp.; $5\frac{1}{2} \times 8\frac{3}{4}$ in. (Izd-vo "Pishchevaya promyshlennost", Moskva B-110, Mruzovskii per., d.l, USSR.) 1967. Price: 1.56 roubles; 14s 0d.

This is a revised edition of the book first published in 1958 under the title "Technology of beet sugar production and refining". In some cases the revisions are extensive, the aim of this 2nd edition being to cover modern practices reflected in the reconstruction of the Soviet sugar industry during the 1959–1965 Seven-Year-Plan. The book is divided into nine sections, one more than the 1st edition, the newcomer being a relatively short section on processing of cane raws (this and the section on refining were written by I. N. KAGANOV). The other sections cover: the sugar beet; juice extraction from beet; raw juice purification; juice evaporation; boiling and crystallization; by-product utilization; and general questions regarding beet sugar manufacture (including heat, steam, power and water consumption). The author, who until his death in 1967 held a most prominent position in the Soviet sugar industry, refers to his book as a course in sugar technology, emphasizing the point that he does not consider it a reference book for the technologist nor an "encyclopaedia of sugar manufacture". Undoubtedly the work will make a valuable contribution to the training of sugar technologists in the Soviet Union. The contents are laid out in a very methodical manner and there is no difficulty in following the author's lines of thought. For the beet sugar technologist outside the USSR the value of the book will lie in the information on Soviet processes and equipment. Unfortunately the problem of language is a very real one in this case, which will limit the number of technologists in the West who will be able to read the book.

* * *

Disposal of process wastes. Transl. M. WULFINGHOFF. 240 pp.; $5\frac{1}{2} \times 8\frac{3}{4}$ in. (Chemical Publishing Co. Inc., New York, N.Y., USA.) 1968. Price: \$12.50; £5 4s 0d.

This is a translation from the German of DECHEMA Monograph Series No. 895–911, Vol. 52 (published by Verlag Chemie, Weinheim-Bergstrasse, Germany, in 1964), and is a symposium of papers presented at the ACHEMA meeting at Frankfurt/Main in 1964. It includes 17 articles on various facets of process waste disposal and a progress report for 1964-1966 on the situation in the USA. Of possible interest to the sugar technologist are "Industry's contributions toward maintaining a clean environment", by O. JAAG (this deals with treatment of effluent from various plants, including distilleries), "Ion exchange—a basic operation in the treatment of industrial waste waters", by K. H. F. MEHLS, and "Biodegradable detergents", by H. SIMONIS, who discusses the potential application of various biodegradable detergents, particularly surface-active sugar esters, and mentions, *inter alia*, the work of HAAS, SNELL and others on behalf of the Sugar Research Foundation. The book ends with a glossary of terms used in waste disposal, conversion tables and a subject index. The text is clearly presented. However, since the book is relatively small, deals only generally with the subject, and has little direct reference to sugar, the price is likely to deter most technologists of our industry.



Laboratory methods & Chemical reports

Study of raw sugar beet saponin. D. STEGANOVIĆ, M. STEFANOVIĆ and O. GAŠIĆ. *Glas. Khem. Drushtva*, 1967, **32,** (1), 26.—Raw saponin was isolated by various methods from ripe and unripe sugar beet, beet tails and saturated brei. The isolated saponin was identified by reaction with antimony pentachloride in chloroform solution and with cholesterol, and by its capacity to form foam, which caused hemolysis and was toxic to fish. A new method for determining saponin by thin-layer chromatography is described. It was found that raw saponin consists of six components, which, however, could not be separated on a column of neutral aluminium oxide. Beet saponin did not have any insecticidal properties but was found to be of value as a fungicide.

* * *

Theory of molasses formation. T. P. KHVALKOVSKII. *Sakhar. Prom.*, 1969, **43,** (3), 21–22.—The article by SAVVIN[1] is examined critically.

* * *

Determination of true dirt content on beets. L. M. LASKUTOVA and E. V. PANFEROVA. *Sakhar. Prom.*, 1969, **43,** (3), 40–41.—Sampling beets from the centre of the pile on a road truck using a "Rüpro" sampler is shown from data collected at a Soviet sugar factory to provide a sufficiently accurate determination of the amount of soil adhering to beets.

* * *

Measurements of ion exclusion equilibria for the system sucrose-sodium chloride-water-"Dowex 50W-X4". D. N. SUTHERLAND and C. B. MOUNTFORT. *Ind. Eng. Chem., Process Design Dev.*, 1969, **8,** 75–79. Phase equilibria for the system were investigated at 25°C using the material balance technique. A ternary density table for sucrose-NaCl-water was drawn up for the analysis, covering the weight concentration range 0–3% for NaCl and 0–60% for sucrose. Regression equations were obtained from the results: $S_R = 0{\cdot}2901S + 0{\cdot}006514S^2 + 0{\cdot}01387XS$ (standard deviation of 0·46) and $X_R = 0{\cdot}0118X^2 + 0{\cdot}0134X^3 + 0{\cdot}00133XS$ (standard deviation of 0·060), where S_R and X_R are, respectively, sucrose and NaCl concentrations within the resin beads, and S and X are, respectively, sucrose and NaCl weights in the external solution. The results showed the expected strong exclusion of electrolyte, a sucrose-salt interaction being indicated by a fall in electrolyte exclusion as the sucrose concentration rose.

Analytical profiles of sorghum cane and sugar cane syrups. A. R. JOHNSON and A. T. STURDIVANT. *J.A.O.A.C.*, 1969, **52,** 1–4.—Analysis of sorghum syrups and cane syrups from various sources in the USA for total solids, reducing sugars, sucrose, ash, Winston lead number and polarization at 87°C showed sufficient similarity and overlapping ranges of values that, although the data may be useful as guides in establishing purity of the two types of syrup, the syrups cannot be readily distinguished in blends.

* * *

Experiences from twelve-year control studies for determination of sugar beet sugar content. H. NEUMANN. *Zucker*, 1969, **22,** 184–188.—The equipment and procedures used in sampling cossettes and in analysing and controlling determinations of sugar contents in southern German sugar factories are described. Results are summarized for Ochsenfurt (these have been checked by various institutes since 1954/55) and for Zeil for the 1960/61–1967/68 campaigns and for all southern German factories for the 1965/66 campaign. Reasons for differences are given. Under the system the factories work in conjunction with the Verband Süddeutscher Zuckerrübenbauer (South German Beet Farmers' Association).

* * *

Filtration characteristics of cane juice. A. C. RAHA. *Sugar J.*, 1969, **31,** (8), 20–25.—In studies of factors affecting mud particle size and distribution in cane juice, the lower of the two alkalinities investigated (250 mg CaO/litre and 450 mg/litre) gave more uniform precipitates. This effect was greater with middle juice carbonatation than with De Haan carbonatation.

* * *

Determination of sugar content for beet payment on the basis of sugar content. M. FRIML and K. TONINGER. *Listy Cukr.*, 1969, **85,** 64–75.—The procedure used in beet tarehouses is described and details and illustrations given of various pieces of equipment used. These include a number of automatic polarimeters and sampling lines.

* * *

Boiling point elevation of pure sucrose solutions. V. I. TUZHILKIN and I. N. KAGANOV. *Sakhar. Prom.*, 1969, **43,** (4), 6–9.—Semi-empirical equations for calculation of BPE of pure sucrose solutions in water and of the thermodynamic activity of the water at boiling point of the solution (ratio between water vapour pressure in the solution and that of pure water) were

[1] *I.S.J.*, 1968, **70,** 55.

developed and used to compile a table of sucrose solution BPE at Brix values in the range 60–90° and temperatures in the range 60–90°C. Graphs are given showing the relationship between water vapour pressure and sucrose solution concentration and between BPE and solution concentration at various pressures.

* * *

Sucrose decomposition products in the evaporator and substances accompanying them in ammoniacal water. E. R. SHIRING and A. YA. ZAGORUL'KO. *Sakhar. Prom.*, 1969, **43**, (4), 16–20.—A modification of the WALLENSTEIN & BOHN displacement chromatography method[1] and a method for analysis of waste water were used to analyse the acids in barometric condenser water which were concentrated on an anion exchanger. In some cases acetic acid and in others acetic and lactic acids made up the bulk of the organic acids. Condensates contained, as a rule, small quantities of formic, propionic and butyric acids, and in some cases tartaric, citric and succinic as well as other volatile acids.

* * *

Decomposition of invert sugar at elevated temperatures in an alkaline solution. V. A. KOLESNIKOV, V. A. MAKSYUTOV and L. N. DOBROVOL'SKAYA. *Sakhar. Prom.*, 1969, **43**, (4), 21–24.—Tests in which buffered alkaline solutions of invert sugar (0·1% concentration) were heated at constant temperature in the range 100–140°C showed that the optical density rose to a higher level with higher initial pH at temperatures of 115°C and above, the differences being most marked at the highest temperature studied. The amount of invert sugar decomposed rose initially more quickly with higher pH, but the final values at 140°C were about the same (about 95–98%). Fe^{+++} added to the solution had practically no effect on coloration, NH_4Cl caused a sharp increase in colour, and SO_2 considerably reduced the colour.

* * *

Determination of the nitrite content in molasses and other sugar factory products. C. REICHEL. *Zucker*, 1969, **22**, 212–216.—Methods of determining nitrite are surveyed. Comparison of the ZIMMERMANN colorimetric method (diazotizing of sulphanilic acid and coupling with 1-naphthylamine) with that of BUCKETT *et al.* [diazotizing of sulphanilamide followed by coupling with N-(1-naphthyl)-ethylenediamine-dihydrochloride] showed that both were suitable for nitrite determination in molasses, raw and prelimed juice, although the former method was preferable for rapid determination, since both reagents could be added simultaneously and there was no need for preclarification with lead acetate.

* * *

Interaction of some sugars with alkalis at various temperatures. S. Z. IVANOV and E. S. LYGIN. *Zhurn. Priklad. Khim.*, 1968, **41**, 2722–2725.—Studies reported earlier[2] have been extended to include lactose and maltose, the ionization constants of which rose by 800% and 700%, respectively, with temperature rise from 20 to 50°C. In absolute terms, the ionization constants for the five sugars investigated are ranged in the following increasing order: sucrose < dextrose < levulose < lactose < maltose.

* * *

Effect of some non-sugars on the kinetics of sucrose decomposition. Z. A. MIL'KOVA, S. Z. IVANOV and A. R. SAPRONOV. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (1), 45–48.—In tests to find the effect of various non-sugars and non-sucrose sugars on the extent of the induction period in autocatalytic sucrose decomposition, it was found that NaCl, KCl and dextrose catalysed the reaction, while melanoidins, invert sugar decomposition products and glutamic acid inhibited it. No relationship was found between purity and buffering capacity of the sucrose solutions tested, the buffering capacity being governed by the nature of the impurities and not by their concentration, in contrast to earlier findings.

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Movement and conversion of nitrogenous non-sugars during juice purification. S. P. OLYANSKAYA and K. D. ZHURA. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (1), 49–52. The results achieved with conventional juice carbonatation and with a system in which predefecation mud was separated[3] showed that at a lime usage of 1% CaO on juice the new scheme removed about the same quantity of amino-acid N as did the conventional scheme at 2% CaO on juice, while 2% CaO on juice with the new scheme increased the extent of removal. This is attribed to the reduction in $CaCO_3$ absorptive capacity in conventional 1st carbonatation caused by high molecular compounds such as albumins and pectins, which block the surface of the carbonate. Removal of the predefecation mud also helps to reduce juice colour, since amino-acids were found by ascending paper chromatography to participate in the formation of melanoidin-type colouring compounds.

* * *

Investigation of the rheological properties of massecuites. YU. D. KOT and E. M. GLYGALO. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (1), 69–71.—Studies showed that the rheological properties of massecuite (plasticity, pseudo-plasticity, etc.) increase or decrease depending on the qualities of the mother liquor, crystal content and composition, which tend to make the massecuite approximate to one or other known forms. A physical model of massecuite is reproduced, which, together with two formulae, permits a course of investigation to be planned and values of the individual elements in the model to be determined.

* * *

Probable sugar—deduction from formulae and applicability. E. R. DE OLIVEIRA. *Brasil Açuc.*, 1969, **73**, 12–18.—The WINTER and DEERR formulae for calculating probable sugar yield from juice analysis and molasses purity are briefly discussed with variations introduced by other authors.

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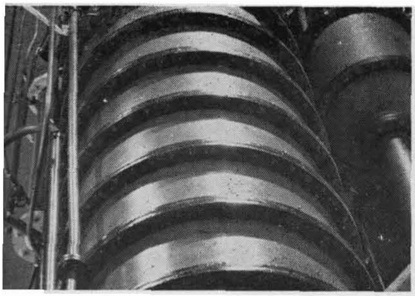
[1] *I.S.J.*, 1965, **67**, 26.
[2] LYGIN & IVANOV: *ibid.*, 1968, **70**, 24.
[3] ZHURA & OLYANSKAYA: *ibid.*, 246.



By-products

Perspectives in furfural investigations in Cuba. J. Lodos. *CubaAzúcar*, 1967, (May/June), 27–31. Aspects of furfural production by hydrolysis of pentosans are discussed, including raw materials, use of whole bagasse or only part, continuous and batch processing, and reduction of losses. A scheme of investigation is set out for study of the possibility of furfural production.

* * *

Studies on the composition of distillery spent wash and the possible utilization as concentrated manure and the recovery of potassium salts. D. L. N. Rao. *Indian Sugar*, 1968, **17**, 895–896, 899–890.—An analysis of distillery vinasse is presented and the amount of N-P-K nutrients available in it on a daily basis are calculated. It is proposed in the author's factory to concentrate the vinasse in the evaporators after the end of the crop, to settle it in the clarifier and to apply the clarified liquid to the fields. The economics are discussed, as is the possibility of neutralizing the alkaline carbonate solution and recovering the potassium content as sulphate and chloride salts by evaporation and crystallization.

* * *

Processes and progress in the chemistry of sucrose. C. R. Bonati. *Ind. Sacc. Ital.*, 1968, **61**, 131–140. A review is presented, with 64 references to the literature, on recent developments in utilization of sucrose and beet and cane by-products.

* * *

Cane juice as a substrate in the production of food yeast. P. R. Cantarelli and J. G. B. Caruso. *Brasil Açuc.*, 1968, **71**, 527–529.—Experiments on the use of cane juice for growth of *Candida utilis* showed that efficiency, measured as g protein produced per g of carbohydrate consumed, was greatest at low carbohydrate content in the substrate (2·66%). Successful production of yeast protein is demonstrated, however, and it is concluded that use of cane juice for fermentation would be desirable on economic grounds during periods of over-production of sugar.

* * *

Surface active sugar derivatives. F. Schneider and H. U. Geiger. *Tenside*, 1967, **4**, 330–334; through *J. Appl. Chem. Abs.*, 1968, **18**, ii–71.—Title compounds were prepared by linking sugars or hydrophilic sugar derivatives with lipophilic substances, with N as connecting link. The reaction was made more readily variable by using predominantly bifunctional connecting parts in the form of aliphatic compounds with at least one NH_2 group, e.g. diamines, acid amides, acid hydrazides, amino-acids. This led to the formation of 1-*N*-alkyl-amino-D-ketoses, aldose fatty acid hydrazones, 1-deoxy-1-*N*-(1′-amino-2′-fatty aminoethane)-D-fructose oxalates, "aldose cystein" esters, gluconamidoalkanes, 1-D-gluconamido-2-fatty acylamidoethanes, as well as gluconyl-glycine esters. In 0·01M aqueous solution, the surface tension of water was reduced to well below 30–35 dynes/cm. The effective optimum was mostly obtained with compounds having 10–14 CH_2 groups.

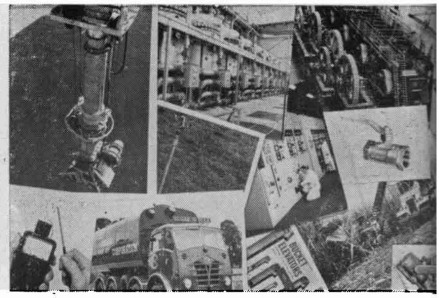
* * *

Effect of the molecular ratio fatty acid methyl ester/sucrose on formation of sucrose mono-, di- and tri-esters. M. Raaný, J. Haumer and J. Novák. *Tenside*, 1968, **5**, 40–42; through *J. Appl. Chem. Abs.*, 1968, **18**, ii–71.—An examination of the conditions under which sucrose fatty acid esters (I) are formed from sucrose and fatty acid methyl esters (methyl stearate) in methyl sulphoxide shows that the composition of the resultant mixture of I depends not only on the molecular ratio of the initial components, but also on the rate of MeOH removal as it is formed. It is shown by thin-layer chromatography that di- and tri-esters are formed even in the early reaction phase.

* * *

Processing of bagasse for paper and structural board. W. J. Nolan. *Tappi*, 1967, **50**, (9), 127A–136A; through *S.I.A.*, 1968, **30**, Abs. 68–546.—A method of depithing bagasse is described, consisting of decortication in an attrition mill at 20% consistency, followed by washing the pith and fines from the fibre on a travelling screen belt. Short fibre was recovered from tailings, giving an overall fibre yield of up to 70% on whole bagasse. A rapid laboratory method of determining pith and fines in bagasse is described. Possible uses of pith are discussed. Data on the strengths of beaten and unbeaten bagasse and bagasse-pine mixture pulps are presented. Unbeaten strength of fully cooked bagasse kraft pulps were: breaking length 7500 m, burst factor 50, tear factor 80 at a freeness of 550 ml. Bagasse fibres were converted into wall-board with a modulus of rupture of 700 lb/sq.in. at a density of 16 lb/cu.ft., or 1400 lb/sq.in. at 25 lb/cu.ft. Water absorption after 24 hours' submergence was $\not>$25%. Hardboard with a 24 hr water absorption of 8–10% and a modulus of rupture of 8000 lb/sq.in. at a density of 70 lb/cu.ft. was produced from low-density wall-board by hot pressing at 1000 lb/sq.in.

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.

Level controller. Thorn Automation Ltd., Rugeley, Staffs., England.

A new continuous level indicator/controller introduced by Thorn Automation is designed for continuous measurement of the level of most liquids and free-flowing solids in bulk storage containers, hoppers, etc. Known as the "Quantimeter" Series CLI 3, the instrument operates on the principle that a change in the level of the materials is reflected by a proportional change in the capacitance between an insulated probe in the container and earth, which is measured by a fully-transistorized measuring circuit. High accuracy is obtained by using a servo-operated self-balancing bridge circuit, and control is achieved by adjustable limit switches which can be set to operate at any two levels. A static eliminator circuit is also incorporated in the system. The equipment is available for 110–115 and 220–250 V 50 Hz A.C. supplies.

* * *

Seed drill. Massey-Ferguson (Export) Ltd., Coventry, England.

A new MF seed drill is announced which meets the requirements of narrow row crop production, including sugar beet. It has a hopper capacity of 230 or 363 litres, and a transport width of 3 m. One version provides row widths of 1·95 or 2·34 m at a maximum of 15 seed runs, while a larger version gives 2·5 m or 3·08 m widths at a maximum of 19 runs. The seed metering mechanism is driven by rubber-tyred ground wheels, the sowing rates being controlled by a lever which opens or shuts the feed gates and a high and low speed drive.

* * *

"Rota-Master" brushes. Dendix Brushes Ltd., Lower Church St., Chepstow, Mon., England.

"Rota-Master" rotary brushes can be used for a number of applications, including cleaning rubber and fabric conveyor belts. The new, improved lightweight brush unit carries 10 brush strips held in place by continuous channels forming a 36° helix. Each Dendix-Osborn strip brush is heavily filled with "Korfil P", a durable, hard-working, long-wearing synthetic fill material. Details of the units and installation instructions are given in a leaflet which also describes the Dendix technical brushing service, which includes a brushing analysis of any processing operation.

* * *

PUBLICATIONS RECEIVED

RENOLD LIMITED NEWS LETTER. Renold Limited. Renold House, Wythenshawe, Manchester M22 5WL, England,

Featured in issue No. 3 of the News Letter is a description of the company's new Research and Development Centre which houses, amongst other things, a wormgear reduction test rig and a chain wear test rig. The issue also includes a description of the new Holroyd SM shaft-mounted wormgear speed reducers, which have a wormwheel mounted on a hollow bush with internal keyway. Replacing the normal output shaft, the bush may be split or solid, with a number of alternative bores available to accommodate a wide range of shafts. Thus, the reducer can be mounted directly on the driven shaft, obviating the need for bedplates, slide rails, support structures, or couplings.

* * *

EVAPORATOR SCALE PREVENTION. Basic Chemicals, 845 Hanna Building, Cleveland, Ohio, 44115 USA.

A leaflet describes, with the aid of two illustrations, how the use of "Magox" sugar grade MgO as a substitute for half the usual weight of lime in clarification at a Philippine sugar factory over a 2-week test period prevented scaling of the evaporator tubes, whereas the use of all lime during the previous 2 weeks had resulted in a heavy coating of scale which was closely attached to the metal.

* * *

French filters for Cuba.—As part of a modernization plan for the Cuban sugar industry, 50 rotary vacuum filters have been ordered from Filtres Vernay, of Villeurbanne, France. The filters will be made of 18/8 nickel stainless steel, which has excellent resistance to corrosion, is easy to clean and ensures maximum hygiene in the handling of the juice. The filters will each have a daily throughput equivalent to 350 tons of cane and will replace filters made of materials which have corroded rapidly, particularly during the inter-season period.

* * *

Bagasse digesters in Mexico.—Equipment at the Kimberly-Clark de Mexico S.A. bagasse pulp and paper mill which started operations in 1969 at Orizaba, Vera Cruz, includes a continuous digester with a daily output of 110 tons of bleached bagasse pulp. Manufactured by American Defibrator Inc., of New York, N.Y., U.S.A., the digester is the largest single unit for bagasse pulping at present in operation. It has a new type of screw feeder of 20 inches diameter, and two horizontal digester tubes, each 30 ft long and of 60 inches i.d. Bagasse is dewatered by a screw press 21 inches in diameter.

* * *

Weir Group Engineering Division.—A new company, Weir Pumps Ltd., which is now the largest pump manufacturing concern in the UK, was formed on January 1st 1970 to integrate the operations of G. & J. Weir Ltd., Drysdale & Co. Ltd., The Harland Engineering Co. Ltd., and Weir Drysdale Service (London) Ltd. The Weir Group Engineering Division includes the new pump company and Alley Compressors Ltd., Weir-Pacific Valves Ltd., Dobbie McInnes Ltd. and Harland Simon Ltd.

World sugar production estimates 1969-70[1]

BEET SUGAR	Campaign	*Estimate* 1969/70	1968/69
EUROPE		*(metric tons, raw value)*	
Belgium/Luxembourg ..	Sept/Jan.	660,000	588,000
France	,,	2,667,000	2,433,322
Germany, West*	,,	2,066,000	2,020,654
Holland	,,	750,000	734,806
Italy	July/Oct.	1,390,000	1,316,665
Total E.E.C.		*7,533,000*	*7,093,447*
Austria	Sept/Jan.	350,000	299,234
Denmark	,,	317,000	347,777
Finland	,,	58,000	50,098
Greece	July/Oct.	150,000	97,919
Ireland	Sept./Jan.	143,000	160,944
Spain	July/March	750,000	707,929
Sweden	Sept./Jan.	236,000	303,551
Switzerland	,,	64,000	69,210
Turkey	Aug./Feb.	576,000	721,613
United Kingdom	Sept./Jan.	955,000	997,305
Yugoslavia	Aug./Jan.	533,000	398,691
Total West Europe		*11,665,000*	*11,247,718*
Albania	Aug./Jan.	16,000	16,000
Bulgaria.............	July/Jan.	246,000	230,000
Czechoslovakia	Sept./Jan.	731,500	880,000
Germany, East	,,	500,000	505,550
Hungary	,,	456,000	446,873
Poland	,,	1,640,000	1,707,000
Rumania	Aug./Feb.	495,000	415,000
USSR	Sept./Jan.	9,500,000	9,925,000
Total East Europe		*13,584,500*	*14,125,423*
Total Europe		*25,249,500*	*25,373,141*
OTHER CONTINENTS			
Afghanistan	Nov./Feb.	8,500	8,500
Algeria	June/Nov.†	7,000	7,000
Azores	June/March	13,000	12,000
Canada	Oct./Dec.	137,000	135,326
Chile	April/June‡	245,000	195,122
China	Jan./Dec.‡	650,000	650,000
Iran	Oct./March	508,000	484,000
Iraq	,,	5,000	5,000
Israel	April/June	28,000	28,000
Japan	Oct./Feb.	328,000	321,455
Lebanon	June/Nov.†	10,000	9,000
Morocco	May/Aug.‡	120,000	120,000
Pakistan	June/July	21,000	20,941
Syria	May/June	30,000	28,747
Tunisia	May/April†	7,000	7,000
United States	July/June	3,234,000	3,184,202
Uruguay	May/April	45,000	55,481
Total Other Continents		*5,396,500*	*5,271,774*
TOTAL BEET SUGAR.............		30,646,000	30,644,915

CANE SUGAR	Campaign	1969/70	1968/69
EUROPE			
Spain	March/Sept.	49,000	49,423
NORTH AND CENTRAL AMERICA			
British Honduras	Dec./June	55,000	52,987
Costa Rica	,,	145,000	140,000
Cuba	Nov./June	6,500,000	4,700,000
Dominican Republic ..	Nov./Sept.	900,000	820,000
Guadeloupe §	Jan./June	170,000	161,943
Guatemala	Dec./June	215,000	179,467
Haiti	,,	65,000	58,946
Honduras	,,	70,000	57,062
Martinique§	Jan./June	35,000	34,377
Mexico	Nov./July	2,489,000	2,565,101
Nicaragua	Dec./June	110,000	127,000
Panama	,,	85,000	80,519
Puerto Rico	Oct./April	500,000	439,982
Salvador	Nov./June	170,000	152,408
USA—Mainland	Oct./June	950,000	1,097,000
Hawaii	Jan./Dec.‡	1,150,000	1,088,600
West Indies—Antigua§	Jan./June‡	10,000	—
Barbados§	,,	160,000	141,688
Jamaica§	,,	450,000	393,000
St. Kitts§	,,	35,000	35,920
Trinidad§	,,	245,000	241,027
Total North and Central America		*14,509,000*	*12,567,027*
SOUTH AMERICA			
Argentina	June/Dec.†	985,000	954,436
Bolivia	May/Sept.‡	120,000	113,400
Brazil§	June/May	4,500,000	4,111,827
Colombia	Jan./Dec.‡	750,000	700,000
Ecuador.............	June/Jan.	270,000	215,000
Guyana§	Oct./June‡	370,000	366,000
Paraguay	July/Nov.†	46,000	37,391
Peru§	Jan./Dec.‡	750,000	630,000
Surinam.............	Aug./May	20,000	20,000
Uruguay	May/April	8,000	7,866
Venezuela	Sept./Aug.	410,000	393,601
Total South America		*8,229,000*	*7,550,061*
AFRICA			
Angola§.............	July/April	75,000	70,000
Congo (Brazzaville) ..	Oct./April	100,000	92,400
Congo (Kinshasa)	May/Nov.†	50,000	45,000
Ethiopia	Nov./June	105,000	75,000
Ghana	April/Sept.	20,000	20,000
Kenya	July/June	120,000	117,400
Madeira.............	March/Sept.	3,000	3,000
Malagasy	July/June	115,000	115,000
Malawi	May/Nov.†	25,000	22,000
Mauritius§	July/Jan.	660,000	596,549
Mozambique§	May/Nov.†	225,000	215,000
Nigeria	Nov./May	30,000	27,206
Réunion	Aug./Jan.	254,500	252,737
Rhodesia§	May/Nov.†	120,000	120,000
Somalia	Nov./June	46,000	39,917
South Africa§	May/April	1,500,000	1,514,377
Sudan	Dec./June	100,000	91,213
Swaziland§	May/Feb.	175,000	172,005
Tanzania	July/June	98,000	93,100
Uganda	,,	165,000	165,000
UAR (Egypt)	Dec./June	425,000	455,000
Zambia	May/Nov.†	25,000	23,709
Total Africa		*4,436,500*	*4,325,613*
ASIA			
Afghanistan	Oct./April	11,000	10,000
Burma	Nov./April	85,000	85,000
Ceylon	Nov./June	10,000	10,000
China	Jan./Dec.‡	2,050,000	2,050,000
India, excl. khandsari ..	Oct./July	4,300,000	3,950,000
Indonesia	May/Dec.†	600,000	600,000
Iran	Oct./April	55,000	55,000
Japan & Ryukyu Islands	Nov./June	302,000	299,990
Nepal	Oct./April	10,000	10,000
Pakistan	Nov./May	525,000	491,902
Philippines§	Nov./July	1,725,000	1,652,104
Taiwan	Nov./June	675,000	768,370
Thailand§	Oct./April	420,000	350,000
Total Asia		*10,768,000*	*10,332,366*
OCEANIA			
Australia	May/Dec.†	2,310,000	2,846,000
Fiji	,,	325,000	422,000
Total Oceania		*2,635,000*	*3,268,000*
TOTAL CANE SUGAR		40,626,500	38,092,490
TOTAL BEET SUGAR.............		30,646,000	30,644,915
TOTAL SUGAR PRODUCTION		71,272,500	68,737,405

[1] F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (33), 1–3.
* Including production from desugarizing of molasses
† 1969, 1968
‡ 1970, 1969
§ tel quel

Brevities

Tunisian sugar industry[1].—Sugar production in Tunisia is in the hands of one company, Société Tunisienne du Sucre, which controls both domestic beet sugar production and refining of imported raw sugar. One beet sugar factory exists at the moment at Béja; further factories are planned at Mateur and Soub el Arba. Beet sugar production was 6085 tons in 1966, 6865 tons in 1967 and 3973 tons in 1968. Sugar imports reached a record 32,700 tons in 1968, of which the UK supplied 16,200 tons, Yugoslavia 10,000 tons and Poland 6500 tons. In recent years the USSR has begun to export white sugar to Tunisia. Altogether 15,000 tons of white sugar was made into loaves at Béja factory in 1968.

* * *

Argentina sugar production target[2].—The production of sugar in Argentina was originally limited to 800,000 tons[3] but was raised to 850,000 in May[4]. The limit has now been raised by a further 40,000 tons to 890,000 tons.

* * *

Philippines sugar factory expansion[5].—Ormoc Sugar Co. recently signed a contract with Honiron Philippines Inc. for the expansion of the capacity of their mill in North Leyte involving a new investment of 20 million pesos. The present capacity of 3000 tons of cane per day will be increased to 5000 tons/day and eventually to 7500 tons/day.

* * *

Erratum.—In our reference to the new refinery being constructed at Usine Ste. Madeleine in Trinidad[6], the cost of the new plant was given as £3,000,000 whereas it should have been $3,000,000.

* * *

UK sugar surcharge.—In view of the fall in the world price of raw sugar, the UK Sugar Board surcharge has been increased from 2¼d per lb (21s 0d per cwt) to 2½d per lb (23s 4d per cwt) from the 28th November.

* * *

Mexican food technologists' association.—The Asociación de Técnicos en Alimentos de México A.C., formed to establish a closer contact among technicians and manufacturers of food products, is to hold its first congress during the 19th–20th February 1970. Principal themes will be food preservation processes, packaging, quality control, nutrition, and acceptability testing. The address of the association is : A.T.A.M., Chicago 162, Col. Napoles, México 18, D.F.

* * *

UK beet mechanization demonstrations.—The 1970 sugar beet spring and autumn demonstrations are both scheduled to take place on the Owmby Cliff farm of Mr. F. Arden, near Caenby, Lincolnshire. The spring event will be held on the 28th May and the autumn one, which will include full-scale harvester trials, will be a two-day demonstration on the 21st and 22nd October.

* * *

Fiji drought[7].—Drought conditions are expected to cut the 1969 sugar crop in Fiji from its target of 385,000 tons to between 300,000 and 310,000 tons.

* * *

Thailand and the International Sugar Agreement[8].—The Government of Thailand is considering adhering to the International Sugar Agreement since she would thereby obtain an export quota of 13,600 metric tons and would also be able to export sugar to Japan, thereby helping to improve its balance of payments with that country.

Cane harvesting difficulties in Puerto Rico[9].—Cane tends to mature in Puerto Rico up to April but the harvesting period has been extended into the rainy season from May onwards when the longer days of stronger light intensity also promote growth. Inevitably the sugar content and sugar recovery fall, and the weather causes harvesting difficulties. In addition, the number of cane cutters has fallen and there is an inadequate supply of harvesters. The work force totalled 67,000 in 1963 but fell to 52,000 by 1965, 39,000 by 1967, 30,000 in 1968 and 14,000 in 1969; for the 1970 harvest it is predicted that there will only be 8000 workers available to cut cane. The numbers of harvesting machines available will be 130, of which half are likely to be out of operation undergoing repairs during the crop, according to past experience. Thus it seems likely that existing facilities will not be able to harvest the available cane and it will be necessary to import foreign labour or use convict labour, or face the prospect of shrinkage of the industry and closing of more sugar factories on the island.

* * *

Portuguese East Africa sugar production, 1968[10].—Production of sugar in 1968 amounted to 214,452 metric tons, compared with 119,507 tons in 1967.

* * *

Jamaica standover cane[11].—About 404,000 tons of cane, capable of yielding approximately 40,000 tons of cane had it been crushed, was left in the ground from the 1969 crop and will be reaped in the 1970 crop. This situation came about because the slow reaping of the crop in the earlier part of the season pushed too great a volume of cane into the uneconomic period when the sucrose content drops sharply. The rains in May and June and, in addition, serious transport and labour problems worsened the position. As a consequence sugar outturn was some 20% less than in the previous year[12].

* * *

Environmental pollution reduction by US refiner[13].—Refined Syrups & Sugars Inc. have announced a major programme of improvements at their Yonkers, N.Y., refinery designed to help curb air and water pollution. It involves installation of an interceptor sewer which will carry effluents to the Westchester County treatment and disposal system, conversion of the plant's three boilers from coal to gas-firing, and the adoption of granular carbon decolorization instead of powdered carbon which has previously been disposed of by discharging into the Hudson River.

* * *

Yugoslavia beet crop, 1968/69[14].—According to official figures, the 1968/69 beet crop in Yugoslavia amounted to 2,910,000 metric tons, produced from 79,000 hectares, equivalent to a yields of 36·9 tons of beet/ha.

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1 *Zeitsch. Zuckerind.*, 1969, **94**, 575.
2 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (30), 6.
3 *I.S.J.*, 1969, **71**, 31.
4 *ibid.*, 352.
5 *Sugarland*, 1969, **6**, (6), 22.
6 *I.S.J.*, 1969, **71**, 352.
7 *Producers' Review*[7], 1969, **59**, (10), 53.
8 *International Sugar Organization*, 2nd September 1969.
9 *Sugar y Azúcar*, 1969, **64**, (10), 32–33.
10 *Bank of London & S. America Review*, 1969, **3**, 721.
11 *Barclays Overseas Review*, November 1969, 43.
12 *I.S.J.*, 1969, **71**, 383.
13 *Willett & Gray*, 1969, **93**, 410.
14 F. O. Licht, *International Sugar Rpt.*, 1969, **101**, (31), 6.

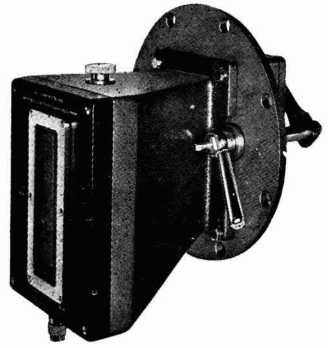
Index to Advertisers

FOR THE BUYERS' GUIDE SEE THIS ISSUE pp. xxviii-xlv

Precision Instruments

How do you control supersaturation?

Bring it under close control with the new B-S pan refractometer developed by British Columbia Sugar Ltd. This modification to a standard R.23 pan refractometer applies AUTOMATIC control to the pan during the critical period of crystal formation thus ensuring consistent, reproducible results. The visual display of concentration level is retained for those pan operators who like to see what is going on whilst the automatic control is being applied.



The modification can be fitted to an existing model R.23 by the user without difficulty. Full details of this instrument and other refractometers and saccharimeters from the manufacturers.

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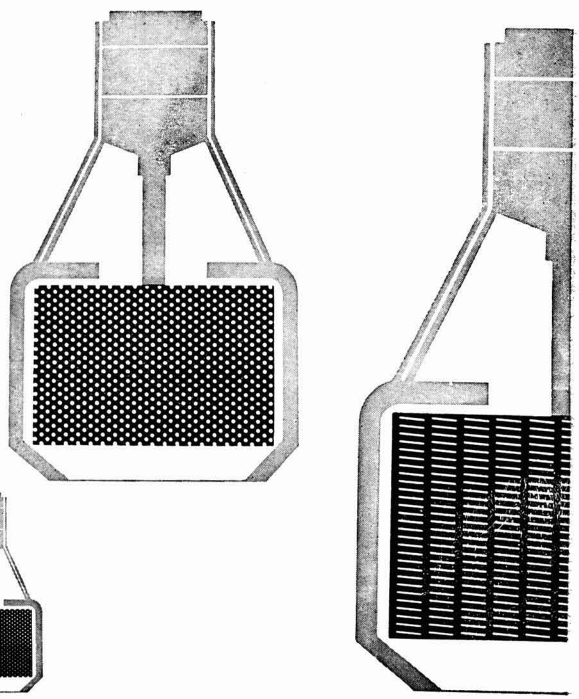

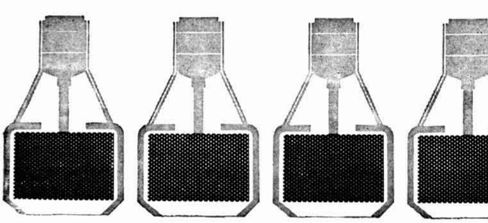

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BUYERS' GUIDE

Certain of the classifications have sub-headings for individual types of equipment. Specialist makers appear under these sub-headings, while inclusion of manufacturers under the general headings implies that they supply all or most of the types of equipment described by the sub-headings.

Accumulators, Hydraulic.
Edwards Engineering Corp.
Soc. Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam.
see Steam Accumulators.

Activated carbon.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Dearborn Chemicals Ltd., Farnell Carbons Division.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft fur Wärme- und Chemotechnik m.b.H.
Norit Sales Corporation Ltd.
Pittsburgh Activated Carbon Division.
Suchar.

Air clutches.
Farrel Company.
Renold Ltd.

Air compressors.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Peter Brotherhood Ltd.
George Cohen Machinery Ltd.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
Krupp Stahlexport G.m.b.H.
Nash International Company.

Air compressors, Oil-free.
Peter Brotherhood Ltd.

Air conditioning equipment.
A.B. Svenska Fläktfabriken.

Air coolers.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken.

Air filters.
Buhler Brothers Ltd.
Norit Sales Corporation Ltd.
A.B. Svenska Fläktfabriken.

Air heaters.
E. Green & Son Ltd.
A.B. Svenska Fläktfabriken.
Yarrow Engineers (Glasgow) Ltd.

Air-operated portable stitchers.
Thames Packaging Equipment Co.

Alcohol plant.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
T. Giusti & Son Ltd.
Mardon (Engineering) N.V.
S.P.E.I. Chim.
Tate & Lyle Enterprises Ltd.
UCMAS.

Ammonia removal from condensates.
Imacti N.V.

Anti-foam agents.
Drew Chemical Corporation.
Drew Chemical Corporation (P.R.)
Drew Chemical (Nederland) N.V.
Drew Produtos Quimicos Ltda.
Hodag Chemical Corporation.
Schill & Seilacher Chemische Fabrik.

Automatic beet laboratories.
Venema Automation N.V.

Automatic saccharimeters and polarimeters.
O. C. Rudolph & Sons Inc.
Schmidt + Haensch.

Automatic tare rooms.
Venema Automation N.V.

Bag, *see* Sack.

Bagasse analysis apparatus.
A. H. Korthof N.V.

Bagasse baling presses.
Buckau-Wolf Maschinenfabrik A.G.
Honiron.
Shirtliff Bros. Ltd.
Thibodaux Boiler Works Inc.

Bagasse depithing equipment.
Gruendler Crusher & Pulverizer Company.
Stedman Foundry & Machine Co. Inc.

Bagasse furnaces.
Babcock & Wilcox (Operations) Ltd.
Honiron.
S.E.U.M.

Bagasse preparation equipment for particle board manufacture.
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.

Bagasse presses.
C F & I Engineers Inc.

Bagasse utilization plant for manufacture of cellulose, paper pulp, particle board, etc.
Buckau-Wolf Maschinenfabrik A.G.
Defibrator A.B.
Dorr-Oliver Inc.
Tate & Lyle Enterprises Ltd.

Beet diffusers, Continuous.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
UCMAS.

Beet flume equipment.
Dreibholz & Floering Ltd.

Beet mechanical discharging and storage equipment.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Soc. Fives Lille-Cail.
UCMAS.

Beet molasses sugar recovery.
Imacti N.V. (*Quentin process*).
Robert Reichling & Co. K.G. (*Quentin process*).
Stork-Werkspoor Sugar N.V.
UCMAS.

Beet pulp presses.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
AB. Kockum-Landsverk.
Etablissements F. Moret.
Rose, Downs & Thompson Ltd.
Stord Bartz Industri A/S.

Beet seed.
A/S De Danske Sukkerfabrikker.

Beet slicers.
Dreibholz & Floering Ltd.
Soc. Fives Lille—Cail.
H. Putsch & Comp.

Beet tail utilization plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
H. Putsch & Comp.

Beet tare house equipment.
Dreibholz & Floering Ltd.
Ingeniörsfirman Nils Weibull AB.

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Salzgitter Maschinen A.G.
UCMAS.

Beet water-jet unloading equipment.
BMA Braunschweigische Maschinenbauanstalt.
Dreibholz & Floering Ltd.

Belting, Conveyor & elevator.
see Conveyor belting.

Blending machines.
Arenco-Alite Ltd.

Boiler tube brushes, Spiral and expanding.
Rotatools (U.K.) Ltd.

Boiler tube cleaners, Air and electric.
Rotatools (U.K.) Ltd.

Boiler water treatment.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Drew Chemical Corporation.
Drew Chemical Corporation (P.R.)
Drew Chemical (Nederland) N.V.
Drew Produtos Quimicos Ltda.
Eimco (Great Britain) Ltd.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Boilers, Shell.
Marshall, Sons & Co. Ltd.
Newell Dunford Engineering Ltd.

Boilers, Water tube.
Buckau-Wolf Maschinenfabrik A.G.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd.
Marshall, Sons & Co. Ltd.
Murray Iron Works Company.
Newell Dunford Engineering Ltd.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
Yarrow Engineers (Glasgow) Ltd.

Bone Char.
British Charcoals & Macdonalds Ltd

Brushes.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Bulk handling.
see Conveyors and Elevators, *etc.*

Bulk storage hoppers.
Babcock Atlantique.
Fletcher & Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
T. Giusti & Son Ltd.
The Tills Engineering Co. Ltd.

Bulk sugar containers, Transportable.
The Tills Engineering Co. Ltd.

Bunker discharge equipment.
Buhler Brothers Ltd.
Redler Industries Ltd.
The Triton Engineering Co. (Sales) Ltd.

Burners, Sulphur.
see Sulphur furnaces, Continuous.

Calciners, Fluidized bed.
Buell Ltd.
Rosin Engineering Co. Ltd.

Cane car tippers.
Fletcher and Stewart Ltd.
Honiron.
The Mirrlees Watson Co. Ltd.
Walkers Ltd.

Cane cars and trailers.
Honiron.
J & L Engineering Co. Inc.
Kingston Industrial Works Ltd.
Krupp Stahlexport G.m.b.H.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.

Cane carts.
Honiron.
J & L Engineering Co. Inc.
Kingston Industrial Works Ltd.
Tate & Lyle Enterprises Ltd.

Cane conveyor drives.
Edwards Engineering Corp.

Cane cultivation equipment.
J & L Engineering Co. Inc.
Massey-Ferguson (Export) Ltd.
Wyper Brothers Ltd.

Cane diffusers, Continuous.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc.
Extraction De Smet S.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Walkers Ltd.

Cane grapples.
Honiron.
J & L Engineering Co. Inc.
Priestman Brothers Ltd.
Joseph Westwood & Co. Ltd.

Cane harvesters.
Honiron.
J & L Engineering Co. Inc.
Massey-Ferguson (Export) Ltd.
Tate & Lyle Enterprises Ltd.
Wyper Brothers Ltd.

Cane loaders.
Crone & Taylor (Engineering) Ltd.
Honiron.
J & L Engineering Co. Inc.
Massey-Ferguson (Export) Ltd.
Tate & Lyle Enterprises Ltd.

Cane maturity testers.
A. H. Korthof N.V.

Cane planters.
Massey-Ferguson (Export) Ltd.
Wyper Brothers Ltd.

Cane preparation equipment for diffusion.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Co.
Stork-Werkspoor Sugar N.V.

Cane shredders.
see Shredders.

Cane trash shredders.
Dorr-Oliver Inc.
Gruendler Crusher & Pulverizer Co.

Cane washing plants.
Soc. Sucrière de l'Atlantique (Engineering).
J & L Engineering Co. Inc.
Tate & Lyle Enterprises Ltd.

Cane washing tables.
Honiron.
Tate & Lyle Enterprises Ltd.

Carbon, Decolorizing.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
C.E.C.A.
Dearborn Chemicals Ltd., Farnell Carbons Division.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft für Wärme- und Chemotechnik m.b.H.
Norit Sales Corporation Ltd.
Pittsburgh Activated Carbon Division.
Suchar.
The Sugar Manufacturers' Supply Co. Ltd.

Carbon decolorizing equipment.
Norit Sales Corporation Ltd.

Carbon decolorizing systems.
Norit Sales Corporation Ltd.
Suchar.

Carbon reactivation.
Norit Sales Corporation Ltd.

Carbonatation equipment.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Neyrpic.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Castings.
E. Green & Son Ltd.
Newell Dunford Engineering Ltd.
Stork-Werkspoor Sugar N.V.

Castings, Non-ferrous.
Blundell & Crompton Ltd.
Fletcher and Stewart Ltd.

Centrifugal backings.
Associated Perforators & Weavers Ltd.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Krieg & Zivy Industries.
Charles Mundt & Sons.
The Western States Machine Co.

Centrifugal clarifiers.
Alfa-Laval AB.
Dorr-Oliver Inc., Cane Sugar Division.

Centrifugal motors.
ACEC.
ASEA.
Hinz Elektromaschinen und Apparatebau.
The Western States Machine Co.

Centrifugal screens.
Associated Perforators & Weavers Ltd.
Balco Filtertechnik G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.

Centrifugal screens—*continued*
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Hein, Lehmann & Co. A.G.
Krieg & Zivy Industries.
Charles Mundt & Sons.
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.
The Western States Machine Co.

Centrifugals and accessories.
ACEC.
Alfa-Laval AB.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Hein, Lehmann & Co. A.G.
Honiron.
AB. Kockum-Landsverk.
Manlove Alliott & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.
The Western States Machine Co.

Centrifugals—Complete electrical equipment.
ACEC.
ASEA.
Hinz Elektromaschinen und Apparatebau.

Centrifugals, Continuous.
Alfa-Laval AB.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
Salzgitter Maschinen A.G.
UCMAS.
Western States Machine Co.

Centrifugals—Fully automatic batch-type.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.

Centrifugals—Fully automatic batch-type—*continued*
AB. Kockum-Landsverk.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
UCMAS.
The Western States Machine Co.

Centrifugals—Semi-automatic batch-type.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
UCMAS.
The Western States Machine Co.

Chain cane slings.
Wheway-Watson Ltd.

Chains.
Bagshawe & Co. Ltd.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Renold Limited.
Wheway-Watson Ltd.

Char revivifying plants.
Stein Atkinson Stordy Ltd.

Chemical plants.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
George Cohen Machinery Ltd.
John Dore & Co. Ltd.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Mardon (Engineering) N.V.
Metal Propellers Ltd.
S.P.E.I. Chim.
Wellman-Heurtey Ltd. Swenson Equipment Division.

Chemicals.
Fabcon Inc.
Hodag Chemical Corporation.
Schill & Seilacher Chemische Fabrik.
The Sugar Manufacturers' Supply Co. Ltd.

Clarifiers.
Alfa-Laval AB.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Eimco Industriale S.p.A.
Fletcher and Stewart Ltd.
Honiron.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.

Clarifiers, Tray-type.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.

Collapsible containers for transporting sugar.
The Tills Engineering Co. Ltd.

Colorimeters.
The Sugar Manufacturers' Supply Co. Ltd.

Complete cane sugar factories.
Walkers Ltd.

Condensers, Water jet ejector.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

Condensing plant, Barometric.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Honiron.
Stork-Werkspoor Sugar N.V.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Continuous belt weighing machines.
Adequate Weighers Ltd.
Ashworth Ross & Co. Ltd.

Control switchgear—limit switches, centrifugal switches, emergency trip gear, etc.
ASEA.
Honeywell Ltd.

Conveyor belting.
Scandura Ltd.

Conveyor belting, Wire.
N. Greening (Warrington) Ltd.

Conveyor chains.
Bagshawe & Co. Ltd.
Buhler Brothers Ltd.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Redler Industries Ltd.
Renold Limited.
A. & W. Smith & Co. Ltd.
Wheway-Watson Ltd.

Conveyor idler rollers and pulleys.
Mavor & Coulson Ltd.

Conveyors and elevators.
Bagshawe & Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
George Cohen Machinery Ltd.
The Eimco Corporation.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
Hein, Lehmann & Co. A.G.
Honiron.
Kingston Industrial Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.
Ingeniörsfirman Nils Weibull AB.

Apron conveyors.
Etablissements F .Moret.

Belt and bucket elevators.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Etablissements F. Moret.
Redler Industries Ltd.

Belt conveyors.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Etablissements F. Moret.

Bucket elevators.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
The Mirrlees Watson Co. Ltd.
Etablissements F. Moret.
Redler Industries Ltd.

Chain and bucket elevators.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Redler Industries Ltd.

Chain conveyors.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Redler Industries Ltd.

Feeder conveyors.
Aldersley Engineers Ltd.
Crone & Taylor (Engineering) Ltd.
see also Sugar throwers and trimmers.

Grasshopper conveyors.
Thomas Broadbent & Sons Ltd.
The Mirrlees Watson Co. Ltd.

Pneumatic conveyors.
Buhler Brothers Ltd.
Collectron (Sales) Ltd.
Redler Industries Ltd.
The Tills Engineering Co. Ltd.

Scraper conveyors.
Mavor & Coulson Ltd.

Screw conveyors.
Ewart Chainbelt Co. Ltd.
The Mirrlees Watson Co. Ltd.
Etablissements F. Moret.
The Triton Engineering Co. (Sales) Ltd.

Vibratory conveyors.
Ewart Chainbelt Co. Ltd.
The Triton Engineering Co. (Sales) Ltd.

Conveyors and elevators, Mobile.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Mavor & Coulson Ltd.
Salzgitter Maschinen A.G.

Coolers, Fluidized bed.
Buell Ltd.
Rosin Engineering Co. Ltd.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Fletcher and Stewart Ltd.
Manlove Alliott & Co. Ltd.
Etablissements F. Moret.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.
UCMAS.

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Metal Propellers Ltd.

Cranes.
Soc. Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Jones Cranes Ltd.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.
Wheway-Watson Ltd.

Crystallization aids.
Fabcon Inc.
Hodag Chemical Corporation.

Crystallizers.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Cube-making machinery.
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Goka N.V. Machine Works.
Standard Steel Corporation.

Cube sugar moulding, ranging and packeting plant.
Chambon Ltd.
Standard Steel Corporation.

Cube wrapping machines.
SAPAL.

Deaerators.
William Boby & Co. Ltd.
The Permutit Co. Ltd.
Stork-Werkspoor Sugar N.V.

Decolorizing plants.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
BMA Braunschweigische Maschinenbauanstalt.
Honeywill-Atlas Ltd.
IMACTI.
Norit Sales Corporation Ltd.
The Permutit Co. Ltd.
Pittsburgh Activated Carbon Division.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.

Decolorizing resins.
Diamond Shamrock Chemical Co., Resinous Products Division.
IMACTI.
Montecatini Edison S.p.A.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

Deliming plants.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
IMACTI.
Robert Reichling & Co. K.G.

Demineralization plants.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
IMACTI.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Density meters, In-line.
Rotameter Manufacturing Co. Ltd.

Diatomaceous earth, *see* Filter-aids.

Diesel alternator sets.
ACEC.
W. H. Allen, Sons & Co. Ltd.
ASEA.
Stork-Werkspoor Sugar N.V.

Distillery plant, *see* Alcohol plant.

Drives, Chain.
Ewart Chainbelt Co. Ltd.
Renold Ltd.

Drives, Variable speed.
Renold Limited.

Drives.
see also Cane conveyor drives, Flexible drives, Knives, Milling—Drives *and* Shredder drives.

Dryers.
BMA Braunschweigische Maschinenbauanstalt.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
Manlove Alliott & Co. Ltd.
The Mirrlees Watson Co. Ltd.
Etablissements F. Moret.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
S.E.U.M.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Standard Steel Corporation.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.
UCMAS.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Dryers, Fluidized bed.
Bosco S.p.A. Officine Meccaniche e Fonderie.
Buell Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Dust control equipment.
Buell Ltd.
Buhler Brothers Ltd.
Collectron (Sales) Ltd.
Dust Control Equipment Ltd.
Mikropul Ltd.
Newell Dunford Engineering Ltd.
Standard Steel Corporation.
A.B. Svenska Fläktfabriken.
Thermix Industries Ltd.
The Tills Engineering Co. Ltd.

Dust sleeves and bags.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
Samuel Hill Ltd.
S.A. Lainière de Sclessin.
P. & S. Textiles Ltd.

Economizers.
E. Green & Son Ltd.

Effluent screens.
F. W. Brackett & Co. Ltd.

Effluent treatment.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Eimco (Great Britain) Ltd.
Film Cooling Towers (1925) Ltd.
Jones & Attwood Ltd.
The Permutit Co. Ltd.

Electric motors.
ACEC.
ASEA.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Weir Pumps Ltd.

Electric power generators.
ACEC.
ASEA.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Krupp Stahlexport G.m.b.H.
Murray Iron Works Company.
Stork-Werkspoor Sugar N.V.

Electric surface heaters.
Isopad Ltd.
Stabilag Engineering Ltd.

Electric tube cleaning machines.
Rotatools (U.K.) Ltd.

Electronic equipment.
ACEC.
ASEA.
Honeywell Ltd.

Engineering design and contracting services.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
Lucks + Co. G.m.b.H.
Mardon (Engineering) N.V.
The Mirrlees Watson Co. Ltd.
Tate & Lyle Enterprises Ltd.
UCMAS.

Engines, Diesel.
W. H. Allen, Sons & Co. Ltd.
George Cohen Machinery Ltd.
Stork-Werkspoor Sugar N.V.

Engines, Steam.
George Cohen Machinery Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Entrainment separators.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
Lancaster & Tonge Ltd.
St. Mary Iron Works Inc.

Evaporator additives.
Drew Chemical Corporation.
Drew Chemical Corporation (P.R.)
Drew Chemical (Nederland) N.V.
Drew Produtos Quimicos Ltda.
Fabcon Inc.
Hodag Chemical Corporation.

Evaporators and condensing plant.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Evaporator tube cleaners.
see Tube cleaners.

Expanders, Tube.
see Tube expanders.

Fans, Induced and forced draft.
Stork-Werkspoor Sugar N.V.
A.B. Svenska Fläktfabriken.

Fertilizers.
Fisons Ltd., International Division.

Filling machines.
Arenco-Alite Ltd.

Filters.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Lancaster & Tonge Ltd.
Sankey Green Wire Weaving Co. Ltd.
S.P.E.I. Chim.
UCMAS.
Wire Weaving Co. Ltd.

Automatically controlled filters.
F. W. Brackett & Co. Ltd.
Chemap A.G.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.

Bag pressure filters.
A. F. Craig & Co. Ltd.

Candle filters.
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stella-Meta Filters Ltd.

Diatomite filters.
Chemap A.G.
The Mirrlees Watson Co. Ltd.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.

Filter presses.
BMA Braunschweigische Maschinenbauanstalt.
Manlove Alliott & Co. Ltd.

Filter thickeners.
Buckau-Wolf Maschinenfabrik A.G.
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
H. Putsch & Comp.
Schumacher'sche Fabrik.

Gravity and pressure filters.
William Boby & Co. Ltd.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.

Iron removal filters.
William Boby & Co. Ltd.
Brimag Ltd.
The Permutit Co. Ltd.
Rapid Magnetic Ltd.

Leaf filters.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.

Plate and frame filters.
Manlove Alliott & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Pressure filters.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Chemap A.G.
George Cohen Machinery Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stella-Meta Filters Ltd.
Suchar.

Rotary vacuum filters.
Soc. Sucrière de l'Atlantique (Engineering).
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Eimco Industriale S.p.A.
H. Putsch & Comp.

Filter aids.
C.E.C.A.
Dicalite/GREFCO Inc.
Filter-Media Company.
Kenite Corporation.
Sil-Flo Incorporated
The Sugar Manufacturers' Supply Co. Ltd.

Filter cloths.
Associated Perforators & Weavers Ltd.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
Samuel Hill Ltd.
James Kenyon & Sons Ltd.
S.A. Lainière de Sclessin.
Nordiska Maskinfilt AB.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.

Filter leaves.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Charles Mundt & Sons.
Sankey Green Wire Weaving Co. Ltd.
Sparkler Manufacturing Company.

Filter papers.
J. Barcham Green Ltd.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Filter pulp.
J. Barcham Green Ltd.

Filter screens.
Associated Perforators & Weavers Ltd.
F. W. Brackett & Co. Ltd.
Cotton Bros. (Longton) Ltd.
Endecotts (Test Sieves) Ltd.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Haver & Boecker.
Krieg & Zivy Industries.
Charles Mundt & Sons.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.

Flanges, Non-Ferrous.
Blundell & Crompton Ltd.

Flexible drives.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Flexible shaft couplings.
David Brown Gear Industries Ltd.
A. Friedr. Flender & Co.
Renold Limited.

Flexible shafting.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Flowmeters.
Alfa-Laval AB.
Fischer & Porter Ltd.
Honeywell Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
Siemens A.G., Wernerwerk für Messtechnik.
The Sugar Manufacturers' Supply Co. Ltd.

Gas purifying equipment.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.

Gear couplings.
David Brown Gear Industries Ltd.
A. Friedr. Flender & Co.
Renold Ltd.

Gearing, *see* Reduction gears.

Gearmotors.
ASEA.
David Brown Gear Industries Ltd.
Renold Ltd.

Grabs, Cane, Beet and Raw sugar.
Honiron.
Priestman Brothers Ltd.
Joseph Westwood & Co. Ltd.

Granulators, *see* Dryers.

Harvesters, *see* Beet harvesters *and* Cane harvesters

Heat exchangers, Air-cooled.
E. Green & Son Ltd.
J. & L. Engineering Company Inc.

Heat-exchangers, Lamella-type.
Alfa-Laval AB.

Heat exchangers, Plate-type.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Buckau-Wolf Maschinenfabrik A.G.

Heat exchangers, Spiral-type.
Alfa-Laval AB.
E. Green & Son Ltd.

Heat exchangers, Tubular.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
E. Green & Son Ltd.
Honiron.
Kingston Industrial Works Ltd.
Metal Propellers Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
S.P.E.I. Chim.
UCMAS.

Heat sealers.
The Thames Packaging Equipment Co.

Heating mantles and tapes, Electric.
Isopad Ltd.
Stabilag Engineering Ltd.

Herbicides.
Fisons Ltd., International Division.

Hydraulic controls for valves, etc.
Edwards Engineering Corp.

Insecticides.
Fisons Ltd., International Division.

Instruments, Process control.
Anacon Inc.
ASEA.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Fischer & Porter Ltd.
Honeywell Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
Scientific Furnishings Ltd.
Siemens A.G., Wernerwerk für Messtechnik.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.

Ion exchange plants.
BMA Braunschweigische Maschinenbauanstalt.
William Boby & Co. Ltd.
Buckau-Wolf Maschinenfabrik AG.
IMACTI.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

Ion exchange resins.
Diamond Shamrock Chemical Co., Resinous Products Division.
IMACTI.
Montecatini Edison S.p.A.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

Irrigation equipment.
Farrow & Sons Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

Juice heaters.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshutte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.

Juice scales.
Ashworth Ross & Co. Ltd.
Fletcher and Stewart Ltd.
Carl Schenck Maschinenfabrik G.m.b.H.
N.V. Servo-Balans.
see also Weighing Machines

Juice strainers and screens.
Buckau-Wolf Maschinenfabrik A.G.
The Deister Concentrator Co. Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Endecotts (Test Sieves) Ltd.
Farrel Company.
Ferguson Perforating & Wire Co.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Gutehoffnungshütte Sterkrade A.G.
Haver & Boecker.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.
Walkers Ltd.

Juice and syrup mixers.
Anacon Inc.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Gutehoffnungshütte Sterkrade A.G.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor (V.M.F.)
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.

Knives, Beet.
Dreibholz & Floering Ltd.
H. Putsch & Comp.

Knives, Milling.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.

Knives, Milling—Drives.
Farrel Company.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

Laboratory apparatus and equipment.
Chemap A.G.
Endecotts (Test Sieves) Ltd.
A. H. Korthof N.V.
The Permutit Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
see also Laboratory instruments, *etc.*

Laboratory instruments.
Anacon Inc.
Honeywell Ltd.
A. H. Korthof N.V.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.
see also Automatic saccharimeters and polarimeters, Laboratory apparatus and equipment, Refractometers, Saccharimeters and polarimeters, *etc.*

Laboratory reagents.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Lens cleaning tissues.
J. Barcham Green Ltd.

Level indicators and controllers.
Goring Kerr Ltd.
Haver & Boecker.
Honeywell Ltd.
Negretti & Zambra Ltd.
Rotameter Manufacturing Co. Ltd.
Siemens A.G., Wernerwerk für Messtechnik.

Lime density meters.
Rotameter Manufacturing Co. Ltd.

Lime slaking equipment.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
The Eimco Corporation.
Etablissements F. Moret.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.

Limestone pulverizers for agricultural stone.
Gruendler Crusher & Pulverizer Co.

Liming equipment.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Etablissements F. Moret.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.

Loading machinery.
Buhler Brothers Ltd.
The Eimco Corporation.

Locomotives, Diesel.
Krupp Stahlexport G.m.b.H.

Magnetic lifting equipment.
Brimag Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

Magnetic separators.
Brimag Ltd.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

Massecuite heat treating equipment.
Babcock Atlantique.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.
The Western States Machine Co.

Metal detectors.
ASEA.
Goring Kerr Ltd.

Microbiocidal agents.
Drew Chemical Corporation.
Drew Chemical Corporation (P.R.)
Drew Chemical (Nederland) N.V.
Drew Produtos Quimicos Ltda.

Mill hydraulics.
Edwards Engineering Corp.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Mill rolls.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.

Mill roll movement indicators and recorders.
Edwards Engineering Corp.

Milling plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.

Milling plant—complete electrical equipment.
ASEA.

Mixing machines.
Arenco-Alite Ltd.

Moisture expellers.
Richard Simon & Sons Ltd.

Molasses addition plants for beet pulp.
Buckau-Wolf Maschinenfabrik A.G.
Amandus Kahl Nachf.

Molasses tanks.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Honiron.
Kingston Industrial Works Ltd.
Krupp Stahlexport G.m.b.H.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.

Packeting machinery.
Auto Wrappers (Norwich) Ltd.
Brecknell, Dolman & Rogers Ltd.
Thomas C. Keay Ltd.
SIG Swiss Industrial Company.

Packeting machinery for individual sachets.
SIG Swiss Industrial Company.

Pan boiling aids.
Fabcon Inc.
Hodag Chemical Corporation.

Pans, Vacuum.
A.P.V. Co. Ltd.
Babcock Atlantique.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Gutehoffnungshütte Sterkrade A.G.
Honiron.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.
Wellman-Heurtey Ltd., Swenson Equipment Division.

Parcelling machines.
SIG Swiss Industrial Company.

Pelleting presses for bagasse and pith.
Amandus Kahl Nachf.

Pelleting presses for dried pulp.
Buhler Brothers Ltd.
Amandus Kahl Nachf.

Perforated metals.
Associated Perforators & Weavers Ltd.
Ferguson Perforating & Wire Co.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
Charles Mundt & Sons.
J. & F. Pool Ltd.

Pipe fittings.
see Tube fittings

Pipes, Non-ferrous.
Birmingham Battery Tube Company.
Yorkshire Imperial Metals Ltd.

Pipework installation.
Blundell & Crompton Ltd.

Polythene bag sealers.
The Thames Packaging Equipment Co.

Power plants.
W. H. Allen, Sons & Co. Ltd.
ASEA.
Stork-Werkspoor Sugar N.V.

Power transmission equipment.
W. H. Allen, Sons & Co. Ltd.
ASEA.
Thomas Broadbent & Sons Ltd.
David Brown Gear Industries Ltd.
Farrel Company.
A. Friedr. Flender & Co.
Renold Limited.

Preliming equipment.
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.

Pressure feeders.
Walkers Ltd.

Pressure gauges.
The British Rototherm Co. Ltd.
Honeywell Ltd.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

Pressure vessels.
A.P.V. Co. Ltd.
Babcock Atlantique.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
E. Green & Son Ltd.
Metal Propellers Ltd.
Newell Dunford Engineering Ltd.
St. Mary Iron Works Inc.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Thibodaux Boiler Works Inc.

Printing machinery—Rotary multicolour for sugar cartons and bags, etc.
Chambon Ltd.

Process computers.
Siemens A.G., Wernerwerk für Messtechnik.

Pulley blocks.
Wheway-Watson Ltd.

Pulp screens.
Associated Perforators & Weavers Ltd.

Pulverizers, Sugar.
Gruendler Crusher & Pulverizer Co.
Mikropul Ltd.
The Sugar Manufacturers' Supply Co. Ltd.

Pumps.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Weir Pumps Ltd.

Centrifugal pumps.
ACEC.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Peter Brotherhood Ltd.
GEC-Elliott Mechanical Handling Ltd.
Etablissements F. Moret.
Saunders Valve Co. Ltd.
Schabaver.
Stothert & Pitt Ltd.

Corrosion-proof pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
GEC-Elliott Mechanical Handling Ltd
Mono Pumps Ltd.
Simonacco Ltd.
Stothert & Pitt Ltd.

Dosing pumps.
BMA Braunschweigische Maschinenbauanstalt.
Fabcon Inc.
The Permutit Co. Ltd.

Filtrate pumps.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret.
Stothert & Pitt Ltd.

Irrigation pumps.
Allen Gwynnes Pumps Ltd.
Ateliers de Construction d'Ensival S.A.
Farrow & Sons Ltd.
Saunders Valve Co. Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

Massecuite pumps.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Soc. Fives-Lille-Cail.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.

Membrane pumps.
The Eimco Corporation.
Saunders Valve Co. Ltd.

Molasses pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Comet Pump & Engineering Co. Ltd.
Amandus Kahl Nachf.
Mono Pumps Ltd.
Etablissements F. Moret.
Stothert & Pitt Ltd.

Positive-action pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Comet Pump & Engineering Co. Ltd.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

Rotary pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Comet Pump & Engineering Co. Ltd.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret.
Stothert & Pitt Ltd.

Self-priming pumps.
The Albany Engineering Co. Ltd.
The Comet Pump & Engineering Co. Ltd.
The Eimco Corporation.
Flexible Drives (Gilmans) Ltd.
Mono Pumps Ltd.
Stothert & Pitt Ltd.

Sump pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret.
Saunders Valve Co. Ltd.

Vacuum pumps.
see Vacuum pumps.

Railway, *see* Locomotives *and* Track.

Rectifiers.
ACEC.
ASEA.

Reduction and composting equipment for trash and cane waste.
Gruendler Crusher & Pulverizer Co.

Reduction gears.
W. H. Allen, Sons & Co. Ltd.
ASEA.
David Brown Gear Industries Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
A. Friedr. Flender & Co.
Fletcher and Stewart Ltd.
Lufkin Foundry & Machine Co.
Murray Iron Works Company.
Renold Limited.
Salzgitter Maschinen A.G.
A. &. W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

Refinery equipment.
ASEA.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.

Refinery equipment—*continued.*
Gutehoffnungshütte Sterkrade A.G.
Honiron.
The Mirrlees Watson Co. Ltd.
Norit Sales Corporation Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stein Atkinson Stordy Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
Tate & Lyle Enterprises Ltd.
UCMAS.

Refractometers.
Anacon Inc.
Bellingham & Stanley Ltd.
A. H. Korthof N.V.
Schmidt + Haensch.
Scientific Furnishings Ltd.

Refractory bricks.
GR–Stein Refractories Ltd.
Lucks + Co. G.m.b.H.

Refractory cement.
GR–Stein Refractories Ltd.

Roller chain.
Ewart Chainbelt Co. Ltd.
Renold Limited.

Rubber belt cane carriers.
Farrel Company.
Fletcher and Stewart Ltd.

Saccharimeters and polarimeters.
Bellingham & Stanley Ltd.
A. H. Korthof N.V.
O. C. Rudolph & Sons Inc.
Schmidt + Haensch.
The Sugar Manufacturers' Supply Co. Ltd.

Sack closing machines.
Thomas C. Keay Ltd.
Reed Medway Sacks Ltd.
Sack Fillers Ltd.
The Thames Packaging Equipment Co.

Sack counting equipment.
The Thames Packaging Equipment Co.

Sack filling machines.
Haver & Boecker.
Thomas C. Keay Ltd.
Reed Medway Sacks Ltd.
Sack Fillers Ltd.
Richard Simon & Sons Ltd.
Ingeniörsfirman Nils Weibull AB.

Sack openers.
Thames Packaging Equipment Co.

Sack printing machines.
Thomas C. Keay Ltd.

Sampling equipment.
The Thames Packaging Equipment Co.
Ingeniörsfirman Nils Weibull AB.

Scale removal and prevention
Fabcon Inc.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Hodag Chemical Corporation.
Rotatools (U.K.) Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
see also Tube cleaners.

Screens, Centrifugal, *see* Centrifugal screens.

Screens, Filter, *see* Filter screens.

Screens, Rotary.
Associated Perforators & Weavers Ltd.
F. W. Brackett & Co. Ltd.
Jones & Attwood Ltd.
J. & F. Pool Ltd.

Screens, Vibrating.
BMA Braunschweigische Maschinenbauanstalt.
George Cohen Machinery Ltd.
The Deister Concentrator Co. Inc.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
Gruendler Crusher & Pulverizer Company.
Gutehoffnungshütte Sterkrade A.G.
Haver & Boecker.
Hein, Lehmann & Co. A.G.
Carl Schenck Maschinenfabrik G.m.b.H.
The Sugar Manufacturers' Supply Co. Ltd.
The Triton Engineering Co. (Sales) Ltd.
see also Juice strainers and screens.

Screens, Wire.
Associated Perforators & Weavers Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
N. Greening (Warrington) Ltd.

Second-hand plant and machinery.
George Cohen Machinery Ltd.

Sedimentation accelerator.
Fabcon Inc.
Hodag Chemical Corporation.

Sedimentation tanks and clarifiers.
BMA Braunschweigische Maschinenbauanstalt.

Sewing threads, Heavy grade.
Thames Packaging Equipment Co.

Ship loading installations.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.
Stothert & Pitt Ltd.
Tate & Lyle Enterprises Ltd.

Shredders.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Co.
Gutehoffnungshütte Sterkrade A.G.
The Mirrlees Watson Co. Ltd.
Stedman Foundry & Machine Co. Inc.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

Shredder drives.
ASEA.
Farrel Company.
Stork-Werkspoor Sugar N.V.

Tubes, Bimetal.
Birmingham Battery Tube Company.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd.

Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.
Birmingham Battery Tube Company.
Soc. Fives Lille-Cail.
Kamani Tubes Private Ltd.
T.I. Stainless Tubes Ltd.
Yorkshire Imperial Metals Ltd.

Vacuum conveying systems for sugar.
The Tills Engineering Co. Ltd.

Vacuum pans, *see* **Pans.**

Vacuum pumps.
Ateliers de Construction d'Ensival S.A.
Bosco S.p.A. Officine Meccaniche e Fonderie.
George Cohen Machinery Ltd.
The Comet Pump & Engineering Co. Ltd.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Nash International Company.
Neyrpic.
A. & W. Smith & Co. Ltd.

Vacuum pumps, Oil-free.
Nash International Company.

Valves.
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Auto Wrappers (Norwich) Ltd.
SAPAL.
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John Dore & Co. Ltd.
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ACEC Ateliers de Constructions Electriques de Charleroi SA.,
Boite Postale 4, 6000 Charleroi 1, Belgium.
Tel.: 07/36.20.20. *Cable:* Ventacec, Charleroi.
Telex: Acec Charleroi 51.227.

Adequate Weighers Ltd.,
Bridge Road, Sutton, Surrey, England.
Tel.: 01–642 6666/8. *Cable:* Adegrate, London.
Telex: 24.16.

The Albany Engineering Co. Ltd.,
Church Road, Lydney, Glos., England.
Tel.: Lydney 2275/2276/2277. *Cable:* Bolthead, Lydney.

Alfa-Laval AB.,
Tumba, Sweden.
Tel.: 0753/31100. *Cable:* Alfalaval, Tumba.
Telex: altumba s.

Allen Gwynnes Pumps Ltd.,
see W. H. Allen, Sons & Co. Ltd.

W. H. Allen, Sons & Co. Ltd.,
Queens Engineering Works, Bedford, England.
Tel.: Bedford 67400. *Cable:* Pump, Bedford, Telex.
Telex: 82100.

Anacon Inc.,
62 Union St., Ashland, Mass., 01721 U.S.A.
Tel.: (617) 881-3000.

The A.P.V. Co. Ltd.,
Manor Royal, Crawley, Sussex, England.
Tel.: Crawley 27777. *Cable:* Anaclastic, Crawley, Telex.
Telex: 87237.

Arenco-Alite Ltd.,
Pixmore Avenue, Letchworth, Herts., England.
Tel.: Letchworth 3965-9. *Cable:* Aral, Letchworth.
Telex: 82368.

von Arnim'sche Werke G.m.b.H., Werk Schneider & Helmecke,
605 Offenbach/Main, Germany.
Tel.: 83 20 54. *Cable:* Kondenstopf, Offenbachmain.
Telex: 4-152899 shof.

ASEA,
Västeras, Sweden.
Tel.: 021/100000. *Cable:* Asea, Vasteras.
Telex: 4720.

Ashworth Ross & Co. Ltd.,
Scout Hill, Dewsbury, Yorkshire, England.
Tel.: 0924–2–5642. *Cable:* Duros, Dewsbury.

Associated Perforators & Weavers Ltd.,
Perforating Division, Woolwich Road, London S.E.7., England.
Tel.: 01–858 6401.
Telex: 896648.

Ateliers de Construction d'Ensival S.A.,
44 rue Hodister, B-4851 Wegnez, Belgium.
Tel.: 087-60166. *Cable:* Pompensi, Pepinster.
Telex: 41.358.

Soc. Sucrière de l'Atlantique (Engineering),
18 Avenue Matignon, Paris 8ème, France.
Tel.: 225-60-51/359-22-94. *Cable:* Sucatlan, Paris.
Telex: 20.602 Jilion.

Atlas Chemical Industries Inc.,
Wilmington, Delaware, 19899 U.S.A.
Tel.: (302) OL8-9311. *Cable:* Atchem, Wilmington.
TWX: 762-2355.

Atlas Chemical Industries S.A.,
15 Rue Blanche, Brussels 5, Belgium.

Atlas Chemical Industries, Canada, Ltd.,
P.O. Box 1085, Brantford, Ontario, Canada.

Atlas Chemical Interamerica Inc.,
420 South Dixie Highway, Coral Gables, Florida, 33133 U.S.A.

Auto Wrappers (Norwich Ltd.,
Whiffer Road, Norwich NOR 07N, England.
Tel: Norwich 49231. *Cable:* Autowrap, Norwich.
Telex: 97395 Autorap.

Babcock Atlantique,
48 Rue la Boétie, Paris 8e (75), France.
Tel.: 256.68.00. *Cable:* Babcock, Paris.
Telex: 29 027.

Bagshawe & Co. Ltd.,
Church Street, Dunstable, Beds., England.
Tel.: Dunstable 64302–5.
Telex: 81287.

William Bain & Co. Ltd.,
80 Ebury St., Westminster, London S.W.1., England.
Tel.: 01–730 2219. *Cable:* Lochrin, London.

Balco-Filtertechnik G.m.b.H.,
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: 26518. *Cable:* Balco, Braunschweig.
Telex: 952509.

Bellingham & Stanley Ltd.,
61 Markfield Rd., London N.15., England.
Tel.: 01–808 2675. *Cable:* Polyfract, London, N.15.
Telex: 23784.

Birmingham Battery Tube Company,
Selly Oak, Birmingham 29, England.
Tel.: 021–472 1151. *Cable:* Batmetco, Birmingham, Telex.
Telex: 338285.

Blundell & Crompton Ltd.,
West India Dock Road, London, E.14, England.
Tel.: 01–987 6001/3838. *Cable:* Blundell, London, E.14.

BMA Braunschweigische Maschinenbauanstalt,
(33) Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: Braunschweig 20111 and 23o 1.
Cable: Bema, Braunschweig.
Telex: Bema Bswg. 0952840.

William Boby & Co. Ltd.,
23 High Street, Rickmansworth, Hertfordshire, England.
Tel.: Rickmansworth 76363. *Cable:* Boby, Ricmanswth.
Telex: 24193.

Bookers Agricultural & Technical Services Ltd.,
Bucklersbury House, 83 Cannon St., London E.C.4, England.
Tel.: 01–248 8051. *Cable:* Sugarcane, London E.C.4.
Telex: 23605.

Bosco S.p.A. Officine Meccaniche e Fonderie,
Piazzale Antonio Bosco N.3, Terni, Italy.
Tel.: 55341. *Cable:* Bosco, Terni.
Telex: 66032 Boscoter.

F. W. Brackett & Co. Ltd.,
Hythe, Colchester, Essex, England.
Tel.: Colchester 73958. *Cable:* Brackett, Colchester.

Brecknell, Dolman & Rogers Ltd.,
Pennywell Road, Bristol BS5 0TL, England.
Tel.: Bristol 558222. *Cable:* Bremaners, Bristol.
Telex: 44871.

Brimag Ltd.,
Amington Colliery, Glascote Heath, Tamworth, Staffs, England.
Tel.: Tamworth 3581.

British Charcoals & Macdonalds Ltd.,
21 Dellingburn St., Greenock, Scotland.
Tel.: 20273. *Cable:* Brimac, Greenock.

The British Rototherm Co. Ltd.,
Merton Abbey, London S.W.19, England.
Tel.: 01–542 7661. *Cable:* Rototherm, London S.W.19.
Telex: 262355.

Thomas Broadbent & Sons Ltd.,
Queen Street South, Huddersfield, Yorkshire, England.
Tel.: Huddersfield 22111. *Cable:* Broadbent, Huddersfield.
Telex: 51515.

Peter Brotherhood Ltd.,
Peterborough, England.
Tel.: 71321. *Cable:* Brotherhoods, Peterborough.
Telex: 32154 Brotherhd Pboro.

David Brown Gear Industries Ltd.,
Park Gear Works, Huddersfield HD4 5DD, Yorks., England.
Tel.: Huddersfield 22180. *Cable:* Gearing, Huddersfield.
Telex: 51562/3

Buckau-Wolf Maschinenfabrik A.G.,
D4048 Grevenbroich, Postfach 69, Germany.
Tel.: 02181/421. *Cable:* Buckauwolf, Grevenbroich.
Telex: 08 517 111.

Buell Ltd.,
George Street Parade, Birmingham 3, England.
Tel.: 021–236 5391. *Cable:* Buellon, Birmingham.
Telex: 338458.

Buhler Brothers Ltd.,
Engineering Works, 9240 Uzwil, Switzerland.
Tel.: (073) 5 01 11. *Cable:* Buhler, Uzwil.
Telex: 7 75 41.

John R. Carmichael Ltd.,
Kenmore Works, Broad Lane, Liverpool, L11 1AE, England.
Tel.: 051–226 1336/7. *Cable:* Filclo, Liverpool L11 1AE.

C.E.C.A.,
24 Rue Murillo, Paris 8e, France.
Tel.: Carnot 82-00. *Cable:* Ceca, Paris.

C F & I Engineers Inc.,
3309 Blake Street, Denver, Colo., 80205 U.S.A.
Tel.: (303) 623-0211.
Telex: 045-567 CF&I-engr Dvr.

Chambon Ltd.,
Riverside Works, Standish Rd., London W.6, England.
Tel.: 01-748 6086. *Cable:* Chambonted, London W.6.
Telex: 261476.

Chemap A.G.,
Alte Landstrasse 415, 8708 Männedorf/ZH, Switzerland.
Tel.: (051) 73 91 01. *Cable:* Servochemie, Männedorf.
Telex: 75 508.

George Cohen Machinery Ltd.,
600 Wood Lane, London W.12, England.
Tel.: 01-743 2070. *Cable:* Omniplant, London W.12.
Telex: 21288/9.

Collectron (Sales) Ltd.,
5 Greenhills Road, Charlton Kings, Cheltenham, Gloucestershire, GL53 9ED, England.
Tel.: 0242-56355. *Cable:* Colextract, Cheltenham.

The Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, CR9 2ND England.
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Telex: 21127.

Cooper, Pegler & Co. Ltd.,
P.O. Box 9-98, Burgess Hill, Sussex, England.
Tel.: Burgess Hill 2525. *Cable:* Stomata, Burgess Hill.

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Crown Works, Portland Rd., Longton, Stoke-on-Trent, ST3 1EN England.
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A. F. Craig & Co. Ltd.,
Caledonia Engineering Works, Paisley, Scotland.
Tel.: Paisley 2191. *Cable:* Craig, Paisley.
Telex: 778051.

Crone & Taylor (Engineering) Ltd.,
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Telex: 627110 Chamcom Liverpool.

A/S De Danske Sukkerfabrikker,
(The Danish Sugar Corporation),
Langebrogade 5, Copenhagen K, Denmark.
Tel.: ASTA 6130. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 5530 Sukker KH.

Dearborn Chemicals Ltd., Farnell Carbons Division,
Widnes, Lancs., England.
Tel.: 051-424 5351. *Cable:* Scofar, Widnes.
Telex: 627341.

Defibrator AB.,
Box 270 73, S-102 51 Stockholm 27, Sweden.
Tel.: 08/23 04 40. *Cable:* Defibrator, Stockholm.
Telex: 19026 Defiber.

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Diamond Shamrock Chemical Company, Resinous Products Division,
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Tel.: (415) 369–0071. *Cable:* Daco-West, Redwood City.
Telex: 415-364-9063.

Dicalite/GREFCO Inc., International Division,
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Telex: 67-4224.

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Tel.: 01–500 4144. *Cable:* Cuivre, Ilford.

Dorr-Oliver Inc., Cane Sugar Division,
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Tel.: (203) 348-5871.
Telex: 965912.

Dreibholz & Floering Ltd.,
Dereham, Norfolk, England.
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Telex: 97357.

Drew Chemical Corporation,
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P.O. Box 157, Boonton, N.J., 07005 U.S.A.
Tel.: (201) 334-2900/(212) TN7-6700. *Cable:* Palmo, New York.
Telex: 136416.

Drew Chemical Corporation (P.R.)
P.O. Box 3249, Ponce, Puerto Rico.
Tel.: 842-5060.

Drew Chemical (Nederland) N.V.,
Scheepmakershaven 60, Rotterdam, Holland.
Tel.: 137465/137466. *Cable:* Aneroid, Rotterdam.
Telex: 22590.

Drew Produtos Quimicos Ltda.,
Caixa Postal 4885, São Paulo, Brazil.

Dust Control Equipment Ltd.,
Thurmaston, Leicester LE4 8HP, England.
Tel.: Syston 3333. *Cable:* Dust, Leicester.
Telex: 34500.

Maschinenfabrik H. Eberhardt,
3340 Wolfenbüttel, Frankfurterstr. 14/17, P.O. Box 266, Germany.
Tel.: 22002 and 3263. *Cable:* Eberhardt, Wolfenbüttel.
Telex: 09 52620 ebhdt d.

Edwards Engineering Corp.,
1170 Constance Street, New Orleans, La., 70130 U.S.A.
Tel.: 524–0175. *Cable:* Joedco, New Orleans.
Telex: 058-342.

The Eimco Corporation,
P.O. Box 300. Salt Lake City 10, Utah, U.S.A.,
Tel.: (801) 521-2000. *Cable:* Eimco, Salt Lake City.
Telex: 2066-0388446.

Eimco (Great Britain) Ltd.,
Process Machinery Division, Station Rd., St. Neots, Hunts., England.
Tel.: St. Neots 3461. *Cable:* Eimfilt, St. Neots.
Telex: 32606.

Eimco Industriale S.p.A.,
Strada Cerca, 20067 Tribiano (Milano), Italy.
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Telex: 2023-32606.

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Lombard Road, London S.W.19, England.
Tel.: 01-542 8121/2/3. *Cable:* Endtesiv, London S.W.19.

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Case Postale-Gare Centrale, 8023 Zurich, Switzerland.
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Telex: 53906/7/8.

Ewart Chainbelt Co. Ltd.,
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Tel.: Derby 45451. *Cable:* Chainbelt, Derby.
Telex: 37575.

Extraction De Smet S.A.,
265 Ave. Prince Baudouin, Edegem-Antwerp, Belgium.
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Telex: 31824.

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314 Public Square Building, Cleveland, Ohio, 44113 U.S.A.
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Farrel Company,
Division of USM Corporation,
Ansonia, Conn., U.S.A.
Tel.: 734–3331. *Cable:* Farrelmach Ansonia.

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Welland Road, Off London Road, Spalding, Lincs., England.
Tel.: Spalding 3764. *Cable:* Farrow, Spalding.

Ferguson Perforating & Wire Co.,
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Tel.: Williams 1–8876. *Cable:* Ferguson, Providence.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
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Fischer & Porter Ltd.,
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Telex: 262478.

Fisons Ltd., International Division,
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Tel.: 01–493 1611. *Cable:* Fisons, London W.1.
Telex: 263 184 Fisons London.

Société Fives Lille-Cail,
7 Rue Montalivet, 75 Paris 8e, France.
Tel.: 265.22.01. *Cable:* Fivcail, Paris.
Telex: Fivcail 65328.

A. Friedr. Flender & Co.,
4290 Bocholt, Postfach 139, Germany.
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Telex: 0813841.

Fletcher and Stewart Ltd.
Masson Works, Litchurch Lane, Derby, England.
Tel.: Derby 40261. *Cable:* Amarilla, Derby, Telex.
Telex: 37514.

Flexible Drives (Gilmans) Ltd.,
Skatoskalo Works, Millers Road, Warwick, England.
Tel.: Warwick 44331/5. *Cable:* Skatoskalo, Warwick.
Telex: 31451.

Flexotube (Liverpool) Ltd.,
25 Hope Street, Liverpool 1, Lancs., England.
Tel.: 051–ROY 3345. *Cable:* Flexotube, Liverpool.

Fontaine & Co. G.m.b.H.,
51 Aachen, Grüner Weg 31, Germany.
Tel.: 31340. *Cable:* Fontaineco, Aachen.
Telex: 832558 fonte d.

Foster Wheeler John Brown Boilers Ltd.,
3 Ixworth Place, London S.W.3, England.
Tel.: 01–589 6363. *Cable:* Rewopsteam, London.
Telex: 23945.

John Fowler & Co. (Leeds) Ltd.,
Leathley Road, Leeds 10, Yorkshire, England.
Tel.: Leeds 30731.
Telex: 55461.

GEC-Elliott Mechanical Handling Ltd.,
Beanacre Rd., Melksham, Wilts., England.
Tel.: Melksham 3481. *Cable:* Spencer, Melksham.
Telex: 44392.

Girling Ltd.,
Industrial Products Group, Grange Rd., Cwmbran, Mon. NP4 3XU, South Wales.
Tel.: Cwmbran 2022. *Cable:* Wonder, Cwmbran.
Telex: 49205.

T. Giusti & Son Ltd.,
202-224 York Way, Kings Cross, London N.7, England.
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Goka N.V. Machine Works,
Postbus 3530, Koestraat 2a, Amsterdam C, Holland.
Tel.: Amsterdam 222255/6. *Cable:* Kagodam, Amsterdam.
Telex: 14173.

Goring Kerr Ltd.,
Hanover Way, Windsor, Berks., England.
Tel.: Windsor 63211. *Cable:* Metlokate, Windsor.

GR-Stein Refractories Ltd.,
Castlecary Works, Bonnybridge, Stirlingshire, Scotland.
Tel.: Banknock 255. *Cable:* Stein, Bonnybridge.
Telex: 77506.

E. Green & Son Ltd.,
Calder Vale Road, Wakefield, Yorkshire, England.
Tel.: Wakefield 71171. *Cable:* Economiser, Wakefield.
Telex: 55452.

J. Barcham Green Ltd.,
Hayle Mill, Tovil, Maidstone, Kent, England.
Tel.: 0622-52040/56852. *Cable:* Green, Tovil, Maidstone.

N. Greening (Warrington) Ltd.,
Britannia Works, Warrington, Lancs., England.
Tel.: Warrington 32401. *Cable:* Greenings, Warrington, Telex.
Telex: 62195.

Gruendler Crusher & Pulverizer Co.,
2915 North Market Street, St. Louis, Mo., 63106 U.S.A.
Tel.: Jefferson 1–1220. *Cable:* Grupulco, St. Louis.
Telex: 44–7415.

Gutehoffnungshütte Sterkrade A.G.,
Werk Düsseldorf, 4 Düsseldorf-Grafenberg, Germany.
Tel.: Düsseldorf 66 61 21. *Cable:* Hoffnungshütte, Düsseldorf.
Telex: 0858 6710.

Haver & Boecker,
4740 Oelde/Westfalen, Postfach 163, Germany.
Tel.: (02522) 301. *Cable:* Haboe, Oelde.
Telex: 8921571.

Hein, Lehmann & Co. A.G.,
P.O. Box 4109, Fichtenstr. 75, 4000 Düsseldorf, Germany.
Tel.: 780201. *Cable:* Eisenbau, Dusseldorf.
Telex: 8582740.

John M. Henderson & Co. Ltd.,
P.O. Box 26, King's Works, Aberdeen AB9 8BU, Scotland.
Tel.: Aberdeen 24262. *Cable:* Cranes, Aberdeen.
Telex: 73109.

Samuel Hill Ltd.,
Balderstone Mill, Oldham Rd., Rochdale, Lancashire, England.
Tel.: Rochdale 46748/9. *Cable:* Filtering, Rochdale.

Hinz Elektromaschinen und Apparatebau,
3300 Braunschweig, P.O. Box 103, Hansestrasse 30, Germany.
Tel.: (0531) 3 15 95. *Cable:* Hinzmotoren, Braunschweig.
Telex: 9 52 753 himot d.

Hodag Chemical Corporation,
7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A.
Tel.: Orchard 5–3950. *Cable:* Hodag, Skokieill.

Honeywell Ltd.,
Great West Rd., Brentford, Middlesex, England.
Tel.: 01-568 9191. *Cable:* Honeywell, Hounslow, Telex.
Telex: 22765.

Honeywill-Atlas Ltd.,
Mill Lane, Carshalton, Surrey, England.
Tel.: Franklin 2261/2/3/4.

Honiron,
Division of Ward Foods Inc.,
2 Pennsylvania Plaza, New York, N.Y., 10001 U.S.A.
Cable: Honiron, New York.

IMACTI Industrieele Maatschappij Activit N.V.,
Postbus 240c, Amsterdam, Holland.
Tel.: 60153, 60821. *Cable:* Activit, Amsterdam.
Telex: 11652 Ion exchange.

Industrial Magnets Ltd.,
Enfield Industrial Estate, Redditch, Worcs.
Tel.: Redditch 66611. *Cable:* Unimag, Redditch.

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: 01-953 2817. *Cable:* Isopad, Borehamwood.
Telex: 261761.

J & L Engineering Co. Inc.,
P.O. Box 620, Jeanerette, La., 70544 U.S.A.
Tel.: (318) 276–6314. *Cable:* Jalenco, Jeanerette.

Jones & Attwood Ltd.,
Stourbridge, Worcestershire, England.
Tel.: Stourbridge 5106/7/8/9. *Cable:* Heat, Stourbridge.
Telex: 338120.

Jones Cranes Ltd.,
see George Cohen Machinery Ltd.

Amandus Kahl Nachf.,
Hamburg 26, Eiffestrasse 432, Germany.
Tel.: 0411/722/4245. *Cable:* Kahladus, Hamburg
Telex: 0212775.

Kamani Tubes Private Ltd.,
Lal Bahadur Shastri Marg., Kurla, Bombay 70 (A.S.), India.
Tel.: 555561. *Cable:* Kamatubes, Kurla North.
Telex: 011–574 Kamanis By.

Thomas C. Keay Ltd.,
P.O. Box 30, Densfield Works, Dundee, Scotland.
Tel.: Dundee 89341. *Cable:* Keay, Dundee.
Telex: 76278.

Kenite Corporation,
Overhill Building, Scarsdale, N.Y., U.S.A.
Tel.: (914) 723–8110. *Cable:* Diatomite, Scarsdaleny.

James Kenyon & Son Ltd.,
P.O. Box 28, Roach Bank Mills, Bury, Lancs., BL9 7HA England.
Tel.: Bury 5121.
Telex: 66440.

Kingston Industrial Works Ltd.,
138 Spanish Town Road, P.O. Box 72, Kingston 11, Jamaica, West Indies.
Tel.: 36121. *Cable:* Industrial, Kingston.

AB Kockum-Landsverk,
Fack, S-261 20 Landskrona, Sweden.
Tel.: 77000. *Cable:* Landsverk, Landskrona.
Telex: 72285.

A. H. Korthof N.V.,
48 Herengracht, Amsterdam-C., Holland.
Tel.: 020/230734. *Cable:* Sugarlab, Amsterdam.

Krieg & Zivy Industries,
10 Avenue Descartes, 92 Le Plessis-Robinson, France.
Tel.: 644-62-26. *Cable:* Zedka, Plessis-Robinson.

Krupp Stahlexport G.m.b.H.,
Department FFB, 4 Düsseldorf, Grabbeplatz 2, Germany.
Tel.: 0211/87791. *Cable:* Kruppstahl, Düsseldorf.
Telex: Düsseldorf 0858 2251/52 ksd-d

Aktiengesellschaft Kühnle, Kopp & Kausch,
6710 Frankenthal/Pfalz, Germany.
Tel.: (06233)-4021. *Cable:* Maschinenkessel, Frankenthal/Pfalz.
Telex: 04 65221.

John Laing & Son Ltd.,
Page Street, London N.W.7, England.
Tel.: 01-906 5425. *Cable:* Rotcartnoc, London N.W.7.
Telex: 263271.

S.A. Lainière de Sclessin,
Sclessin-lez-Liège, Belgium.
Tel.: (04) 52.21.50. *Cable:* Lainière, Sclessin.

Lancaster & Tonge Ltd.,
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Tel.: 061-736 1484. *Cable:* Pistons, Manchester.

Lucks + Co. G.m.b.H.,
33 Braunschweig, P.O. Box 382, Germany.
Tel.: Braunschweig 5971. *Cable:* Baulucks, Braunschweig.
Telex: 09-52713.

Lufkin Foundry & Machine Co.,
P.O. Box 849, Lufkin, Texas, 75901 U.S.A.
Tel.: NE4–4421. *Cable:* Luffo, Lufkin
Telex: 713–632–3103.

Lurgi Gesellschaft für Wärme- und Chemotechnik m.b.H.,
6 Frankfurt (Main), Lurgihaus, Germany.
Tel.: 55071. *Cable:* Lurgiwaerme, Frankfurt

Manlove, Alliott & Co. Ltd.,
P.O. Box 81, Bloomsgrove Works, Nottingham NG7 3HQ, England.
Tel.: 75127. *Cable:* Manloves, Nottingham.
Telex: Chamcom Nottm No. 37605.

Mardon (Engineering) N.V.,
Metelerkampweg 18, Brummen, Holland.
Tel.: 05756-2058. *Cable:* Mardon, Brummen.

Marshall, Sons & Co. Ltd.,
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Tel.: Gainsborough 2301.
Telex: 56134.

Massey-Ferguson (Export) Ltd.,
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Telex: Masferg, Coventry, 31-657.

Mavor & Coulson Ltd.,
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Telex: 778109.

Metal Propellers Ltd.,
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Tel.: 01-684 3611. *Cable:* Metaprops, Croydon.
Telex: 25635.

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The Mirrlees Watson Co. Ltd.,
Cosmos House, 1 Bromley Common, Bromley BR2 9NA, Kent, England.
Telex: 2-2404.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London E.C.1, England.
Tel.: 01-253 8911. *Cable:* Monopumps, London EC1.
Telex: 24453.

Montecatini Edison S.p.A.,
Dipi/Sezione Kastel, Largo Donegani 1/2, 20100 Milano, Italy.
Tel.: Milano 6333–6334. *Cable:* Gabbroind, Milano.
Telex: MI 31-415.

Etablissements F. Moret,
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Tel.: 62-50-93.

Charles Mundt & Sons,
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Telex: JCY 774.

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Negretti & Zambra Ltd.,
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Tel.: Aylesbury 5931. *Cable:* Negretti, Aylesbury, Telex.
Telex: 83285.

Newell Dunford Engineering Ltd.,
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Telex: 22413.

Neyrpic,
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Tel.: (76) 96.48.30. *Cable:* Neyrpic, Grenoble.

Nordiska Maskinfilt AB.,
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Telex: 3558.

Norit Sales Corporation Ltd.,
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N.V. Norit Verkoopcentrale,
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Telex: 43228.

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Telex: 96148.

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Sack Fillers Ltd.,
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Telex: 896095.

St. Mary Iron Works Inc.,
P.O. Box 581, Franklin, La., 70538 U.S.A.
Tel.: (318) 828-5390. *Cable:* SMIW, Franklin.

Salzgitter Maschinen A.G.,
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Telex: 95445 smg d.

Sankey Green Wire Weaving Co. Ltd.,
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SAPAL Société Anonyme des Plieuses Automatiques,
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Telex: 24 541.

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Telex: 49241.

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Schabaver,
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Tel.: 59-00-49. *Cable:* Schabaver, Castres s/Agout.
Telex: 51786.

Carl Schenck Maschinenfabrik G.m.b.H.,
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Telex: 0419 441.

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Telex: 0212932.

Schmidt + Haensch,
Berlin 62, Naumannstrasse 33, Germany.
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Telex: 183 343 suhfo d.

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713 Bietigheim/Wurttemberg, Germany.
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Siemens A.G., Wernerwerk für Messtechnik,
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Tel.: (0721) 5951. *Cable:* Wernerwerkmess, Karlsruhe.
Telex: 7826851.

SIG Swiss Industrial Company,
CH-8212 Neuhausen Rhine Falls, Switzerland.
Tel.: (053) 8 15 55. *Cable:* Sig. Beringen.
Telex: 7 61 57.

Sil-Flo Incorporated,
P.O. Box 388, 407 E. Main St., Port Jefferson, N.Y., 11777 U.S.A.
Tel.: (516) 928-0200/(817) 834-1944. *Cable:* Silflo, Port Jefferson.

Richard Simon & Sons Ltd.,
Phoenix Works, Basford, Nottingham, England.
Tel.: 74211-9. *Cable:* Balance, Nottingham.

A. & W. Smith & Co. Ltd.,
Cosmos House, 1 Bromley Common, Bromley BR2 9NA, Kent, England.
Tel.: 01-464 3681. *Cable:* Sugrengine, Bromley, Kent.
Telex: 2-2404.

Société Sucrière de l'Atlantique, *see* Atlantique.

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TWX: 910-880-4185.

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Telex: 65088 Spechim.

Stabilag Engineering Ltd.,
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Telex: 85145.

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Telex: STOBA 42051.

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Telex: 44324.

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Tel.: Stockholm 23 83 20. *Cable:* Flaktfabriken, Stockholm.
Telex: 10430 flakt s.

Tate & Lyle Enterprises Ltd.,
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Tel.: 01-464 3681. *Cable:* Tecserve, Bromley, Kent.
Telex: 22404 Sugrengine Bmly.

Tate & Lyle Technical Services Ltd.,
No. 1 Cosmos House, Bromley Common, Bromley, BR2 9NA England.
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Tel.: 021-552 1585. *Cable:* Tistan, Oldbury, Telex.
Telex: 33387'

The Tills Engineering Co. Ltd.,
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Telex: 67539.

The Triton Engineering Co. (Sales) Ltd.,
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Tel.: Ashford (Kent) 25133. *Cable:* Triton, Ashford, Kent.

UCMAS Union des Constructeurs Belges de Matériel de Sucrerie, Soc. Coop.,
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Tel.: (02) 13 84 90. *Cable:* Ucmascoop, Bruxelles.
Telex: 22–328 a b r bruxelles.

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Tel.: Maryborough 2321. *Cable:* Itolzak, Maryborough.

Ingeniörsfirman Nils Weibull AB.,
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Tel.: Malmö 73495. *Cable:* Nilswei, Malmö.
Telex: 32226.

Weir Pumps Ltd.,
20 Park Street, London, W1Y 4BD England.
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Telex: 22881.

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The Western States Machine Company,
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Telex: 77–667–Code III (through Chamber of Commerce)

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Telex: 77357 Yarrow Glasgow.

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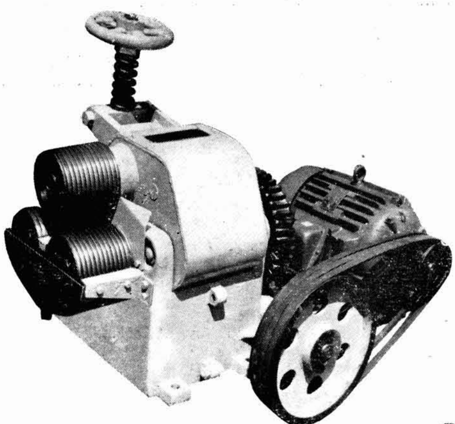
Suma Products

CANE AND BAGASSE ANALYSIS



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

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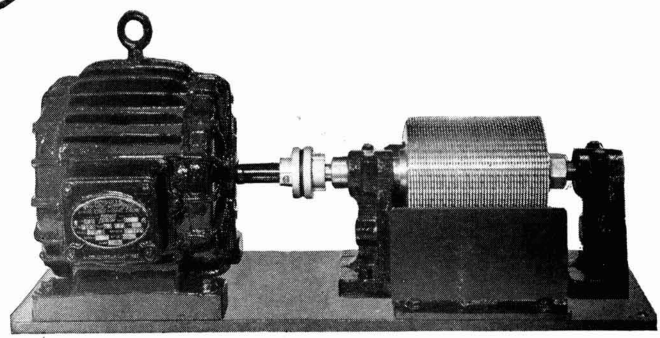

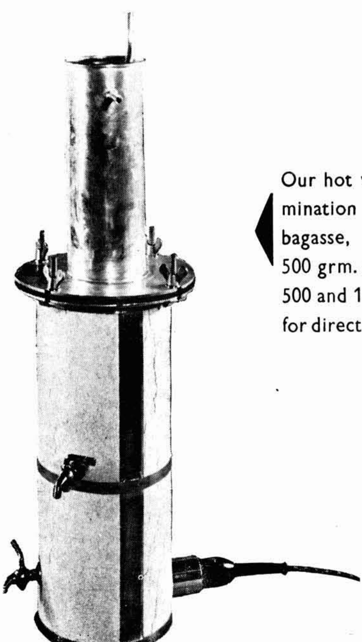

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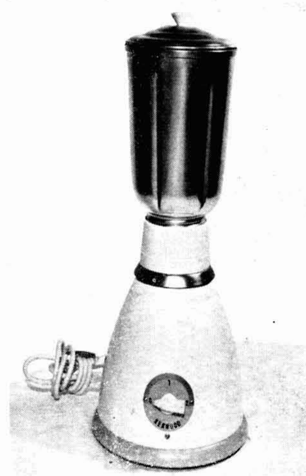

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.
PRINTED IN GREAT BRITAIN.