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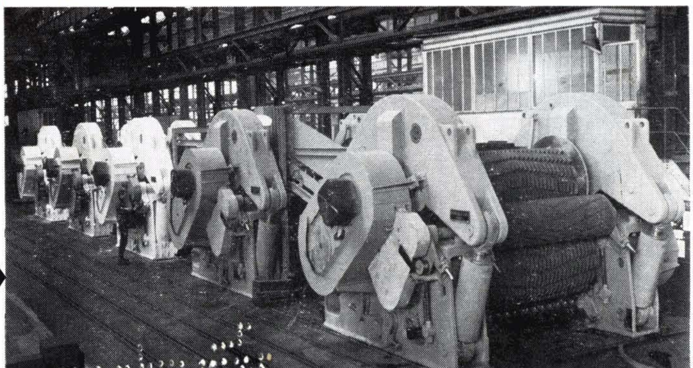

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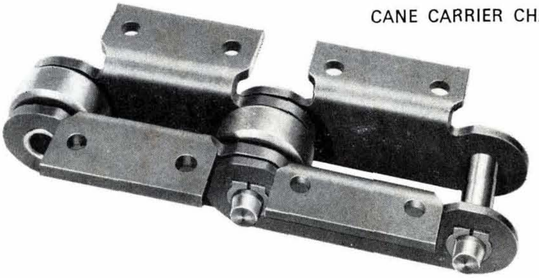

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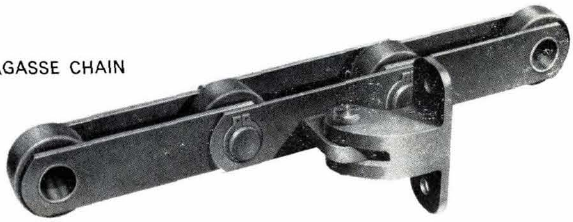

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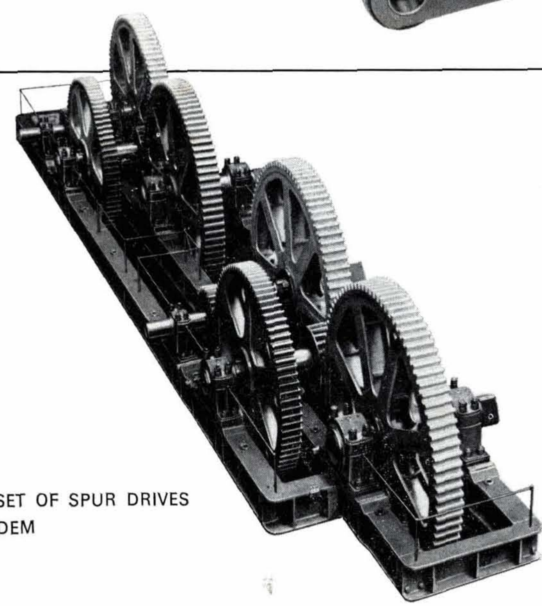

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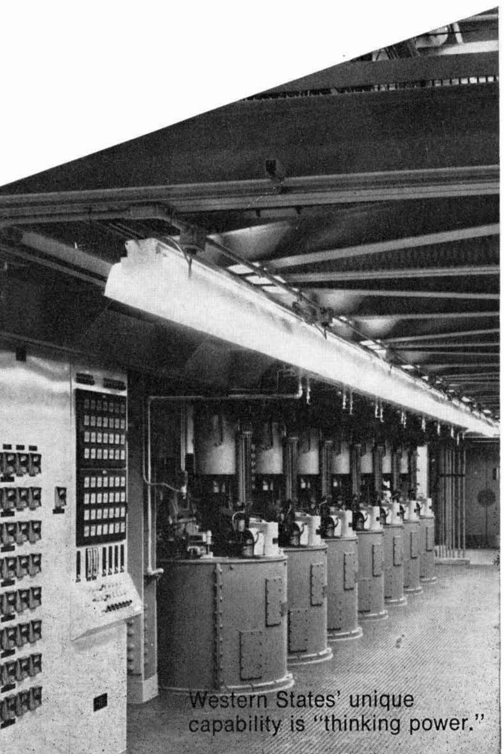

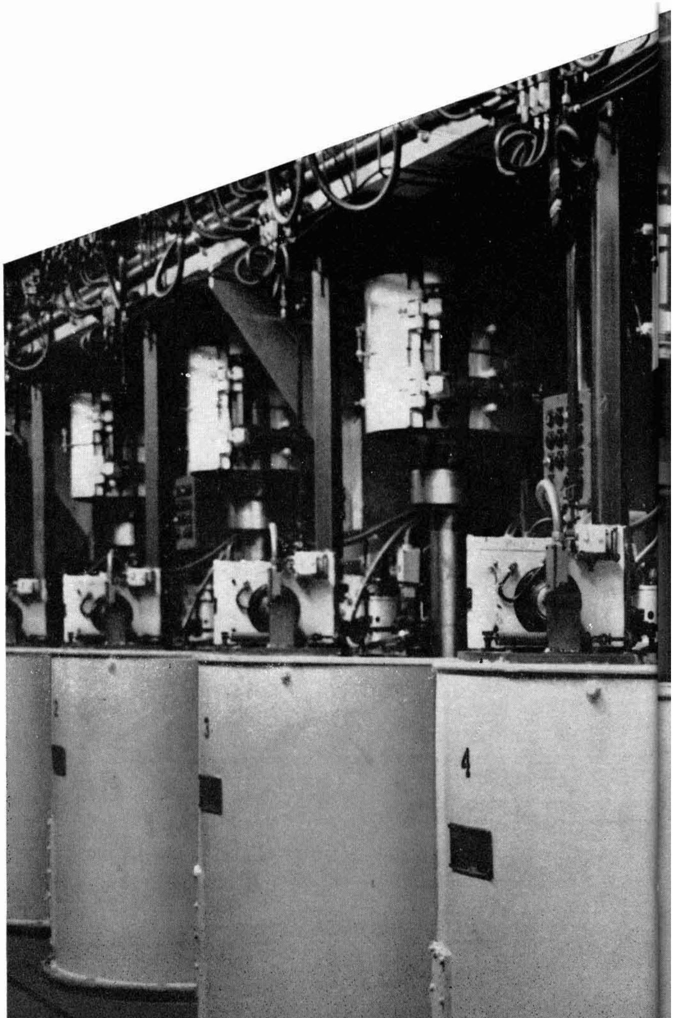

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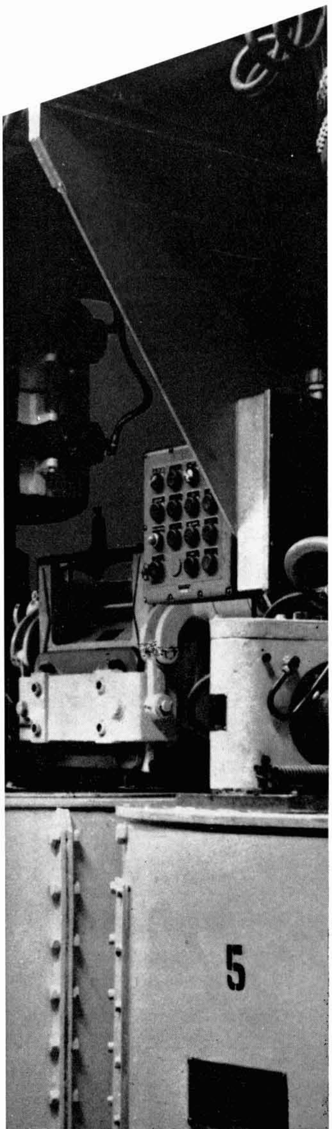

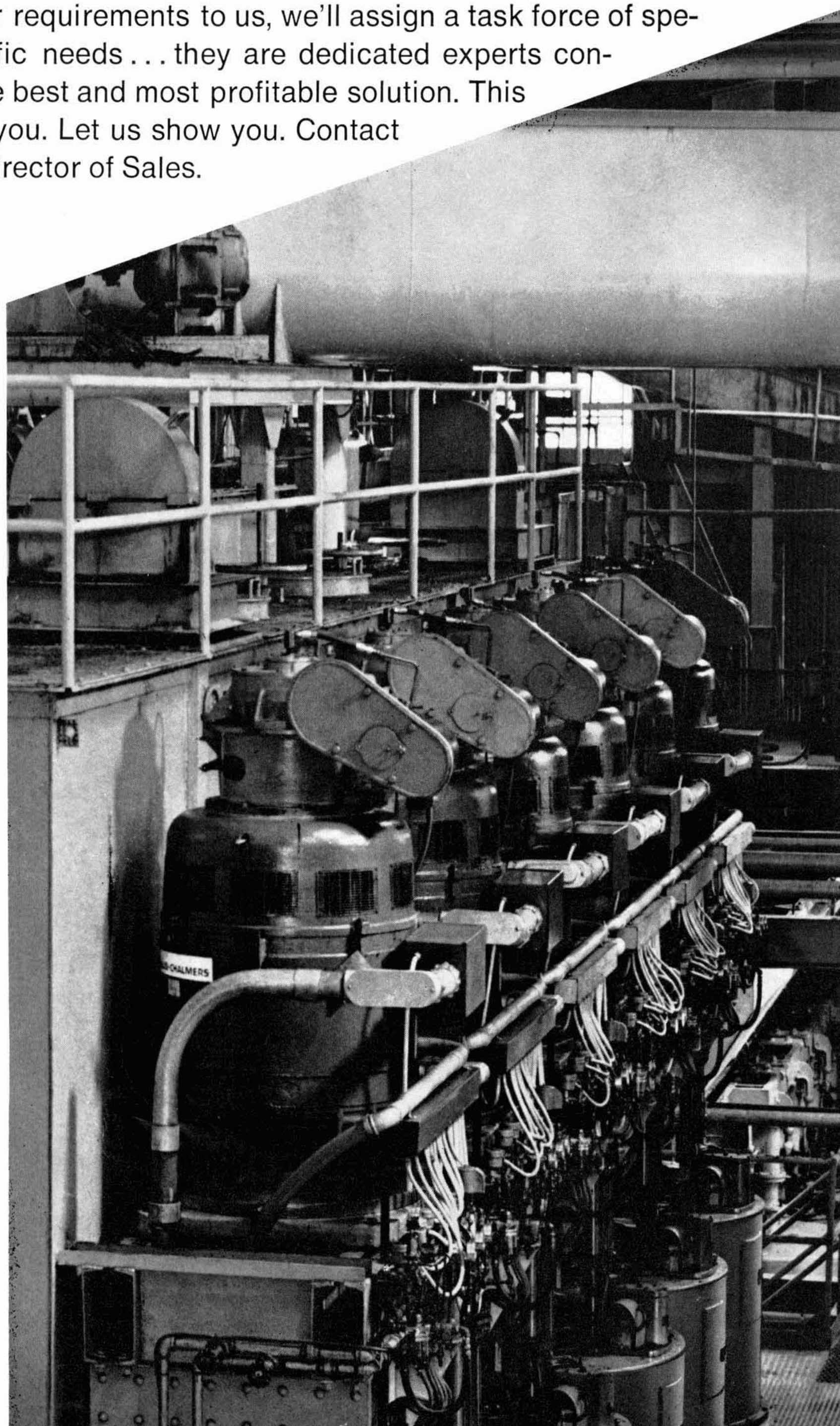

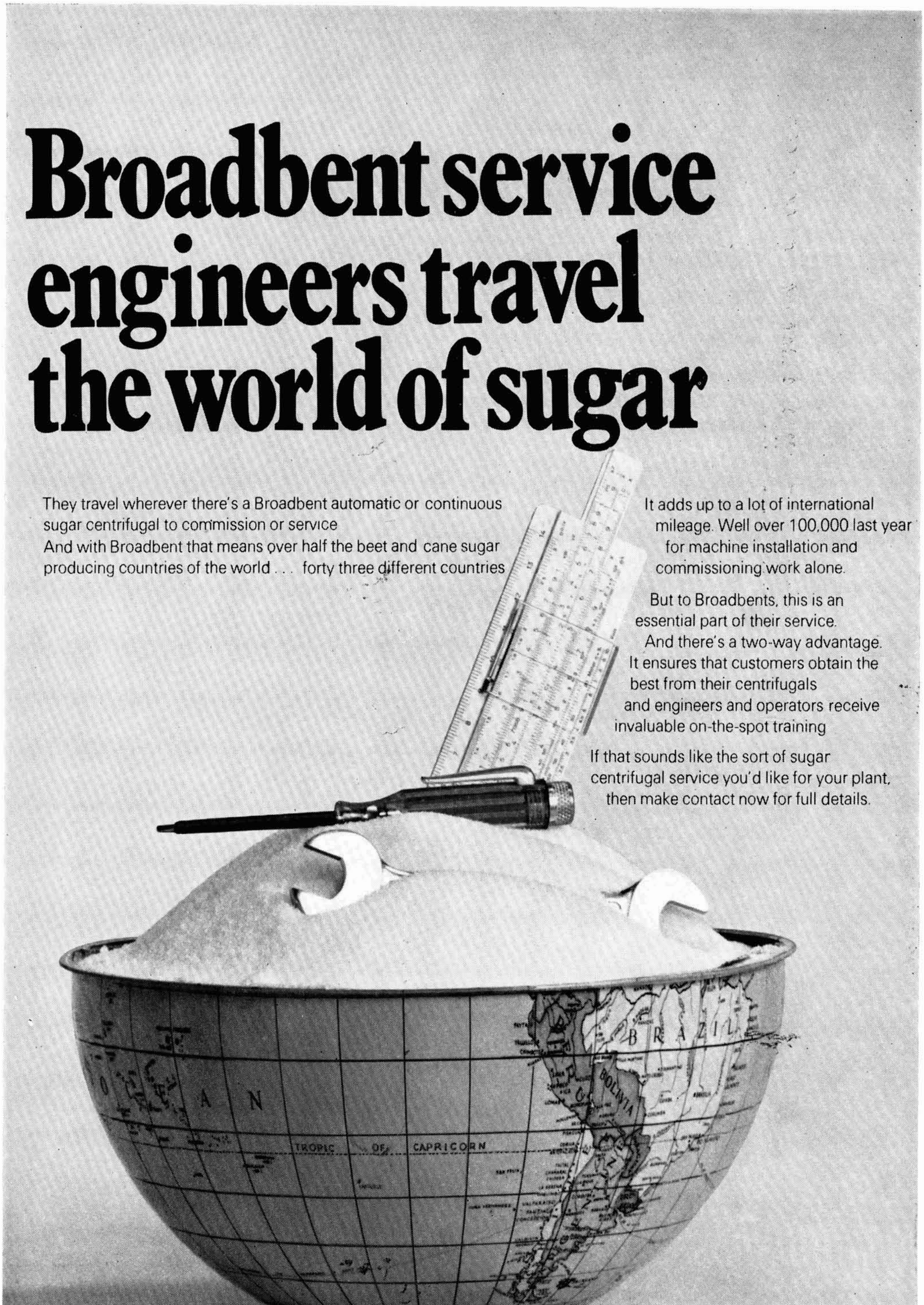
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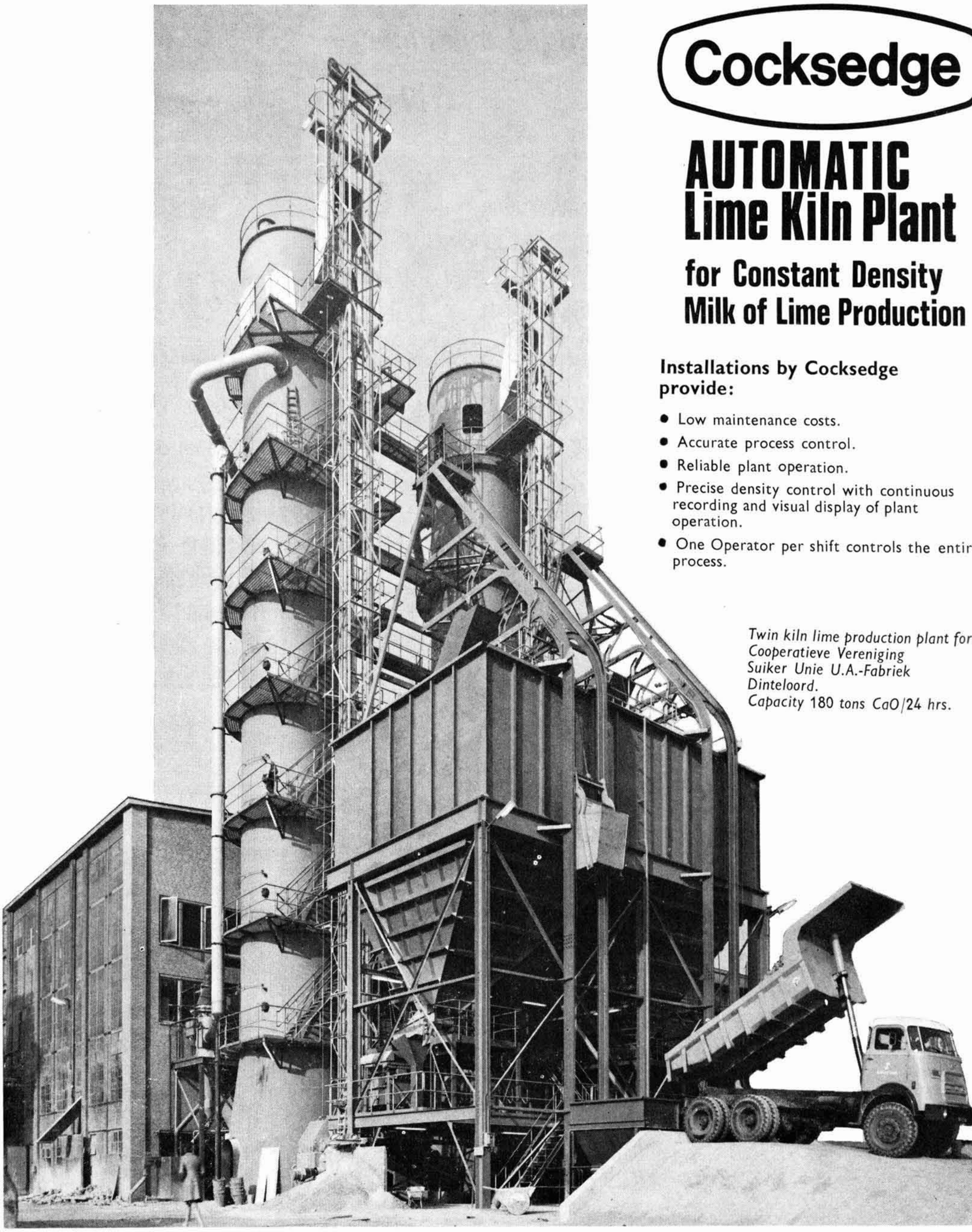

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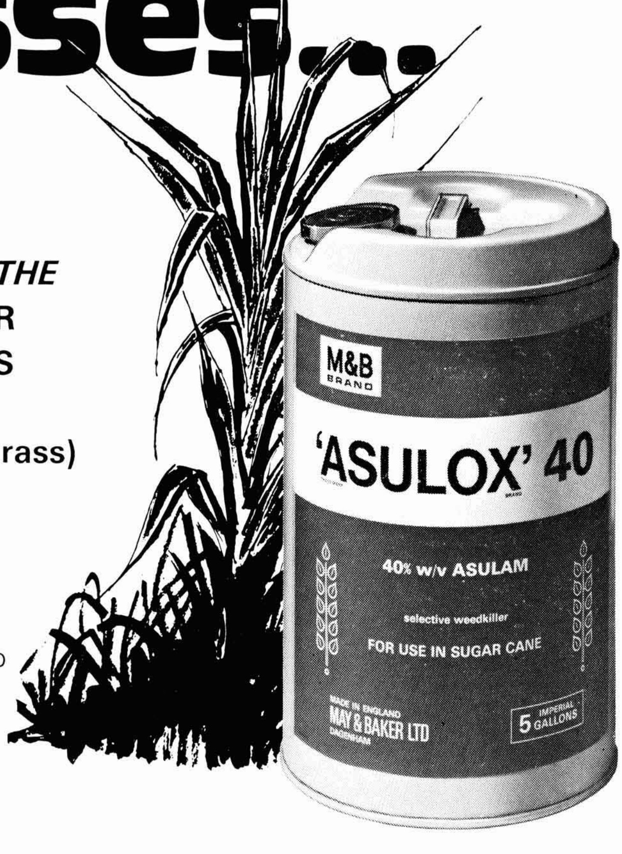

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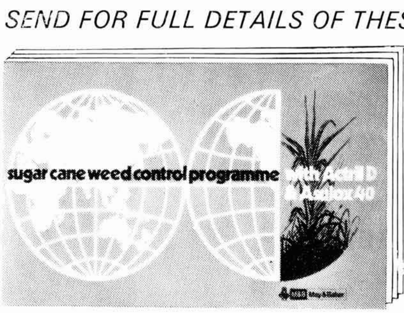

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International Sugar Journal

January 1973

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On décrit une méthode selon laquelle les dérivés triméthylsilylés des sels ammoniques des acides organiques sont séparés par chromatographie gazeuse après isolement par échange ionique des sels ammoniques des acides des jus ou mélasses de betteraves. La partie I donne les détails des différentes étapes de la méthode, ainsi que l'établissement des courbes étalons.

* * *

Récolte mécanique à la Jamaïque. J. C. VAN GROENIGEN. *p.* 6–10

On décrit deux machines à récolter mécaniquement la canne, la "Cost Cutter" de Cameco et la Massey-Ferguson "M-F 201" et on donne les résultats des essais effectués avec les machines à la Jamaïque. En conclusion, l'auteur énumère les conditions nécessaires au plein succés d'une récolte mécanique.

* * *

Le chauffage électrique de la masse cuite. Partie I. R. J. BASS, N. W. BROUGHTON et J. S. HOGG. *p.* 10–14

On décrit un travail expérimental sur le chauffage par résistance électrique des masses cuites de troisième jet, travail exécuté aux sucreries de Brigg et Cantley de la British Sugar Corporation Ltd. On montre des schémas de la forme finale du réchauffeur et du circuit électrique utilisés pour chauffer la masse cuite aux deux sucreries.

La partie I comporte des sections sur des considérations thermiques et électriques, des sections sur des considérations sur les flux et sur la taille du réchauffeur. On discute aussi les essais faits en vue de déterminer si l'utilisation des réchauffeurs à Cantley a causé une augmentation de pureté ou a eu quelque autre effet sur la qualité du produit, et on présente un tableau résumant résultats obtenus à cette usine.

Gleichzeitige Bestimmung von Phosphorsäure und organischen Säuren in Zuckersäften und Melassen. Teil I. J. F. T. OLDFIELD, R. PARSLOW und M. SHORE. *S.* 3–6

Es wird eine Methode beschrieben, bei der die organischen Säuren von Rübensaften oder Melassen durch Ionenaustausch in Form der Ammoniumsalze isoliert, zu Trimethylsilylderivaten umgesetzt und mit Hilfe der Gaschromatographie getrennt werden. Teil I dieser Arbeit enthält Einzelheiten über die verschiedenen Verfahrensschritte bei dieser Methode einschliesslich der Erstellung der Eichkurven.

* * *

Mechanisierung der Ernte auf Jamaika. J. C. VAN GROENIGEN. *S.* 6–10

Es werden zwei Zuckerrohrerntemaschinen beschrieben, und zwar der Cameco "Cost Cutter" und die Massey-Ferguson "M-F 201", und die mit ihnen beim versuchsweisen Einsatz auf Jamaika erzielten Ergebnisse angegeben. Zum Schluss der Arbeit führt der Autor diejenigen Bedingungen auf, deren Einhaltung er für die erfolgreiche Anwendung von Erntemaschinen für notwendig erachtet.

* * *

Die elektrische Anwärmung von Füllmassen. Teil I. R. J. BASS, N. W. BROUGHTON und J. S. HOGG. *S.* 10–14

Es werden Versuche zur elektrischen Anwärmung von Nachproduktfüllmassen mit Hilfe der Widerstandsheizung beschrieben, die in den Rübenzuckerfabriken Brigg und Cantley der British Sugar Corporation Ltd. durchgeführt wurden. In Abbildungen ist die endgültige Form des in den beiden Fabriken zur Erwärmung der Füllmassen benutzten Messgerätes und die elektrische Schaltung dargestellt. In den einzelnen Abschnitten des Teils I sind thermische, elektrische und strömungstechnische Betrachtungen wiedergegeben. Ferner werden Versuche besprochen, bei denen ermittelt wurde, ob die Verwendung der Heizgeräte in Cantley eine Erhöhung der Melassereinheit mit sich brachte oder irgendeinen anderen Einfluss auf die Produktqualität hatte. In einer Tabelle sind die in dieser Fabrik erzielten Ergebnisse zusammengestellt.

Determinación simultánea de ácido fosfórico y ácidos orgánicos en jugos y melazas de la fabricación de azúcar de remolacha. Parte I. J. F. T. OLDFIELD, R. PARSLOW y M. SHORF. *Pág.* 3–6

Se describe un método en que los derivados preparado por trimetilsililación de sales amoníacos de ácidos orgánicos se separan por cromatografía gas-líquido después de aislamiento de los sales amoníacos de los ácidos de jugo de remolacha o melaza por una técnica de cambio de iones. En el primer parte se presentan detalles de la distintas etapas del método, incluyendo la preparación de curvas normales.

* * *

Mecanización de la cosecha en Jamaica. J. C. VAN GROENIGEN. *Pág.* 6–10

Se describe dos cosechadoras mecánicas de caña—el "Cost Cutter" de Cameco y el "M-F 201" de Massey-Ferguson—y se presentan resultados de pruebas en que se usaban en Jamaica. Como conclusión el autor hace una lista de las condiciones que considera imprescindible para tener éxito en la cosecha mecánica.

* * *

Calefacción eléctrica de masa cocida. Parte I. R. J. BASS, N. W. BROUGHTON y J. S. HOGG. *Pág.* 10–14

Se describe trabajo experimental en las fábricas Brigg y Cantley de azúcar de remolacha de la British Sugar Corporation Ltd. sobre calefacción de 3a masa cocida por aplicación de una voltaje eléctrica. Se reproducen diagramas que indican la forma final del calentador y el circuito eléctrico que se usaba para calentar la masa cocida a las dos fábricas. Este primer parte contiene secciones sobre consideraciones termales, eléctricas y de flujo, tanto como sobre el tamaño físico del calentador. Se discuten también ensayos para determinar si el uso de los calentadores a Cantley causó aumento en la pureza de la melaza o tuvo otro efecto sobre la calidad del producto; se presenta una tabla en que se resumen los resultados obtenido en esta fábrica.

THE

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VOL. LXXV | JANUARY 1973 | No. 889

Notes & Comments

World raw sugar price

The price of sugar on the world market remained fairly steady during the second half of November; with an estimate by Licht of a world sugar production increase of 4·6 million tons in 1972/73 compared with 1971/72 there was a small fall in price levels but this recovered very quickly as the market realized that this still meant a production level lower than consumption and a further decline in stocks. In the first week of December, however, prices started to rise markedly, largely because of strong indications that the USSR was needing to buy sugar to make up a deficit caused by a poor beet crop. The situation of March 1972 was being repeated and the sugar price exceeded the peak of that period with nearby futures traded at over £100 per ton and a London daily price reaching £95.00 per ton on the 12th December, its highest level since November 1963.

* * *

UK Sugar Board

Following an easing of world raw sugar prices on the London Terminal Market, the distribution payments made under the Sugar Act 1956 were reduced from £26 to £24 per ton with effect from the 29th November. Subsequently the world price started to rise rapidly and distribution payments were raised from £24 to £32 per ton from the 7th December. Because of the rapid price increase, however, the ex-refinery price remained outside the desired range of £77–£87 per ton and the distribution payment was raised again to £38 per ton with effect from the 8th December, to £42 from the 12th December and to £48 per ton from the 15th December.

* * *

World sugar balance, 1971/72

F. O. Licht K.G. have recently published their fourth estimate of the world sugar balance up to the 31st August last, the end of the 1971/72 crop year[1]. The figures appear below.

Since their previous assessment in July 1972, Licht have increased their estimate of production in 1971/72 by 236,000 tons while at the same time the consumption assessment has been reduced by 279,000 tons in response to the higher prices obtaining in the year. As a consequence, the final stock figure is raised by 600,000 tons compared with the July estimate; nevertheless at 15·7 million tons this represents less than 21% of the previous year's consumption which is much less than the normal stock level which has traditionally been three months' supply, or 25%.

	1971/72	1970/71	1969/70
	(*metric tons, raw value*)		
Initial stocks	18,822,543	21,120,085	19,289,669
Production	72,667,508	72,590,953	74,346,292
Imports	24,895,538	23,685,705	23,628,020
	116,385,589	117,396,743	117,263,981
Exports	24,764,369	23,908,164	23,853,758
	91,621,220	93,488,579	93,410,223
Consumption	75,923,986	74,666,036	72,290,138
Final stocks	15,697,234	18,822,543	21,120,085
Increase in production	77,555	−1,755,339	6,562,019
(%)	0·11%	−2·36%	9·68%
Increase in consumption	1,257,950	2,375,898	4,066,490
(%)	1·68%	3·29%	5·96%

International Sugar Organization

The 9th session of the International Sugar Council was held during the 15th–17th November 1972. The Council adopted the report of its Statistics Committee estimating that net import requirements of the free market in 1973 were about 10·3 million tons. It was thought that, over the year as a whole, total supplies would be sufficient to meet the net import requirements of the free market.

Article 45 provides for initial export quotas to be assigned in November of a quota year. At present, however, quotas are inoperative and are likely to remain so, at least in the early part of 1973. In these circumstances, and having regard to the flexibility inherent in Article 48, the Council decided not to allocate initial export quotas for 1973 or fix at this stage any other limitations on exports for 1973.

[1] *International Sugar Rpt.*, 1972, **104**, (32), 1.

The Council was informed that the Secretary-General of UNCTAD had decided to call a United Nations Sugar Conference to negotiate a new International Sugar Agreement to come into force on the 1st January 1974. The Conference will open in Geneva on the 7th May 1973. At the request of the Secretary-General of UNCTAD the Council will prepare the draft text of a document which will form the basis for the negotiation.

The Council adopted its budget for 1973 and elected Señor Raul Léon Torras, First Vice-Minister of Foreign Trade in the Republic of Cuba, as its Chairman for 1973. Mr. S. Takahashi of Japan was elected Vice-Chairman. The members of the Executive Committee for 1973 are as follows: Australia, Brazil, Canada, Cuba, Finland, Guyana, Ireland, Japan, Mexico, Nigeria, Philippines, Poland, South Africa, Sweden, USSR and the UK.

* * *

Thailand and the ISA

It is reported in the press that Thailand is considering re-entry into the International Sugar Agreement, according to the US Department of Agriculture[1]. In spite of a substantial increase in its export business after leaving the Agreement on the 21st July 1972, Thailand is considering membership again because indications are that it would face economic hardship within a few years as a non-member.

Several non-member countries, importing Thai sugar, have applied for membership and Thailand could lose her outlets to these if she remained outside the agreement and prices were to fall. China is contemplating membership and if the application succeeded, Taiwan would withdraw from membership so becoming a great competitor of Thailand for export markets outside the Agreement.

In addition, with UK entry into the European Economic Community and phasing-out of Australia's supplies to the UK after 1974, Australia will be competing with Thailand on the world market and probably at a price advantage.

* * *

US sugar quotas 1972

The US Department of Agriculture announced on the 20th November a shortfall of 31,000 short tons, raw value, in the 1972 supply quota of the West Indies. As before, the Philippines relinquished her entitlement to her share of the redistributions and the entire amount was reallocated to Western Hemisphere producers as follows: Dominican Republic 7271 tons, Mexico 6431 tons, Brazil 6272 tons, Peru 4488 tons, Ecuador 926 tons, Argentina 869 tons, Costa Rica 824 tons, Colombia 773 tons, Nicaragua 770 tons, Guatemala 704 tons, Venezuela 699 tons, El Salvador 513 tons, British Honduras 386 tons, and Paraguay 74 tons.

Caroni Ltd. 1971/72 report

With a good crop of cane in the ground it had been anticipated that the Company's situation would be favourable. Reaping operations were, however, severely delayed and inhibited by unseasonal rains such that at one time two factories had to suspend operations. Further, harvesting could not be accelerated after the rains had ceased for risk of damage to the fields. Sugar production was 206,013 tons as against 193,077 tons in 1970/71 but increased operating costs and an unfavourable cane:sugar ratio resulted in a financial loss.

* * *

International sugar development symposium

An international symposium was held in Paris in November to discuss the development of sugar production in the next ten years[2]. A gathering had been held in Brussels the previous year[3] to try to forecast world consumption of sugar in the next ten years, and it was the function of the Paris meeting to consider where the supplies will come from to meet this demand.

C. Czarnikow Ltd. reported the meeting[4]: "It was recognized by speakers that beet sugar producers could respond to a call for more sugar more rapidly than cane producers, but several felt that the developing cane countries should be granted preferential treatment while some also suggested that cane producers scored on a comparative cost basis.

"Several speakers mentioned that the sugar needed to feed the world will hardly be forthcoming as long as prices fixed as ISA trigger points are so low. There seemed to be little agreement as to what realistic levels might be, but up to 10.00 cents per lb was mentioned. Calls for the establishment of an International Buffer Stock did not appear to meet with any enthusiasm from most of the delegates, but it was pointed out that the minimum stock provisions of the ISA had already proved beneficial to the health of the market and could have been more so had sufficient time elapsed for the full reserves to be built up.

"Almost all delegates referred to the need for a continuing International Sugar Agreement, though some would prefer it to have greater executive powers and a valuable suggestion was one that the ISO might have authority to vary quotas to take into account levels of performance.

"It was reassuring to note the remarks of the French Minister of Agriculture in which he stated that Europe would be entering a world sugar agreement. It may be noted, however, that this is capable of varying interpretations and is not the same as saying specifically that the EEC will adhere to the ISA".

[1] *The Times*, 27th October 1972.
[2] *I.S.J.*, 1972, **74**, 321.
[3] *ibid.*, 2.
[4] *Sugar Review*, 1972, (1102), 212.

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

By J. F. T. OLDFIELD, R. PARSLOW AND M. SHORE

(British Sugar Corporation Ltd., Research Laboratories, Colney, Norwich, England)

PART I

Introduction

THE changes in the concentrations of individual organic and inorganic acid anions in sugar beet juices at all stages of processing can be used to study many of the reactions involved in the production of beet sugar. A knowledge of these changes provides a sound basis for the specification of operating conditions and will also give an indication of possible sugar losses.

The extent of sugar losses due to bacterial action and inversion are indicated by the production of lactic acid during diffusion[1] and lactic and saccharinic acids during carbonatation[2,3]. The decrease in the total amount of acids, resulting from the complete or part removal of some as their calcium salts but offset in part by the production of others as a result of degradation reactions, gives a measure of the base available for the production of carbonate ions during second carbonatation.

The requirement for soda ash addition at second carbonatation to maintain the required acid/base balance at thick juice may be deduced, taking into account the base lost as ammonia, from the change in the balance due to acids gained as a result of glutamine degradation and invert destruction and lost as carbon dioxide during evaporation[4,5].

The loss of oxalate and citrate from juice as their insoluble calcium salts is shown by the decrease in their concentrations during evaporation and pan boiling. These precipitated calcium salts form the major portion of the scales deposited in evaporator tubes and pans and are one cause of turbidity in white sugar[6].

The determination of individual acids by specific methods, with or without the aid of ion exchange clean-up procedures, is very time-consuming and methods which measure several acids simultaneously have been devised, including the partition of organic acids on silicic acid columns[7], the gas-liquid chromatographic (GLC) separation of methyl esters of organic acids[8] and the GLC separation of trimethylsilyl (TMS) esters and ether esters of organic acids[9,10,11,12,13].

The preparation of TMS esters and ether esters is simpler than the preparation of methyl esters; moreover it has been reported[14] that the TMS ether esters are superior to methyl esters for GLC separation of hydroxycarboxylic acids.

Trimethylsilylation of acids as their precipitated lead salts[10,11,12], is not suitable for beet juices owing to the solubility of lead salts of lactic acid and pyrrolidone carboxylic acid but the TMS derivatives of organic acids can be readily prepared from their ammonium salts, as can derivatives of some inorganic acids[15]. An ion exchange/drying procedure for the isolation of the dry ammonium salts of the acids from beet juices has been developed and after trimethylsilylation the resultant derivatives of the acids are determined by GLC.

It proved possible to determine simultaneously with good precision and in a relatively short time the major organic acids and phosphoric acid in beet juices.

METHOD

Reagents

Cation exchange resin "Zerolit 225" 14–52 mesh 8% DVB

Anion exchange resin "Zerolit FFip" 54–100 mesh 7–9% cross linkage

2N hydrochloric acid AR

N sodium hydroxide solution AR

N sodium carbonate solution AR

5% w/v ammonium carbonate solution AR

0·5% w/v tartaric acid solution AR used as an internal standard

N,O—*bis* (trimethylsilyl) acetamide (BSA)

Apparatus

(*A*) *Ion exchange*

125 mm × 15·0 mm diameter glass ion exchange columns

Rotary evaporator

2 cm³ test tube fitted with B14 ground joint and stopper

Vacuum desiccator with P_2O_5 drying agent

1 CARRUTHERS and OLDFIELD: *Paper presented to the 8th Tech. Conf., British Sugar Corporation*, 1955; *I.S.J.*, 1956, **58,** 48.
2 CARRUTHERS *et al.: Paper presented to the 7th Tech. Conf., British Sugar Corporation*, 1954; *I.S.J.*, 1954, **56,** 218.
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13 MAKITA and WELLS: *Anal. Biochem.*, 1963, **5,** 523.
14 MARTIN and SWINEHART: *J. Gas Chromatogr.*, 1968, **6,** 533.
15 BUTTS and RAINEY: *Anal. Chem.*, 1971, **43,** 538–542.

(B) *Gas chromatography*

The gas chromatograms were obtained using a Hewlett-Packard 5750 gas chromatograph equipped with dual columns and dual flame ionization detectors. The samples were injected, with a 1 μl capacity SGE microsyringe, into the empty first 60 mm section of a 6 ft × 4 mm i.d. glass column packed with 10% SE52 silicone gum coated on 85-100 mesh, acid-washed dimethyldichlorosilane-treated "Chromosorb W".

The column oven was temperature programmed from an initial temperature of 75°C to a final temperature of 250°C at a rate of 6°C/min. The injection port temperatures and flame ionization detector block temperatures were 250°C and the dry oxygen-free nitrogen carrier gas flow rate was 54 cm^3 min^{-1}. The detectors were fed with hydrogen, at 11 psi and flow rate 45 cm^3 min^{-1}, and oxygen at 33 psi and flow rate 500 cm^3 min^{-1}.

The electrometer was set on Range 10^3, equivalent to 10^{-9} amp full scale deflection with an attenuation setting X1, and attenuation settings from X2 to X16 were used when recording the elution chromatograms.

Ion exchange procedure

Preparation of resins.—The ion exchange columns contain only 10 cm^3 of resin and, for routine determinations, it is more convenient to regenerate the resins in bulk than to regenerate the individual columns.

A stock quantity of 1 to 5 litres of cation exchanger is converted to the hydrogen form in a large glass column by treatment with 2 bed volumes of 2N hydrochloric acid. The resin is then washed with deionized water until free from acid and chloride as indicated by testing with silver nitrate solution.

Resin previously used for the analysis of raw juice samples is washed free from precipitated material by decantation before regeneration.

A stock quantity of 1 to 5 litres of new anion exchanger is regenerated with about 50 bed volumes of N sodium hydroxide solution until virtually chloride free, i.e. until the effluent produces only a faint turbidity with silver nitrate solution acidified with nitric acid. The resin is then washed with 3 bed volumes of water followed by N sodium carbonate solution until the output pH is the same as the input pH (3 bed volumes). 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 wate:.

Used resin is regenerated, after washing free from ammonium carbonate, with only 2 bed volumes of sodium hydroxide solution followed by 3 bed volumes of N sodium carbonate solution.

Separation of acids from beet process juices.—To 50 cm^3 of raw juice, thin juice or diluted thick juice at 15°Bx or 5 cm^3 of diluted molasses at 15°Bx, containing not more than 6·5 meq of total acids, is added 5 cm^3 of 0·5% tartaric acid as an internal standard. The mixture, diluted to 200cm³ with deionized water to avoid the evolution of CO_2 in the anion exchanger which would break up the resin bed and cause acid leakage due to channelling, is applied to 10 cm^3 of "Zerolit 225" cation resin in the H^+ form in a glass column followed in series by a second column containing 10 cm^3 of chloride-free "Zerolit FFip" anion resin in the CO_3^{--} form such that the acid effluent from the cation exchanger passes directly onto the anion exchanger. About 50 cm^3 of deionized water is run through the columns, the cation exchange column is then discarded and the anion exchanger is washed sugar-free, as shown by the Molisch test, before eluting the acids as their ammonium salts with 250 cm^3 of 5% ammonium carbonate solution at a rate of 3 cm^3 min^{-1}. The resin must be sugar-free before elution since the TMS ether of fructose has a similar retention time to the TMS ester of citric acid. Freedom from interfering peaks is shown in Fig. 1 which is a complete method blank produced by omitting the juice sample.

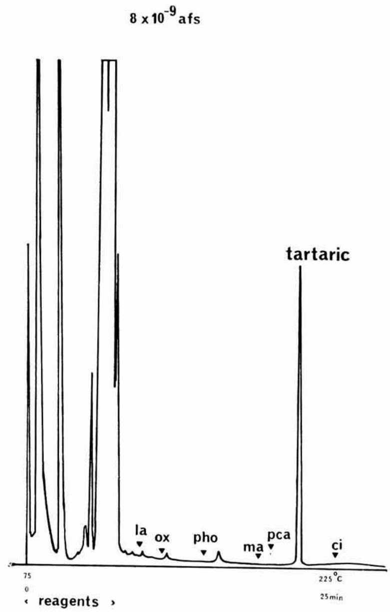

Fig. 1. Complete method blank

Preparation of TMS derivatives

Ammonium carbonate will react to form a TMS derivative[16] which has the same retention time as the lactic acid TMS ester; so, to avoid interference, the excess ammonium carbonate in the eluate must be completely removed by boiling at atmospheric pressure until the volume reduces from 250 cm^3 to 75 cm^3. The ammonium carbonate is broken down and the resultant ammonia and carbon dioxide are boiled off.

The concentrated eluate is transferred quantitatively to a 250 cm^3 round bottom flask which is then coupled to a rotary evaporator and its contents evaporated to dryness at 60°C under reduced pressure. The residue of dry ammonium salts is dissolved completely in 5 cm^3 of deionized water and a 0·2 cm^3 aliquot of the solution transferred to a 2 cm^3 test tube fitted with a B14 ground joint which is then placed in a vacuum desiccator over P_2O_5 for about 3 hours until all the water has been removed. To the residue, which is equivalent to 2 cm^3 of the 50 cm^3 juice sample, is added 300 µl of N,O—*bis* (trimethylsilyl) acetamide (BSA) and the tube stoppered. The reaction mixture is heated gently, but not boiled, using a low flame on a micro-burner until evolution of gas (ammonia) has ceased. The tube is allowed to stand for 5 minutes with occasional shaking until the ammonium salts have dissolved. At this stage conversion of the acids to TMS esters is complete but if any solid residue remains the heating should be repeated.

The derivatives prepared by the procedure are stable and may be stored for up to 3 weeks in the tightly stoppered test tube at —10°C; crystals separate during such storage but redissolve readily when warmed.

Incomplete removal of chloride from the regenerated ion exchange resins will yield considerable amounts of ammonium chloride at this stage and to ensure complete reaction the mixture would have to be heated to boiling. Such excessive heating has been found to cause a loss in response to oxalic acid. The chloride content of the applied juice sample is not sufficient by itself to cause this effect.

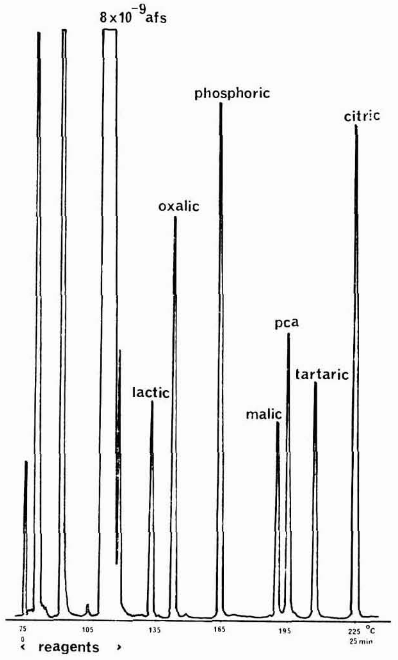

Fig. 2. Separation of acid standards (TMS esters)

Gas-liquid chromatography

Procedure.—Injection of 1 µl aliquots of the mixture of TMS esters is made directly into the empty first 60 mm of the column and the peak heights obtained relative to that obtained for the internal standard are determined from the chromatograms, a typical example of which is shown in Fig. 2. The concentrations of the acids are then obtained by reference to standard curves.

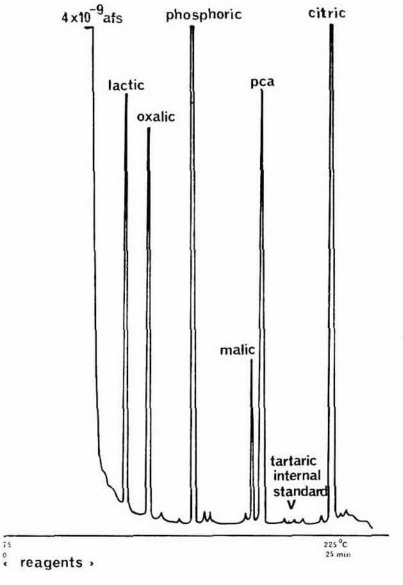

Fig. 3. Typical raw juice acid separation

Direct on-column injection with sample discharge onto the column packing caused deterioration in the column performance and repacking was required after about 2 weeks' use, but when the first 60 mm of the column was left unpacked this was no longer necessary.

Preparation of standard curves.—5 cm^3 aliquots of 0·5% tartaric acid solution are added to increasing aliquots of a standard solution of the acids under consideration. Each of these aliquots is then taken through the complete analytical procedure. A plot of relative peak height for each acid (tartaric acid = 1·0) against acid concentration is linear in the range equivalent to between 20 mg and 1000 mg/litre of juice (2000 mg/litre for citric acid and PCA) for a juice aliquot of 50 cm^3.

In general the consistency of response is good but some variations do occur and to obtain the highest accuracy calibration was carried out with each batch of juice samples. The standard curves are linear and were determined by processing the two aliquots of the mixture of standard acids giving the extreme values.

In order that the total acid applied to the ion exchange columns does not exceed 6·5 meq, while at

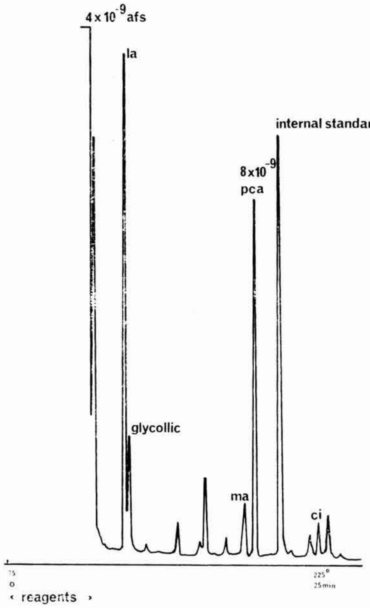

Fig. 4. Typical carbonatated juice separation

the same time the highest acid concentration for each standard curve is greater than the maximum concentration of the same acid likely to occur in the juice sample, it is not possible to use a mixture containing equal amounts of each acid and the relative proportions of the constituent acids in the mixture of standard acids should be similar to those in the type of process juice being analysed (e.g. raw juice or thin juice or molasses). Figs. 3 and 4 show typical separations of the acids from raw juice and second carbonatation juice.

Preparation of standard solutions of acids.—The predominant acids of beet raw juice are citric and phosphoric acids while those of thin juice, thick juice and molasses are pyrrolidone carboxylic and lactic acids so that two standard acid mixtures are required.

Standard A, used when analysing raw juice, contains:

20 mg % w/v	lactic acid as lithium lactate
60 mg % w/v	oxalic acid
60 mg % w/v	phosphoric acid as potassium dihydrogen phosphate
10 mg % w/v	malic acid
25 mg % w/v	pyrrolidone carboxylic acid
70 mg % w/v	citric acid

Standard B, used when analysing thin juice, thick juice and molasses, contains:

50 mg % w/v	lactic acid as lithium lactate
10 mg % w/v	glycollic acid as sodium glycollate
5 mg % w/v	malic acid
160 mg % w/v	pyrrolidone carboxylic acid
10 mg % w/v	citric acid

(To be continued)

Mechanical harvesting in Jamaica

By J. C. van GROENIGEN
(The Sugar Manufacturers' Association (of Jamaica) Ltd., Jamaica, W.I.)

Paper presented to the 14th Congress, I.S.S.C.T., 1971

Introduction

IN the early 1960's mechanical loaders were introduced in Jamaica. It had become difficult to find sufficient manual loaders, and the introduction of burning aggravated the situation. Manual loading of burnt cane is a dirty job, and even increased labour wage rates would not have solved the shortage problem. Apart from this, mechanical loading proved to be cheaper.

The big controversy with the introduction of mechanical loaders was whether push-pile or heap loaders should be used. Tests showed that the amount of soil sent in by push-pile loaders was higher than the amount included in heap loaded cane. In spite of this, the push-pile system became more or less standard. Only a few estates are presently using heap loaders. Heap loading never became popular because of the low loading rate and the high maintenance costs of the heap loaders available on the market.

Because of push-pile loading, three factories considered the construction of special washing plants necessary. Some factories give the cane a "shower" but do not have special washing plants.

The majority of the cane is still handled in slings, but there is a gradual change to the chain-net (spreader bar) system, which seems to be the most suitable for the present situation.

Although there is no general shortage of cane cutters, experimentation with mechanical harvesters to evaluate the machines on the market, to make recommendations with regard to field conditions and cane varieties, and to demonstrate the machines on various estates, was considered desirable. As a result of the Mordecai inquiry, the Government gave permission to import five harvesters for test purposes. A team of specialists went to Puerto Rico in May 1969 and made the following recommendations:

(1) A short-term programme for the introduction of whole-stalk harvesters. This type of harvester only replaces the manual cane cutter; it does not affect the system of loading and transportation. Heavy, recumbent and brittle conditions of cane were considered severe limitations to the extensive use of the machine.

(2) A long-term programme for the introduction of combine harvesters. The combine harvester was expected to be the final solution to the harvesting problem as it was felt that this type of machine would handle a large range of yields without including a high percentage of extraneous matter in the cane sent to the factory.

The introduction of windrow-type harvesters, gaining popularity in Puerto Rico at the time, was not considered. The situation in Jamaica does not require an immediate solution to the harvesting problem, and the receipt of clean cane at the factories is very important.

Another recommendation was that machines introduced should have the back-up services of a representative in Jamaica. For this reason the M-F 201 combine harvester and the Cameco whole-stalk harvester were the first selected for evaluation under Jamaican conditions.

Harvesters tested in Jamaica

M-F 201 *Combine Harvester.*—This machine (Fig. 1) was introduced on the export market in 1970, after one season of commercial operation in Australia. It was designed for the Australian as well as for the export market. The machine is a combine harvester, also called a chopper harvester. Standing cane is topped before a twin basecutter cuts it near to, at, or just below soil level. The cut cane is drawn into the machine by a big roller and conveyed to the chopper by a series of rollers. At this stage loose soil drops out. The chopper consists of two sets of contra-rotating ("killing") blades which chop the cane in pieces of approximately 11 in and throw them into the 1st elevator. An air blast blows out trash when the cane drops from the 1st into the 2nd elevator. An extractor on top of the 2nd elevator sucks out trash when the cane drops into the cart. The hydrostatically driven machine is powered by a 140-hp Perkins V-8 diesel engine.

An elevator slew of 180° makes it possible to deliver cane at both sides and at the rear, in the last of which cases the cart is pulled by the harvester (Fig. 2). This means the machine can start cutting from the side as well as from the middle of a field. The best method is to work up and down on one side, but this requires transport which can be loaded from both sides (height less than $9\frac{1}{2}$ ft). One side of the 10-ton carts was too high, a real disadvantage, especially when cane is more or less uniformly lodged across the rows.

The machine operated on two estates during the 1970 crop. The fields, which had a large number of stones and foreign material on one estate, were not specially prepared for mechanical harvesting, but field conditions were better than average. The cane, yielding 40–55 tons/acre, varied from fairly erect to very recumbent. Towards the end of the crop burning was very poor.

The average time available for harvesting was about 7 hours/day, the average daily output about 100 tons of cane. Time studies show a potential of 30 – 55 tons/hour (net time); in one instance a rate of 62 tons/hour was recorded during the filling of a cart with a 12-ton capacity. A harvesting rate of 20 – 30 tons/hour (field time) seems to be achievable under good conditions.

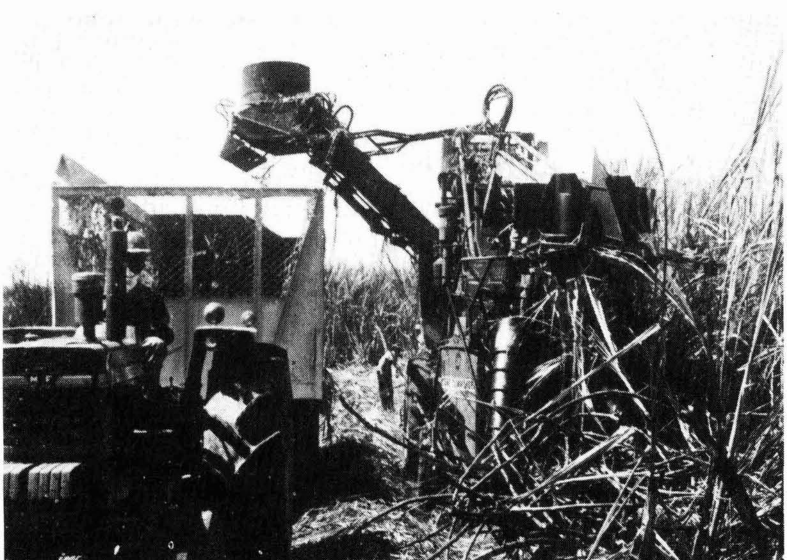

Fig. 1. Massey-Ferguson M-F 201

Results show that the amount of extraneous matter in mechanically harvested cane is considerably higher than in cane harvested by the present methods. In particular, the amount of immature tops is very high, as the machine is unable to top recumbent cane. As a result the purity of the first expressed juice is about 2% lower than with manually cut cane. Even more serious is the amount of soil in

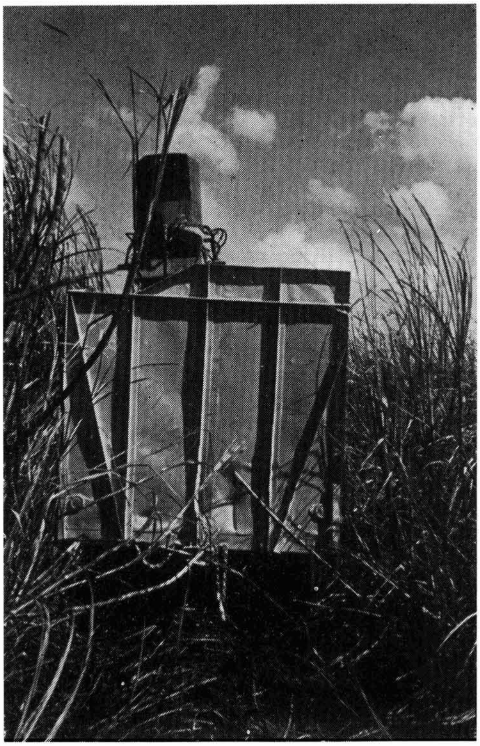

Fig. 2. M-F 201 "opening" a field

mechanically harvested cane. This is a result of uprooted stools, irregular bank heights, quarter drains and twigs and operator-machine faults. Dry, loose soil drops out before it reaches the chopper, but soil attached to stools that are fed in is not removed.

Machine losses, before scrapping, varied from 3 to 12%. An average in recumbent cane was about 7%. In erect cane the losses are very small. For minimum losses a uniform bank height is very important; cutting too high in recumbent cane results in whole stalks of cane being left behind.

Deterioration experiments were carried out and have shown that chopped cane deteriorates much faster than whole-stalk cane. Quick processing of chopped cane is important, and the maximum delay between cutting and processing seems to be only 12 hours, under unfavourable conditions.

During the evaluation, a chain-net (spreader bar) system with a 4-in square steel wire netting was used. This was not very satisfactory; there were losses through the netting (approximately 1%), the carts had to be cleaned after unloading, and there was a considerable amount of spillage at both ends of carts during unloading. The cane density in the carts was approximately 23 lb/ft^3, or about 25% higher than in carts with whole-stalk mechanically loaded cane. The average length of M-F 201-harvested cane is 10·5 in; 50% of the cane is between 9 in and 13 in long.

Some cost figures became available during the operations: others were estimates. The price of the machine has been increased to J$38,000, which will make the cost/ton of cane J$0·08 higher. It is felt that even under ideal conditions a cost figure under J$1.00 (US $1.20) per ton is not likely to be achieved.

The M-F 201 has shown promise under the conditions that prevail in Jamaica. It will handle quite satisfactorily the vast majority of the cane grown in Jamaica. Real limitations are the conditions of the fields. Other factors will affect the speed of the operation and the quality of the work performed, both cost factors. Difficulties are expected in recruiting personnel who appreciate the machine and are prepared to work under such trying conditions as long hours and dust.

The necessary change-over to a handling system for chopped cane will require extremely high investment. Deterioration problems with chopped cane will make a well organized system of delivery, assuring minimal delay between harvesting and grinding, a necessity.

No basic modifications were made in the machine. Some points of concern are:

(1) The machine requires far more attention and appreciation than the machines presently used in the Jamaican sugar industry. As mentioned, problems are expected in acquiring the right type of personnel.

(2) The topper cannot cope with heavy trashy tops as were encountered in some fields. A more sturdy and simpler topper is required.

(3) Chokes occurred too frequently and clearing was time-consuming. A more even feeding will prevent chokes; a more powerful rewinder will remove chokes quickly.

(4) The precision and frequent (weekly or fortnightly) blade changes required are undesirable characteristics of a chopping system that works well. Some cane, less than ½%, is lost at the choppers. Heavier losses occur when the engine speed is not maximum.

(5) The hydrostatic drive, although an ideal system for a cane harvester, was found to cause difficulty in setting the desired speed. The neutral position is not fixed.

(6) The machine has a 14-in clearance. This was not sufficient when high banks were encountered.

Cameco "Cost Cutter".—The machine is a Louisiana-type, also called soldier-type or whole-stalk harvester (Fig. 3). It is designed for a relatively light, erect crop which prevails under the conditions in Louisiana. Before topping the stalk, bent canes are picked up and stretched. After topping, cane is cut at the base while it is being held by conveying chains. These chains convey the cut cane in a vertical position to a pile where it is dropped. By means of a gate system, 6 rows can be put together. The pile can be

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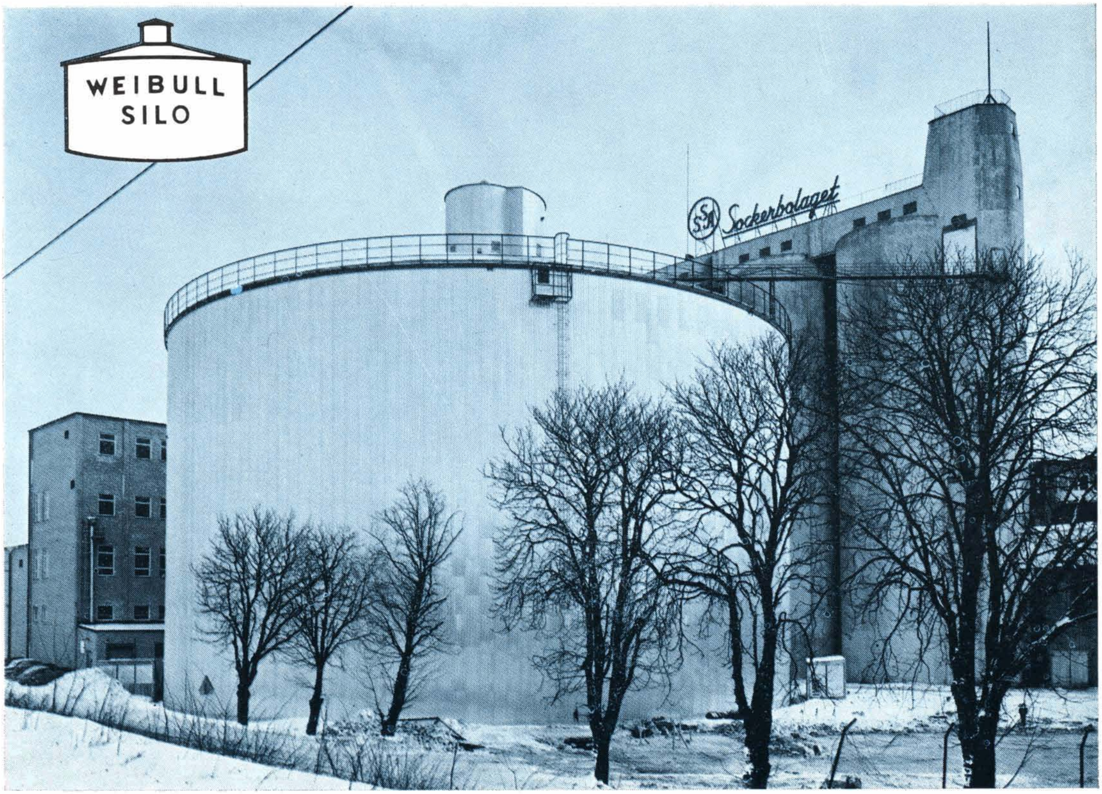

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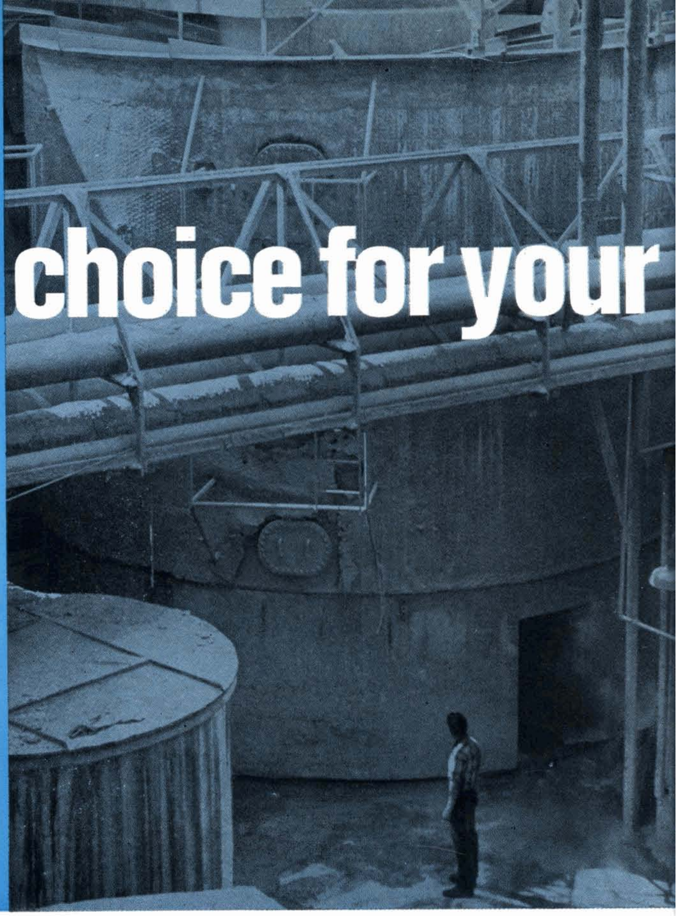

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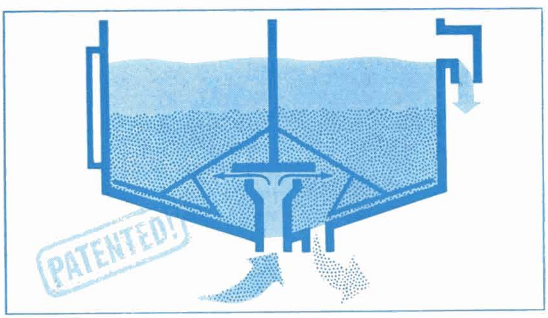

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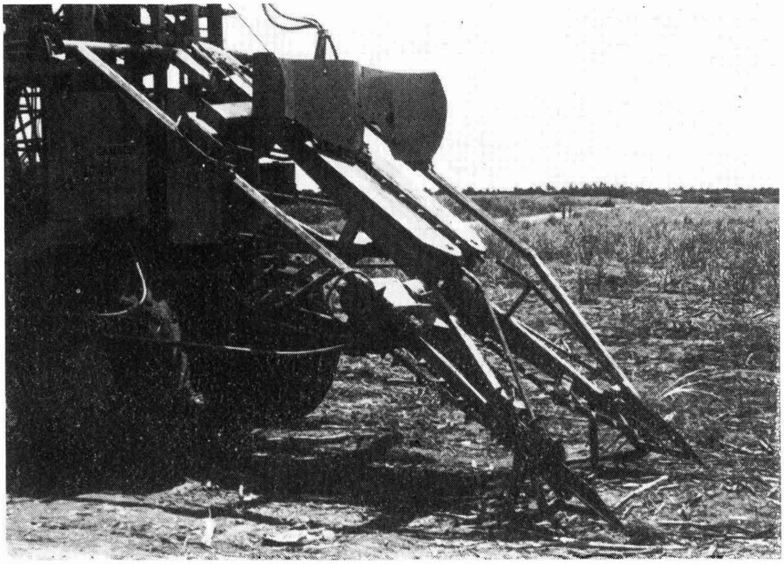

Fig. 3. Cameco "Cost Cutter"

was often too high. Poor burning, due to wet weather, caused a high percentage of trash. Extraneous matter classified as debris contains a high percentage of ash. This is a result of burning piled cane; in standing cane the ash falls on the ground. The amount of soil in the sample would have been higher if the cane cutting height had been correct. The operator tended to cut too high.

Measurements revealed a 1–12% combined loss for the harvester and a push-pile loader. Losses of top parts, caused by low topping, are not included. Very heavy losses, higher than 12%, will occur in recumbent cane.

loaded by a push-pile loader. The harvester is powered by a Caterpillar D 330 diesel engine.

The machine starts cutting a group of 6 rows by cutting the 4th row and putting the cane in a pile across the 3rd and 4th rows. On its way back, while travelling over the pile, the harvester will cut the 3rd row and put it on the pile. The next row to be cut will be the 5th row and so on. After 6 rows are cut, the harvester will start with another group of 6 in exactly the same way. Cane is cut green and burnt afterwards.

The harvester was tested at Worthy Park and Trelawny Estates. At Worthy Park a selection of fields was made by observing the field conditions (slope, drains, etc.) and the condition of the cane (recumbency, yield). As far as possible fields with a good layout and low yielding, erect cane were selected. The main purpose of the trials at Trelawny Estate was to see if the machine could work in fields with a 4½-ft row spacing. Fields with banks and erect cane were selected. The performance figures of only 1 month's operation do not give a picture of a commercial operation. Sometimes only a few rows were cut in fields where the operation was not satisfactory. Wet weather caused problems during the operations at Worthy Park. Standing cane dries much quicker than cane in a pile. For this reason the harvesting operation was stopped several times. The machine itself can cope with wet weather conditions. A time study revealed that a harvesting rate (field time) of 15–30 tons/hour (field time) is probably achievable.

High percentages of extraneous matter were obtained at Worthy Park. The amount of tops in the sample could have been reduced considerably without causing serious losses of sound cane, as the topping

The present price of the machine is J$24,000, which will increase the estimated costs by J$0·07/ton of cane.

Satisfactory performance of the Cameco "Cost Cutter" can be expected under the following conditions: erect cane; cane yielding 35 tons/acre or less; flat or gently rolling lands without deep quarter drains; 5–5½-ft row spacing.

Although the average cane yield in Jamaica is about 30 tons/acre, this machine will only be able to cut a small proportion of the cane grown in Jamaica. Low yields are mainly obtained on steep lands. The yields on most of the flat lands are usually higher and have a potential higher than 35 tons/acre.

Conditions necessary for successful mechanical harvesting

The evaluation of the two harvesters has clearly demonstrated that preparation for mechanical harvesting is one of the key factors for successful mechanical harvesting operations.

Precision land grading in surface irrigated areas and land forming in areas with high rainfall will eliminate or reduce the number of twigs and quarter drains. Land grading and land forming are often profitable even without taking mechanical harvesting into account.

Uniform row spacing, preferably 5½ ft, and uniform bank height can be achieved by proper planting and cultivation practices. Prevention of uprooting of cane stools should be considered as an important factor in cultivation practices.

Varieties with a strong root system will prevent uprooting and reduce the amount of soil sent to the factories.

Erectness and uniformity of cane are considered important for every harvesting system. Uniform, erect cane can be topped satisfactorily by mechanical means.

Good burning characteristics and the absence of suckers at harvesting time are important.

Because of the high density and the favourable cleaning characteristics, chopped cane is the form which is expected to be handled in the future. The deterioration problems with chopped cane can be solved by good organization of the delivery system.

As very high investments are required for a change-over to a chopped-cane handling system, a gradual and early introduction is recommended.

An awareness of the quality of people required for mechanical harvesting operations will enable management to make preparations.

Summary

In Jamaica cane is presently cut by hand and mechanically loaded by push-pile loaders. Although there is little shortage of manual cane cutters, early evaluation of mechanical harvesters is considered important. Two machines were evaluated. A whole-stalk harvester, the Cameco "Cost Cutter", was found suitable for only a very small proportion of the cane grown in Jamaica. A combine harvester, the M-F 201, quite satisfactorily handled the vast majority of the cane grown on the comparatively flat lands in Jamaica. Present field conditions are severe limitations. Preparation for mechanical harvesting should include improvement of the field conditions and the introduction of more suitable cane varieties. A gradual change-over to a handling system for chopped cane is recommended.

The electrical heating of massecuite

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

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

PART I

Introduction

DURING the past four years a series of trials have been carried out within the British Sugar Corporation in order to test the feasibility of using electrical resistance heating for 3rd product massecuites.

The direct passage of electric current through massecuite has been successfully used in cane sugar plants and there are several papers describing the results[1-4].

The method relies upon the electrical resistance of the mother liquor to generate the heat in the massecuite. Provided sufficient power can be developed in the massecuite safely, the technique offers a very simple and fast method of heating.

Early work in BSC was devoted to assessing the feasibility of this process with beet massecuite. Latterly, it has been centred upon evaluating the results of controlled plant tests.

This paper describes the work done and discusses the results obtained to date. It also includes the results of work carried out at the BSC Research Laboratory where the specific heat and electrical conductivity of massecuite and mother liquors have been measured.

Preliminary work

In late 1968 some very small-scale tests were carried out in the Corporation.

The tests proved two things that had been expected: first, that beet massecuite would conduct sufficient electrical current at relatively low voltages for electrical heating to be possible and, second, that if direct current was used very pronounced electrolytic action took place, while with alternating current no such action was observed.

For the plant trial at Brigg a small resistance heater was made using materials that were readily available with little attempt at sizing the unit on a scientific basis. The most readily available material was pipe of standard sizes so that a unit of the annular gap type with continuous electrodes was evolved (Fig. 1). The power supply unit was a multi-step transformer.

The heater was too small for continuous use on the station but during the campaign many tests were carried out to determine the performance and design criteria for future heaters. The results of the tests at Brigg[5] showed that resistance heating of beet massecuites on a large scale with properly designed equipment was possible. The results however did not prove conclusively that the use of the electric heater caused no re-solution of sugar. The only conclusion that could be drawn was that any change in molasses

[1] DOSS and VISHNU: *Proc. 9th Congr. I.S.S.C.T.*, 1956, 323–329.
[2] WRIGHT: *I.S.J.*, 1965, **67**, 368–371.
[3] PIAT: *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1967, 128–135.
[4] WRIGHT: *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 89–93.
[5] ROBERTS: *British Sugar Corporation Ltd. Internal Report*, 1970.

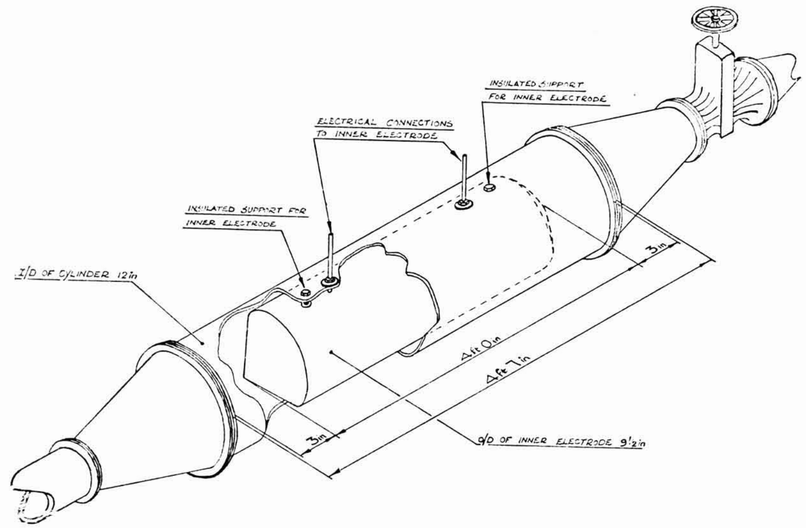

Fig. 1. The final form of heater as used at Brigg and Cantley

purity measured before and after the heater was smaller than the error in measurement of purity. The results were sufficiently encouraging for a full-scale system consisting of three heaters, an electrical supply system and temperature control to be designed for use in the 1970/71 campaign.

Full-scale tests at Brigg

The results of the 1969/70 tests were used as the basis for an empirical design of heater capable of taking the full throughput of the continuous centrifugals installed at Brigg. The same heater configuration as the preliminary scheme was used and again the cylindrical sections consisted of lengths of standard pipe. The tapered outer ends were specially coated with insulating material in an attempt to cut down current leakage to earth via the process plant rather than through the electrical return conductor. Provision was made at the outlet end of the heater for fitting of a thermometer pocket.

Careful attention was given to the two requirements, (a) safe operation, and (b) rapid temperature control. A transformer and thyristor voltage regulator with temperature control of the voltage was installed (Fig. 2). The use of thyristors on the primary side of the transformers gives the most economical arrangement and proved reliable.

The heaters had a 12-in outer shell internal diameter with an 11-in inner core external diameter giving an annular gap of ½ in. However, "lumps" in the massecuite caused the annulus to become blocked on several occasions. This was overcome by reducing the inner core to 9½ in diameter, thus increasing the gap to 1¼ in. No further problems were encountered with blockages.

The process conditions prevailing at the factory were such that the heaters were not used at their full output. The heaters were however sufficiently successful for an installation at another factory to be considered. It was decided to install heaters at Cantley for the 1971/72 campaign.

Cantley production unit

During the 1971 off-season a complete new centrifugal station was installed at Cantley. The three heaters from Brigg and two additional heaters manufactured at Cantley were installed.

The Cantley system was to be a production unit; it was therefore important that the heaters should be capable of passing the full throughput of the station and of giving the required temperature rise. Wright[2] and Piat[3] give several relationships in their papers that apply to a parallel annulus type of heater. These relationships were used as the basis of the calculations. Obtaining the correct values of the parameters to be used in the calculations was a problem, however. There did not appear to be any reliable figures available for such parameters as viscosity, specific heat, electrical conductivity or resistivity and no

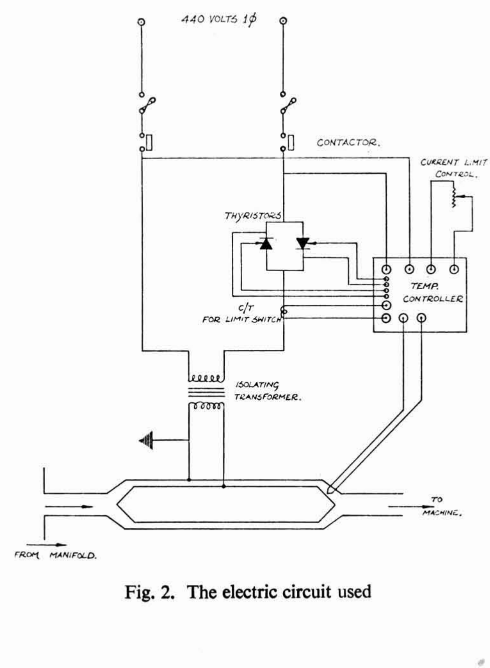

Fig. 2. The electric circuit used

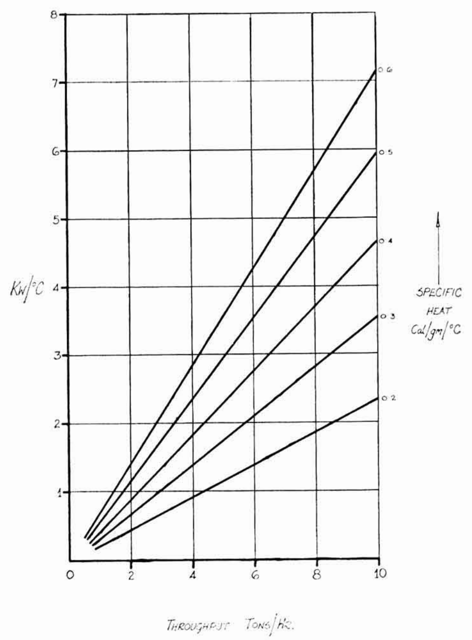

Fig. 3. Power per °C rise *vs.* throughput at various specific heats

information on the changes in their values with temperature.

Thermal considerations.—The thyristor stack used at Brigg had a rating that would allow an output power up to 50 kW. It was therefore decided that the stacks would be transferred to Cantley, thus fixing the maximum power available. WRIGHT[3] gives a value of 0·45 cal/g/°C and PIAT[3] gives a figure of 0·37 cal/g/°C for specific heat. The experiments at Brigg indicate that the specific heat would be about 0·6 cal/g/°C.

The relationship between temperature rise, power and throughput has been plotted as a graph for various values of specific heat (Fig. 3). This graph enables the heater performance for a given flow-temperature rise situation to be assessed quickly. In the case of Cantley the desired throughput was 6 tons per hour; the heater rating is 50 kW so that the maximum temperature rise that could be expected at a specific heat of 0·6 is 11·7°C.

The physical size of the heater.—The geometry of the heater has to be determined by reference to two conflicting requirements. First, the gap should be kept as small as possible in order that the lowest possible voltage can be used with a heater of moderate overall dimensions. Second the gap should be sufficiently large to permit a full flow of massecuite without a high head loss in the heater. The object of the calculations was to determine if the heaters used at Brigg would be suitable at Cantley.

Electrical considerations.—PIAT[3] derives two formulae for calculating the electrical performance of a massecuite heater, one for the heat transferred per unit length of electrode and one for the mean value of conductivity to be used. The difficulty with using the equations was that there were no figures available for massecuite conductivity. It was therefore decided to use the figures given by PIAT and take his recommendation of a mean conductivity of 75 micromhos/cm. By re-arranging the form of PIAT's equation and plotting a graph of power against applied voltage for various values of the ratio D_0/D_1 where D_0 is the external diameter and D_1 is the internal diameter of the heater, a family of curves has been obtained (Fig. 4). This graph can be used to determine the electrical rating of any given heater.

The heaters proposed for Cantley were 50 in long, of 12 in external diameter and 9·5 in internal diameter. Using these figures on the graph gives a heat output of 50 kW at an applied voltage of 440 V.

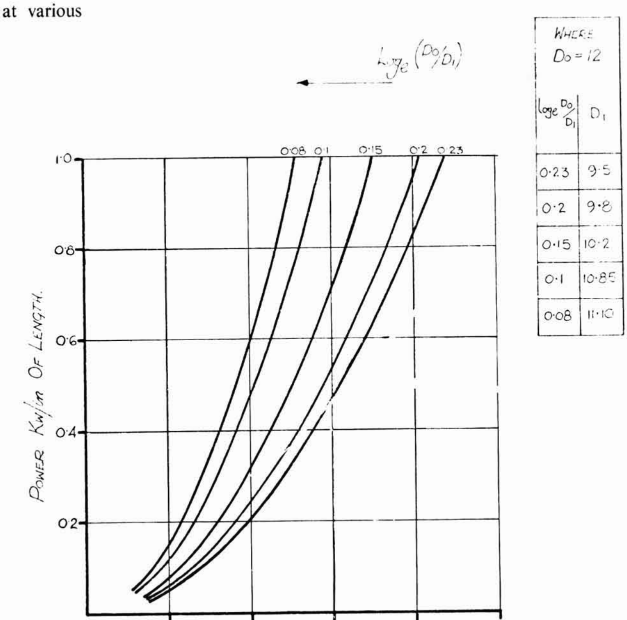

Fig. 4. Power-voltage relationships for various heater dimensions

Flow considerations.—Solution of the equation for steamline flow through an annulus requires a knowledge of the viscosity of massecuite, for which no figure was readily available. However, some of the most important parameters of the massecuite at Cantley were known. SILIN[6] gives tables for determining the viscosity of molasses and gives a method for determining the viscosity of a massecuite from its mother liquor viscosity and the percentage by weight of the crystals in the mother liquor.

Using Table IV of SILIN's work and interpolating to suit the Cantley massecuite, the following parameters were obtained:—

viscosity at 45°C	1,628 poises
at 55°C	600 poises

Using the equation for streamline flow and substituting the dimensions of the heater into the equation, the graph (Fig. 5) is obtained showing the variation of flow with head at constant temperature. However, the temperature of the massecuite varies from minimum to maximum through the heater so that the actual head loss will lie in the band between the two lines.

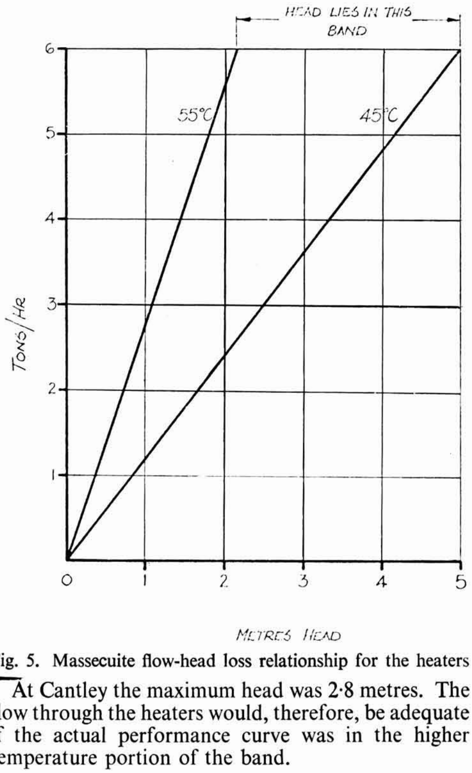

Fig. 5. Massecuite flow-head loss relationship for the heaters

At Cantley the maximum head was 2·8 metres. The flow through the heaters would, therefore, be adequate if the actual performance curve was in the higher temperature portion of the band.

Tests at Cantley

The heaters installed at Cantley were subjected to a series of tests to prove the design figures. During commissioning of the heaters it was found that with the heater on the 220 volt transformer connexion only about 140 amps equivalent to about 30 kW could be delivered, with a massecuite inlet temperature of about 62°C. There would be no point in reconnecting the transformer for 440 volts because the current limit override control on the thyristor unit would limit the output to 115 amps before an output voltage of 220 volts was reached. This indicates a mean conductivity in the range 62°C to 70°C of 180 micromhos. Later in the series of tests a lower massecuite inlet temperature was obtained; under these conditions, with an inlet temperature of about 48°C, the current fell to 100 amps and power to about 23 kW. The mean conductivity was then found to be 130 micromhos in the range 48°C to 55°C. From the point of view of electrical output the heaters did not reach their design figure because the conductivity of the massecuite was very much higher than expected.

No attempt was made to measure the throughput of the heaters when the inlet temperature was 62°C; however, on the occasion when inlet temperatures were low the throughput was measured with the heater switched off and the inlet temperature was 52°C. The throughput was 7·05 tons/hr with the flow limited by the combined control valve/discharge nozzle. With the head of 2·8 metres the flow would not be expected to exceed 7·6 tons/hr at 55°C (Fig. 5). The massecuite viscosity must therefore have been very near to that obtained by SILIN's method.

Considering that the heater output was approximately half of the design figure the temperature rises obtained were more than those expected.

From the graph (Fig. 3) using the results of test B, in Table II, it is found that the specific heat is about 0·43, a figure very much nearer to WRIGHT's value[2] than that previously obtained by calculation from the Brigg results.

Tests to determine the effectiveness of the heater as a process tool

During the 1971/72 campaign a variety of tests were carried out on the installation at Cantley to determine if the use of the heaters caused any increase in molasses purity or other effect on product quality.

The first tests carried out were to determine the speed with which the heater acted. These tests showed that the heating took place very quickly, at least 90% of the final temperature rise being obtained in the first minute after switch-on. Table I is typical of the results obtained in all the tests on the Cantley installation. Unfortunately it was not possible with the test equipment available to measure the temperature at smaller intervals than every minute. However, the time taken to heat the massecuite in the electric heater is so much shorter than the time taken in a water-heated extended-surface tubed type of heater that from the process point of view there was little point in trying to measure over shorter periods of time.

[6] SILIN: "Technology of beet-sugar production and refining" (Israel Program for Scientific Translations, Jerusalem). 1964. pp. 359–360, 461–462.

Table I. Speed of response of heater at Cantley

Time, min.	*Temp. rise, °C*	*Heater power, kW*	*Comments*
0	0	11·7	
1	6·0	10·5	Heater switched on
2	6·0	10·5	
3	6·0	10·5	
4	6·5	10·5	
5	6·5	10·5	
9	6·5	—	Heater switched off
10	6·5	—	
11	3·0	—	
12	1·0	—	
13	0·5	—	

Time—temperature rise test results obtained from heater on No. 2 centrifugal at Cantley. Massecuite inlet temperature 58°C. Throughput not measured.

Tests were conducted to determine if the heaters caused sugar to be dissolved. The first tests consisted of raising the temperature in approximately 2°C steps, allowing the system to settle down over a fifteen-minute period and then taking samples of raw sugar and molasses over a further fifteen-minute period. The settling and sampling periods were repeated for each step of temperature rise. In this way it was expected that any changes in the molasses and raw sugar polarization and purities would show as a trend in the results.

The number of samples taken at each temperature step was small and the variation between samples was large. The mean for each batch of samples was calculated and the results showed an upward trend for both molasses purity and raw sugar polarization with increasing temperature.

In spite of this trend, however, the results were not considered to be conclusive because

(a) The number of samples taken was small and the variation between samples in the batch was high.

(b) The flow of massecuite to the centrifugal was not kept constant for each step of temperature rise.

(c) The wash water flow was not adjusted to suit the changing flow rates.

(d) The tests were spread over several hours and it was possible that some of the differences in the molasses purity were caused by changes in the feed massecuite.

In order to get a conclusive result an experiment was designed that kept the operating conditions as constant as possible and by using two machines would enable changes in the massecuite over the period of the test to be eliminated.

At first it was hoped that no wash water would be required so that the possibility of dissolving sugar with the wash would be eliminated. It was found, however, that, at the test throughput of about six tons per hour, it was not possible to operate without water.

The flow of massecuite through the machines was set at the beginning of the test period by collecting over a set period of time and measuring the volume. At the end of the test period the massecuite was collected over a set time and weighed. In this way the throughput of each machine and for each test period was kept reasonably constant.

The changes in the molasses and raw sugar appeared to be so small when the temperature was raised in steps that it was decided that only tests with no heat and full heat would be conducted. This would serve two purposes. First, if there was going to be any effect from using the heater it would be more readily apparent at the higher temperature. Second, by reducing the number of test periods more samples could be taken in each test without overwhelming the resources of the laboratory.

The decision to use two machines in each test and take samples from both at the same time introduced a complication in that it was possible that the two machines would have different separation characteristics. To eliminate this possibility the test periods were repeated with machine No. 2 heated and machine No. 4 unheated and then No. 4 heated and No. 2 unheated.

Samples were taken, at 3-minute intervals, of the massecuite, molasses and raw sugar from both machines. In addition the massecuite and molasses temperatures, the centrifugal drive motor load, the water flow and the heater power were recorded at the same 3-minute intervals. The results from the tests are summarized in Table II.

Table II. Summary of results obtained from tests at Cantley

	Test A		*Test B*		*Test C*	
	Machine No. 2	*Machine No. 4*	*Machine No. 2*	*Machine No. 4*	*Machine No. 2*	*Machine No. 4*
Heater power, kW	—	—	22·26	—	—	25·3
Massecuite temperature, °C	52·0	52·0	55·4	47·3	51·3	57·9
Machine drive power, kW	21·0	22·0	22·4	20·3	19·8	21·8
Wash water, litres/hr	129	116	124	126	137	128
Throughput, tons/hr	7·05	6·95	5·50	5·57	not weighed	
Raw Sugar						
Mean Polarization	94·00	92·00	92·9	92·5	94·8	93·8
Standard Deviation	0·87	0·67	1·04	0·54	0·83	1·0
Mean Purity	95·83	94·40	94·85	94·98	96·46	95·61
Standard Deviation	0·72	0·56	0·85	0·51	0·55	0·85
Molasses						
Mean Purity	63·68	63·89	63·62	63·65	63·58	63·41
Standard Deviation	0·25	0·52	0·08	0·13	0·39	0·30
Mean Colour	5839	5946	6045	6072	6306	6115
Standard Deviation	106	149	108	108	150	158

(*To be continued*)

Sugar cane agriculture

Effects of varying numbers of cultivations on sugar cane production in Louisiana. R. RICAUD. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp. Because of labour shortage there is a tendency to reduce the number of cane cultivations. The experiments here reported were conducted to determine the effects of number of cultivations on the production of sugar cane in several areas of the Mississippi River alluvial flood plain in Louisiana. The effects of 0, 1, 2, 3 and 6 cultivations on sugar cane yield, row height and weed control were tested with plant cane and ratoon cane crops. Plant cane generally produced normal yields with little or no cultivation and the broadcast application of long-term residual herbicides. Ratoon cane produced normal yields with a low number of cultivations and herbicides in areas with a low infestation of Johnson grass. Ratoon cane required at least 3 cultivations in addition to herbicides to produce normal yields in areas with a high infestation of Johnson grass.

* * *

The effect of silicon on enzyme activity *in vitro* and sucrose production in sugar cane leaves. Y. W. Y. CHEONG, A. HEITZ and J. DEVILLE. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 9 pp.—The efficiency of sugar production in leaf tissue collected from canes of two varieties growing in nutrient solution, containing different levels of silicon, was studied as well as the effect of Si *in vitro* on the activity of cane and yeast invertase and cane tyrosinase. Si deficiency decreased the rate of photosynthesis in symptom-free leaf tissue of cane whose older leaves were showing Si deficiency symptoms. The effect was also obtained in completely symptomless Si-deficient cane growing under a "Perspex" roof. It would appear therefore that the lower efficiency of photosynthesis of Si-deficient leaves was not connected with the appearance of symptoms, i.e. degradative changes in leaf tissue. It was probably related to some other unknown function of Si in plant metabolism.

* * *

Influence of interrow spacing and planting rate on stalk population and cane yield in Louisiana. R. J. MATHERNE. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—Two experiments were carried out to determine if higher yields of sugar cane could be obtained by increasing plant populations as a result of varying interrow spacing and planting rates. The yields obtained from 36- and 42-inch rows were significantly greater than those recorded from 72-inch rows. In the case of L 60-25 small but significant yield increases were obtained from planting rates higher than the recommended rate—2 running stalks plus 10% overlap. However, the CP 61-37 results were variable and only suggestive. Correlation of stalk population with yields was significant, indicating the importance of obtaining high populations. Stalks were smaller in diameter and shorter on the narrow rows.

* * *

Sugar cane planting date trials in Mozambique. F. M. RAMOS and J. S. MELO. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 7 pp.—Two varieties of cane (N:Co 310 and N:Co 376) on two alluvial soils were used, and planted monthly. N:Co 310 germinated better from February to September and N:Co 376 from October to January. Flowering is discussed. Neither the variety nor the date × variety interaction differences are significant although the planting date variations are highly so, the October yields being the highest. There is progressive yield decline with later planting, from October to September, averaging 2·8 tons/ha/month. However, the data apply to only one season and complete statistical analysis was not possible.

* * *

Root studies of outstanding sugar cane varieties of Bihar, India. O. P. NEGI, S. P. NAITHANI and S. PODDAR. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—Root systems of 7 sugar cane varieties under commercial cultivation in Bihar were studied at 12 weeks, 24 weeks and 36 weeks of growth. There was a wide degree of variation in the rate of growth, extent and branching of the roots in different varieties. The fibrous root ratio of all the varieties at different stages of growth showed variation indicative of their comparative efficiency. The variety resistant to water-logging conditions, BO3, was conspicuously different from the others in the development and activity of its root system.

* * *

Foliar symptoms of silicon deficiency in the sugar cane plant. Y. W. Y. CHEONG, A. HEITZ and J. DEVILLE. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—The object of this work (in Mauritius) was to try to reproduce foliar symptoms of Si (silicon) deficiency (leaf freckling) on sugar cane growing in nutrient solution. Some of the factors influencing the appearance of freckling, as well as the nature of Si deposits in leaf tissue, were also studied. Leaf freckling developed after 75 days on Si-deficient cane receiving direct sunlight; no symptoms ever appeared on Si-deficient cane kept under a "Perspex" or glass roof, as in a greenhouse, indicating that UV radiation might be necessary for the appearance of the symptoms. Deficiency symptoms always developed on the physically upper surface and could, at an early stage, be made to disappear by treating the cane with soluble Si. Si was deposited mainly as insoluble Si in dumb-bell-shaped cells, trichomes, hairs and stomata.

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Accidental introduction of *Diatraea centrella* into Abaco, Bahamas, and attempts at its control. M. N. Beg and F. D. Bennett. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—The yellow-headed sugar cane borer, *Diatraea centrella*, was apparently accidentally introduced into Abaco Island, the Bahamas, in planting material from Guyana in late 1965. It increased steadily, a severe attack occurring for the first time in the summer of 1967. Immediate measures to eradicate the pest by burning the severely infested cane and treating all fields with heavy applications of "Endrin" and "Azodrin" failed. Control attempts included the release of several parasites and aerial applications of various insecticides. No permanent success was obtained with biological control, but the infestation was reduced from an average of 8% in the 1969/70 crop to 1% in the 1970/71 crop through the judicious and timely use of insecticides. By the end of 1968 this new pest had virtually displaced the other borer *Diatraea lineolata*, which also attacks maize.

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Effects of dates of planting on infestations of *Chilo agamemnon* in sugar cane in U.A.R. M. T. Kira and H. el-Sherif. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—One of the most important measures generally recommended for borer control is to adjust the planting dates so that one or more dates will coincide with the periods when the populations of the borers are at their minimum levels. This investigation was conducted to study the point and to determine the most suitable date(s) of cane planting in the Abu Qurqas area of Egypt to avoid, as much as possible, heavy infestation by the purple lined borer, *Chilo agamemnon.* Canes planted in February and March received more egg masses, harboured more larvae, and exhibited higher levels of infestation than those from May planting. These observations proved to be true during both years of investigation. Therefore, from the entomological point of view, cane growers should not plant cane early in the season if they want to avoid high levels of this pest.

* * *

Estimation of losses in cane and sugar yields caused by infestations of *Chilo agamemnon.* M. T. Kira and H. el-Sherif. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 2 pp.—Owing to serious losses in both cane and sugar yields in Egypt during the past decade from infestations of the lined borer, *Chilo agamemnon*, a need arose to estimate the effect of borer infestation. Results indicated that each 1% of infestation caused 0·55% loss in cane yield of the variety Co 413 and 0·52% loss in variety N:Co 310. With regard to yield of sugar, each 1% infestation was estimated to cause 0·65% and 0·67% loss for Co 413 and N:Co 310' respectively.

* * *

***Eldana saccharina*, a pest of sugar cane in East Africa.** D. J. Girling. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—This cereal stem borer was first described from West Africa over a century ago. It has spread into East Africa during the last 20 years and is becoming a serious pest of sugar cane and other crops. It is able to attack mature sugar cane and is difficult to control because insecticides cannot reach it once it is in the cane, and it has several wild host plants which act as a reservoir of reinfestation. The use of resistant varieties of cane, chemical treatment of setts before planting and clean cultural methods before and after harvesting help to keep infestations down. There is a need for research on East and West African parasites as possible biological control agents.

* * *

Differential survival of *Diatraea saccharalis* larvae on two varieties of sugar cane. G. E. Coburn and S. D. Hensley. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—Differences in response of sugar cane varieties to attack by the sugar cane borer, *Diatraea saccharalis*, have been observed and reported for many years in Louisiana. Only recently have attempts been made to elucidate mechanisms responsible for varietal resistance or susceptibility and to emphasize utilization of resistant varieties in an integrated control programme. In studies on host plant resistance to *Diatraea saccharalis* emphasis was placed on the establishment and survival of larvae on a resistant variety (N:Co 310) and a susceptible variety (CP 44-101). The tests were conducted in the greenhouse and in the field in 1968 and 1969. It was concluded that tightness of leaf sheaths was partially responsible for resistance of N:Co 310.

* * *

Rôle of predaceous arthropods of the sugar cane borer, *Diatraea saccharalis*, in Louisiana. A. A. Negm and S. D. Hensley. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 9 pp.—Resurgence of arthropod pest populations following use of the chlorinated hydrocarbon insecticides is a well-known phenomenon. Increases in crop damage by the sugar cane borer during the programme for eradication of the imported fire ant, *Solenopsis saevissima ritcheri* from the southern US have been reported. It was concluded that increases in sugar cane borer infestation and damage following soil applications of "Heptachlor" were largely due to its suppressive effect on predator populations. Several groups of insects have been repeatedly recorded as possible predators of the sugar cane borer, e.g. ants, earwigs, ground beetles, spiders, wireworms, lady beetles (ladybirds), mites, soldier beetles and chrysopids. The studies reported were concerned with population dynamics of the arthropod predators, relative importance in borer control, feeding behaviour and habits of predators.

A consolidated list of wild and cultivated plant species attacked by sugar cane borers in North India. K. R. NAIR, S. PRAKASH and S. NAGARKATTI. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp. A list of wild and cultivated plants that serve as alternative hosts for one or more of nine species of lepidopterous stalk borers indigenous to North India has been prepared from scattered information contained in published reports and from data obtained in a recent survey. *Bissetia steniellus* appears to be very restricted in host range for it has only been recorded from rice and sugar cane. *Sesamia inferens* appears to possess the largest host range since it was recorded from 37 species of wild or cultivated hosts.

* * *

Control of the sugar cane borer, *Diatraea saccharalis*, in Louisiana. S. D. HENSLEY. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 8 pp.—The maximum number of insecticide applications recommended annually to cane growers in Louisiana for control of *Diatraea saccharalis* has been reduced from 12 to 3 within the past decade. Changes in pest management practices most responsible for reduction in applications are: (1) discontinuance of insecticidal control in the 1st generation and of late season infestations, (2) utilization of a reliable economic population threshold for determining the need for insecticidal treatment, (3) improvement in field survey methods for detecting potentially damaging infestations, (4) use of highly effective synthetic insecticides in control programmes and (5) more emphasis on host plant resistance as a means of reducing insecticide use.

* * *

A comparison of three artificial diets for the sugar cane borer. J. W. SANFORD. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—Three artificial diets, the modified Adkisson diet, the pinto bean diet, and the CSM diet, were compared as rearing media for the sugar cane borer. The pinto bean diet proved to be superior to the modified Adkisson diet, which in turn proved to be superior to the CSM diet. The pinto bean diet is used to rear the corn (maize) earworm and the fall army worm. CSM is a food product developed by the US Dept. of Agriculture for shipment to underdeveloped countries. It consists of processed corn meal (68%), soybean flour (25%), non-fat dry milk (5%), vitamins and minerals (2%).

* * *

Biological control of sugar cane insects in the continental United States—a historical review. L. J. CHARPENTIER, J. R. GIFFORD, T. E. SUMMERS and R. D. JACKSON. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—Attempts at biological control of sugar cane insects in the continental United States have a long history, having started in 1915. Fifty-six biological agents introduced as combatants against various injurious insects of sugar cane are listed. In all, five introduced species have become established. It is felt that *Stromatodexia (Leskiopalpus) diadema* is the only reasonably promising parasite of the sugar cane borer *Diatraea saccharalis* that has not been introduced into the continental US.

* * *

The white scale, *Aulacaspis tegalensis*, on sugar cane. J. R. WILLIAMS. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—White scale occurs in the islands of S.E. Asia, the Mascarenes, Madagascar and in East Africa. In Mauritius, and more recently in East Africa, it has become an important sugar cane pest. It is essentially a stem-inhabiting insect and infested canes have low Brix, sucrose and purity. Rotting and death of canes may also result. The most practicable control methods are cultural, including hygienic measures to minimize dispersal of the insect and its carry-over from one crop to the next, and the use of resistant varieties. Efforts to improve biological control by parasite and predator introductions are also being made. Insecticidal control is not feasible.

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Mating behaviour and the dispersion of the pasture soldier fly, *Inopus rubriceps*. A. W. OSBORN and E. J. HALBERT. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 10 pp.—The pasture soldier fly mates in the morning and early afternoon. The females disperse shortly after pairing. Near Harwood, Australia, the flies extend their range of distribution by dispersing along the Clarence River, periodically resting on the surface. Kikuyu grass, *Pennisetum clandestinum*, is a good host plant for the larvae. The reproductive morphology of both sexes, the mode of mating, number of eggs produced and the oviposition sites used are described.

* * *

Host-parasite interrelationships of West Indian canefly, *Saccharosydne saccharivora*. J. H. FRANK. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp. A predator, *Stenocranophilus quadratus*, of the West Indian canefly causes segregation of the generations of *Saccharosydne saccharivora* at high population levels of the latter. Two-egg parasites, 2-egg predators and possibly a nymphal parasite of *S. saccharivora* are probably prevented from achieving a high rate of parasitism of their host because of the segregation. Under this situation epidemics of *S. saccharivora* are not rapidly controlled by natural enemies.

* * *

***Lixophaga diatraea* reared on non-congeneric lepidopterous hosts.** J. ETIENNE. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 7 pp.—This tachinid larval parasite of American tropical stalk borers of the genus *Diatraea* was successfully reared in the laboratory on the Asian stalk borer, *Chilo sacchariphagus*. Preliminary rearing tests were also conducted on *Sesamia calamistis*, an African pink borer, and *Galleria mellonella*, a wax moth, as hosts. The major portion of the rearing study was devoted to *C. sacchariphagus*, which is an important pest of sugar cane in Réunion. A total of 82,000 larvae of this species was exposed to *L. diatraea* maggots in the laboratory, and 87,000 parasite puparia were produced during 23 generations of continuous rearing. Releases were made in sugar cane fields infested with *C. sacchariphagus*. Altogether 54,000 adults, including 17,000 mated females, were released. Parasite populations were recovered in two release areas, 1–2 months after release. None were recovered in 1970. Possible reasons for this are suggested.

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Insecticidal control of the sugar cane froghopper. D. E. EVANS and D. A. BUXO. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 9 pp.—With the increase in aerial spraying this pest has shown resistance to "Carbaryl", the most commonly used insecticide in Trinidad. Laboratory and field experimentation, which has led to the recommendation of "Arprocarp" and "Monocrotophos" as replacements for "Carbaryl", is described. The effect of the froghopper control programme on the levels of secondary pests such as *Diatraea* spp., *Silpha flava* and *Longiunguis sacchari* is considered. In one instance the effect of the programme was economically beneficial and in the other deleterious.

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Insecticide use against *Numicia viridis*. A. J. M. CARNEGIE. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 11 pp.—This paper concerns insecticide trials conducted in Swaziland during 1966 and 1967 against the green leaf-sucker of sugar cane, *Numicia viridis*. The history of this indigenous South African sugar cane pest is given and reference made to two egg parasites. Aerial spraying experiments were made with "Mercaptothion", "Fenthion" and "Endosulfan". Initial outbreaks were successfully controlled with aerial applications of "Mercaptothion" 5% dust, but there was some indication that insecticide application was followed by an increase in numbers of the insect and of other cane insects as well.

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Notes on a recent outbreak of *Aulacaspis tegalensis* **on sugar cane in Tanzania.** D. W. FEWKES. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 9 pp.—The sugar cane white scale insect (*Aulacaspis tegalensis*) was introduced to East Africa from S.E. Asia at least 50 years ago but has become economically important only recently. In an outbreak of this pest at the Tanganyika Planting Company Ltd. (TPC) during 1969–70 the heaviest infestations caused a loss of about one third the potential yield of sugar. Infestations develop on the cane stems, usually under the protection of a loose leaf sheath. Details of the insect's life cycle are given. Sugar cane varieties with persistent leaf sheaths tend to encourage the development of heavy scale infestations. Natural enemies destroyed large numbers of the pest at TPC but did not appear capable of limiting populations to an economically tolerable level. Chemical control is difficult, especially in well grown cane. A change from susceptible to tolerant or resistant cane varieties may prove the best long-term measure against the pest. Hot water treatment of planting material is recommended.

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Nymphal growth of *Yanga guttulata*, **a harmful cicada of sugar cane in Madagascar.** M. BETBEDER-MATIBET. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 5 pp.—This sugar cane pest is native to Madagascar. Its nymphs live in the soil, inside a round cavity made of earth, and suck the sap of the roots of numerous plants with their buccal stylets. This cicada has become harmful since 1961 when it quickly multiplied in the sugar cane fields of several sugar factories in Madagascar. It causes reduction in the yield of the crop becase of the progressive exhaustion of the plants. Some details are given of its life history. Tests have shown that newly hatched nymphs can survive 37 days without feeding and that a nymph of the 5th stage can survive as long as 252 days. Nymphs which seldom meet roots during their movement are thus able to fast for long periods and to survive with a very slow rhythm of growth.

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Fungi parasitic on the nymph of *Mogannia hebes* **in Taiwan.** L. S. LEU and Z. N. WANG. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 7 pp.—Two species of parasitic fungi, *Isaris sinclairii* and *Metarrhiza anisopliae*, induced mortality in nymphs of *Mogannia hebes* in sugar cane fields in Taiwan. Nymphs killed by *I. sinclairii* hardened more than those killed by *M. anisopliae*. Nymphs killed by both fungi were found in the soil. *I. sinclairii* could be separated into two strains, designated red and white strains, depending on the colour of synnemata produced on the dead nymphs. Synnemata were formed by gathering of hyphae and the production of conidia on the periphery. When field-collected nymphs of *Mogannia hebes* were inoculated by dipping into a conidial suspension prepared from a culture of *I. sinclairii*, mortality of the nymphs ranged from 39 to 100%.

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Pocket gopher pest species in Mexican cane areas. C. M. RIESS and S. FLORES. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 3 pp.—Pocket gophers, which live underground and construct extensive galleries in sugar cane fields, damage more than 60,000 acres of cane per year. Four genera of gopher are distributed in different regions, i.e. *Thomomys*, *Pappogeomys*, *Orthogeomys* and *Heterogeomys*. Primitive control methods include trapping, shooting, extermination with CO and flooding the galleries. Commercial fumigants that have been or are being used include cyanogas, methyl bromide and aluminium phosphide ("Delicia" pellets). The best and most economical control is obtained with cane soaked in sodium fluoroacetate and placed at entrances to pocket gopher galleries.

Rat damage and control in the Florida sugar cane industry. H. H. SAMOL. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—Rats have been a pest in the Florida sugar industry since the late 1920's. The 4 species damaging sugar cane are the cotton rat *Sigmodon hispidus*, rice rat *Oryzomys palustris*, roof rat *Rattus rattus*, and the Florida water rat *Neofiber alleni*. Surveys as recent as 1963 did not record the roof rat from cane fields. Today, however, it is of major importance and is very difficult to control. The Florida water rat is also difficult to control because it seldom leaves its underground burrow system. Laboratory studies have shown that zinc phosphide preparations are very effective against both cotton and rice rats, while anticoagulants are somewhat better against the roof rat.

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Rat damage to sugar cane in Florida. H. H. SAMOL. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 6 pp.—Results of rat damage surveys in 1967–68 and 1969–70 are given. The 1967–68 survey included a total of 12,659 stalks from 16 fields. The average stalk damage was 10·59%. The survey of 1969–70 included 94 fields, with a total of 23,650 stalks sampled. The average stalk damage was 4·87%, with individual fields ranging from 0·4 to 21·6%. Damage was greater near the field edges than towards the middles. The amount of damage was lowest in plant cane and increased progressively in first and second ratoons. The fields harvested early were damaged more than those harvested late. The age of the cane appeared to have no direct relationship to the amount of damage.

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Dynamics of a sparse population of the rat *Melomys littoralis* in sugar cane and natural vegetation. T. D. REDHEAD. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 13 pp.—Since the earliest years of the Queensland sugar industry rats have been recorded as damaging cane. By far the greater proportion, about 90%, of the damage takes place in the mill area situated north of Townsville, and is caused almost entirely by two indigenous murid species, *Rattus conatus* and *Melomys littoralis*, a climbing rat. *R. conatus* is a ground rat and considerably larger. This paper describes an investigation into the behaviour of a population of *M. littoralis*, particularly its fluctuation in numbers, in a cane field and surrounding grassland, in one of the few instances encountered by the writer in which *R. conatus* was virtually absent.

* * *

Zinc phosphide as a rodenticide for rats in Hawaiian sugar cane. H. W. HILTON, W. H. ROBISON and A. H. TESHIMA. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 10 pp.—Zinc phosphide was selected as the preferred toxic substance to be made up into grain bait form and aerially distributed over Hawaiian sugar cane fields. Recent changes in regulations controlling it are likely to increase its use. Research in Hawaii has provided increased knowledge about rat habits, bait acceptance and efficiency, possible residues of zinc phosphide or phosphine in sugar cane, and environmental aspects of the fate of zinc phosphide and phosphine in soils and water. From a consideration of these data, zinc phosphide appears to be the safest acute rodenticide with the least environmental impact.

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A study of destructive rodents that damage cane at Haft Tappeh. H. AZIZI and K. A. SUND. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 4 pp.—Rodents are considered to be among the most destructive pests of sugar cane in Haft Tappeh (Iran) and two of the more important species are the rat *Nesokia indica* and the mouse *Mus musculus*. Details are given of the life histories and habits of the two pests. Both species breed mostly from spring to late autumn. Zinc phosphide poison baits appear to provide better control than coumarin-type baits or traps. Wheat containing a film of vegetable oil is coated with zinc phosphide and placed in burrows in the cold winter months, and cucurbits coated with zinc phosphide are used in the summer months.

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Leaf scald disease: introduction. B. T. EGAN. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 3 pp. The writer expresses the view that, among the sugar cane diseases of the world, this disease is the major potential troublemaker. It was originally confined to certain Indian Ocean to mid-Pacific areas but was later identified in several South American countries, the Caribbean, North America, southern Africa, West Africa and southern Asia. Because of poor symptoms the disease may remain undetected, making quarantine difficult. The presence of strains of the causative organism further complicates the problem, especially in breeding for resistant varieties. Little is known of methods other than mechanical for spread of the disease. Whether or not diseased seed cane can be cured is not known.

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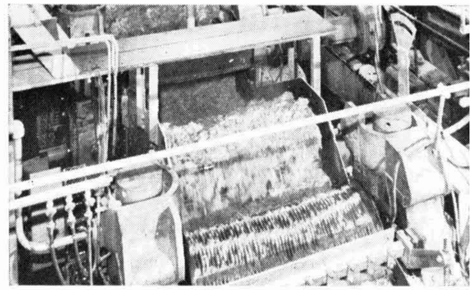
Breeding for resistance to leaf scald disease. B. T. EGAN. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—Leaf scald resistant varieties of sugar cane have been successfully bred in certain countries, notably Mauritius and Queensland. The occurrence of various strains of the disease is a complication which is currently annoying, but which will become serious. Basic sources of disease resistance seem to be confined to *Saccharum spontaneum* clones, or are derived from them. Clones of *S. robustum* and *S. officinarum* tend to be quite susceptible, although some possess considerable field resistance to leaf scald. The reaction of some pathogenic strains is not known adequately. Little work has been done on inheritance of resistance to leaf scald. Progeny trials in Queensland have shown interesting trends, indicating that leaf scald resistance is a highly heritable character. Further investigations are planned.

Cane sugar manufacture



Studies on the storage of sugar in a godown; a procedure for maintenance of humidity. S. C. GUPTA, N. A. RAMAIAH and L. P. TIWARI. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 371–375.—The procedure described involves bubbling compressed air through a solution of $CaCl_2$ or NaOH before feeding it through perforated pipes into the godown. Solution concentration will depend on the required relative humidity, 50% NaOH solution providing 70% R.H. for raw sugar storage and 60% solution 55–60% R.H. for white sugar.

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The treatment of sugar factory effluents of high pollution load—self-oxidation and use of water hyacinth. D. R. PARASHAR. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 381–391.—Details are given of effluent treatment schemes based on dilution with low-pollution waste water, auto-oxidation under anaerobic conditions, biological oxidation with water hyacinth and further auto-oxidation in a long channel where the effluent undergoes vigorous agitation. The BOD is reduced by about 94% (from 1487 to 91 ppm).

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Electronics in process controllers. R. C. SHARMA. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 409–411.—A brief explanation is given of the basis of electronic process control which is compared with pneumatic control techniques.

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Spontaneous combustion of final molasses at Mehran Sugar Mills, Tando Allahyar, Pakistan. H. AHMED. *Zeitsch. Zuckerind.*, 1971, **96,** 558–560.—Boiling and charring of stored cane molasses at Mehran took place with a temperature rise to 320°C and the destruction of 3500 tons of molasses. Possible reasons for the phenomenon are suggested, including (i) exothermic side reactions creating more heat than was lost to the surroundings, and (ii) reaction between amino-acids and reducing sugars, leading to froth fermentation, discoloration and eventually a sharp rise in temperature. The determination of total nitrogen (as a guide to amino-acid content) is suggested as one means of checking stored molasses, and other measures are also mentioned.

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Division of Mill Technology. P. G. ATHERTON. *Ann. Rpt. Bur. Sugar Expt. Sta.*, 1971, (71), 56–67.—Information is given on the total performance of Queensland sugar factories during 1970 and major changes in and additions to factory plant are noted. Details are given of new equipment installed in the metrology laboratory of the Mill Technology Division which is concerned with testing laboratory apparatus. The numbers of items tested are tabulated, showing 35 Brix hydrometers rejected out of 855 submitted, i.e. 4·1% compared with 7·2% in 1969. Out of 15 saccharimeters submitted, 2 were rejected. Individual reports included cover model condenser tests (P. N. STEWART)[1], heat economy in sugar factories and evaporator tube scaling (D. B. BATSTONE and K. J. NIX)[2] and clarifier mud filtration (A. G. NOBLE)[3]. In a comparison of different types of centrifugals for low-grade massecuite treatment[4], mention is made of the feed distributor with which a Buckau-Wolf machine is provided; this is considered to contribute to the high performance of the centrifugal in handling heavy massecuites. Since continuous centrifugals operate more efficiently at maximum capacity, it is thought better to shut down part of a centrifugal station during periods of light massecuite loading. A report on clarification (K. J. NIX, E. J. STEWART and A. G. NOBLE) includes information on the performance of a model clarifier which is intended as an aid in evaluating clarifier design, juice feed and withdrawal and in determining polyelectrolyte suitability without the need for factory-scale trials. It was found that the rake action in ATV clarifiers does not help with mud thickening but merely serves to move the mud to the discharge pipe. Filter cake treatment in a solid-bowl decanter centrifuge gave pol recoveries of 83–89% even without washing (not possible in the model used). In flocculation tests, "Separan AP-273" proved better than "A 130" and "Magnafloc LT 25" and gave a juice turbidity 2 units lower than did the others. Laboratory tests on other flocculants are briefly mentioned, in which "Praestol 2900" showed promise. Tests with the direct cane analysis system mentioned previously[5] are reported. Comparison between a wet disintegrator method and a first expressed juice method in a series of tests at Babinda indicated an average difference between the two methods of 0·36 units in c.c.s. and 0·17 units as pol % cane, the wet disintegrator method giving the higher results. The average loss in moisture during mixing of prepared cane for sub-sampling was not

[1] *I.S.J.*, 1972, **74**, 147.
[2] BATSTONE: *ibid.*, 147.
[3] *ibid.*, 148.
[4] *See also* KIRBY: *ibid.*, 115.
[5] *ibid.*, 1971, **73**, 341.

statistically significant at 0·25%. Results of tests on a prototype wet disintegrator indicate that ½ hr is sufficient for complete extraction.

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Manufacture of sugar from sorghum—preliminary notes. A. GONZÁLEZ G. *Bol. Azuc. Mex.*, 1971, (258), 23–27.—An account is given of modern experience in growing sorghum for sugar extraction in Texas, USA, and in Mexico. Notes are given on the characteristics of the plant, pests, growing period, etc., and processing of the juice to eliminate starch and aconitates and to recover the sugar content.

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Rôle of 2-roller crusher in 14-roller milling tandem. B. M. TIWARI. *Indian Sugar*, 1971, **21**, 311–316. Improved mill performance at the author's factory is attributed to installation of a vibratory feed chute between the 2-roller crusher and the 1st mill which has eliminated choking of the 1st mill and permitted the crusher to operate as a main unit in the train.

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TSC's mill modernization achievements. Y. P. YU. *Taiwan Sugar*, 1971, **18**, 171–172.—Among items in the Taiwan Sugar Corporation's modernization programme which are mentioned is a 30% reduction in bagasse fuel consumption and replacement of bagasse with heavy oil as fuel so as to make more bagasse available for pulp manufacture (a new plant is to be set up for a yearly output of 100,000 tons of pulp), extension of automatic controls to more factories, installation of a diffuser at Nanchou in 1968, the raising of sugar quality and manufacture of a wider range of sugars. Among problems confronting the TSC are a decline in cane sugar yield, and air and water pollution by sugar factory waste products.

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Achieving high efficiency milling operation by means of automatic control in cane feeding and maceration. H. I. H. CHEN and L. F. HUANG. *Taiwan Sugar*, 1971, **18**, 176–181.—At Kaohsiung cane feeding regulation involves control of the main carrier speed as a function of the elevator speed (in turn dependent on cane blanket thickness) and the current load on the cane cutter and shredder motors. A pre-carrier and feeding table together with an automatic cane unloading device permit ideal loading of the cane on the main carrier. Automatic maceration control (aimed at providing a final bagasse of about 43% moisture and no greater than 1·5% pol while maintaining the mixed juice Brix at about 17°) is based on mixed juice Brix and quantity. Tests have shown that pol extraction in milling is increased to 93·81% with automatic cane feed and maceration control compared with 92·11% when manual control is used.

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Three years testing of ring diffuser. Y. C. YEN. *Taiwan Sugar*, 1971, **18**, 182–185.—Operation of a Silver ring diffuser (supplied by Mitsubishi Heavy Industries Ltd.) at Nanchou sugar factory is reported. Problems encountered in cane preparation and bagasse dewatering are discussed. Extraction of the diffuser during the 1970/71 season was 95·62% at a draft of 97·88% (nominal throughput is 1500 metric tons/day), and a bagasse pol of 1·99. This performance compared with a predicted extraction of 97% at 100% draft.

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Preventive safety measures for evaporator explosion. Y. C. YEN and K. W. PI. *Taiwan Sugar*, 1971, **18**, 188–189.—Three evaporator explosions in different Taiwan sugar factories are reported. Each occurred during boiling-out and was attributed to pressure build-up in the absence of adequate relief means. Steps to take to avoid recurrences are listed and a follow-up to ensure compliance with the regulations is briefly described.

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The changing fortunes of TSC, 1946-1971. J. F. WILLIAMS. *Taiwan Sugar*, 1971, **18**, 190–197.—Information is given on Taiwan Sugar Corporation sugar factories, alcohol distilleries and other facilities that have closed down, been converted to other uses or merged with other units.

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A review of research work for improvement of (the) defecation process and raw sugar refinability in Taiwan. S. L. SANG. *Taiwan Sugar*, 1971, **18**, 198–203.—A survey is presented of investigations conducted in Taiwan on starch distribution in the juice from five cane varieties and in raw sugar crystals from the juices, clarification and settling problems encountered in Taiwan factories (in tests on various clarification processes the mud volume on juice was greatest with the use of phosphate at constant settling time), starch removal, factors affecting raw sugar filtrability, and juice zeta-potential and stability as a function of pH.

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Quick milling in TSC's Jente sugar mill. K. W. YAO. *Taiwan Sugar*, 1971, **18**, 204–209.—Modifications and additions to the mill train and changes in the steam generation plant at Jente cane factory in order to reduce the season while increasing the sugar yield are reported. At a daily throughput of about 2300 t.c.d. compared with about 2000 t.c.d. previously, pol extraction was about the same with only slight increase in bagasse pol. Bagasse moisture was some 7% absolute greater at 54·48% compared with the 1969/70 value.

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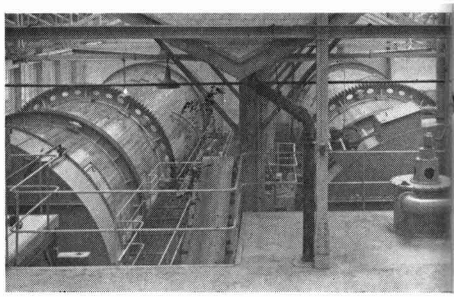
The relative merits of cane milling and cane diffusion in terms of pol extraction and boiling house recovery with the respective capital and operating costs compared and also the heat balance. U. C. UPADHIAYA. *Indian Sugar*, 1971, **21**, 369–376.—See *I.S.J.*, 1972, **74**, 214.

Beet sugar manufacture



Variants in the process scheme for beet sugar production. YU. D. GOLOVNYAK. *Sakhar. Prom.*, 1971, **45**, (10), 18–22.—The use of a carbonatation scheme including main liming for 15–20 min at 90°C, 1st carbonatation to pH 11·5–11·8, 2nd carbonatation to pH 9·5–9·8, sulphitation to a pH no lower than 9·0 (9·0–9·5) (sulphitation of remelt liquor to pH 8·0–8·5), and treatment of 2nd carbonatation juice with sodium triphosphate, increased the throughput of the boiling house by 15% and improved sugar quality while reducing molasses sugar by 0·3% in tests at Pervomaiskii sugar factory. The system is aimed at improving the processing of poor quality beet, for which a 3-massecuite boiling scheme, which is described, has been designed and tested. Replacement of clarifiers with filter-thickeners is also advocated.

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Kinetics of sugar crystal growth in vacuum pans. L. G. BELOSTOTSKII and V. A. SHESTAKOVSKII. *Sakhar. Prom.*, 1971, **45**, (10), 22–25.—Tests in which the performance of a pan with a mechanical stirrer was compared with that of a standard pan without stirrer showed that only by means of massecuite stirring can the rate of crystal growth be equilibrated with the water evaporation rate. Without agitation crystal size was 1 mm and the final total surface area 3315·54 m^2 per ton of massecuite compared with 1·1 mm and 2970·73 m^2, respectively, with stirring.

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Results of tests on a KDA-30-66 diffuser at Tsybulevskii factory. A. P. PARKHOD'KO. *Sakhar. Prom.*, 1971, **45**, (10), 25–29.—Over a 25-day period a KDA-30-66 tower diffuser of 3000 tons/day throughput operated satisfactorily, despite a number of structural and design defects which are listed. At a juice draft in the range 118–130% and a retention time of 80–145 (usually 102–120) min, pulp sugar varied between 0·30 and 0·50% on beet weight. Throughput was between 62 and 122·5 metric tons/hr.

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Some recommendations on mounting the shafts of sloping screw diffusers. A. YU. VOLOKHOV. *Sakhar. Prom.*, 1971, **45**, (10), 30–33.—Calculations are given for use in the correct mounting of the scroll shafts in twin-scroll DDS diffusers during initial installation and after repairs.

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The economic effects of forced ventilation of stored sugar beet. M. Z. KHELEMSKII. *Sakhar. Prom.*, 1971, **45**, (10), 42–46.—The costs of forced ventilation are found under Soviet conditions to be justified in view of the reduced sugar losses and improved beet quality, since over half of the beet harvested must be stored for a fairly long period. The ventilation costs are easily outweighed by the value of the extra sugar.

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Effect of using forced ventilation under Kuban' conditions. I. I. DIK and A. I. SOLOV'EV. *Sakhar. Prom.*, 1971, **45**, (10), 47–48.—The economics of using forced ventilation for stored beet under the climatic conditions of the Northern Caucasus are considered, in which it is shown that a 1% reduction in beet weight loss could mean an extra 12,500 tons of sugar, the value of which would easily justify the expenditure on forced ventilation. Where temperatures are high and the relative humidity low, the use of moist air for beet pile ventilation is advocated.

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Our experience in the use of forced ventilation of sugar beet. L. LITVINENKO and D. POTABENKO. *Sakhar. Prom.*, 1971, **45**, (10), 49–50.—Seven years' experience in the use of forced ventilation at the authors' sugar factory is discussed. The advantages are indicated in terms of the low storage losses and high sugar yields of the factory.

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Preliminary tests on the possibility of beet reception according to sugar content. B. SWIATKOWSKI. *Gaz. Cukr.*, 1971, **79**, 254–257.—Investigations involving over 1500 tons of beet have shown that under Polish conditions and assuming a maximum error of 0·5% in beet sugar content evaluation, 7 samples per beet load would be required in the case of one farmer, and 32 samples per load when this was supplied by a number of farmers in a village.

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Effect of storage temperature on sugar beet processing quality. K. VUKOV. *Cukoripar*, 1971, **24**, 173–181. See *I.S.J.*, 1972, **74**, 117.

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Study tour of the German Democratic Republic. J. DÁVID and A. ZELMAN. *Cukoripar*, 1971, **24**, 189–194. A survey is presented of the East German sugar industry.

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Steam economy measures in the Danish sugar industry. P. V. L. MARASIMHAM. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 299–305.—Details and a steam flow diagram are given of a Danish beet sugar factory where the steam consumption is 31·05% on beet compared with a normal consumption in India of 60% on cane.

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Use of protococcal algae for waste water purification. V. N. YUZVENKO. *Sakhar. Prom.*, 1971, **45,** (11), 20–22.—Satisfactory results obtained in the treatment of sugar factory effluent with algae are indicated. Water temperature and level of water in the pond were decisive in the growth of the algae, which could be added in the form of a paste or as a suspension. The ponds should have a surface area of 0·3–1·2 ha and should be filled to within 1·5 m of the brim to give a quantity of 3,000–12,000 m^3. The temperature should be at least 15°C and the pH 7–8.

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Beet and sugar losses in the beet feed line to the factory. F. DOBRONRAVOV and M. BARKO. *Sakhar. Prom.*, 1971, **45,** (11), 33–36.—Detailed breakdowns are given of the beet and sugar losses incurred at three Soviet sugar factories between the beet piles and the washers, and measures recommended to reduce them are listed.

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Sugar solution evaporation with reverse flow forced circulation. M. A. GEISHTOVT and V. V. GONCHAR. *Izv. Vuzov, Pishch. Tekh.*, 1971, (4), 109–112.—Tests with a single-tube evaporator are reported in which the juice of given concentration was pumped to the top of the tube. In its descent the juice passed to a higher pressure zone so that boiling did not take place, although the juice became superheated. However, ebullition occurred once the juice left the tube, so that the boiling zone was located beyond the limits of the tube. A circulation pump was used for forced circulation. At flow rates of 1–3 m/sec turbulence had the major effect on heat transfer. The forced circulation system used is recommended for high Brix solutions and was found to reduce scaling. An equation for calculation of the Nusselt number in terms of the Reynold and Prandtl numbers gives good approximation for the system tested.

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Method of calculation for a controlled multiple-effect evaporator. L. A. POPOVICH and A. M. KOZAK. *Izv. Vuzov, Pishch. Tekh.*, 1971, (4), 113–116.—Equations are developed for calculation of evaporation parameters involved in an automatic control system aimed at creating equilibrium between the amount of water evaporated and the quantity and concentration of the juice feed. The method is suitable as a basis for other multiple-effect evaporator calculations, including determination of optimum temperatures with allowance for scale formation.

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Continuous sucrose crystallization. N. BARKOW and G. WITTE. *Zucker*, 1971, **24,** 687–699, 715–725, 733–738.—After a survey of various continuous vacuum pan designs, details are given of the Fives Lille-Cail continuous pan installed at Ochsenfurt (West Germany) with information on the control systems used for juice feed and distribution as well as the unit for preparation of seed slurry (used in the second campaign after introduction of the pan despite the advice of the pan manufacturers). Results from the 1969/70 and 1970/71 campaigns are reported in detail, indicating a higher quality and yield of sugar than would be obtained from a conventional pan of comparable size. A number of teething problems are noted. A subsequent discussion of the article bears on the subjects of relative costs, crystal uniformity, circulation rate (not determined in the Fives Lille-Cail pan) and the use of supersaturation measurement as a control basis, reference also being made to the pan installed at Nassandres in France.

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The S.W.S.-Suiker Unie continuous sugar crystallization system. G. C. DE BRUYN, L. C. GILJAM and L. H. DE NIE. *Zucker*, 1971, **24,** 726-733.—Details are given of the S.W.S.-Suiker Unie continuous vacuum pan installed as a test plant at Dinteloord[1]. While continuous operation has proved satisfactory, with production of 1st product massecuite which could be easily cured in the centrifugals and with no increase in colour despite the high temperature in the evaporator section, crystal uniformity and quality have proved unsatisfactory. Modifications at present being made to the plant are expected to solve the problem, after which the unit will be offered for sale.

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Investigation of pH change during evaporation of sugar solutions in a system using reverse forced circulation. M. A. GEISHTOVT, V. V. GONCHAR and V. V. MAIOROV. *Izv. Vuzov, Pishch. Tekh.*, 1971, (5), 77–81.—The hydrodynamics of evaporation had no essential effect on pH change at the temperatures (105–125°C) and Brix values (10–50°) studied. On the other hand, the heat parameters and temperature did affect pH, which fell more steeply with rise in concentration at constant temperature. A linear relationship was found between change in pH and time. An equation is presented for calculation of pH as a function of the various factors affecting it at rates of circulation (natural or forced) in the range 1–3 m/sec. Values compared with measured values to within ± 0·5%.

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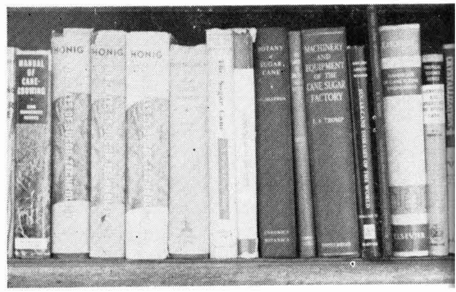
Critical study of the diffusion process. IV. G. D'ORAZI. *Ind. Sacc. Ital.*, 1971, **64,** 151–156.—Diffusion loss X_n may be calculated from the formula $\frac{100}{X_n} = e^{K.\zeta_m.l.t.E}$, where K is a constant, ζ_m is the average temperature (°C), l is the cossette length (metres/100g), t = time (minutes) and E is the draught expressed as a fraction, e.g. 1·20. A procedure is described for graphical representation of this function, whereby it is possible to calculate the final loss from data obtained at an intermediate point in the diffuser.

[1] *I.S.J.*, 1970, **72,** 221, 286.

New books



Elimination of the non-sugars. Preservation of beets. (Comptes Rendus de la 14e Assemblée Générale de la Commission Internationale Technique de Sucrerie.) 626 pp.; 15·5 × 23·6 cm. (Secrétariat Général de la Commission Internationale Technique de Sucrerie, Aandorenstraat 1, B-3300 Tienen, Belgium.) 1972. Price: 1000 Belgian francs.

This is the Proceedings of the General Assembly of the CITS held in Brussels during 3rd–7th May 1971, which was attended by 177 delegates representing 22 countries[1]. As the title indicates, the two major themes of the Assembly were elimination of non-sugars and beet storage, although the programme was much wider than this, and a number of other topics were covered, including crystal growth, ultra-filtration, electrodialysis and ion exclusion as well as a number of analytical procedures. The volume contains the 32 papers presented to the Assembly, published in the language (English, French or German) in which they were delivered, with summaries in all three languages. (Abstracts have appeared in our pages.) The presentation is excellent, with very legible print on a cream laid paper. It is perhaps a pity that the covers are limp and not hard. However, the book will certainly be a valuable addition to a sugar technology library. Orders for the book should be sent to the address given above and accompanied by payment of 1040 Belgian francs. They should be made out to C.C.P. 18.180, "Caisse Tirlemontoise de Dépôts", Account C.I.T.S. No. 061/1652/0.

* * *

Sugar year book 1971. 374 pp.; 10 × 14 cm. (International Sugar Organization, 28 Haymarket, London S.W.1, England.) 1972. Price: £2.00.

The 25th edition of this annual collection of sugar statistics covers 119 countries apart from the EEC and French and Dutch overseas territories. The book contains data for International Sugar Agreement members as well as non-members, the figures relating to the period 1965–1971 (those for 1971 are sometimes estimates). The information covers world centrifugal sugar production in calendar years (with some exceptions) tabulated by countries in alphabetical order. The figures are expressed in metric tons, raw value (96 pol), and have either been submitted by ISA members or, in the case of non-members, supplied by the governments concerned, extracted from statistical publications or estimated. Where possible, the figures are broken down into raw and refined (or white) sugar. The main section is followed by a collection of general tables, such as world production, imports, exports and consumption, stocks, per caput consumption, world prices, US supply quotas, etc. For the reader requiring information on world sugar, this book is undoubtedly the most suitable. As always, the print is clear and easily readable, while it is remarkable how much detailed information can be provided in such a small volume.

* * *

The qualities of sugar. (British Sugar Bureau, 140 Park Lane, London W.1, England.) 1972.

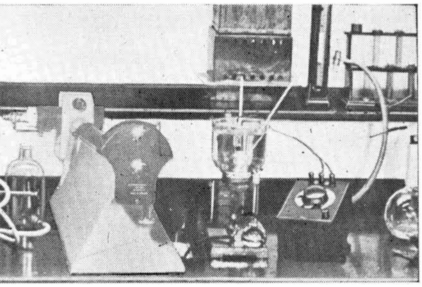
To meet a demand for information on the properties of sugar and the rôle it plays in the balanced diet, the British Sugar Bureau has published this leaflet which describes the versatility of sugar, the part it plays in nutrition in relation to other nutrients (including the biological processes involved in its consumption) and the various types of sugar available. The leaflet is couched in simple language and will doubtless prove highly useful in spreading knowledge about sugar. Copies are available from the address given above.

* * *

The Gilmore Louisiana-Florida-Hawaii sugar manual 1971. Ed. A. C. Bloomquist. 267 pp; 20 × 28 cm. (The Gilmore Sugar Manual Division, Bloomquist Publications, 112 North University Drive, Fargo, North Dakota, 58102 USA.) 1971. Price: $10.00.

Up to now, the well-known Gilmore sugar manuals have included an edition for Hawaii and one for Louisiana and Florida (besides other sectors of the Western Hemisphere); but now one edition covers Hawaii and the US Mainland cane area. This, the first combined edition, includes a section of sugar statistics for 1971, a section giving information on sugar industry organizations as well as some general information, details of the US Sugar Act, and individual sections for each of the states named in the title, covering factory processes, equipment and personnel (both factory and field) and 1969 and 1970 crop results for each sugar factory. A Buyers' Guide is also included at the front of the book. The work contains a wealth of data on the cane industries of the three states and is to be recommended to anyone seeking such information.

[1] *I.S.J.*, 1971, **73**, 195–196.



Laboratory methods & Chemical reports

Automated determination of starch in raw sugar. S. L. Sang, W. C. Cheng and P. H. Su. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 8 pp.—In a method proposed for starch determination, the 10 g sugar sample is dissolved to make 100 ml solution, filtered through SS No. 589-2 paper and a 25 ml aliquot of the filtrate transferred to a 50 ml flask where 0·5 ml of 10% potassium iodide solution, 2·5 ml of 10% acetic acid solution and 5 ml of 0·01N potassium iodate are added in succession to develop a blue colour. The solution is made up to volume with distilled water and thoroughly mixed, after which the absorbance of the coloured solution is measured at 570 nm against a reference solution made up with the same quantities of reagents but without the sugar sample. Another 25 ml aliquot of the filtrate is transferred to another 50 ml flask and the reagents, except potassium iodate, added; the absorbance is then measured against the reference reagent solution and the starch in the sugar sample then obtained from the difference in absorbance between the two measurements by reference to a standard curve. Details are given of an adaptation of the method for use with a Technicon "AutoAnalyzer". Comparison of results with values obtained by the standard Balch method showed good agreement while the standard deviation and coefficient of variation of the proposed method were smaller. Automatic measurement has improved the reliability and speed of measurement and eliminated analytical errors occurring in the manual method.

* * *

Analytical techniques for colour studies. P. Smith and P. E. Gregory. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—Details are given of the methods used at the Colonial Sugar Refining Research Laboratories to measure the colour of clarified and unclarified cane juice and determine the phenolics content as well as amino-N. The use of gel filtration for separation of fractions of differing molecular size and of precipitation of high M.W. impurities with methanol are also described. The application of these methods is illustrated by two examples, viz. a study of the differences in the composition of colorants and their precursors in the upper and lower parts of the cane stalk, and the difference in colorant composition between 1st mill juice and macerate. Results indicated that juice from the upper part of the cane stalk had a higher proportion of high M.W. phenolic impurities than the lower part, and that while clarification removed virtually all the impurities from the lower stalk juice it left a small quantity in the juice from the upper part. Hence, cane which is topped higher than usual or which includes abnormally high proportions of shoots and suckers will yield darker clarified juice and thus darker raw sugars. Anthocyanins were particularly noticeable at the growing point; these are strongly pigmented and unstable flavonoids which polymerize and form colourless phenolic acids when decomposed during clarification. The pH sensitivity of maceration juice was more than three times, the phenolic content nearly double and the amino-N content double that of 1st mill juice, so that most of the pH-sensitive colorants (mainly alkali-stable flavonoids which largely survive clarification) in mixed juice originated from maceration, which was also found to lead to a considerable loading of colour precursors in mixed juice. Clarification appeared to be more effective in removing polymeric rather than monomeric colorants.

* * *

Crystal size distribution by direct weighing. P. G. Wright and E. T. White. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—For crystals > 200 µm the most accurate method of three for determination of crystal size distribution was one in which crystals were weighed at the rate of 10–15 per min on a Beckman-RIIC type LM600 electronic microbalance combined with a punched-tape data logging system. This was more accurate than the Zeiss-Endter particle size analyser, use of which involves certain difficulties, and the Coulter counter, which analyses the voltage pulses resulting when crystals suspended in an electrolyte are drawn through an orifice through which a constant current is flowing, the volume equivalent size thus being obtained directly. More development work with the Coulter counter is recommended, since many thousands of particles can be counted in a matter of minutes. However, the counter cannot detect conglomerates, the choice of suitable electrolyte presents a problem, and the instrument is better applied to smaller crystals such as in seed slurries and samples from nucleation and early crystal growth stages.

* * *

Starch determination in raw sugar by colorimetric methods. M. Matic. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 10 pp.—Details are given of the method used at the Sugar Milling Research Institute in South Africa to determine starch in raw sugar, and comparative tests involving this method and six other methods reported in the literature are discussed. Reasons are given for the considerable differences obtained, and it is demonstrated that the results depend on the starch used as standard, the concentration and pH of the $CaCl_2$ solution used for extraction, the ratio between amylose and amylopectin (the two basic components of starch), and the wavelength at which the colour is measured. It is concluded that reproducible results can be expected only if the same method and the same standard are used.

* * *

A study of colour development in plantation white sugar manufacture. W. CHEN. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 5 pp.—Investigations on colour formation in products from various Taiwan sugar factories are reported. The distribution of amino-acids in plantation white sugar is tabulated. Reaction of these with invert sugar plus degradation of the latter into a series of high M.W. organic acids (humic acids) form the principal colorants during manufacture. Colour formation during carbonatation was found to be greater at extreme pH, but even within the optimum pH range of 10·2–10·8 the effect of change in pH on colour and other juice properties was quite considerable. The colour of 2nd carbonatation juice and sugar was found to vary almost linearly with CaO content. Tabulated data indicate the extent of yellowing in sugar stored at 70°C for 90 hr. The mechanism of the process, involving liberation of SO_2 when exposed to air and subsequent release of the carbonyl group, is briefly explained. Details are also given of colorant identification or characterization by their visible and u.v. absorption spectra after isolation by ion exchange chromatography.

* * *

Inversion control in sugar cane juice by sodium metasilicate. A. G. ALEXANDER, N. ACIN-DÍAZ and R. MONTALVO-ZAPATA. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 11 pp.—Sucrose inversion in sugar cane juice samples was delayed for several days by adding sodium meta-silicate immediately after milling. The quantity of inhibitor required was lowered to 2·3μ moles/ml by prior filtration and treatment of the juice with zinc sulphate and barium hydroxide. Although the deterioration rate for untreated samples varied greatly among different batches of juice the relative inversion control of meta-silicate remained essentially constant. The principal effect of meta-silicate appears to be the inhibition of endogenous invertases released from stalk tissue by the grinding process. The presence of glucose or fructose in fresh juice leads to more rapid juice deterioration. This suggests that the meta-silicate has no immediate effect upon bacterial invertase other than to deny the microbes their source of carbon for rapid growth.

* * *

Identification of cane pigments that persist into refined sugar. L. FARBER and F. G. CARPENTER. *Paper presented to the 14th Congr. I.S.S.C.T.*, 1971, 12 pp. Results are given of high-voltage paper electrophoretic and chromatographic studies on cane pigments (from the actual plant as opposed to colorants resulting from chemical reaction and decomposition) which also appear in refined sugar. The compounds identified included: chlorogenic and caffeic acids, *p*-hydroxycinnamic acid, 4-hydroxy-3-methoxycinnamic acid, 4-hydroxy-3,5-dimethoxycinnamic acid, kaempferol and umbelliferone. Other non-coloured constituents were also identified: *p*-hydroxybenzoic acid, 4-hydroxy-3,5-dimethoxybenzoic acid and 4-hydroxy-3-methoxybenzoic acid. Fumaric acid and aconitic acid were also located. (See also *I.S.J.*, 1971, **73**, 99–100, 170–173.)

* * *

Residues of organochlorine pesticides in beet and its by-products. L. VAN STEYVOORT, L. ZENON-ROLAND and P. H. MARTENS. *Sucr. Belge*, 1971, **90**, 491–497. Investigations in Belgium have revealed toxicologically negligible contents of various organochlorine pesticides in beet and beet sugar factory products, including 1st strike sugar. The pesticides investigated were "Aldrin", "Dieldrin", "Heptachlor", "Heptachlor" epoxide and "Chlordane". Full details are tabulated.

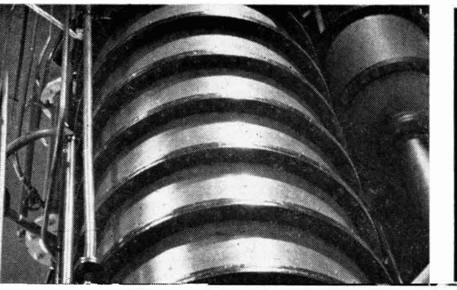
* * *

A method for the automated determination of sulphur dioxide in white sugar. S. L. SANG and W. C. CHENG. *Rpt. Taiwan Sugar Expt. Sta.*, 1970, (52), 13–24. Automatic determination of white sugar sulphur dioxide with a Technicon "AutoAnalyzer" using the rosaniline colorimetric method of CARRUTHERS *et al.*[1] gave a standard deviation of 0·097 ppm, and a coefficient of variation of 1·21% comparded with corresponding values of 0·453 ppm and 6·45% using the conventional method. No significant difference was observed between the measuring data used in the two methods. The automatic method is sufficiently rapid to allow 30 tests per hour instead of 20 with the conventional method.

* * *

Pol in open cells as a measure of cane preparation. E. C. VIGNES and M. RANDABEL. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1970, 164–167.—Details are given of preliminary investigations to compare the degrees of cane preparation in different Mauritius sugar factories. In determination of pol in open cells the method described by HENDERSON[1] was used for tumbler extract pol (P_1), while for disintegrator extract pol the prepared cane from the same batch as for tumbler pol was passed through a Jeffco cutter-grinder, thoroughly mixed and 333 g mixed with 1000 g of water containing 10 ml of 5% sodium carbonate solution before 10 minutes' treatment in a Rietz disintegrator at 8000 rpm. The pol reading of the extract (P_2) was then measured in a 400 mm tube. The % pol in open cells was calculated from *r* (ratio of P_1 to P_2) as $\frac{1193\,r}{4{\cdot}580 - r}$. Values ranged from 45·0% to 71·9% compared with over 80% in cane from Australian factories, indicating poor cane preparation in Mauritius factories. Insufficient tests were carried out (because of lateness in the season) to attempt to correlate pol in open cells with 1st mill extraction.

[1] *I.S.J.*, 1965, **67**, 364–368.
[2] *ibid.*, 1971, **73**, 90.



By-products

Effect of pre-treatment of molasses and recycling of yeast on ethanol fermentation. R. SAMANIEGO and R. L. SRIVASTAS. *Sugar News* (Philippines), 1971, **47,** 301–304, 311–318.—In tests on ethanol production from molasses inoculated with *Saccharomyces cerevisiae*, pre-treatment of the molasses with sulphuric acid, aluminium sulphate and tartaric acid separately, in order to remove calcium and potassium, yielded 8·1%, 7·9% and 7·5% ethanol, compared with 7·9% for the control without molasses pre-treatment. The use of activated carbon, ethyl alcohol and egg albumin to remove colouring matter and colloids yielded 7·9%, 8·5% and 9·1% ethanol, respectively, compared with 8·0% for the control. However, egg albumin is economically unsuitable while the use of ethyl alcohol would present problems in alcohol recovery after removal of the colloid-containing sludge. Furthermore, colouring matter had little effect on fermentation efficiency; hence, only use of sulphuric acid is considered technologically and economically justifiable as it helped remove some colloids as well as calcium, reduced scaling of the distillation coloumns and enabled the yeast to remain active longer in the recycling process. Washing the yeast cells with dilute HCl of pH 3·5 to remove adhering colloidal matter proved more suitable than washing with water as regards ethanol production, while 5% NaCl solution reduced both factors compared with the control. The maximum ethanol yield was provided by three recyclings of the yeast, giving 8·8% ethanol compared with 8·6% for the control.

* * *

The physical and chemical properties of wax extracted from some Philippine sugar cane filter-press cakes. E. O. DE LA CUESTA and R. SAMANIEGO. *Sugar News* (Philippines), 1971, **47,** 215–221.—The quantities of moisture, volatile matter, ash and free fatty acid, saponification, iodine and acetyl numbers and melting point were determined for crude and refined waxes extracted from filter-press cake obtained from four Philippine sugar factories. Extraction yield averaged 20%. The properties of the refined waxes were superior to those of the crude waxes and and were similar to commercial waxes such as carnauba. Details are tabulated and discussed.

* * *

Review of progress with bagasse for use in industry. J. E. ATCHISON. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 13 pp.—After a short discussion on the physical characteristics of bagasse, the question of bagasse availability for use in pulp and paper manufacture and the economics of the use of alternative fuels are considered. Problems involved in bagasse storage are briefly discussed and details given of bale storage methods, bulk storage of wet bagasse and dry storage. Finally, the subject of storage losses and factors to be considered in selecting a suitable storage and handling method are discussed.

* * *

Centrifugal wet depithing. E. J. VILLAVICENCIO. *Paper presented to the* 14*th Congr. I.S.S.C.T.*, 1971, 11 pp.—A description is given of a bagasse depither patented by the author[1] which has been installed at Paramonga paper mill in Peru as an experimental unit. With fresh water used as carrier liquid, a recovery of up to 36% sucrose in the original fibre has been obtained by using the depither as a secondary stage for treatment of the fibre fraction from the initial moist depithing stage. An increase to 58·6% recovery is claimed to be possible if the wet depithing is conducted as a 2-stage process. The process yields a clean pith and fibre free from soluble matter, while power consumption and water requirements are low.

* * *

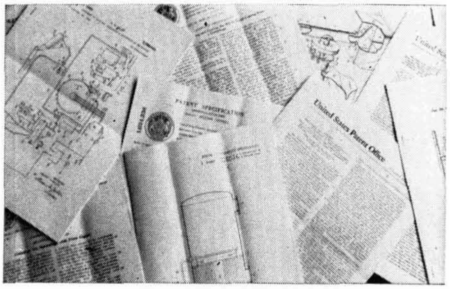
Studies on the production of fodder yeast from alcohol distillation slops of cane molasses. S. F. LIN. *Rpt. Taiwan Sugar Expt. Sta.*, 1970, (51), 1–18.—Of 400 strains of yeast tested for fodder yeast production from vinasse, the best was No. 995 which yielded 2 g of dry cells per 100 ml compared with only 1·2 g/100 ml obtained with the standard culture. Optimum conditions are given as: slops concentration of 13°Bx, pH 5·5–6·0, temperature 30–32°C, aeration ratio 1:1, stirring speed 1000 rpm, and addition of 0·2% N and 0·1% P_2O_5.

* * *

Enzymatic production of fructose. ANON. *Sugar y Azúcar*, 1971, **66,** (9), 22–24.—A brief account is given of research conducted by the Japanese Fermentation Research Institute in an attempt to find an economical method of producing glucose isomerase for glucose conversion to fructose. Previous methods had involved the use of xylose, which is expensive, whereas it was found that *Streptomyces* spp. produced a large quantity of the enzyme when cultured in a medium containing xylan. Advantages of the method, apart from cheapness, include the possibility of conducting the enzymatic isomerization process at a high temperature, since the isomerase is heat-resistant. Both the enzyme- and fructose-producing processes have been patented.

[1] *I.S.J.*, 1972, **74,** 60.

Patents



UNITED STATES

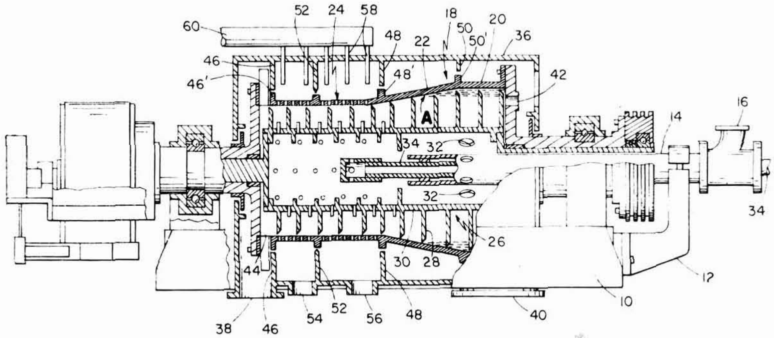
Cane harvester attachment. V. P. BROUSSARD, of St. Martinville, La., USA. **3,572,081.** 17th February 1969; 23rd March 1971.

* * *

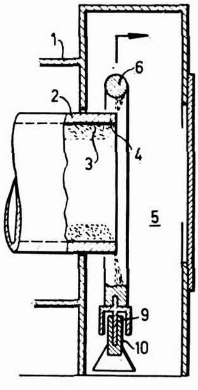
Method of cleaning sugar crystals. F. X. FERNEY, of Walpole, Mass., USA, *assr.* BIRD MACHINE COMPANY. **3,575,709.** 20th August 1968; 20th April 1971.

Massecuite or affination magma is admitted to the centrifuge through the stationary port 16 and enters the feed pipe 14 and so the feed end of the hollow core of the machine. It passes through the ports 32 into the solid bowl section A where it collects as a pool; the liquid portion collects on the innermost surface and overflows through ports 42 and enters the liquid compartment defined by the end of the casing and baffle 50, leaving by port 40.

Mounted on the outside of the core is a conveyor 26 in the form of a double helix having flights 28. The drive is so arranged that the core and the solid bowl turn in the same direction but at slightly different speeds so that the conveyor flights cause the sugar crystals to move along the bowl away from the solid section to the perforated section where further liquid separation takes place, aided by wash liquid or steam admitted through the central pipe 34 which is co-axial with pipe 14. The liquid separating collects in the compartments formed between baffles 48, 52 and the end wall 46, while the sugar passes on, under the action of conveyor 26 and is discharged through duct 38. The outer surface of the perforated section of the bowl may be cleaned by water or steam supplied through spray nozzles 58 from header 60.



Continuous centrifugal. E. RÜEGG, of Kusnacht, Switzerland, *assr.* ESCHER WYSS LTD. **3,580,393.** 16th October 1969; 25th May 1971.



Surrounding the discharge end 4 of drum 2 of a push-type continuous centrifugal is a flexible tube 6 of rubber, flexible plastic, etc. One end of the tube is provided with a closure having a pivot 9 which rotates within bearing 10, while the closure on the other end is provided with a shaft which is driven by a motor. Consequently crystals 3 discharged from the drum impinge on the rotating flexible tube instead of on the rigid casing 1 of the centrifugal, sustaining less damage.

* * *

Preparing granular crystalline sugar products. W. C. BLACK, of Cedar Rapids, Iowa, USA, *assr.* PENICK & FORD LTD. **3,582,399.** 15th July 1968; 1st June 1971. A massecuite, comprising sugar (sucrose, dextrose) micro-crystals in a saturated aqueous sugar solution, is added to and intermixed with a bed of absorbent, free-flowing "Massecuite Aggregated Microcrystalline Sugar" nuclei granules which consist of cohered sugar micro-crystals with internal water-absorbent capillary networks. The massecuite is distributed and coats the exterior surface of the nuclei granules thereby

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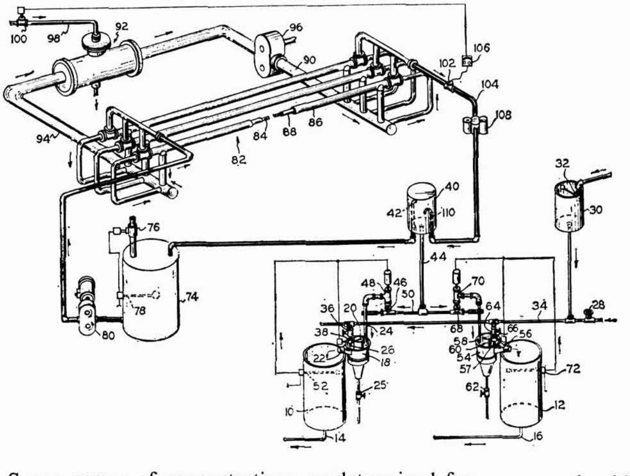
enlarging them. Free water is then removed so as to integrate further the enlarged granules and deposit additional micro-crystals.

* * *

Cane harvester. V. P. BROUSSARD, of St. Martinville, La., USA. **3,583,135.** 18th November 1968; 8th June 1971.

* * *

Sugar blending system. V. D. SMITH, of Hillsboro, Ore., USA. **3,583,415.** 26th August 1969; 8th June 1971.



Sugar syrups of concentrations predetermined for use in e.g. canning of fruit are prepared by controlled addition of the required quantities of water and a concentrated syrup. The latter is admitted through valve 76 to the storage tank 74 under control of a level switch 78 and is circulated by pump 80 through a heat exchanger 82 which comprises a system of tubes, the syrup passing through the annular space between inner tube 84 and intermediate tube 88 where it is heated by hot water passing through tube 84 and through the annular space between tube 88 and outer tube 86. The temperature of the syrup is measured by meter 102 and maintained constant by controller 106 which regulates the flow of steam through valve 100 which heats the circulating water in the shell-and-tube heat exchanger 92.

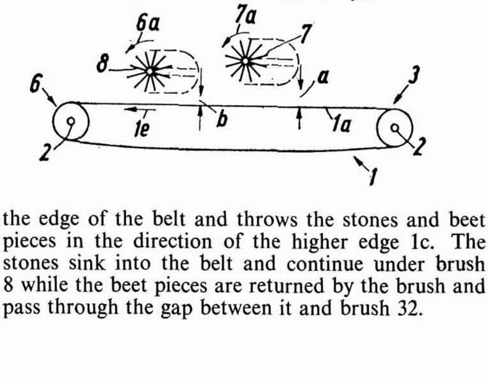
The concentrated syrup at constant temperature (and so viscosity) is supplied to the constant level tank 40 from which the overflow returns to tank 74. Water is supplied either from a constant height tank 30 or from the mains through a pressure regulating valve 28 and supplies the line 34 feeding through shut-off valves 38, 66 and regulating valves 36, 64 to units 18, 54 and so tanks 10, 12. Concentrated syrup from tank 40 passes through pipe 44 to shut-off valves 48, 70 and microvalves 46, 68 feeding mixers 18, 54. The setting of the microvalves governs the Brix of the mixture passing from the units 18, 54 through overflows 22, 56 into tanks 10, 12, and level controls 52, 72 operate the shut-off valves to prevent overfilling of the tanks.

* * *

Dry stone catcher for beets. W. PETERS, H. G. TRELEWSKY and H. HARTMANN, *assrs.* BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **3,583,564.** 3rd June 1969; 8th June 1971.

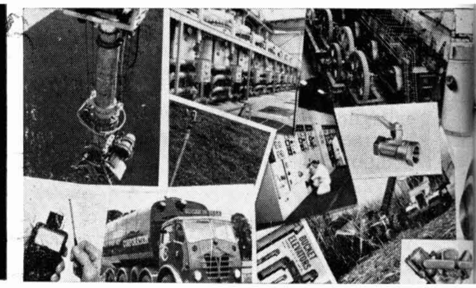
The principle of the cleaning devices which are also described in terms of industrial equipment is illustrated by the diagrams. The beets, containing admixed stones, are delivered onto a continuous belt conveyor 1 which travels in direction 1e about two roller 2 at least one of which is driven. The axes of rollers 2 are parallel and raised at one end to form an angle of about 10–18° with the horizontal. The outer surface of the belt is provided with perpendicular soft rubber fingers which support the beets while allowing the denser stones to sink into them. Above the belt and obliquely parallel to it are two shafts carrying brushes 7, 8 rotated so that their lower halves are moving in the opposite direction to the flow of beets. Beets are directed by brush 7 and discharged over the lower side 1b of the belt as indicated at 5a. Stones, being sunk in the depth of the belt fingers, pass under the brush.

The brush 8 is lower and of harder bristles than brush 7 and catches the smaller beet pieces which it directs over the side of the belt at 5b; to avoid stones on the edge of the belt also falling and mixing with these beet pieces, a transversely acting brush 32 rotates at



the edge of the belt and throws the stones and beet pieces in the direction of the higher edge 1c. The stones sink into the belt and continue under brush 8 while the beet pieces are returned by the brush and pass through the gap between it and brush 32.

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.

Descaling by water jet blasting. Kina Engineering Ltd., Industrial Estate, Hadleigh, Suffolk, England.

Kina Engineering announce the "Big-Wig" Model BW-5, which operates at 11,000 psi to remove all types of scale and deposits by water or wet sand blasting at a flow rate of 83 gal/min. The use of high-velocity retro-nozzles, jets and grenades on a flexible or fixed lance will permit delicate spraying or heavy blasting of the smallest tubular bundles and pipes and the largest underground sewers and drains. Power is from a 150-hp totally-enclosed fan-cooled electric motor or diesel engine.

* * *

Weatherproof pressure switch. Actuated Controls Ltd., Vale Lane, Hartcliffe Way, Bristol BS3 5RU, England.

Actuated Controls Ltd. announce the introduction of a new weatherproof pressure switch, the Model MDK, which offers precise dial setting in one of five pressure ranges: 1–5, 5–20, 15–60, 50–150, 140–250 psig; overload pressure may be up to 50% above the full rated pressure.

* * *

CANE SUGAR FACTORY CHAINS. Ewart Chainbelt Co. Ltd., Colombo St., Derby, England.

A new 64-page catalogue (No. 400) gives a comprehensive survey of Ewart Chainbelt conveying, elevating and driving chains suitable for use in cane sugar factories. The catalogue is printed in English, French, German and Spanish and gives advice on matching carrier chains to a variety of applications and operating conditions and dealing with the problem of corrosive conditions created by juices and cane wash water. Metallurgical data on steel and malleable iron chains is followed by a quick-reference summary and index of standard chains offered by Ewart. More detailed information is given on steel driving chains, elevator roller chains, conveyor roller chains, SS-class bushed chains, combination chains, detachable chains, pintle chains, Gray pin chains, Ley bushed chains, intermediate carrier chains, malleable roller chains plus data on links. Other data include chain service and speed correction factors to help calculate a specific chain pull and details of cast sprocket wheels matched to Ewart conveying and transmission chains. A special section is devoted to the "Cobra" cane carrier outboard roller assembly, while another section deals with apron slats for intermediate and cane carriers. Copies of the catalogue are available from Ewart at the above address.

* * *

"SUGAR BULLETIN". A. & W. Smith & Co. Ltd./The Mirrlees Watson Co. Ltd., No. 1 Cosmos House, Bromley Common, Bromley BR2 9NA, England.

The latest available issue of "Sugar Bulletin" (No. 19) gives information, in both English and Spanish, on Ingenio Tambaca, a new sugar factory to be supplied to Operadora Nacional de Ingenios S.A. in Mexico for the processing of 4000 t.c.d.; the performance of Central Río Turbío, in Venezuela, which crushed 1 million tons of cane from November 1971 to March 1972 in a milling tandem consisting of two sets of knives and eighteen 36 × 78 inch rollers (the factory was supplied by A. & W. Smith in 1953 and subsequently expanded to 5000 t.c.d.); an order from La Fronterita sugar factory in Argentina for two cane mills of 41 × 72 inch rollers (with provision for widening to 84 inches) plus two 1000-hp turbines and gearing; an order for fully-automatic centrifugals under construction for Woodford Lodge factory in Trinidad and the new refinery at Nakambala in Zambia; an order for "Konti 10" continuous centrifugals to be supplied to the Caribbean; and the 1972 performances and economics of six "Konti 10" machines supplied to Brechin Castle factory in Trinidad, showing that the centrifugals are capable of paying for themselves in less than five crops.

* * *

SUGAR FACTORY CHEMICALS. Hodag Chemical Corporation, 7247 North Central Park Ave., Skokie, Ill., 60076 USA.

Five bulletins in Spanish have been issued by Hodag Chemical Corporation describing "Rapisol", a surface-active agent which helps scale removal when added to caustic solution (Bulletin D 27-172), "Vap-99" scale inhibitor (Bulletin D 29-272) describes its properties while Bulletin D 32-272 gives guidance on its application), CB-6 surface-active agent for improving pan boiling, and PH-2 scale remover.

* * *

Symposium on Bosco centrifugal performance.—A symposium of sugar technologists, organized by the Committee for the Yugoslavian Sugar Industry, was held in November 1972 at Osijek sugar factory and attended by 48 representatives from various East European countries to examine and discuss the success achieved at Osijek with a 1200-kg B7 batch centrifugal design by Officine Meccaniche e Fonderie A. Bosco S.p.A., of Terni, Italy. The centrifugal at Osijek, partly manufactured under licence by the Polish organization POLIMEX-CEKOP, who also supplied the D.C. drive equipment, has been operating continually at the rate of 25 cycles/hr since its installation at the start of the 1972/73 beet campaign. It has perfect dynamic and mechanical balance, runs silently and steadily with massecuite of any quality and has been highly praised for its aesthetic and functional lines.

* * *

M. Dedini S.A. Metalúrgica.—In the advertisement appearing in our November 1972 issue (p. xiii) on behalf of the Brazilian company, M. Dedini S.A. Metalúrgica, a list is given of firms with which Dedini have agreements. In the case of BMA, the reader may have been given the impression that the licence applies internationally to all BMA products, whereas in fact it applies only to BMA diffusers and only in Brazil.

1972 Technical Session on Cane Sugar Refining Research

LEADERS of the sugar refining industry met in New Orleans, 13th–14th November 1972, to discuss the latest advances in refining technology. This Technical Session is held every two years jointly by the Cane Sugar Refining Research Project and the Southern Regional Research Laboratory of the United States Department of Agriculture. The sponsors of the Cane Sugar Refining Research Project include leading refineries from all over the world. The work is conducted at the Southern Regional Research Laboratory, with Dr. FRANK G. CARPENTER as the Project Director.

Colour remains the chief subject of discussion wherever sugar refiners meet, as evidenced by the subject matter of more than half the papers. Another area which continues to receive much research effort is that of phosphate and carbonate clarification techniques. Two papers were devoted to these subjects. In another paper, an ingenious method was described for evaluation of flocculants which are sometimes used in conjunction with these clarification techniques. Another timely subject was evaluation of heavy metals (mostly lack of them) in various sugars. The refiners also heard about the properties of raw sugar from a possible new source, namely sweet sorghum.

The research staff of the Project reported their latest research results to the refiners in a series of four papers, covering the subjects of colorants, fluorescence, calcium phosphate precipitates in sugar solutions, and gas chromatography for measurement of minor constituents.

Hawaii sugar industry contraction[1].—In January Honokaa Sugar Co. is to buy its neighbour, Paauhau Sugar Co., which will be closed in 1973. The cane grown on the combined plantations which total some 16,000 acres will be processed at Honokaa. Oahu Sugar Co., which closed one of its two factories in 1972, is spending $2,000,000 to streamline facilities at its remaining plant. The factory at Hamakua Mill Co. is to be closed in 1973 and its cane sent for processing by Laupahoehoe Sugar Co. The management of Hawaiian Agricultural Co. and Hutchinson Sugar Co. were recently integrated and factory operations will also be consolidated in the future.

* * *

US Beet Sugar Institute.—Based on the model of European institutes for training of sugar technologists, the American Beet Sugar Institute has come into existence at Fort Collins, Colorado, USA[2]. Instructors have been recruited by Dr. R. A. MCGINNIS from among senior and retired US beet sugar company personnel, and sessions have been held during 1972 on the campus of Colorado State University. They have covered the first half of the factory process (the "beet end") while courses in 1973 will cover the remainder (the "sugar end"). The 61 students are already in the industry and are of an average level of assistant factory superintendents.

* * *

Great Western Sugar Company.—According to reports from Denver, Colorado, the Great Western Sugar Company, which possesses 15 beet sugar factories, has been sold to the Great Western Producers Cooperative[3]. The agreement has still to be approved by the members of the Cooperative as well as by shareholders of the Sugar Company, but the take-over of the latter was expected to be in December.

Brevities

Jamaica sugar production, 1972[4].—Total cane sugar production in Jamaica in 1972 was 377,765 tons, 11,704 tons less than the 1971 output and below the target of 420,000 tons, according to the Sugar Manufacturers' Association. Supplies of refined sugar are to be rationed and 6500 tons imported to meet an expected shortage according to the island's Sugar Industry Authority (SIA)[5]. As a result mainly of drought, British Commonwealth sugar producers in the Caribbean are experiencing their worst year since 1958; Antigua will contribute no sugar and Jamaica's crop is the lowest since 1958, the St. Kitts crop estimate of 27,000 tons is the lowest since 1938, apart from 1971, output from Trinidad is down by 161,000 tons compared with 1971 and the Barbados crop is only 110,000 tons. Guyana's crop is estimated at 324,000 tons compared with an earlier estimate of 390,000 tons, and there are indications of a shortfall of 86,000 tons in Caribbean deliveries to the USA. As a consequence the SIA called for an early start to the 1973 crop to provide sugar to meet the 1972 US quota commitments.

* * *

Puerto Rico sugar production 1971/72[6].—The 1971/72 crop in Puerto Rico totalled 294,817 short tons, produced from 4,381,800 tons of cane, at a yield of 6·728% on average. The average recovery compares with a crop maximum of 8·219% for Central Eureka but a minimum of only 3·284% for Central Juncos. In August, the Government signed a 3-year lease to operate Central Coloso after it had learned that closure was inevitable and that this would result in unemployment of 6000 workers and affect the large number of cane growers supplying the mill. The Association of Sugar Producers of Puerto Rico will now cease activity since the only independent factory remaining is Central San Francisco which is also on the verge of closing down. The remaining fourteen mills (including Central Coloso) are operated by the Government.

* * *

UK beet area expansion.—It was announced on the 15th November that, as a first step towards the expansion of the United Kingdom beet sugar industry, the British Sugar Corporation proposes in 1973 to accept beet from a further 25,000 acres in addition to the 443,000 acres contracted in 1972. The Corporation and the National Farmers' Union are both looking forward to further expansion of the industry; the Corporation is confident that it will have the factory capacity necessary to deal with the quantity of beet likely to be required to fill the additional white sugar quota which it is hoped, as an EEC member, the United Kingdom will be able to negotiate when the opportunity arises in 1975. The initial quota under EEC regulations is 900,000 metric tons, white value, equivalent to the average production from about 425,000 acres, and the total tonnage of beet required to produce this will be paid for at the basic quota price, fixed by the EEC Commission and to be announced in Spring 1973. UK entry into the EEC means that the BSC will for the future depend on beet and sugar prices negotiated by the UK Government with the EEC.

* * *

New Portuguese East Africa sugar factory[7].—A sugar cane plantation of 25,000 hectares and a factory with an annual capacity of 200,000 tons of sugar are to be established by a local concern near Beira at an estimated capital of 1700 million escudos (£26,000,000). Swiss interests are to provide 1400 million escudos (£21,500,000) for the project.

1 *Sugar y Azúcar*, 1972, **67**, (8), 34.
2 MCGINNIS: *Sugar J.*, 1972, **35**, (4), 27.
3 F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (31), 8.
4 *Public Ledger*, 28th October 1972.
5 *ibid.*, 11th November 1972.
6 *Sugar y Azúcar*, 1972, **67**, (9), 37.
7 *Bolsa Review*, 1972, **6**, 587.

Brevities

Corrigendum.—In the article "Two-roller cane mills—a reappraisal in the light of value engineering of milling" by A. T. DE BOER, which appeared in this Journal last year[1], one of the equations appeared incorrectly. Thus, instead of

$$\log N = 10^{(0{\cdot}246 v_c + 1{\cdot}278)}$$

equation (51) should have read

$$\log N = 0{\cdot}246\, v_c + 1{\cdot}278.$$

* * *

New sugar factory in El Salvador[2].—A new sugar factory is to be constructed at a cost of 20 million colones ($US 8,000,000) to process the cane output of about 3000 farmers in the departments of San Vicente, Cuscatlán, Cabañas and La Paz. The initial capacity will be 2500 t.c.d.

* * *

New Czechoslovakian sugar factory[3].—A large sugar factory at Hrušovany has been put into operation which, built in collaboration with Polish manufacturers, is one of the most modern in the world in respect of machinery and technology.

* * *

New Indian sugar factories[4].—According to the Indian Ministry of Agriculture, ten new sugar factories are to commence crushing operations in the 1973/74 season. They include one in Andhra Pradesh, two in Gujerat, six in Maharashtra and one in Orissa. No details are given of the size of the plants. Another factory, of 1500 t.c.d. capacity, is to be erected in the Mandya district of Mysore and is expected to start operations at the end of 1973.

* * *

Costa Rica sugar production 1971/72[5].—Sugar production in the 1971/72 season in Costa Rica amounted to 3·7 million quintals (187,500 short tons) compared with 3·3 million quintals (167,250 short tons) in 1970/71.

* * *

New bulk sugar terminal in Philippines[6].—A bulk terminal costing US $1,200,000 is being set up in San Miguel, Bauan, Batangas for bulk handling of major export products, including sugar. The terminal is owned by a consortium of sugar companies and was expected to be operational by November 1972. It is to have two silos and reception capacity of 200 tons/hour. It is expected to handle 100,000 tons per annum.

* * *

British Honduras sugar crop, 1971/72[7].—The 1971/72 sugar crop in British Honduras was a record, amounting to 69,967 tons or 5116 tons more than in 1970/71 and 3174 tons more than the previous record crop of 1969/70. Of the total, 39,503 tons were made at Corozal from 364,868 tons of cane while the balance of 30,564 tons of sugar was made at Tower Hill from 302,786 tons of cane.

* * *

New beet sugar analysis equipment[8].—A fully automatic machine for extraction and filtration of juice for the determination of the sugar content of beets has been developed in East Germany. Using the equipment, the yield of sugar which may be obtained from the beets can be determined before processing, and numerous orders have already been received for it from the Soviet Union.

* * *

Senegal sugar expansion[9].—The new Senegal Sugar Company (C.S.S.) has an output target of 100,000 tons a year which it is to reach in 1976, when sugar imports, currently totalling 70,000 tons a year, will no longer be needed. C.C.S. has taken over the operations of the Cie. Africaine de Produits Alimentaires, a subsidiary of the French St.-Louis refinery company, which were terminated on the 31st July 1972.

C. W. Murray Award

Mr. C. R. D. SHANNON, a lifelong friend of CECIL MURRAY, has recently retired from the Award panel owing to ill-health. In his place Dr. J. R. ALLEN, Director of Research at the Sugar Research Institute, Mackay, Queensland, has kindly accepted the Board's invitation to fill this vacancy.

Dr. ALLEN has held the position of Director of Research since 1962 and is also Regional Vice-Chairman for Queensland of the International Society of Sugar Cane Technologists. He was Chairman of the Engineering Section at the Congress held in Louisiana in 1971.

Contributors of papers for the 1973 Award are reminded that details regarding the preparation and submission of papers are available from the address given below and entries should be posted to arrive there not later than 31st March 1973:

C. W. Murray Award,
Fletcher and Stewart Limited,
S.P.P. House,
20/26 Lamb's Conduit Street,
LONDON W.C.1, England.

Indian sugar production incentives.—According to reports from India, several new measures are aimed at an increase of sugar production[10]. The minimum price paid to farmers for sugar cane has been raised from 7·37 to 8·00 rupees, and the Indian Government expects sugar production to be increased by 400,000 tons, white value, to 3·5 million tons. A report from the National Council of Applied Economic Research[11] in October set the then current stocks at sufficient to cover only two weeks' demand, based on an average monthly consumption of 300,000 tons. The organization forecast that 1973 output would only just meet demand which they estimated at 3·7 million tons.

* * *

New sugar factories in Spain[12].—In addition to the 1500 tons/day factory to be erected for Azucarera El Carpio S.A. in Córdoba Province[13], a new sugar factory, Ciudad Real, is in construction for Hijos de Carlos Eugui S.A. with a capacity of 1500 tons of beet per day. A third factory at Linares, in Jaen Province, is being built for Azucareras Reunidas de Jaen S.A. with a capacity of 3000 tons of beet per day. All three are white sugar factories. The sugar factory at La Garrovilla in Bajadoz Province, belonging to the Ebro Group, was to start operations in the current campaign with a daily slice of 1100 tons of beet.

* * *

Haiti sugar factory plans[14].—Centrale Sucrière de l'Arcahale plans to build a cane sugar factory in Haiti of 1500 t.c.d. capacity.

* * *

Trinidad sugar production, 1972[15].—Total sugar production during the 1972 season amounted to 228,315 long tons, compared with 389,469 tons produced in 1971.

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[1] *I.S.J.*, 1972, **74**, 103–108, 136–140, 169–172.
[2] *Bolsa Review*, 1972, **6**, 634.
[3] *Zeitsch. Zuckerind.*, 1972, **97**, 594.
[4] *Indian Sugar*, 1972, **22**, 198–199.
[5] *Bolsa Review*, 1972, **6**, 634.
[6] *Sugar News* (Philippines), 1972, **47**, 236.
[7] *W. Indies Chron.*, 1972, **87**, 421.
[8] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (28), 5.
[9] *Reuters Sugar Rpt.*, 22nd September 1972.
[10] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (29), 8.
[11] *Public Ledger*, 14th October 1972.
[12] *Zeitsch. Zuckerind.*, 1972, **97**, 594.
[13] *I.S.J.*, 1972, **74**, 160.
[14] *Zeitsch. Zuckerind.*, 1972, **97**, 595.
[15] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (30), 9.

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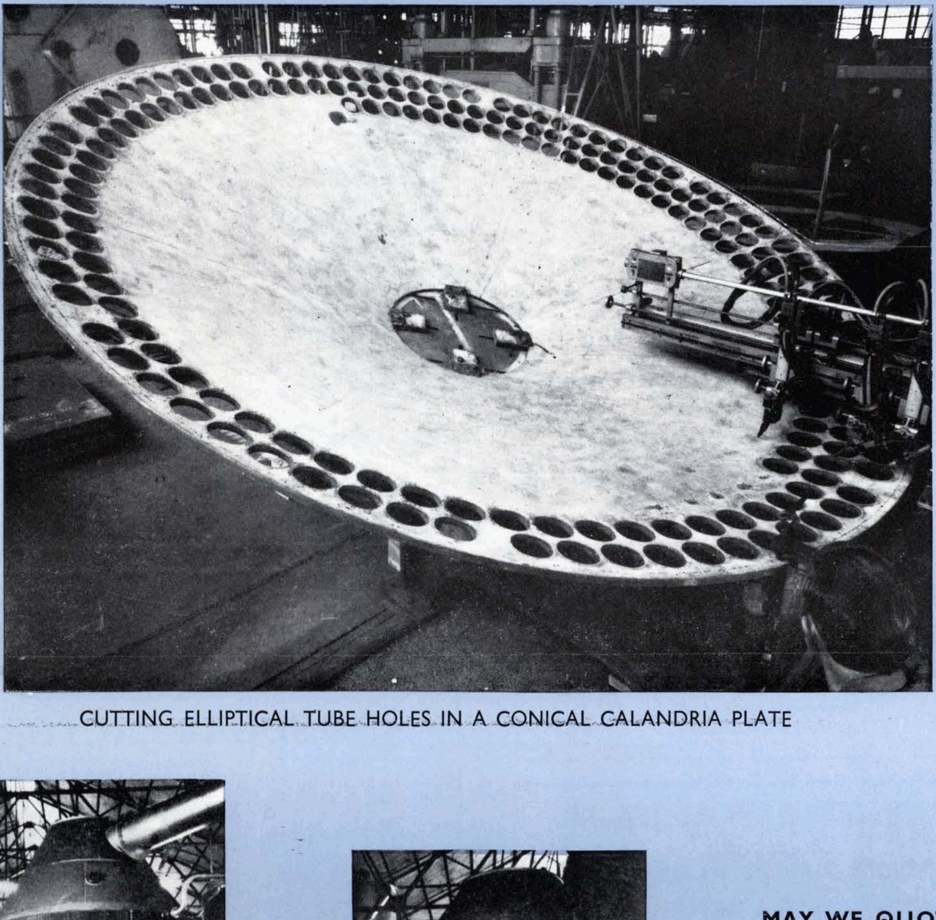

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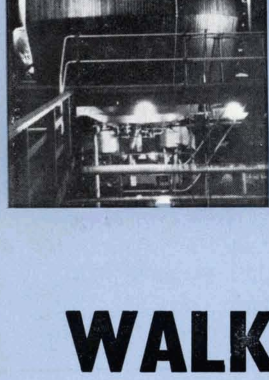

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Index to Advertisers

FOR THE BUYERS' GUIDE SEE THIS ISSUE pp. xxvii-xliv

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
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.

Accumulators, Steam
see Steam Accumulators.

Activated carbon
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Atlas Chemicals Division, ICI America Inc.
Chemviron S.A.
Honeywill-Atlas Ltd.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.

Air clutches
Farrel Company.
Renold Ltd.

Air compressors
Peter Brotherhood Ltd.
Cotton Bros. (Longton) Ltd.
Fives Lille-Cail.
Nash Engineering Company.

Air compressors, Oil-free
Peter Brotherhood Ltd.
Elliott Turbomachinery Ltd.
Nash Engineering Company.

Air coolers
Carter Industrial Products Ltd.
E. Green & Son Ltd.

Air heaters
M. Dedini S.A. Metalúrgica.
E. Green & Son Ltd.

Air-operated portable stitchers
Thomas C. Keay Ltd.
Thames Packaging Equipment Co.

Alcohol plant
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Polimex-Cekop.
Tate & Lyle Enterprises Ltd.

Alcohol plant consultancy services
Bookers Agricultural and Technical Services Ltd.

Ammonia removal from condensates
Robert Reichling & Co. K.G.

Anti-foam agents
Hodag Chemical Corporation.

Automatic beet laboratories
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

Automatic refractometers
Bellingham and Stanley Ltd.

Automatic saccharimeters and polarimeters
Bellingham and Stanley Ltd.
Dr. Wolfgang Kernchen Optik-Elektronik-Automation.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.
Thorn Automation Ltd.
Carl Zeiss.

Automatic tare rooms
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

Bag
see Sack.

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

Bagasse baling presses
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
A. & W. Smith & Co. Ltd.

Bagasse depithing equipment
Stedman Foundry & Machine Co. Inc.
S. A. Verkor.

Bagasse furnaces
Babcock & Wilcox Ltd.
M. Dedini S.A. Metalúrgica.
Foster Wheeler John Brown Boilers Ltd.
S.E.U.M.

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

Bagasse presses
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
French Oil Mill Machinery Co.
Sucatlan Engineering.

Bearings and pillow blocks
Kingston Industrial Works Ltd.

Beet diffusers, Continuous
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.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Polimex-Cekop.
Sucatlan Engineering.

Beet flume equipment
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Polimex-Cekop.

Beet harvesters
Ransomes Sims & Jefferies Ltd.

Beet mechanical discharging and storage equipment
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fives Lille-Cail.
Jenkins of Retford Ltd.
Polimex-Cekop.

Beet molasses sugar recovery
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Polimex-Cekop.
Robert Reichling & Co. K.G. (*Quentin process*).
Stork-Werkspoor Sugar N.V.

Beet pulp presses
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd
Hein, Lehmann A.G.
Polimex-Cekop.
Salzgitter Maschinen A.G.
Simon-Heesen B.V.
Stord Bartz Industri A/S
Ingeniörsfirman Nils Weibull AB.

Beet seed
A/S De Danske Sukkerfabrikker.
Kleinwanzlebener Saatzucht AG.

Beet slicers
Dreibholz & Floering Ltd.
Fives Lille-Cail.
Polimex-Cekop.
H. Putsch & Comp.

Beet tail utilization plant
BMA Braunschweigische Maschinenbauanstalt.
H. Putsch & Comp.

Beet tare house equipment
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Venema Automation N.V.
Ingeniörsfirman Nils Weibull AB.

Beet washing plant
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
Sucatlan Engineering.

Beet water-jet unloading equipment
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
Dreibholz & Floering Ltd.
Polimex-Cekop.

Belting, Conveyor and elevator
see Conveyor belting.

Boiler tube brushes, Spiral and expanding
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Boiler tube cleaners, Air and electric
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Boiler water treatment
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co K.G.
Werkspoor Water N.V.

Boilers, Shell
Babcock & Wilcox Ltd.
Robey of Lincoln Ltd.

Boilers, Water tube
Babcock & Wilcox Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd
International Combustion Ltd.
Kawasaki Heavy Industries Ltd.
Polimex-Cekop.
Riley Stoker Corporation.
Stork-Werkspoor Sugar N.V.
Takuma Co. Ltd.

Bone char
British Charcoals & Macdonalds Ltd.
see also Char.

Brushes
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.

Bulk handling
see Conveyors and Elevators, *etc.*

Bulk liquid sugar handling plants.
T. Giusti & Son Ltd.

Bulk storage hoppers
A.P.V.-Kestner Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
The Tills Engineering Co. Ltd.

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

Bunker discharge equipment.
Redler Conveyors Ltd.

Burners, Sulphur
see Sulphur furnaces, Continuous.

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

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

Cane cars and trailers
AB. Bolinder-Munktell.
Fletcher and Stewart Ltd.
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Cane carts
Fletcher and Stewart Ltd.
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

Cane conveyor drives
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.

Cane cultivation equipment
Massey-Ferguson (Export) Ltd.
Napier Bros. Ltd.
Ransomes Sims & Jefferies Ltd.
Rome Industries.

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BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A/S De Danske Sukkerfabrikker.
Extraction De Smet S.A.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Walkers Ltd.

Cane grapples
Mennesson & Cie.

Cane harvesters
Massey-Ferguson (Export) Ltd.
Toft Bros. Pty. Ltd.

Cane loaders
AB. Bolinder-Munktell.
F. W. McConnel Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Pty. Ltd.

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

Cane planters
Massey-Ferguson (Export) Ltd.
Thomson International Company.

Cane preparation equipment for diffusion
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Co.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Cane shredders
see Shredders.

Cane slings
Parsons Chain Co. Ltd.

Cane trash shredders
C F & I Engineers Inc.
Gruendler Crusher & Pulverizer Co.

Cane washing plants
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Thomson International Company.

Cane washing tables
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Tate & Lyle Enterprises Ltd.

Cane wash water cleaning systems
Dorr-Oliver Inc., Cane Sugar Division.

Cane wet disintegrators for analysis
Jeffress Bros. Ltd.

Carbon, Decolorizing
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Atlas Chemicals Division, ICI America Inc.
Chemviron S.A.
Honeywill-Atlas Ltd.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
The Sugar Manufacturers' Supply Co. Ltd.

Carbon decolorizing systems
Pittsburgh Activated Carbon Division, Calgon Corporation.
Suchar.
Tate & Lyle Enterprises Ltd.

Carbon reactivation
Chemviron S.A.
Pittsburgh Activated Carbon Division, Calgon Corporation.

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

Castings
Babcock & Wilcox Ltd.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
Kingston Industrial Works Ltd.
Newell Dunford Engineering Ltd.
Stork-Werkspoor Sugar N.V.

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

Centrifugal backings
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Krieg & Zivy Industries.
The Western States Machine Co.

Centrifugal clarifiers
Dorr-Oliver Inc., Cane Sugar Division.

Centrifugal motors
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.
The Western States Machine Co.

Centrifugal screens
ASEA-Weibull.
Balco Filtertechnik G.m.b.H.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Hein, Lehmann A.G.
Krieg & Zivy Industries.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

Centrifugals and accessories
ACEC.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
CF & I Engineers Inc.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co. Ltd.
The Western States Machine Co.

Centrifugals—Complete electrical equipment
ACEC.
Hinz Elektromaschinen und Apparatebau G.m.b.H.

Centrifugals, Continuous
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Fives Lille-Cail.
Hein, Lehmann A.G.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
Western States Machine Co.

Centrifugals—Fully automatic batch-type
ASEA-Weibull.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Western States Machine Co.

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

Chain cane slings
Codistil–Construtora de Distilarias Dedini S.A.
Kettenfabrik Unna G.m.b.H.
Parsons Chain Co. Ltd.

Chains
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Kettenfabrik Unna G.m.b.H.
Parsons Chain Co. Ltd.
Renold Limited.

Chemical plants
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
T. Giusti & Son Ltd.
Polimex-Cekop.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Chemicals
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
May & Baker Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

Clarifiers
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
The Tills Engineering Co. Ltd.

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

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

Colorimeters
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.

Complete cane sugar factories
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.

Condensers, Water jet ejector
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Condensing plant, Barometric
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Continuous belt weighing machines
Neyrpic.

Controls, Hydraulic
Edwards Engineering Corporation.

Conveyor belting
Habasit A.G.

Conveyor chains
Codistil–Construtora de Distilerias Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Renold Limited.
A. & W. Smith & Co. Ltd.

Conveyors and elevators
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
British Ropeway Engineering Co. Ltd.
C F & I Engineers Inc.
Fives Lille-Cail.
Hein, Lehmann A.G.
Kingston Industrial Works Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Sucatlan Engineering
Walkers Ltd.
Ulrich Walter Maschinenbau.
Ingeniörsfirman Nils Weibull AB.

Belt and bucket elevators
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Nordon & Cie.
Redler Conveyors Ltd.

Belt conveyors
Buckau-Wolf Maschinenfabrik A.G
Codístil–Construtora de Distilarios Dedini S.A.
Jenkins of Retford Ltd.

Bucket elevators
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Redler Conveyors Ltd.

Chain and bucket elevators
Ewart Chainbelt Co. Ltd.
Jenkins of Retford Ltd.
Redler Conveyors Ltd.

Chain conveyors
Codístil–Construtora de Distilarios Dedini S.A.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
The Thames Packaging Equipment Co.

Feeder conveyors
M. Dedini S.A. Metalúrgica.
see also Sugar throwers and trimmers *and* Vibrating feeders.

Grasshopper conveyors
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G
The Mirrlees Watson Co. Ltd.

Pneumatic conveyors
Codístil–Construtora de Distilarias Dedini S.A.
Newell Dunford Engineering Ltd.
Nordon & Cie.
Redler Conveyors Ltd.
The Tills Engineering Co. Ltd.

Scraper conveyors
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart.
Jenkins of Retford Ltd.

Screw conveyors
Ewart Chainbelt Co. Ltd.
The Mirrlees Watson Co. Ltd.

Vibratory conveyors
Ewart Chainbelt Co. Ltd.
The Sinex Engineering Co. Ltd.

Conveyors and elevators, Mobile
The Thames Packaging Equipment Co.

Coolers, Fluidized bed
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Codistil–Construtora de Distilarias Dedini S.A.
Rosin Engineering Co. Ltd.

Coolers, Pellet
Simon-Heesen B.V.

Coolers, Sugar
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil–Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Polimex-Cekop.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Ingeniörsfirman Nils Weibull AB.

Coolers, Water
Codistil–Construtora de Distilarias Dedini S.A.
Film Cooling Towers (1925) Ltd.

Cranes
Babcock & Wilcox Ltd.
Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.

Crystallization aids
Fabcon Inc.
Hodag Chemical Corporation.

Crystallizers
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Crystallizers, Continuous
C F & I Engineers Inc.
Fives Lille-Cail.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Cube-making machinery
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Ingeniörsfirman Nils Weibull A.B.

Cube sugar moulding, ranging and packeting plant
Buckau-Wolf Maschinenfabrik A.G.
Chambon Ltd.
Elba Machinefabrieken B.V.

Cube wrapping machines
SAPAL.

Deaerators
The Permutit Co. Ltd.
Robert Reichling & Co. KG..
Stork-Werkspoor Sugar N.V.

Decolorizing plants
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Atlas Chemicals Division, ICI America Inc.
BMA Braunschweigische Maschinenbauanstalt.
Chemviron S.A.
Honeywill-Atlas Ltd.
The Permutit Co. Ltd.
Pittsburgh Activated Carbon Division, Calgon Corporation.
Polimex-Cekop.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.

Decolorizing resins
Montedison—Div Prodotti Industria.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Rohm and Haas Company.

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

Demineralization plants
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Werkspoor Water N.V.

Diatomaceous earth
see Filter-aids.

Diesel alternator sets
ACEC.
Stork-Werkspoor Sugar N.V.

Distillery plant
see Alcohol plant.

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

Drives, Hydraulic
Edwards Engineering Corporation.

Drives, Variable speed
Renold Limited.
Thorn Automation Ltd.

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

Dryers
A.P.V.-Mitchell (Dryers) Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Codistil Construtora de Distilarias Dedini S.A.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Newell Dunford Engineering Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Dryers, Fluidized bed
A.P.V.-Mitchell (Dryers) Ltd.
Buell Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.
West's (Manchester) Ltd.

Dust control equipment
Buell Ltd.
Carter Industrial Products Ltd.
Dust Control Equipment Ltd.
Newell Dunford Engineering Ltd.
Stansteel Corporation.
Takuma Co. Ltd.
The Tills Engineering Co. Ltd.
Zurn Air Systems.

Dust sleeves and bags
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
JK Industrial Fabrics.
P. & S. Textiles Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

Economizers
E.Green & Son Ltd.
International Combustion Ltd.

Effluent treatment
The Davenport Engineering Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.
International Combustion Ltd.
Perkin-Elmer Ltd.
The Permutit Co. Ltd.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

Electric motors
ACEC.
Weir Pumps Ltd.

Electric motors, Fractional horsepower
The Thames Packaging Equipment Co.

Electric power generators
ACEC.
Stork-Werkspoor Sugar N.V.

Electric tube cleaning machines
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.

Electronic control systems for process plant
Bailey Meters & Controls Ltd.
C F & I Engineers Inc.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Tate & Lyle Enterprises Ltd.

Electronic equipment
ACEC.
Bailey Meters & Controls Ltd.

Engineering design and contracting services
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Jenkins of Retford Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
The Tills Engineering Co. Ltd.

Engines, Diesel
Stork-Werkspoor Sugar N.V.

Engines, Steam
Fives Lille-Cail.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Entrainment separators
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

Enzymes
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

Evaporator additives
Allied Colloids Manufacturing Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fabcon Inc.
Hodag Chemical Corporation.

Evaporator tube cleaners
see Tube cleaners.

Evaporators and condensing plant
Alfa-Laval AB.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.
Wiegand Karlsruhe G.m.b.H.

Evaporators, Falling film
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.
Wiegand Karlsruhe G.m.b.H.

Expanders, Tube
see Tube expanders.

Fans, Induced and forced draft
M. Dedini S.A. Metalúrgica.
Stork-Werkspoor Sugar N.V.
Zurn Air Systems.

Feasibility studies for sugar projects
F. C. Schaffer & Associates Inc.

Filter aids
Dicalite/GREFCO Inc., International Division.
Fabcon Inc.
Filter-Media Company.
Sil-Flo Incorporated.
The Sugar Manufacturers' Supply Co. Ltd.

Filter cloths
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

Filter leaves
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.

Filter papers
Evans, Adlard & Co. Ltd.
A. H. Korthof N.V.
The Sugar Manufacturers' Supply Co. Ltd.

Filter screens
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
Krieg & Zivy Industries.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.
Weco Filter Sleeve Manufacturing Co. Ltd.

Filters
Fives Lille-Cail.
Polimex-Cekop.
Sucatlan Engineering.
Werkspoor Water N.V.
Wire Weaving Co. Ltd.

Automatically controlled filters
Chemap A.G.
Schumacher'sche Fabrik.
Stella Meta Filters.
Stockdale Engineering Ltd.
U.S. Filter Systems.

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

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

Diatomite filters
Chemap A.G.
The Mirrlees Watson Co. Ltd.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.
U.S. Filter Systems.

Filter presses
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

Filter thickeners
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
H. Putsch & Comp.
Schumacher'sche Fabrik.
Stockdale Engineering Ltd.

Gravity and pressure filters
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Stockdale Engineering Ltd.

Iron removal filters
Rapid Magnetic Ltd.
Stockdale Engineering Ltd.

Laboratory filters
see Laboratory filters.

Leaf filters
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
U.S. Filter Systems.

Plate and frame filters
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

Pressure filters
BMA Braunschweigische Maschinenbauanstalt.
Chemap A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
H. Putsch & Comp.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Stockdale Engineering Ltd.
Suchar.
U.S. Filter Systems.

Rotary vacuum filters
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Dorr-Oliver Inc., Cane Sugar Division.
H. Putsch & Comp.
Stockdale Engineering 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.
Renold Limited.

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

Flocculants
Allied Colloids Manufacturing Co. Ltd.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

Flowmeters
Bailey Meters & Controls Ltd.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
Negretti & Zambra Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.

Gas purifying equipment
Maschinenfabrik H. Eberhardt.
Newell Dunford Engineering Ltd.
Stork-Werkspoor Sugar N.V.

Gear couplings
David Brown Gear Industries Ltd.
M. Dedini S.A. Metalúrgica.
Renold Limited.

Gearing
see Reduction gears.

Gearmotors
David Brown Gear Industries Ltd.
Renold Limited.

Granulators
see Dryers.

Harvesters
see Beet harvesters *and* Cane harvesters.

Heat exchangers, Air-cooled
E. Green & Son Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.

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

Heat exchangers, Plate-type
Alfa-Laval AB.
A.P.V. Co. Ltd.

Heat exchangers, Spiral-type
Alfa-Laval AB.

Heat exchangers, Tubular
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
International Combustion Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Ingeniörsfirman Nils Weibull A.B.

Heat sealers
The Thames Packaging Equipment Co.

Infield cane transport
Toft Bros. Pty. Ltd.

Magnetic lifting equipment
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics Co.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.

Magnetic separators
Brimag Ltd.
Electromagnets Ltd.
Eriez Magnetics Co.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.
Ulrich Walter Maschinenbau.

Massecuite heat treating equipment
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers 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.

Mill hydraulics
M. Dedini S.A. Metalúrgica.
Edwards Engineering Corporation.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Mill roll movement indicators and recorders
Edwards Engineering Corporation.

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

Milling plant
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Kawasaki Heavy Industries Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

Mixing machines
Babcock & Wilcox Ltd.

Moisture expellers
Richard Simon & Sons Ltd.
Sucatlan Engineering.

Molasses addition plants for beet pulp
Amandus Kahl Nachf.
Ulrich Walter Maschinenbau.

Molasses scales, Fully automatic
N.V. Servo-Balans.

Molasses tanks
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Codistil–Construtora de Distilarias Dedini S.A.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Kingston Industrial Works Ltd.
Polimex-Cekop.
Stork-Werkspoor Sugar N.V.

Packeting machinery
Thomas C. Keay Ltd.

Pan boiling aids
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Hodag Chemical Corporation.

Pan circulators
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Tate & Lyle Enterprises Ltd.

Pans, Vacuum
A.P.V.-Mitchell (Dryers) Ltd.
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.
M. Dedini S.A. Metalúrgica.
John Dore & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

Pelleting presses for bagasse and pith
Amandus Kahl Nachf.
Simon-Heesen B.V.

Pelleting presses for dried pulp
Amandus Kahl Nachf.
Simon-Heesen B.V.

Perforated metals
Ferguson Perforating & Wire Co.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
J. & F. Pool Ltd.
Ulrich Walter Maschinenbau.

Pipe fittings
see Tube fittings.

Pipes, Non-ferrous
Birmingham Battery Tube Company

Pipework installation
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
Nordon & Cie.

Polythene bag sealers
The Thames Packaging Equipment Co.

Power plants
Stork-Werkspoor Sugar N.V.

Power transmission equipment
Thomas Broadbent & Sons Ltd.
David Brown Gear Industries Ltd.
Engrenages et Reducteurs Citröen-Messian.
Farrel Company.
Renold Limited.

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

Pressure feeders
Walkers Ltd.

Pressure gauges
Negretti & Zambra Ltd.
Serseg (Seguin-Sergot).
G. H. Zeal Ltd.

Pressure vessels
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
International Combustion Ltd.
Robey of Lincoln Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Printing machinery for sugar cartons, etc.
Chambon Ltd.

Pulp screens
C F & I Engineers Inc.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.

Pulverizers, Sugar
The Sugar Manufacturers' Supply Co. Ltd.

Pumps
Dorr-Oliver Inc., Cane Sugar Division.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Weir Pumps Ltd.

Beet pumps
Ateliers de Construction d'Ensival S.A.
Foster Pump Works Inc.
Polimex-Cekop.
Weise & Monski, Weise Soehne G.m.b.H.

Sugar factory design and erection (Cane and Beet)
ABR Engineering.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Waschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Reggiane O.M.I. S.p.A.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Sugar machinery, General
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Dorr-Oliver Inc., Cane Sugar Division.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Kay Iron Works (Pvt.) Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
Reggiane O.M.I. S.p.A.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.

Sugar refinery consultancy services
C F & I Engineers Inc.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
Polimex-Cekop.
F. C. Schaffer & Associates Inc.
Tate & Lyle Technical Services Ltd.

Sugar refinery design and erection
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
M. Dedini S.A. Metalúrgica.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
The Mirrlees Watson Co. Ltd.
Polimex-Cekop.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Sugar silos
A/S De Danske Sukkerfabrikker.
Fives Lille-Cail.
The Tills Engineering Co. Ltd.
Ingeniörsfirman Nils Weibull A.B.

Sugar tabletting machinery
Chambon Ltd.
Elba Machinefabrieken B.V.
Stansteel Corporation.
Ingeniörsfirman Nils Weibull A.B.

Sugar throwers and trimmers
Redler Conveyors Ltd.

Sulphur furnaces, Continuous
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
M. Dedini S.A. Metalúrgica.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.

Switchgear
ACEC.

Temperature recorders and controllers
Bailey Meters and Controls Ltd.
Chemap A.G.
Fischer & Porter Ltd.
Foxboro-Yoxall Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.

Test sieves, B.S. and A.S.T.M.
A. H. Korthof N.V.

Thermometers
A. H. Korthof N.V.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

Thickeners, Tray-type
Dorr-Oliver Inc., Cane Sugar Division.

Trailers
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.
Toft Bros. Pty. Ltd.

Transmission belting
Habasit A.G.

Tube brushes, Wire
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

Tube cleaners, Rotary (Electric and air)
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool)Ltd.
Nordon & Cie.
Rotatools (U.K.) Ltd.
see also Scale removal and prevention.

Tube expanders
Rotatools (U.K.) Ltd.

Tube fittings
Realm Engineering Works Ltd. (*stainless steel*).

Tubes, Bimetal
Birmingham Battery Tube Company.

Tubes for boilers, evaporators, juice heaters, vacuum pans, etc.
Babcock & Wilcox Ltd.
Birmingham Battery Tube Company.
Fives Lille-Cail.
General Tubing Pty. Ltd.

Tubes, Stainless steel
General Tubing Pty. Ltd.
Welding Technical Services Ltd.

Urea addition plant for molasses fodder mixtures
Ulrich Walter Maschinenbau.

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

Vacuum pans
see Pans.

Vacuum pumps
Ateliers de Construction d'Ensival S.A.
Cotton Bros (Longton) Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Nash Engineering Company.
Neyrpic.
A. & W. Smith & Co. Ltd.

Vacuum pumps, Oil-free
Nash Engineering Company.
George Waller & Son Ltd.

Valve actuators, Hydraulic
Edwards Engineering Corporation.

Valves
Chemap A.G.
M. Dedini S.A. Metalúrgica.
George Waller & Son Ltd.

Ball valves
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

Diaphragm valves
Negretti & Zambra Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot)

Diverter valves
The Tills Engineering Co. Ltd.
Westinghouse Brake and Signal Co. Ltd.

Glass ball valves
Fischer & Porter Ltd.

Relief valves
Blundell & Crompton Ltd.

Rotary valves
The Tills Engineering Co. Ltd.
Westinghouse Brake and Signal Co. Ltd.

Stainless steel valves
A.P.V. Co. Ltd.
Realm Engineering Works Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).

Vacuum pan discharge valves
Fletcher and Stewart Ltd.

Vibrating feeders
Electromagnets Ltd.
Eriez Magnetics Co.
Riley (I.C.) Products Ltd.
The Sinex Engineering Co. Ltd.

Vibrators
Electromagnets Ltd.
Eriez Magnetics Co.
Riley (I.C.) Products Ltd.
The Sinex Engineering Co. Ltd.

Water cooling towers
Carter Industrial Products Ltd.
The Davenport Engineering Co. Ltd.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.

Water treatment
Babcock & Wilcox Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Fabcon Inc.
The Permutit Co. Ltd.
Polimex-Cekop.
Robert Reichling & Co. K.G.

Weed control chemicals
May & Baker Ltd.

Weighing machines
Cellier S.A.
Fletcher and Stewart Ltd.
Librawerk Pelz & Nagel K.G.
N.V. Servo-Balans.
Richard Simon & Sons Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
see also Juice scales.

Wire brushes, Rotary and manual
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.

Wirecloth
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.
Wire Weaving Co. Ltd.

Wire gauze strainers
N. Greening (Warrington) Ltd.

Wire tying sack tool
Thames Packaging Equipment Co.

Woven wire
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.

Wrapping machines
SAPAL.

Yeast plants
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Hitachi Shipbuilding & Engineering Co. Inc.
Nordon & Cie.
Polimex-Cekop.
Tate & Lyle Enterprises Ltd.

BUYERS' GUIDE—ADDRESS LIST

A.B.M. Industrial Products Ltd.,
Woodley, Stockport, Cheshire, England.
Tel.: 061–430 4391. *Cable:* Chrievan, Stockport.
Telex: 667835.

ABR Engineering,
Rue du Trône 4, B-1050 Bruxelles, Belgium.
Tel.: 13.84.90.
Telex: 22.328.

ACEC Ateliers de Constructions Electriques de Charleroi SA.,
Boite Postale 4, B 6000 Charleroi, Belgium.
Tel.: 07/36.20.20. *Cable:* Ventacec, Charleroi.
Telex: Acec Charleroi 51.227.

The Albany Engineering Co. Ltd.,
Church Road, Lydney, Glos., GL15 5EQ England.
Tel.: Lydney 2275. *Cable:* Bolthead, Lydney.
Telex: 43363.

Alfa-Laval AB.,
Box 1008, S-221 03 Lund 1, Sweden.
Tel.: 046-14 03 20. *Cable:* Alfalaval, Lund.
Telex: 3145.

Allied Colloids Manufacturing Co. Ltd.,
Low Moor, Bradford, Yorkshire, BD12 0JZ England.
Tel.: Bradford 671267. *Cable:* Colloidall, Bradford.
Telex: 51646.

The A.P.V. Co. Ltd.,
P.O. Box 4, Crawley, Sussex, RH10 2QB England.
Tel.: Crawley 27777. *Cable:* Anaclastic, Crawley, Telex.
Telex: 87237.

A.P.V.-Kestner Ltd.,
Greenhithe, Kent, England.
Tel.: Greenhithe 3281. *Cable:* Kestnerato, Dartford.
Telex: 896356.

A.P.V.-Mitchell (Dryers) Ltd.,
Denton Holme, Carlisle, Cumberland, CA2 5DU England.
Tel.: Carlisle 24205. *Cable:* Dryers, Carlisle.

ASEA-Weibull,
P.O. Box 4015, S-28104 Hässelholm 4, Sweden.
Tel.: (0451) 83000. *Cable:* Nilswei, ässelholm.H
Telex: 48086.

Ateliers de Construction d'Ensival S.A.,
44 rue Hodister, B-4851 Wegnez, Belgium.
Tel.: 087–60166. *Cable:* Pompensi, Pepinster.
Telex: 41358.

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.

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

Babcock & Wilcox Ltd.,
Cleveland House, St. James's Square, London, SW1Y 4LN England.
Tel.: 01–930 9766. *Cable:* Babcock, London S.E.1.
Telex: 884151/2/3.

Bailey Meters & Controls Ltd.,
218 Purley Way, Croydon, CR9 4HE England.
Tel.: 01–686 0400. *Cable:* Bailemeta, London.
Telex: 262335.

Balco-Filtertechnik G.m.b.H.,
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: 830 71–2. *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, E14 8HA England.
Tel.: 01–987 6001. *Cable:* Blundell, London, E14 8HA.

BMA Braunschweigische Maschinenbauanstalt,
33 Braunschweig, Am Alten Bahnhof 5, Postfach 3225, Germany.
Tel.: (0531) 804-1. *Cable:* Bema, Braunschweig.
Telex: 952 456.

AB. Bolinder-Munktell,
S-63185 Eskilstuna, Sweden.
Tel.: 11 00 00. *Cable:* Munktells, Eskilstuna.
Telex: 409 97.

Bookers Agricultural & Technical Services Ltd.,
Bucklersbury House, 83 Cannon St., London EC4N 8EJ England.
Tel.: 01–248 8051. *Cable:* Sugarcane, London E.C.4.
Telex: 888169.

Brimag Ltd.,
Amington Colliery, Glascote Heath, Tamworth, Staffs England.
Tel.: Tamworth 3581.
Telex: 27769 Minsep London for Brimag.

British Brown Boveri Ltd.,
Glen House, Stag Place, London, SW1E 5AM England.
Tel.: 01–828 9422. *Cable:* Brownboveri, London SW1.
Telex: 23448.

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

British Ropeway Engineering Co. Ltd.,
Tubs Hill House, London Rd., Sevenoaks, Kent, England.
Tel.: Sevenoaks 55233. *Cable:* Boxhauling, Sevenoaks.
Telex: 95164.

Thomas Broadbent & Sons Ltd.,
Queen Street South, Huddersfield, Yorkshire, HD1 3EA England.
Tel.: 0484–22111. *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, Yorkshire, HD4 5DD England.
Tel.: 0484–22180. *Cable:* Gearing, Huddersfield.
Telex: 51562/3.

Buckau-Wolf Maschinenfabrik A.G.,
D 4048 Grevenbroich, Postfach 69, Germany.
Tel.: 02181/421. *Cable:* Buckauwolf, Grevenbroich.
Telex: 0851 7111.

Buell Ltd.,
George Street Parade, Birmingham, B3 1QQ England.
Tel.: 021–236 5391. *Cable:* Buellon, Birmingham.
Telex: 338458.

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

Carter Industrial Products Ltd.,
Redhill Road, Birmingham, B25 8EY England.
Tel.: 021–722 4300. *Cable:* Midheat, Birmingham.
Telex: 339219.

Cellier S.A.,
B.P.58, 73102 Aix-les-Bains, France.
Tel.: (79) 35.05.65. *Cable:* Inoxel, Aix-les-Bains.
Telex: 32.053 F Inoxel.

C F & I Engineers Inc.,
3309 Blake Street, Denver, Colo., 80205 U.S.A.
Tel.: (303) 623-0211. *Cable:* Cfienginer, Denver.
Telex: 45-567.

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.: (01) 73 91 01. *Cable:* Servochemie, Männedorf.
Telex: 75 508.

Chemviron S.A.,
P.O. Box 17, Ixelles 1, B-1050 Brussels, Belgium.
Tel.: (02) 13 40 66. *Cable:* Chemviron, Brussels.
Telex: 22 481 Chemviron Bru B.

Cocksedge & Co. Ltd.,
P.O. Box 41, Grey Friars Rd., Ipswich, Suffolk, IP1 1UW England.
Tel.: 56161. *Cable:* Cocksedge, Ipswich.
Telex: 98583.

Codistil-Construtora de Distilarias Dedini S.A.,
see M. Dedini S.A. Metalúrgica.

Cotton Bros (Longton) Ltd.,
Crown Works, Portland Rd., Longton, Stoke-on-Trent ST3 1EN, England.
Tel.: 0782-33021. *Cable:* Cotbro, Stoke-on-Trent.

A. F. Craig & Co. Ltd.,
Caledonia Engineering Works, Paisley, PA3 2NA Scotland.
Tel.: 041–889 2191. *Cable:* Craig, Paisley.
Telex: 778051.

A/S De Danske Sukkerfabrikker,
(The Danish Sugar Corporation).
Langebrogade 5, Copenhagen K, Denmark.
Tel.: (01) AS 6130. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 27030 dansuk dk.

The Davenport Engineering Co. Ltd.,
Harris Street, Bradford, BD1 5JD England.
Tel.: 29361. *Cable:* Humidity, Bradford.
Telex: 517153.

M. Dedini S.A. Metalúrgica,
Ave. Mario Dedini 201, Piracicaba, Est. São Paulo, Brazil.
Tel.: 3-1122.

The Deister Concentrator Co. Inc.,
901/935 Glasgow Ave., Fort Wayne, Indiana, 46801 U.S.A.
Tel.: (219) 742–7213. *Cable:* Retsied, Fort Wayne.

Deplechin,
T8 Avenue de Maire, 7500 Tournai, Belgium.
2*el.:* 069 281.52. *Cable:* Deplechin, Tournai

Dicalite/GREFCO Inc., International Division,
3450 Wilshire Boulevard, Los Angeles, Calif., 90010 U.S.A.
Tel.: (213) 381–5081. *Cable:* Dicalite, Losa.
Telex: 67-4224.

John Dore & Co. Ltd.,
1–55 Fowler Road, Hainault, Essex, England.
Tel.: 01–500 4144. *Cable:* Cuivre, Ilford.

Dorr-Oliver Inc., Cane Sugar Division,
Stamford, Conn., 06904 U.S.A.
Tel.: (203) 348-5871.
Telex: 965912.

Dreibholz & Floering Ltd.,
Dereham, Norfolk, England.
Tel.: Dereham 3145. *Cable:* Slicing, Dereham.
Telex: 97357.

Dust Control Equipm entLtd.,
Thurmaston, Leicester, LE4 8HP England.
Tel.: 053723–3333. *Cable:* Dust, Leicester, Telex.
Telex: 34500.

Maschinenfabrik H. Eberhardt,
3340 Wolfenbüttel, Frankfurterstr. 14/17, Postfach 266, Germany.
Tel.: (0 53 31) 22002/3263. *Cable:* Eberhardt, Wolfenbüttel.
Telex: 09 52620 ebhdt d.

Edwards Engineering Corporation,
1170 Constance Street, New Orleans, La., 70130 U.S.A.
Tel.: (504) 524–0175. *Cable:* Joedco, New Orleans.
Telex: 058-342.

Elba Machinefabrieken B.V.,
P.O. Box 21, Ambachtsweg 3 (Industrieterrein), Huizen, N.H., Holland.
Tel.: (02152) 51956. *Cable:* Elbamachines, Huizen

Electromagnets Ltd.,
Bond Street, Hockley, Birmingham, B19 3LA England.
Tel.: 021–236 9071. *Cable:* Boxmag, Birmingham.
Telex: 339192 Electromag Birmingham.

Elliott Turbomachinery Ltd.,
15 Portland Place, London, W1N 3AA England.
Tel.: 01–637 1591. *Cable:* Carell, London
Telex: 25969.

Engrenages et Réducteura Citröen-Messian,
B.P. 43, Rue Latécoère, 78 Vélizy-Villacoublay, France.
Tel.: 946–96–55. *Cable:* Ercimer, Vélizy-Villacoublay.
Telex: Ercimer 60856 F.

Enviro-Clear Company Inc.,
1251 Avenue of the Americas, New York, N.Y., 10020 U.S.A.
Tel.: (212) 489-9060. *Cable:* Enclear, New York.

Eriez Magnetics Co., International Division,
70724 Magnet Drive, Erie, Pa., U.S.A.
Tel.: (814) 833–9881. *Cable:* Eriez, Erie.
Telex: 91–4470.

Escher Wyss Ltd.,
Case Postale-Gare Centrale, 8023 Zurich, Switzerland.
Tel.: 444451. *Cable:* Escherwyss, Zurich.
Telex: 53906/7/8.

Evans, Adlard & Co. Ltd.
Postlip Mills, Winchcombe, Cheltenham, Glos., GL54 5BB England.
Tel.: 0242–602227. *Cable:* Adlard, Winchcombe.
Telex: 43316.

Evenproducts Ltd.,
Evesham, Worcs., WR11 4TS, England.
Tel.: Evesham 41212.

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

Extraction De Smet S.A.,
265 Ave. Prince Baudouin, B-2520 Edegem-Antwerp, Belgium.
Tel.: (03) 49.42.40. *Cable:* Extraxsmet, Antwerp
Telex: 31824 Desmet B.

Fabcon Inc.,
1275 Columbus Avenue, San Francisco, Calif., 94133 U.S.A.
Tel.: (415) 928-2400/1/2. *Cable:* Fabcon, San Francisco.

Farrel Company,
Division of USM Corporation,
Ansonia, Conn., U.S.A.
Tel.: 734-3331. *Cable:* Farrelmach, Ansonia.

Farrow Irrigation Ltd.,
Horseshoe Road, Spalding, Lincs., PE11 3JA England.
Tel.: Spalding 3764. *Cable:* Farrow, Spalding.
Telex: 22404 Sugrengine Bmly.

Ferguson Perforating & Wire Co.,
130–140 Ernest Street, Providence, R.I., 02905 U.S.A.
Tel.: (401) 941-8876. *Cable:* Ferguson, Providence.
Telex: 927539.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
Tel.: 01–940 6494. *Cable:* Aloof, Richmond, Surrey.
Telex: 27451.

Filter-Media Company,
P.O. Box 19156, Houston, Texas, 77024 U.S.A.
Tel.: (713) 622-1520. *Cable:* Femco, Houston.

Fischer & Porter Ltd.,
Salterbeck Trading Estate, Workington, Cumberland, England.
Tel.: 0946–830611. *Cable:* Saltfisch, Harrington.
Telex: 64114.

Fives Lille-Cail,
7 Rue Montalivet, 75 Paris 8e, France.
Tel.: 742.21.19. *Cable:* Fivcail, Paris.
Telex: Fivcail 65328.

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, L1 9BL England.
Tel.: 051–709 3345. *Cable:* Flexotube, Liverpool.

Fontaine & Co. G.m.b.H.,
51 Aachen, Grüner Weg 31, Germany.
Tel.: Aachen 21233. *Cable:* Fontaineco, Aachen.
Telex: 832558 fonte d.

Foster Pump Works Inc.,
70–73 Airport Road, Westerly, R.I., 02891 U.S.A.
Tel.: (401) 596–7711. *Cable:* Fostrpump, Westerly.
Tel.: 96–6451.

Foster Wheeler John Brown Boilers Ltd.,
P.O. Box 160, Greater London House, Hampstead Rd., London, NW1 7QN England.
Tel.: 01–388 1212. *Cable:* Rewopsteam, London.
Telex: 263984.

Foxboro-Yoxall Ltd.,
Redhill, Surrey, RH1 2HL England.
Tel.: Redhill 65000. *Cable:* Yoxbri, Redhill.
Telex: 25560.

French Oil Mill Machinery Co.,
1035 West Greene St., Piqua, Ohio, 45356 U.SA.
Tel.: (513) 773–3420. *Cable:* French, Piqua.
Telex: 228–009.

General Tubing Pty. Ltd.,
P.O. Box 124, Alexandria, N.S.W. 2015, Australia.
Tel.: Sydney 51-8645. *Cable:* Gentube, Sydney.
Telex: Sydney 21610.

T. Giusti & Son Ltd.,
202–228 York Way, Kings Cross, London N.7, England.
Tel.: 01–607 5021. *Cable:* Giustison, London N.7
Telex: 22592.

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.

N. Greening (Warrington) Ltd.,
Britannia Works, Warrington, Lancs., WA5 5JX England.
Tel.: Warrington 35991. *Cable:* Greenings, Warrington.
Telex: 62195.

Gruendler Crusher & Pulverizer Company,
2915 North Market Street, St. Louis, Mo., 63106 U.S.A.
Tel.: (314) 531-1220. *Cable:* Grupulco, St. Louis.
Telex: 44-7415.

Habasit A.G.,
CH-4153 Reinach-Basel, Switzerland.
Tel.: 061 76 70 70. *Cable:* Habasit, Reinach-Basel.
Telex: 62 859.

Hawaiian Agronomics Company (International),
P.O. Box 3470, Honolulu, Hawaii, 96801 U.S.A.
Tel.: (808) 536-4461. *Cable:* Agronomics, Honolulu.
Telex: (RCA) 723326; (ITT) 430173.

Hein, Lehmann A.G.,
P.O. Box 4109, Fichtenstr. 75, 4000 Düsseldorf, Germany.
Tel.: 77011. *Cable:* Heinlehmann, Duesseldorf.
Telex: 8582740 hl d.

John M. Henderson & Co. Ltd.,
P.O. Box 26, King's Works, Aberdeen AB9 8BU, Scotland.
Tel.: 0224–24262. *Cable:* Cranes, Aberdeen.
Telex: 73109.

Hinz Electromaschinen und Apparatebau G.m.b.H.,
3300 Braunschweig, P.O. Box 2749, Hansestrasse 30, Germany.
Tel.: (0531) 3 15 95. *Cable:* Hinzmotoren, Braunschweig.
Telex: 9 52 753 himot d.

Hiro Zoki Co. Ltd.,
Maruzen Bldg., 2–6 Nihonbashi-Dori, Chuo-ku, Tokyo, Japan.
Tel.: 03-274-5821. *Cable:* Hirozoki Co., Tokyo.
Telex: 2223197.

Hitachi Shipbuilding & Engineering Co. Ltd.,
1-1 Hitotsubashi 1-chome, Chiyoda-ku, Tokyo, 100 Japan.
Tel.: 231-6611. *Cable:* Hitachizosen, Tokyo.
Telex: J 24490/J22363.

Hodag Chemical Corporation,
7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A.
Tel.: (312)-675-3950. *Cable:* Hodag, Skokieill.

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

Houttuin-Pompen N.V.,
Postbus 76, Utrecht, Holland.
Tel.: (030) 44 16 44.
Telex: 47280.

Howard Pneumatic Engineering Co. Ltd.,
Fort Road, Eastbourne, Sussex, England.
Tel.: 22804/5/6. *Cable:* Howmatic, Eastbourne.
Telex: 87672.

Hunslet Engine Co. Ltd.,
Hunslet Engine Works, Jack Lane, Leeds, LS10 1BT England.
Tel.: 32261. *Cable:* Engine, Leeds.
Telex: 55237.

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

Industrieprojekt A.G.,
Sihlstr. 61, CH-8001 Zürich, Switzerland.
Tel.: (01) 27.22.38/39. *Cable:* Indarchag, Zürich.
Telex: 54803.

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

International Combustion Ltd.,
Sinfin Lane, Derby, DE2 9GJ England.
Tel.: 0332–23223. *Cable:* Lopulco, Derby.
Telex: 37581/2.

JK Industrial Fabrics,
Division of James Kenyon & Son Ltd.,
P.O. Box 28, Pilsworth Rd., Bury, Lancs., BL9 8QE England.
Tel.: 061–766 7531. *Cable:* Kenyon, Bury,
Telex: 667440.

Jeffress Bros. Ltd.,
351 Melton Rd., Northgate East, Brisbane, Queensland 4013, Australia.
Tel.: 67-1677. *Cable:* Telejeff, Brisbane.

Jenkins of Retford Ltd.,
Retford, Nottinghamshire, England.
Tel.: Retford 2231. *Cable:* Jenkins, Retford.
Telex: 56122.

Amandus Kahl Nachf.,
2000 Hamburg 26, Eiffestrasse 432, Postfach 260 343, Germany.
Tel.: 722 2024. *Cable:* Kahladus, Hamburg.
Telex: 0217875.

Kawasaki Heavy Industries Ltd.,
World Trade Center Building, 2-4-1 Hamamatsu-cho, Minato-ku, Tokyo, Japan.
Tel.: 435-2418. *Cable:* Kawasakiheavy, Tokyo.
Telex: J22672.

Kay Iron Works (Pvt.) Ltd.,
P.O. Yamuna Nagar, East Punjab, India.
Tel.: Yamuna Nagar 4/4A. *Cable:* Mithal, Yamuna Nagar.

Thomas C. Keay Ltd.,
P.O. Box 30, Densfield Works, Dundee, DD1 9DY Scotland.
Tel.: 0382–89341. *Cable:* Keay, Dundee.
Telex: 76278.

Dr. Wolfgang Kernchen Optik-Elektronik-Automation,
D-3011 Letter/Hannover, Postf. 129, Germany.
Tel.: Hannover 40 19 61. *Cable:* Optronic, Hannover.

Kettenfabrik Unna G.m.b.H.,
475 Unna, Postfach 186, Germany.
Tel.: (02303) 8411. *Cable:* Kettenfabrik, Unna.
Telex: 08 229250.

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

Kleinwanzlebener Saatzucht AG.,
vorm. Rabbethge & Giesecke,
3352 Einbeck, Grimsehlstr. 29, Postfach 146, Germany.
Tel.: 05561/3111. *Cable:* Original, Einbeck.
Telex: 0965612.

Koppers-Wistra-Ofenbau G.m.b.H.
4000 Düsseldorf-Heerdt, Wiesenstrasse 134, Germany.
Tel.: 50 11 97. *Cable:* Wistraofen, Duesseldorf.
Telex: 08 584518.

A. H. Korthof N.V.,
Hertshooiweg 18, Postbus 73, Bergen, N.H., Holland.
Tel.: 02208–5526. *Cable:* Sugarlab, Amsterdam.

Krieg & Zivy Industries,
10 Avenue Descartes, 92 Le Plessis-Robinson, France.
Tel.: 644-62-26. *Cable:* Zedka, Plessis-Robinson.
Telex: 27328 F.

A.G. Kühnle, Kopp & Kausch,
D 6710 Frankenthal/Pfalz. Friedrich-Ebert-Str. 16, Germany.
Tel.: (06233) 85-1. *Cable:* Turbomaschinen, Frankenthalpfalz.
Telex: 0465221.

Librawerk Pelz & Nagel K.G.,
33 Braunschweig, P.O. Box 3712, Germany.
Tel.: (0531) 37 60 51. *Cable:* Librawerk, Braunschweig.
Telex: 0952 866.

Martin-Markham (Stamford) Ltd.,
Lincolnshire Works, Stamford, Lincs., England.
Tel.: Stamford 2621/4. *Cable:* Marktrac, Stamford

Massey-Ferguson (Export) Ltd.,
P.O. Box 62, Banner Lane, Coventry, CV4 9GF England.
Tel.: Coventry 465211. *Cable:* Masferg, Coventry.
Telex: 31-655.

May & Baker Ltd.,
Dagenham, Essex, England.
Tel.: 01–592 3060. *Cable:* Bismuth, Dagenham.
Telex: London 28691.

F. W. McConnel Ltd.,
Temeside Works, Ludlow, Shropshire, England.
Tel.: Ludlow 3131.
Cable: McConnel 35313, Ludlow Shropshire Telex.
Telex: 35313.

Mennesson & Cie.,
Route de Nimes, 30200 Bagnols-sur-Cèze, France.
Tel.: 16-66-89.50.75.
Telex: 48145 Telexer Nimes Code 25.

The Mirrlees Watson Co. Ltd.,
Cosmos House, 1 Bromley Common, Bromley, BR2 9NA England.
Tel.: 01–464 5346. *Cable:* Mirwat, Bromley, Kent.
Telex: 22404.

Mono Pumps Ltd.,
Mono House, Sekforde Street, Clerkenwell Green, London, EC1R 0HE England.
Tel.: 01–253 8911. *Cable:* Monopumps London EC1.
Telex: 24453.

Montedison-Div. Prodotti Industria,
Piazza della Repubblica 14/16, 20124 Milano, Italy.
Tel.: Milano 6333.
Telex: 31679 Montedis.

Napier Bros. Ltd.,
Bunya Street, Dalby, Queensland 4405, Australia.
Tel.: Dalby 2 3155. *Cable:* Nabros, Dalby

Nash Engineering Company,
Norwalk, Conn., 06856 U.S.A.
Tel.: (203) 866-3351. *Cable:* Hytor, Norwalk, Conn.
Telex: 96-5971.

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

Newell Dunford Engineering Ltd.,
143 Maple Road, Surbiton, Surrey, England.
Tel.: 01–546 7799. *Cable:* Lindaresco, London, Telex.
Telex: 22413.

Neyrpic,
Rue Général Mangin, 38 Grenoble, France.
Tel.: (76) 96.48.30. *Cable:* Neyrpic, Grenoble.
Telex: 32.750.

Nordon & Cie.,
9 Avenue du XXeme Corps, B.P. 441, 54001 Nancy Cedex, France.
Tel.: 28–52 2060. *Cable:* Frernordon, Nancy.
Telex: 85040.

Parsons Chain Co. Ltd.,
Worcester Road, Stourport-on-Severn, Worcs., England.
Tel.: Stourport 2551. *Cable:* Chainwork, Stourport-on-Severn.
Telex: 33775 Chainwire Strpt.

Perkin-Elmer Limited,
Beaconsfield, Bucks., HP9 1QA England.
Tel.: Beaconsfield 6161. *Cable:* Peco, Beaconsfield.
Telex: 83257.

The Permutit Co. Ltd.,
632–652 London Rd., Isleworth, Middx., England.
Tel.: 01–560 5199. *Cable:* Permutit, Hounslow.
Telex: 24440.

Pittsburgh Activated Carbon Division, Calgon Corporation,
Calgon Center, Box 1346, Pittsburgh, Pa., 15230 U.S.A.
Tel.: (412) 923-2345. *Cable:* Pitcarb, Pittsburgh.
Telex: 086739.

Plymouth Locomotives Division, Banner International Inc.,
51 Bank Street (Suite 402), Stamford, Conn., 06901 U.S.A.
Tel.: (203) 327-5084. *Cable:* Plylocomot, New York.
Telex: 965887.

Polimex-Cekop,
Czackiego 7/9, P.O. Box 815, Warsaw, Poland.
Tel.: 268001.
Telex: 814271.

J. & F. Pool Ltd.,
Hayle, Cornwall, England.
Tel.: Hayle 3571. *Cable:* Perforator, Hayle.
Telex: 45286 A.B. Poolperf Hayle.

P. & S. Textiles Ltd.,
Broadway Mills, Haslingden, Lancs., BB4 4EJ England.
Tel.: Rossendale 3421. *Cable:* Neotex, Haslingden, Telex.
Telex: 63127 Neotex Hasden.

H. Putsch & Comp.,
Postfach 4221, Frankfurter Str. 5–25, 58 Hagen, Germany.
Tel.: (02331) 31031. *Cable:* Putsch, Hagen.
Telex: 823795.

Ransomes Sims & Jefferies Ltd.,
Nacton Works, Ipswich, Suffolk, IP3 9QG England.
Tel.: 0473–72222. *Cable:* Ransomes, Ipswich, Telex.
Telex: 98174.

Rapid Magnetic Ltd.,
Lombard St., Birmingham, B12 0QW England.
Tel.: 021–773 1361. *Cable:* Magnetism, Birmingham
Telex: 338671 Magnetism Birmingham.

Realm Engineering Works Ltd.,
Milton Avenue, Croydon, CR9 2JP England.
Tel.: 01–684 8391. *Cable:* Realmard, Croydon.

Redler Conveyors Ltd.,
Dudbridge Works, Stroud, Gloucestershire, GL5 3EY England.
Tel.: (04536) 3611. *Cable:* Redler, Stroud.
Telex: 43228.

Reed Darnley Taylor Ltd.,
Larkfield, near Maidstone, Kent, England.
Tel.: 0622–77777. *Cable:* Satchelsac, Larkfield.
Telex: 965131.

Reggiane O.M.I. S.p.A.,
P.O. Box 331, 42100 Reggio Emilia, Italy.
Tel.: 41341. *Cable:* Reggiane, Reggio Emilia.
Telex: 51265 Reggiane.

Robert Reichling & Co. K.G.,
Kölner Strasse 397–403a, Postfach 2380, D4150 Krefeld, Germany.
Tel.: 3.32.17. *Cable:* Reichling, Krefeld.
Telex: 0853 757.

Renold Limited,
Renold House, Wythenshawe, Manchester, England.
Tel.: 061–437 5221. *Cable:* Renold, Manchester.
Telex: 669052.

Riley (I.C.) Products Ltd.,
Sinfin Lane, Derby, DE2 9GJ England.
Tel.: 0332–21252.

Riley Stoker Corporation,
P.O. Box 547, Worcester, Mass., 01613 U.S.A.
Tel.: (617) 852–7100.
Telex: 920426.

Robey of Lincoln Ltd.,
P.O. Box 23, Lincoln, LN5 8HB England.
Tel.: 0522-21381. *Cable:* Robey, Lincoln.
Telex: 56109.

Rohm and Haas Company,
Independence Mall West, Philadelphia, Pa., 19105 U.S.A.
Tel.: (215) 592-3000. *Cable:* Rohmhaas, Philadelphia.
Telex: 845-247.

Rome Industries,
P.O. Box 48, Cedartown, Ga., 30125 U.S.A.
Tel.: (404) 748–4450. *Cable:* Roman, Cedartown.
Telex: 542391.

Rosin Engineering Co. Ltd.,
15/17 St. Cross St., Hatton Garden, London, EC1N 8UR England.
Tel.: 01–242 9361–3.
Telex: 338078.

Rotatools (U.K.) Ltd.,
Brookfield Drive, Liverpool, L9 7EG England.
Tel.: 051–525 8611. *Cable:* Scalewell, Liverpool

Rudolph Research Inc.,
International Sales, Ameresco Inc.,
101 Park St., Montclair, N.J., 07042 U.S.A.
Tel.: (201) 746-5300. *Cable:* Ameresque, Montclair.
Telex: 138619.

Sack Fillers Ltd.,
Northfleet, Gravesend, Kent, DA11 9BX England.
Tel.: Greenhithe 3333. *Cable:* Filasac, Gravesend.
Telex: 896095.

Salzgitter Maschinen A.G.,
D-332 Salzgitter 51, Federal Republic of Germany.
Tel.: (053 41) 302–1.
Telex: 954445 smg d.

Sankey Green Wire Weaving Co. Ltd.,
Thelwall, Warrington, Lancs., WA4 2LZ England.
Tel.: Warrington 61211. *Cable:* Sanco, Warrington.

SAPAL Société Anonyme des Plieuses Automatiques,
44 Avenue du Tir Fédéral, 1024 Ecublens près Lausanne, Switzerland.
Tel.: (021) 34 44 61. *Cable:* Autoplieuses, Lausanne.
Telex: 24 541.

Saunders Valve Co. Ltd.,
Grange Rd., Cwmbran, Monmouthshire, England.
Tel.: 06333–2044. *Cable:* Saunval, Newportmon.
Telex: 49241.

F. C. Schaffer & Associates Inc.,
185 Bellewood Drive, Baton Rouge, La., 70806 U.S.A.
Tel.: 926-2541. *Cable:* Arkel, Baton Rouge.

Schmidt + Haensch,
1 Berlin 62, Naumannstrasse 33, Germany.
Tel.: 784 6031. *Cable:* Polarisation, Berlin.
Telex: 183 343 suhfo d.

Schumacher'sche Fabrik,
712 Bietigheim/Württemberg, Germany.
Tel.: (07142) 7721. *Cable:* Schumafilt, Bietigheim.
Telex: 724217.

Serseg (Seguin-Sergot),
4 Place Félix Eboué, 75 Paris 12e, France.
Tel.: (1)344.29.59. *Cable:* Sersegman, Paris.
Telex: 22.631 Serseg, Paris.

N.V. Servo-Balans,
Wegastraat 40, 2008 Den Haag-6, Holland.
Tel.: (070)-835503. *Cable:* Servobalans, Den Haag.

Sigmund Pulsometer Pumps Ltd.,
Oxford Road, Reading, RG3 1JD England.
Tel.: 0734–25555. *Cable:* Sigmeter, Reading.
Telex: 848189.

Sil-Flo Incorporated,
Sil-Flo Building, Port Jefferson, N.Y., 11777 U.S.A.
Tel.: (516) 928-0200. *Cable:* Silflo, Port Jefferson.

Richard Simon & Sons Ltd.,
Phoenix Works, Basford, Nottingham, England.
Tel.: 74211-9. *Cable:* Balance, Nottingham.
Telex: 37545.

Simon-Heesen B.V.,
P.O. Box 25, Boxtel, Holland.
Tel.: (04116) 2751.
Telex: 50243 simhe nl.

The Sinex Engineering Co. Ltd.,
Market House, Uxbridge, Middx., England.
Tel.: Uxbridge 30541. *Cable:* Sinexvibro, Uxbridge.
Telex: 935259.

A & W. Smith & Co. Ltd.,
Cosmos House, 1 Bromley Common, Bromley BR2 9NA, Kent, England.
Tel.: 01–464 5346. *Cable:* Sugrengine, Bromley, Kent.
Telex: 2-2404.

Soc. Sucrière d'Etudes et de Conseils S.A.,
1 Aandorenstraat, Tienen, Belgium.
Tel.: (016) 830-11. *Cable:* Rafsec, Tienen.
Telex: 22251.

Sopelem,
102 rue Chaptal, 92 Levallois-Perret, France.
Tel.: 737-79-40. *Cable:* Precioptic, Levallois-Perret.
Telex: 62 111.

SPP Systems Ltd.,
Oxford Road, Reading, RG3 1JD England.
Tel.: 0734–25555. *Cable:* Sigmeter, Reading.
Telex: 848189.

Stansteel Corporation,
Subsidiary of Allis-Chalmers Corporation,
5001 South Boyle Avenue, Los Angeles, Calif., 90058 U.S.A.
Tel.: (213) 585-1231. *Cable:* Stansteel, Los Angeles.
Telex: 674737.

Stedman Foundry & Machine Co. Inc.,
Box 209, Aurora, Ind., 47001 U.S.A.
Tel.: (812) 926-0038.

Stella Meta Filters,
Division of The Permutit Co. Ltd.,
Laverstoke Mill, Laverstoke, Whitchurch, Hants., RG28 7NR England.
Tel.: 025–682 2360. *Cable:* Stellameta, Whitchurch, Hants.
Telex: 85128.

Stockdale Engineering Ltd.,
Rock Bank, Bollington, Macclesfield, Cheshire, SK10 5LB England.
Tel.: 0625–72521. *Cable:* Mechanical, Bollington.
Telex: 668885.

Stord Bartz Industri A/S.,
P.O. Box 777, Bergen, Norway.
Tel.: Bergen 11030. *Cable:* System, Bergen.
Telex: Stoba 42051.

Stork-Werkspoor Sugar N.V.,
P.O. Box 147, Hengelo (O.), Holland.
Tel.: 05400-54321. *Cable:* Stowesugar, Hengelo.
Telex: 44485.

Stothert & Pitt Ltd.,
P.O. Box 25, Lower Bristol Road, Bath, BA2 3DJ England.
Tel.: Bath 63401/63041. *Cable:* Stothert, Bath.
Telex: 44311/44177.

Sucatlan Engineering,
18 Avenue Matignon, Paris 8e, France.
Tel.: 225-60-51/359-22-94. *Cable:* Sucatlan, Paris.
Telex: 29–017 Sucatlan Paris.

Suchar,
Division of De Sola Bros. Inc.,
120 Wall Street, New York, N.Y., 10005 U.S.A.
Tel.: (212) 344-2124. *Cable:* Sucharing, New York.
Telex: RCA 222757 Desola.

The Sugar Manufacturers' Supply Co. Ltd.,
196–204 Bermondsey Street, London SE1 3TP, England.
Tel.: 01–407 5422. *Cable:* Sumasuco, London, S.E.1

Takuma Co. Ltd.,
Eitaro Bldg., 2-5-Tori-1 Nihonbashi, Chuo-ku, Tokyo, Japan.
Tel.: 271-2117. *Cable:* Takuma, Tokyo.
Telex: 0222-2878 Takuma Tok.

Tate & Lyle Enterprises Ltd.,
No. 1 Cosmos House, Bromley Common, Bromley BR2 9NA, England.
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.
Tel.: 01–464 3681. *Cable:* Tecserve, Bromley, Kent.
Telex: 22404 Sugrengine Bmly.

The Thames Packaging Equipment Co.,
Senate House, Tyssen Street, Dalston, London, E8 2ND England.
Tel.: 01–254 7132. *Cable:* Pakitup, London, E.8.
Telex: 22776 Senate Ldn.

Thorn Automation Ltd.,
Beech Avenue, New Basford, Nottingham, NG7 7JJ England.
Tel.: 0602–76123.
Telex: 37142.

The Tills Engineering Co. Ltd.,
5 Arbour Lane, Kirkby Industrial Estate, Kirkby, Liverpool. L33 7XF, England.
Tel.: 051–546 2378.

Toft Bros. Pty. Ltd.,
Private Mail Bag, Bundaberg, Queensland 4670, Australia.
Tel.: 71-2216. *Cable:* Toftequip, Bundaberg.

Ronald Trist Controls Ltd.,
Bath Road, Slough, Bucks., England.
Tel.: Slough 34646. *Cable:* Arteecon, Slough.
Telex: 84315.

U.S. Filter Systems,
12242 East Putnam Street, Whittier, Calif., 90608 U.S.A.
Tel.: (213) 698-9414. *Cable:* Filters, Whittier.
Telex: 65–7433.

Venema Automation N.V.,
Smirnoffstraat 3-5, Groningen, Holland.
Tel.: (050) 77 10 20. *Cable:* Venapp, Groningen.
Telex: 53682 Venap NL.

S. A. Verkor,
Koningin Astridlaan, B-8520 Lauwe, Belgium.
Tel.: (056) 44531/2/3. *Cable:* Laboverkor, Lauwe.
Telex: Dewittelit 17245.

Walkers Ltd.,
Bowen Street, Maryborough, Queensland 4650, Australia.
Tel.: Maryborough 2321. *Cable:* Itolzak, Maryborough.

George Waller & Son Ltd.,
Phoenix Iron Works, Stroud, Glos., GL5 2BW England.
Tel.: 045–388 2301/3. *Cable:* Waller, Brimscombe.
Telex: 43113.

Ulrich Walter Maschinenbau,
4006 Erkrath, Bahnstrasse 30, Germany.
Tel.: Düsseldorf 643041.
Telex: 858 6526.

Weco Filter Sleeve Manufacturing Co. Ltd.,
Folkestone Works, Walney, Barrow-in-Furness, Lancs., England.
Tel.: 41931. *Cable:* Weco, Barrow-in-Furness.

Ingeniörsfirman Nils Weibull AB.,
Box 4015, S-281 04 Hässelholm 4, Sweden.
Tel.: (0451) 83000. *Cable:* Nilswei, Hässelholm.
Telex: 48086 Nilswei S.

Weir Pumps Ltd.,
Berners House, 47/48 Berners Street, London, W1P 4LA England.
Tel.: 01–636 0851. *Cable:* Weirpumps, London, Telex.
Telex: 22556.

Weise & Monski, Weise Soehne G.m.b.H.,
752 Bruchsal, Industriestr. 29, Germany.
Tel.: 07251/9841. *Cable:* Weisens, Bruchsal.
Telex: 07 822 207.

Welding Technical Services Ltd.,
Pershore Road South, Kings Norton, Birmingham 30, England.
Tel.: 021–458 5541. *Cable:* Weltexa, Birmingham.

Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division,
Cornwall Rd., Smethwick, Warley, Worcestershire, England.
Tel.: 021–558 3151. *Cable:* Wellman, Warley, Telex.
Telex: 33398.

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Telex: 07 826 765.

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Telex: 41206.

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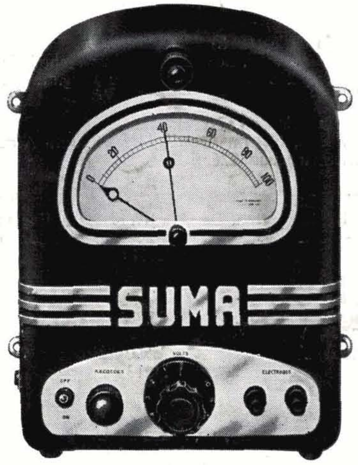
Carl Zeiss,
7082 Oberkochen, P.O. Box 35/36, West Germany.
Tel.: (07364) 201.
Tel.: (07364) 201. *Cable:* Zeisswerk, Oberkochen.
Telex: 7-13213.

Zurn Air Systems,
P.O. Box 2206, Birmingham, Alabama, U.S.A.
Tel.: (205) 252-2181.
Telex: 5-9726.

Suma Products

VACUUM PAN CONTROL



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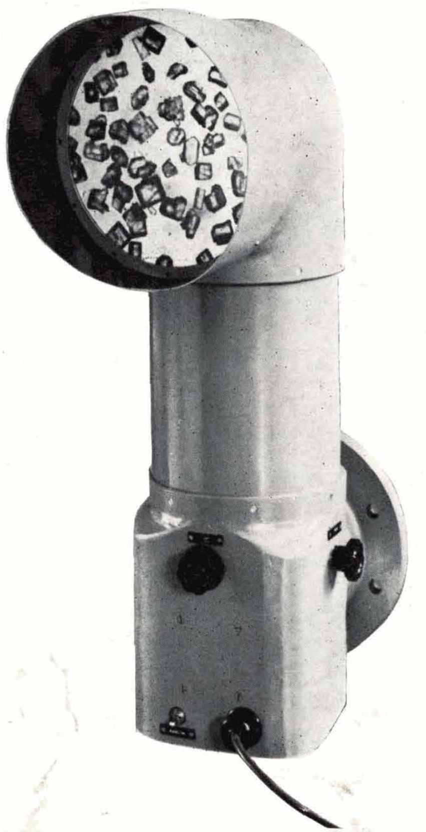
[Extracted by kind permission from "Handbook of Cane Sugar Engineering" (p. 517) by E. Hugot, translated by G. H. Jenkins (Elsevier, Amsterdam). 1960.]



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