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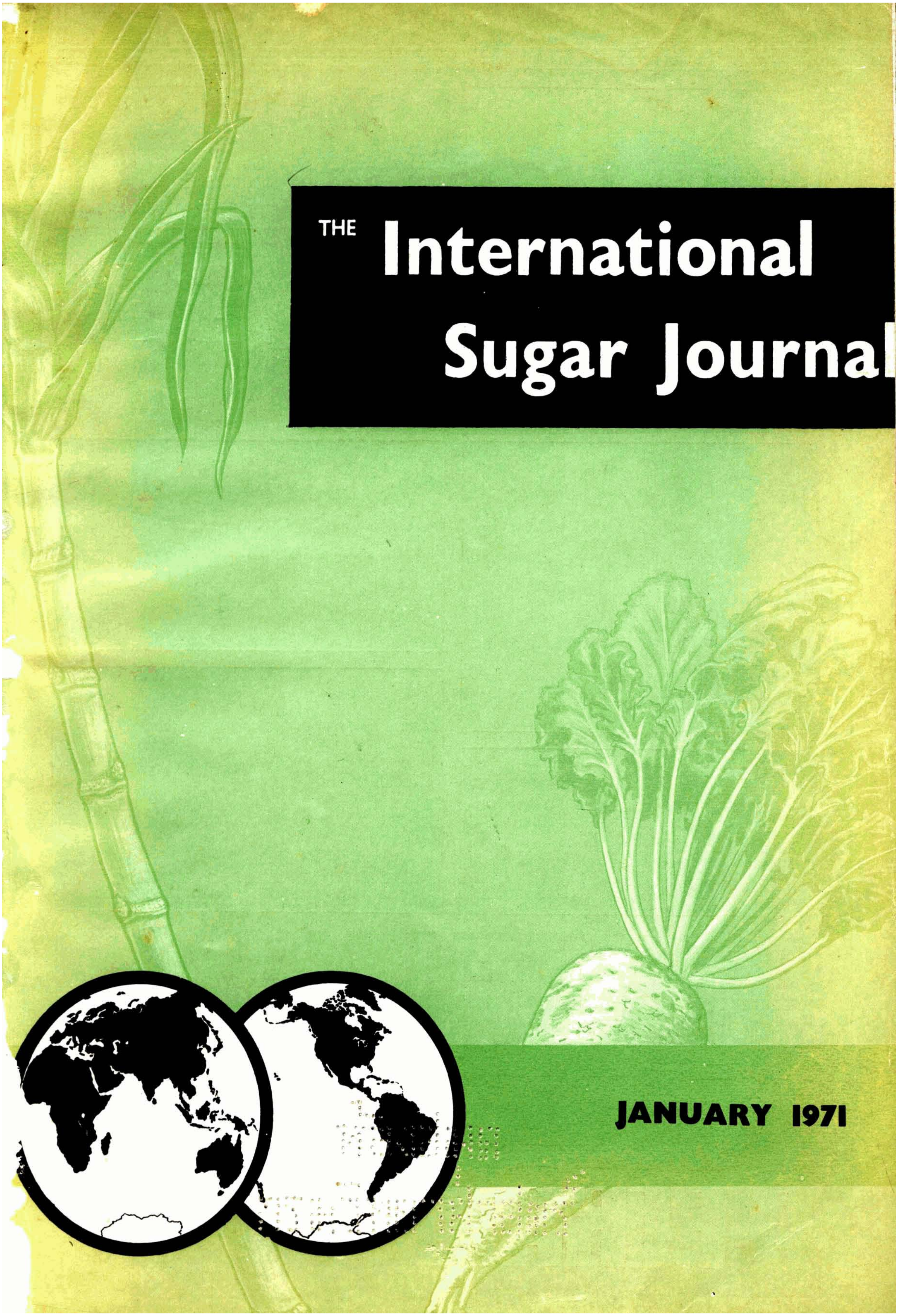

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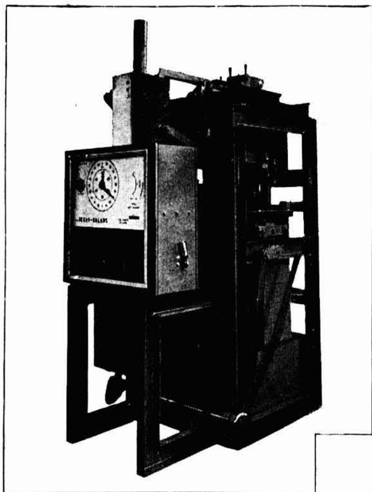

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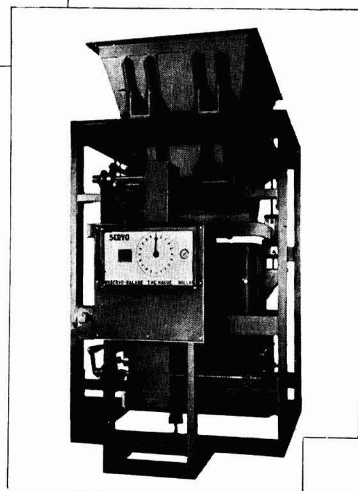

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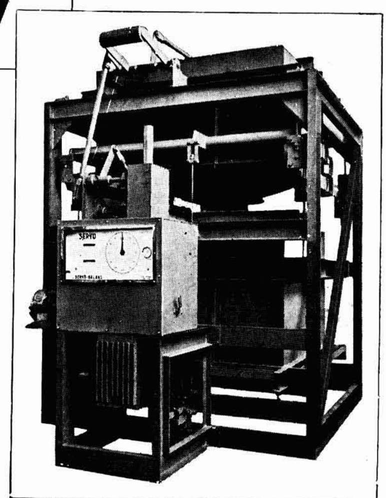

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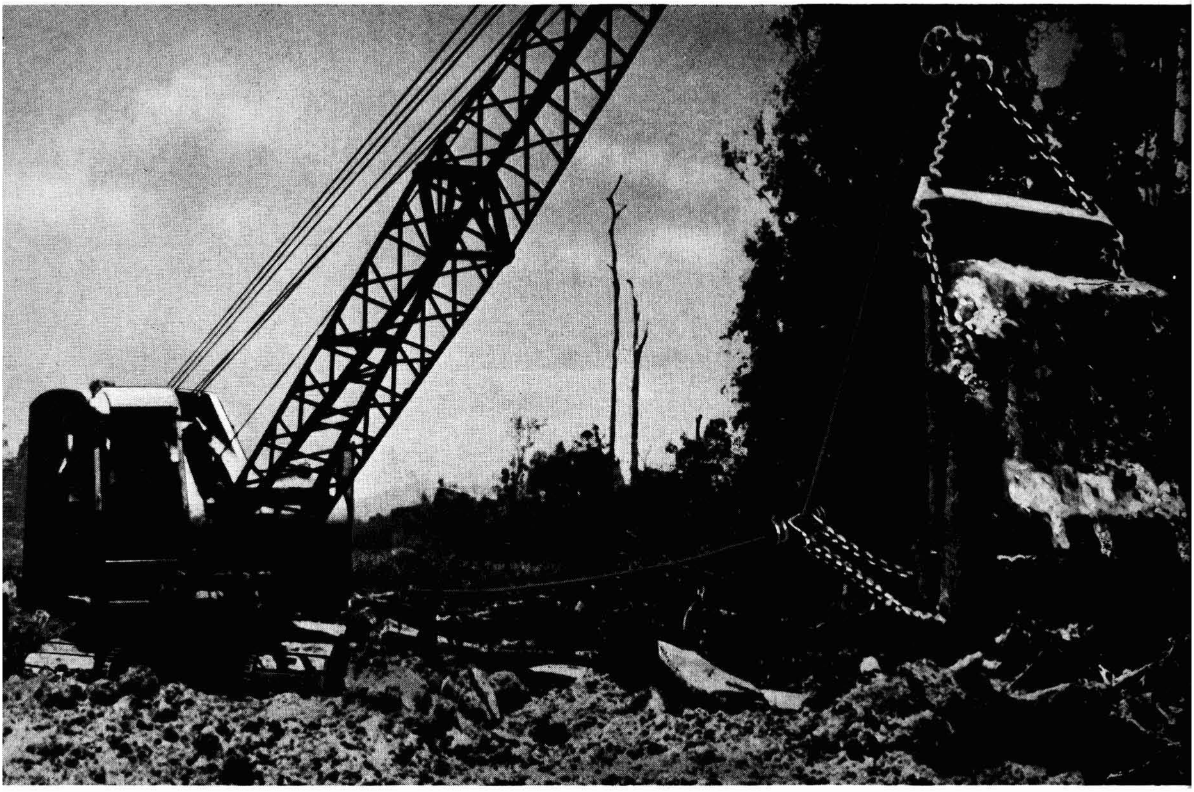

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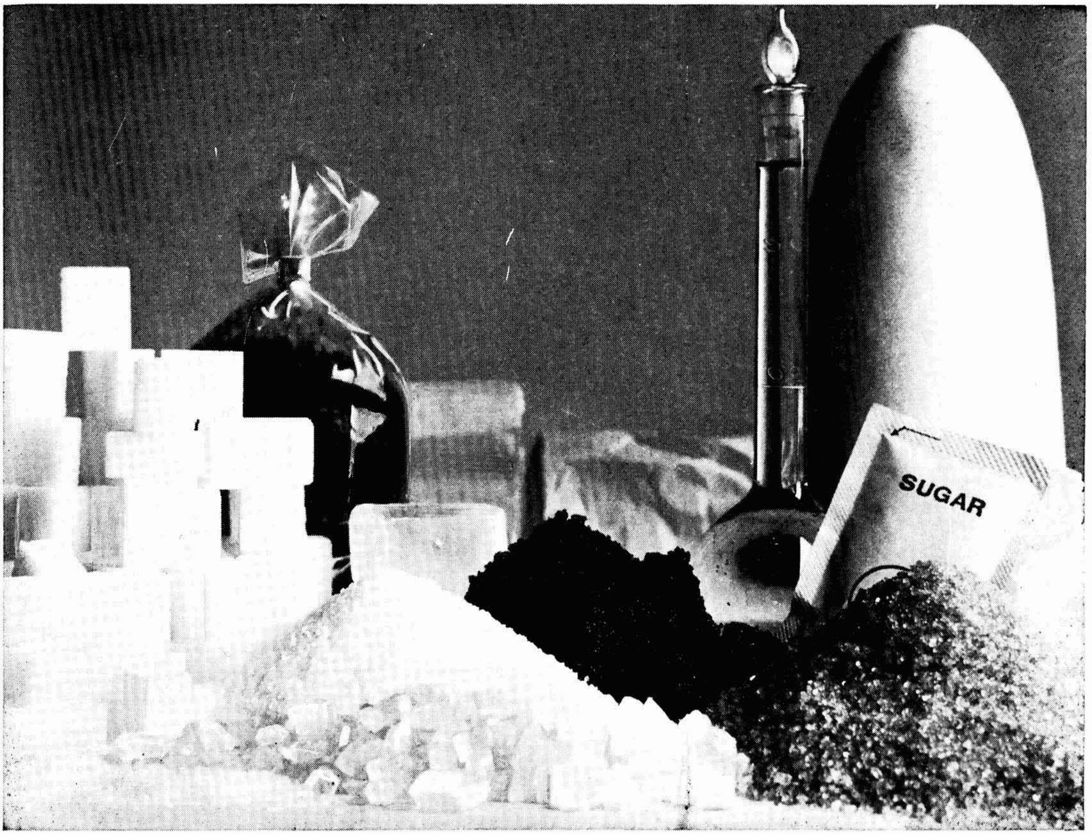
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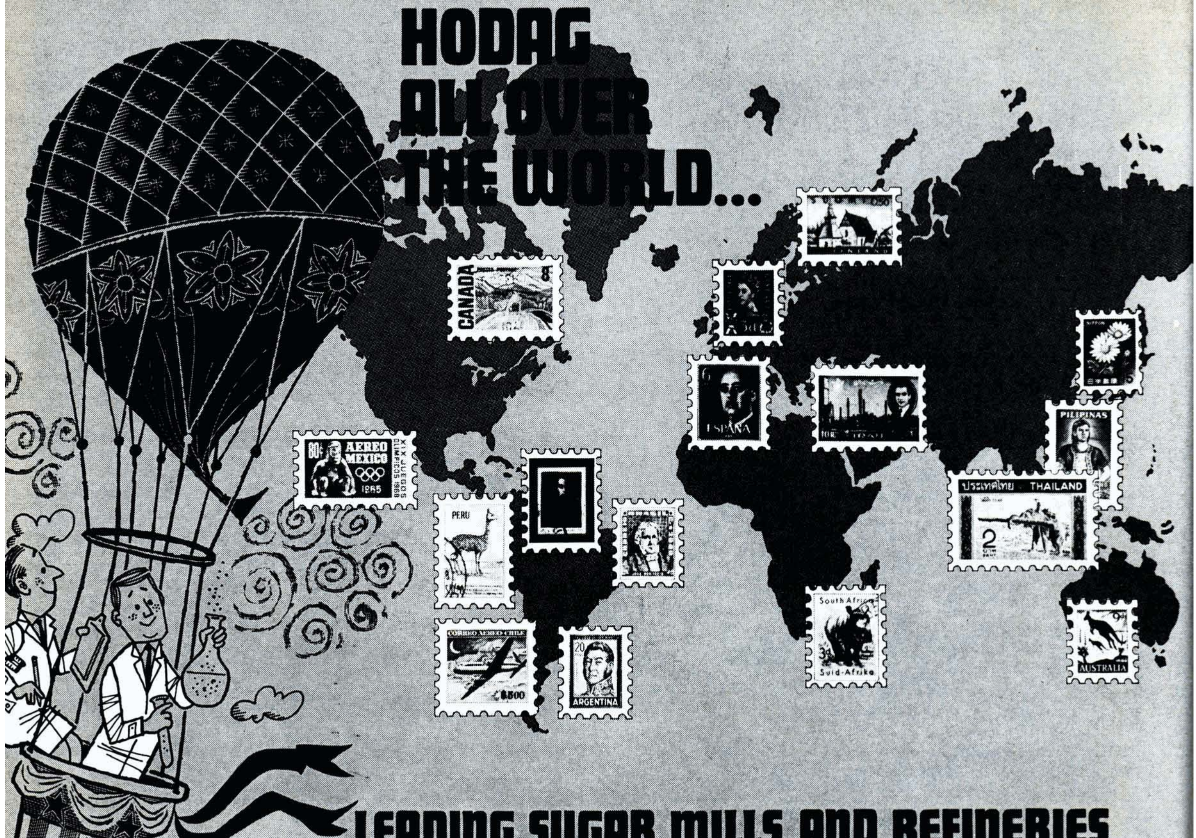

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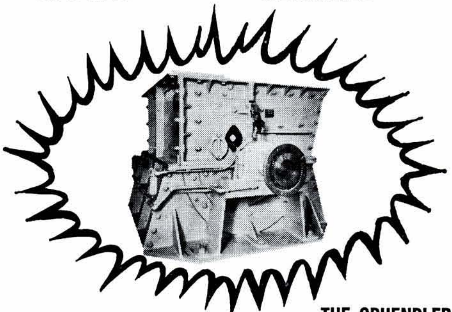

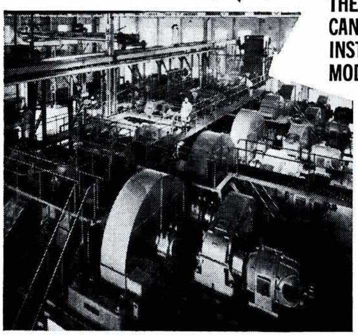

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Tons Cane Crushed per hour	M.	193
	T.D.	189
Time Crushing % Time Mill Open	M.	91
	T.D.	92
Tons Sugar Made and Estimated	M.	15,648
	T.D.	62,000
Percentage of White Sugar Made	M.	Nil
	T.D.	Nil
Sucrose % Cane	M.	13.70
	T.D.	13.39
Fibre % Cane	M.	15.27
	T.D.	14.76
Tons Cane per Ton Sugar	M.	8.52
	T.D.	8.65
Java Ratio	M.	77.53
	T.D.	79.70
Brix. % First Expressed Juice	M.	20.27
	T.D.	19.46
Purity of First Expressed Juice	M.	87.17
	T.D.	86.33
Tons Fibre Crushed per hour	M.	29.46
	T.D.	27.89
Unit Load (lbs./hr./cu. ft. T.R.V.)	M.	49
	T.D.	46
Imbibition % Fibre	M.	342
	T.D.	310
Lost Absolute Juice % Fibre	M.	30
	T.D.	28
Sucrose % Bagasse	M.	1.92
	T.D.	1.72
Moisture % Bagasse	M.	50.82
	T.D.	50.91
Boiling House Performance	M.	97.20
	T.D.	97.15
Extraction	M.	95.40
	T.D.	95.95
Boiling House Recovery	T.D.	88.64
	M.	88.69
Overall Recovery	M.	84.57
	T.D.	85.09
Purity of Mixed Juice	M.	83.45
	T.D.	83.60
Reduced Sugars/Sucrose Ratio of Mixed Juice	M.	3.80
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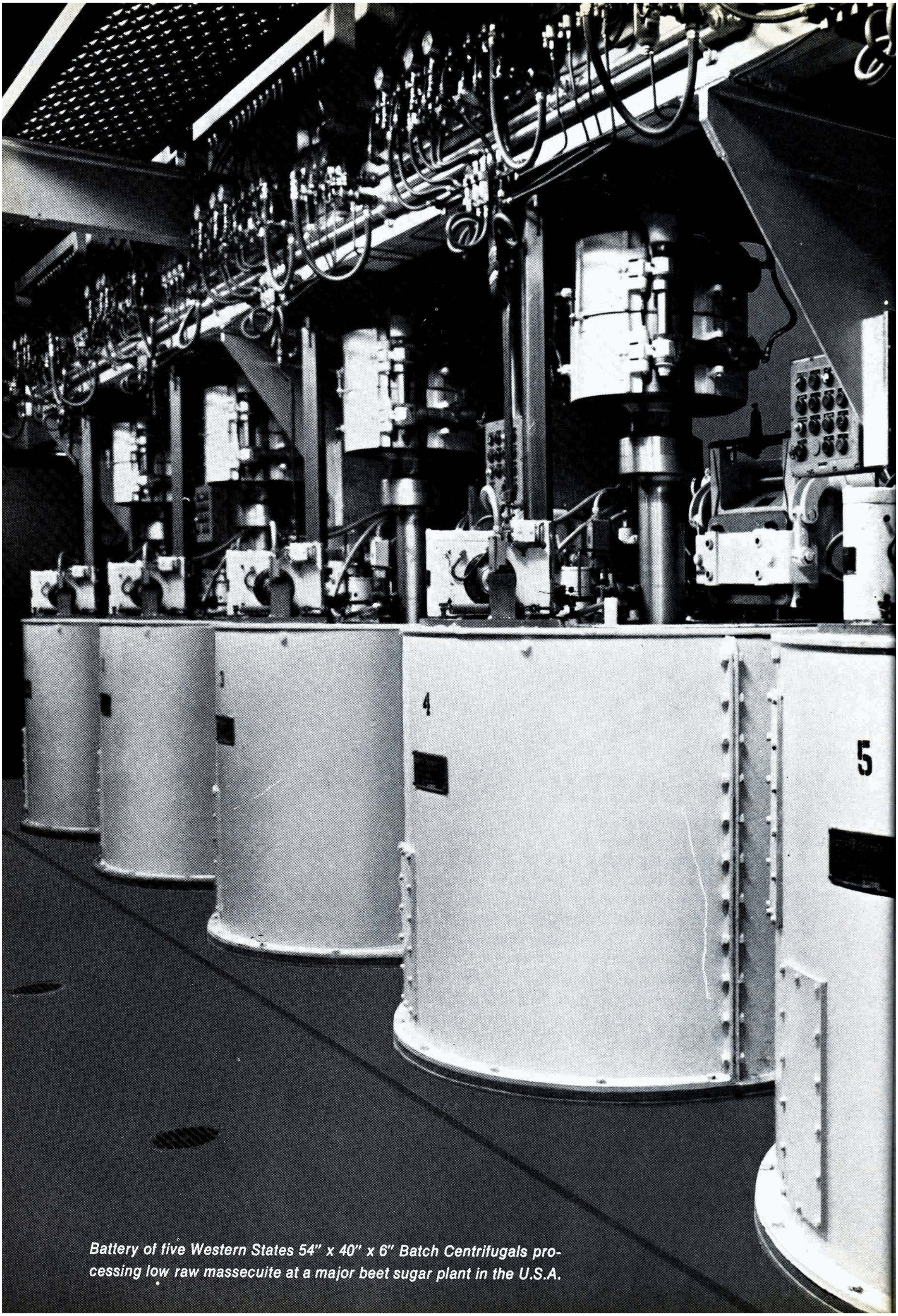
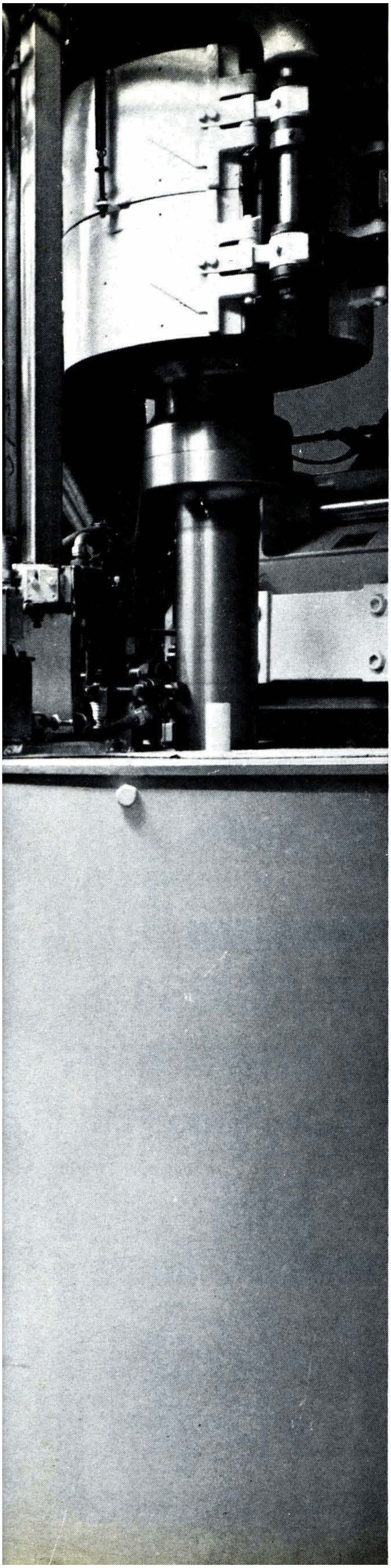


Battery of five Western States 54" x 40" x 6" Batch Centrifugals processing low raw massecuite at a major beet sugar plant in the U.S.A.



International Sugar Journal

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On decrit des recherches au cours desquelles on a déterminé la concentration en inverti, laevane et dextrane (gommes) dans des cossettes d'usine ou de laboratoire dans des betteraves normales et détériorées, stockées dans de tas expérimentaux, ainsi que dans des betteraves qu'on avait laissées intentionnellement geler et dégeler. La teneur en inverti des betteraves fraîches et bien stockées était comprise entre 0,2 et 0,8 g % sucre. Cette teneur fut dépassée dans les betteraves détériorées tandis que la formation de laevane et de dextrane n'était en général pas très significative avant que l'inverti ne dépassait 2 g % sucre. Le gel des betteraves (observé en introduisant des thermocouples à l'intérieur des betteraves qui furent ensuite placées dans une chambre refroidie) commençait à partir de —2°C, bien que la solidification totale ne se faisait que juste en dessous de cette température.

* * *

39e Congrès de l'Association des Techniciens Cubains de Sucre. *p.* 9–11

On présente un rapport du 39e Congrès de l'Asociación de Técnicos Azucareros de Cuba qui s'est tenu à La Havane du 5 au 17 octobre 1970. Certains aspects de l'industrie sucrière cubaine sont décrits et illustrés.

* * *

Recherche sur la canne à sucre en Afrique du Sud. *p.* 11–14

On présente un résumé du Rapport Annuel 1968–69 de la station expérimentale de l'Association Sud-Africaine du Sucre. Ce rapport résume les recherches faites sur la sélection de la canne, sur l'induction à la floraison, sur la brûlare et le brunissement des feuilles, sur les insecticides ainsi que sur un nombre d'autres aspects de l'agriculture de la canne, comprenant également une revue des variétés de canne cultivées en Afrique du Sud.

Die Bedeutung der Bildung von Invertzucker und Polysacchariden in alterierten Rüben. Teil I. J. F. T. OLDFIELD, J. V. DUTTON und H. J. TEAGUE. *S.* 3–8

Es wird über Untersuchungen berichtet, bei denen die Konzentration von Invertzucker und der Polysaccharide Lävan und Dextran in Rüben bestimmt wurde. Die Bestimmung erfolgte in Schnitzeln, die teils in der Fabrik und teils im Laboratorium hergestellt waren, in normalen und alterierten, in Versuchsmieten gelagerten Rüben sowie in Rüben, die absichtlich einer Frosteinwirkung unterworfen und dann wieder aufgetaut waren. Während normalerweise der Invertzuckergehalt in frischen und in einwandfrei gelagerten Rüben zu 0,2 bis 0,8 g a.100°S gefunden wurde, ergab sich ein höherer Wert bei alterierten Rüben, bei denen die Bildung von Lävan und Dextran im allgemeinen erst beträchtlich war, wenn der Invertzuckergehalt 2,0 g a.100°S überstieg. Durch in die enzelnen Rüben vor der Einlagerung in einen kalten Raum oder einen Kühlschrank eingeführte Thermoelemente wurde festgestellt, dass das Erfrieren der Rübenproben bei etwa —2°C einsetzt, wahrend die völlige Vereisung sofort erfolgt, wenn diese Temperature unterschritten wird.

* * *

39.Kongress der Vereinigung der Kubanischen Zuckertechniker. *S.* 9–11

Es wird über den 39.Kongress der Asociación de Técnicos Azucareros de Cuba (Vereinigung der Kubanischen Zuckertechniker) berichtet, der vom 5. bis zum 17. Oktober in Havana abgehalten wurde, und eine Reihe von Problemen der kubanischen Zuckerindustrie beschrieben und erläutert.

* * *

Zuckerrohrforschung in Südafrika. *S.* 11–14

Es wird zusammenfassend über den Inhalt des "Annual Report 1968/69" der Versuchsstation der South African Sugar Association berichtet. Der Band umfasst die Forschungsarbeiten auf dem Gebiet der Rohrzüchtung und des Einleitens der Blüte, einen Überblick über die in Südafrika angebauten Rohrsorten, die Untersuchung über Bakteriose und Blattschorf, Schädlinge und Herbizide sowie eine Anzahl weiterer Gesichtspunkte des Zuckerrohranbaus.

La significación de la formación de azúcar invertido y de goma en remolacha deteriorada. Parte 1. J. F. T. OLDFIELD, J. V. DUTTON y H. J. TEAGUE. *Pág.* 3–8

Se hace un informe sobre investigaciones en que se determinan las concentraciones de azúcar invertido, levana y dextrana (goma) en cosetas producido en la fábrica y en el laboratorio, en remolachas normal y deteriorada de almacenaje en montones experimentales, y en remolachas premeditadamente congeladas y entonces desheladas. Cuando el contenido de azúcar invertido en remolachas frescas y bien montonadas fué normalmente 0,2–0,8 g/100 g sacarosa, excedó este nivel en remolacha deteriorada, mientras formación de levana y dextrana generalmente no tuvo significación hasta que el contenido de azúcar invertido excedó 2,0 g/100 g sacarosa. Los autores observan que congelación de muestras de remolacha, determinado por inserción de pares térmicos en los interiores de raíces individuales antes de su depósito en una cámara fría o un refrigerador, comenzó acerca de —2°C, mientras solidificación completa no ocurre hasta ligeramente abajo de esta temperatura.

* * *

La 39 Conferencia de la Asociación de Técnicos Azucareros de Cuba. *Pág.* 9–11

Se presenta un informe sobre la 39 Conferencia de la Asociación de Técnicos Azucareros de Cuba, celebrada en La Habana el 5–17 octubre 1970, y se describen y ilustran algunos aspectos de la industria azucarera cubana.

* * *

Experimentas sobre caña de azúcar en Sud-Africa. *Pág.* 11–14

Se present un sumario de la Memoria Anual de 1968/69 de la Estación Experimental de la South African Sugar Association. Se resumen experimentas sobre crianza de caña y inducción de floración, escaladura y chamuscado de la hoja, plagas y herbicidas, tanto como varios otros aspectos de la agricultura de caña que incluyen un examen de variedades de caña que se cultivan en Sud-Africa.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIII JANUARY 1971 No. 865

Notes & Comments

Britain and the EEC.

In his recent proposals the Chancellor of the Exchequer has proposed a move away from the traditional practice of importing low-cost food and providing subsidies to British farmers. Levies are to be made on some imported foodstuffs and will permit a reduction in the subsidies necessary; the cost of the food to the housewife will rise accordingly. This has been taken as a first move to bring British practice in line with the practice in the EEC and has been attacked as such since, it is alleged, this will indicate an anxiety to become a member such that terms of entry may be stiffer than they would otherwise have been.

Considerable opposition to membership has become more noticeable in Britain, as the heavy cost has become apparent, and doubt has been thrown on the principal argument in favour of joining, namely that economic growth of the UK would be stimulated by membership. Protagonists have pointed out the disparity between the rates of growth of gross national product and real incomes within Britain and the Common Market, but opponents have replied by quoting the cases of other non-members whose economies have developed even faster during the past ten years.

In September the British negotiators submitted a paper on the question of sugar and argued that Commonwealth producers could be squeezed out of the British market if she joined the EEC without arrangements to safeguard their interests. Although sugar consumption in a 10-nation community should rise by 1,500,000 tons by 1978, this would be more than matched by higher production; the six present members would find a market in Britain for all their current surplus, giving an incentive to produce more, while higher prices would foster domestic beet sugar production in Britain and Denmark, eliminating supplies from the Commonwealth.

The EEC Commission, in its reply, said that it could not assess sugar consumption or production after 1974 because the C.S.A. and the E.E.C.'s own market system were due for review in that year; and this provides cold comfort for the Commonwealth exporters.

The British Government have already indicated to Australia that she would be phased out of the Commonwealth Sugar Agreement by December 1971 and this has met considerable resentment and disappointment. The Australian Deputy Prime Ministry warned of the danger this would cause to the International Sugar Agreement, since loss of the C.S.A. quota would leave Australia with a need to seek other outlets which could harm the I.S.A. Mr. McEWEN had previously stated that the proposal to impose levies on food imported into Britain was in breach of trade agreements with Australia.

The Australian High Commissioner in London also pointed out that Britian would almost certainly lose valuable trade preferences now enjoyed by her exports to Australia, which helped to achieve Britain's £164 million trade balance in 1969. He asked British friends of his country to remember that, in the last 70–80 years, whole settlements, towns and districts had been developed in Australia on the assurance of the British market. Australia sent Britain large proportions of her agricultural produce, and great hardship would result from the imposition of high duties and consequent reduction in trade.

The possible effects of UK membership of the EEC were discussed at a meeting held on the 9th December 1970 between members of the Commonwealth Producers' Organization and representatives of British business interests. Representatives of Mauritius and the Caribbean Commonwealth emphasized the need for safeguards of their position under the C.S.A., pointing out the vulnerability of their economies since sugar constituted the principal one of their few major exports. Mr. B. DOWLING, of the Colonial Sugar Refining Co. Ltd. and a member of the Executive Committee of the CPO, spoke of the C.S.A. which, in the event of Britain's joining the EEC, would terminate on 31st December 1974 unless special arrangements were made to safeguard it. He also was concerned about possible harm to the International Sugar Agreement in the event of Britain's joining the EEC.

The West Indian rum industry was also in jeopardy since rum would carry an EEC import duty of 22s 6d per gallon instead of its present 2s 6d duty, and it would have to compete with rum produced in Martinique, Guadeloupe and Réunion, which are exempt from the Common External Tariff and which are also favoured by discriminatory indirect taxes in Metropolitan France.

A point emphasized was that the status of Associated Overseas Territory of the EEC would not be of advantage to the smaller Commonwealth countries wishing to protect their agricultural industries since the marketing of agricultural products is covered by the EEC Common Agricultural Policy. Moreover, while the EEC's Yaoundé Convention associates receive compensation through the Economic Development Fund for Overseas, such financial help has not hitherto been granted to any of the four Commonwealth countries which have concluded association agreements with the EEC.

* * *

World sugar production, 1970/71.

F. O. Licht K.G. recently published their first estimate of sugar production in 1970/71, the figures being reproduced elsewhere in this issue[1]. The European beet crop figures are very similar to those of his previous estimates and those of the IASS[2] so that the main interest lies in the other countries and the figures for the world as a whole.

A fall of over 2,750,000 tons in the Cuban crop is expected, 1970/71 production being estimated at 5,750,000 tons. As against this, an increase of 645,000 tons is expected from Brazil, 122,000 tons from Colombia, and 330,000 tons from the Philippines. The US cane sugar crop is expected to increase by 185,000 tons and the Dominican Republic by 137,000 tons while Mainland China is expected to produce 100,000 tons more and Australia 375,000 tons more.

However, the Mauritius cyclone damage is expected to reduce production by almost 100,000 tons and the South African crop is expected to be lower by about the same. The next result is a total estimate of 73,254,749 tons in 1970/71 against 73,808,078 tons in 1969/70; production will not match consumption (likely to be about 74·5 million tons) and inroads will have to be made in surplus stocks.

* * *

West Indies sugar production decline[3].

The West Indies declared a shortfall of 62,000 metric tons, raw value in the International Sugar Quota on the 30th September; this followed an earlier declaration of 100,000 tons shortfall and brings their quota in effect to only 18,000 tons. In an editorial on the sugar situation the West Indies Chronicle commented:

"It is tragic that the West Indies, who fought for and achieved in the 1968 International Sugar Agreement negotiations a basic export tonnage of 200,000 metric tons, should only have sufficient sugar to fill a quota of 18,000 tons, following on 1969 when they filled only 57,000 tons out of an original quota in effect of 180,000 tons.

"This declining performance in two successive years could sow doubts as to the West Indies' credibility as a sugar producer in the long term. Production performance is of prime importance, particularly at this point of time, when negotiations for entry into EEC have just begun, to be followed in 1971 by the review of the United States Sugar Act and of International Sugar Agreement quotas and the triennial review of the Commonwealth Sugar Agreement.

"The decline in production in the West Indies as a whole, from its peak in 1965, has, in the main, been due to exceptional weather conditions, industrial unrest and a reluctance on the part of some Governments to face the need to mechanize. However, this does not mean that the decline will continue. The trend in both Guyana and Trinidad is upwards, and Jamaica could produce good crops again, given good weather conditions. But the losses made by the West Indies Sugar Company of £1m plus in 1969, likely to be repeated in 1970, and the forecast of a loss of £950,000 by Caroni in 1970, resulting from poor yields and the increases in wages awarded, are alarming. The sugar industry to be successful must be profitable, whether it is owned by governments or private enterprise or both, and it cannot allow its costs to get out of control, although it must be remembered that the average cost of producing cane sugar in the West Indies is well below the world average cost of producing beet sugar.

"It will need the co-operation of producers, manufacturers, sugar workers and governments to restore production to its former peak and to enable the sugar industry to produce economically. Commonwealth Caribbean Governments have realised the seriousness of the position and are taking steps to allow mechanization to be implemented where required.

"1971 will be a vital year for the West Indies sugar industry."

* * *

US sugar supply quota 1971.

The US Department has announced its proposals for the 1971 sugar supply quotas which are based on an Overall Quota of 10,900,000 short tons, raw value. This compares with the 1970 Quota, originally set in December 1969 at 10,800,000 tons but subsequently raised to 11,600,000 tons. The Department also proposes that imports during the first quarter of the year be limited to 800,000 tons; this restriction is set in order to maintain supplies and prices at levels considered desirable by the Department, and is subjected to amendment.

Details of the quotas for individual countries are tabulated elsewhere in this issue.

[1] *International Sugar Rpt.*, 1970, **102**, (32), 1–4.
[2] *I.S.J.*, 1970, **72**, 354, 384.
[3] *W. Indies Chron.*, 1970, **85**, 483.

The significance of invert and gum formation in deteriorated beet

By J. F. T. OLDFIELD, J. V. DUTTON and H. J. TEAGUE
(British Sugar Corporation Ltd., Research Laboratories, Colney, Norwich)

Paper presented to the 20th Technical Conference of the British Sugar Corporation Limited

PART I

Introduction

A N earlier paper presented to the 16th Technical Conference[1] gave an account of the mechanism of gum formation and the reactions involved in the development of a "fruity" odour in frost-damaged beet. The formation of invert, raffinose and kestoses in stored beet was also reported.

The investigations on frost-damaged beet were particularly relevant in 1963 because in January of that year 300,000 tons of beet were frozen in the land and lost due to subsequent thawing and rapid deterioration. Since that time growers have been advised to harvest and clamp their beet by early December. This is a much safer procedure providing clamping is carried out correctly. General guidelines for good clamping have been published[2], but nevertheless, beet clamps are in some cases left unprotected from frost and consequently factory filtration problems arise as a result of the gums which are formed.

Clause 14 of the Beet Contract requires the grower to take reasonable care that lifted beet are protected from frost and, after severe weather, loads are visually examined at the factories for frost-damaged beet to determine whether the beet are fit for processing.

Since visual examination has its limitations, the B.S.C. Research Laboratories were asked to devise a chemical test to detect badly frosted beet which were unsuitable for processing. It was a prerequisite that the test should be completed within the short period during which the load could reasonably be kept at the tarehouse.

From studies of frosted beet it was observed that before a significant amount of gum formation occurred there was a considerable increase in the invert sugar level. A rapid invert test was therefore devised which gave an invert measurement within 2 to 3 minutes of a tarehouse polarization lead filtrate becoming available.

This test, accompanied by a visual examination of a load, is considered to provide the best rapid assessment of the severity of frost damage. Even without a visual examination of the beet, the invert test provides evidence of general deterioration not only from frost damage but also from overheating, clamp rot or waterlogging. The test can be used in the tarehouse to detect beet which have undergone some avoidable form of degradation and are unfit for processing.

The first section of this paper deals with analysis of normal and deteriorated beet while the second section is concerned with the freezing and thawing of beet and the concentration of invert sugar and gums at different stages of thawing.

In the third section experiments on the processing of deteriorated beet are described and the final section deals with the development of the rapid invert test.

SECTION 1

Beet Analysis

Methods

Invert sugar was determined in factory cossettes, or cossettes produced in the laboratory, after maceration in neutral lead acetate, de-leading with sodium phosphate and colorimetric determination by the tetrazolium method[3] (Appendix A).

Levan and dextran were determined in press juices produced from beet brei or in raw juices produced from cossettes in the laboratory micro-battery. The thin-layer chromatography method described previously was used[1].

Invert sugar in fresh beet

The levels of invert sugar in healthy beet harvested from the Research Laboratory plot at intervals during the past two campaigns are shown in Table I. The beet were well washed and topped to the level of the lowest leaf bud; after slicing, the cossettes were macerated in neutral lead acetate within 1–2 hours of harvesting.

In the case of beet harvested after a frost, as much care as possible was taken to remove any apparently frost-damaged material before analysis, but in the case of the sample taken on 22nd December it is believed that some frost-damaged material was unavoidably included.

Table I. Invert sugar in healthy beet from the ground at different times during 1968–1970

Date of harvest	*Invert in beet*, g/100*S*
13th August 1969	0·49
9th September 1969	0·35
20th September 1968	0·40
6th October 1969	0·57
21st October 1969	0·29
24th October 1968	0·41
4th November 1969	0·51
20th November 1969	0·44
25th November 1968	0·23
2nd December 1969	0·48
9th December 1969	0·35
22nd December 1969	0·86
5th January 1970	0·45
6th January 1969	0·28
16th February 1970	0·34

[1] Atterson *et al.*: *Paper presented to 16th Tech. Conf. British Sugar Corporation*, 1963; *I.S.J.*, 1964, **66**, 126.
[2] Oldfield and Dutton: *British Sugar Beet Rev.*, 1969, **38**, 15.
[3] Oldfield *et al.*: *Sucre. Belge*, 1969, **88**, 69.

The results show that with the exception of this sample, the levels of invert in all samples of beet were within the range 0·23 to 0·57 g invert sugar per 100 g sugar with no systematic change as the season progressed.

Invert sugar in factory cossettes

The levels of invert sugar in random samples of cossettes entering six factories at different dates during the last two campaigns are recorded in Table II. Analysis was carried out within 30 minutes of the samples being taken from the cossette belts.

The results show that the 48 samples taken up to 20th December had invert levels within the range 0·25 to 0·60 per 100 sugar. This is the same range as found in healthy beet fresh from the ground and may be considered as the normal level for satisfactory processing.

The mean level for the four samples of cossettes taken at King's Lynn on 9th January was 0·70 g invert per 100S with individual results of 0·56, 0·65, 0·95 and 0·64 g invert per 100S during the sampling period of 5 hours. The result of 0·95 is considered to be indicative of degradation as also was the one result of 0·83 g invert per 100S at Cantley on 10th January.

Invert sugar in clamped beet

Special observations were made at experimental clamps at 13 factory areas in 1969. These clamps should not be considered as representative of the clamping conditions in the area in which the clamps were built.

At the B.S.C. Central Laboratory invert contents were measured in 10 samples at the time of construction and in 50 samples on dismantling each clamp, except at Ipswich and Spalding where invert was measured in 100 samples at the time of construction and in 100 samples at the time of dismantling each clamp.

Table II. Invert sugar in factory cossettes at different dates

Date of sampling	*Factory*	*Invert in cossettes, g/100S* *Mean*	*Range*	*Number of samples of cossettes*
26th September 1968	King's Lynn	0·45	0·38 — 0·55	7
1st October 1968	Spalding	0·44	0·39 — 0·53	5
3rd October 1968	Cantley	0·42	0·35 — 0·50	6
20th October 1969	Spalding	0·45	0·40 — 0·50	2
28th October 1969	Bardney	0·31	0·25 — 0·35	3
30th October 1968	Cantley	0·42	0·32 — 0·50	6
9th December 1968	Cantley	0·31	0·26 — 0·35	6
12th December 1968	Peterborough	0·54	0·47 — 0·60	2
13th December 1968	Felsted	0·35	0·33 — 0·36	3
18th December 1968	Spalding	0·37	0·34 — 0·41	3
20th December 1968	King's Lynn	0·37	0·30 — 0·50	5
9th January 1969	King's Lynn	0·70	0·56 — 0·95	4
10th January 1969	Cantley	0·52	0·37 — 0·83	4

Table III. Invert sugar in clamped beet

	Invert sugar, g/100S				
	Into clamp		*Out of clamp*		*Days in*
Factory trial	*Mean*	*Range*	*Mean*	*Range*	*clamp*
GROUP A					
Cantley B	0·27	(0·25 — 0·33)	0·59	(0·47 — 0·78)	26
Ipswich A	0·36	(0·28 — 0·63)	0·54	(0·41 — 0·74)	34
Ipswich B	0·38	(0·24 — 0·62)	0·51	(0·36 — 0·66)	34
Spalding B	0·35	(0·22 — 0·43)	0·57	(0·38 — 0·79)	49
York	0·29	(0·27 — 0·34)	0·63	(0·51 — 0·74)	41
Group A Mean	0·33	(0·22 — 0·63)	0·57	(0·36 — 0·79)	37
GROUP B					
Bury	0·29	(0·25 — 0·33)	0·75	(0·60 — 0·87)	23
Ely	0·37	(0·33 — 0·47)	0·67	(0·51 — 0·96)	38
King's Lynn	0·58	(0·54 — 0·61)	0·73	(0·59 — 0·95)	43
Newark	0·31	(0·28 — 0·33)	0·59	(0·37 — 0·84)	41
Selby	0·28	(0·21 — 0·34)	0·70	(0·54 — 0·93)	33
Group B Mean	0·37	(0·21 — 0·61)	0·69	(0·37 — 0·96)	3[illegible]
GROUP C					
Bardney	0·38	(0·34 — 0·41)	0·67	(0·44 — 1·12)	39
Brigg	0·43	(0·31 — 0·49)	1·06	(0·70 — 1·59)	35
Cantley A	0·27	(0·25 — 0·33)	0·60	(0·43 — 1·13)	26
Nottingham	0·30	(0·26 — 0·37)	0·78	(0·54 — 1·33)	36
Peterborough	0·54	(0·40 — 0·68)	0·69	(0·43 — 1·14)	13
Spalding A	0·36	(0·24 — 0·92)	0·59	(0·45 — 1·12)	49
Group C Mean	0·38	(0·24 — 0·92)	0·73	(0·43 — 1·59)	33
Overall Mean	0·36	(0·21 — 0·92)	0·67	(0·43 — 1·59)	35

The results are recorded in Table III and the 16 clamps have been divided into 3 groups according to the extent of deterioration during clamping.

Beet put into the clamp had a mean invert content of 0·36 per 100S with the range generally between 0·2 and 0·6 per 100S, in keeping with the level expected for fresh beet. Out of a total of approximately 500 samples analysed there were only 8 results outside this range, 7 of which (0·61, 0·61, 0·62, 0·63, 0·63, 0·66, 0·68) were only just outside and one sample at Spalding of 0·92 which was well outside. The reasons for this high result are not known but it would not seem unreasonable for one sample in 500 to contain some deteriorated beet straight from the ground.

Beet from the clamp had a mean invert content of 0·67 per 100S with an overall range of 0·43 to 1·59.

Invert sugar and gums in deteriorated beet

Neither levan nor dextran, which are the main gums produced in frosted beet, is found in measurable quantity in fresh beet. Moreover, beet can undergo considerable mould damage, heat damage or water-logging without producing measurable quantities of gums. In one case of excessive heat damage where the resulting beet contained no polarizable sugar there was evidence of the production of levan, but in general the production of gums is associated with the action of micro-organisms in cell tissue disrupted by frost damage.

Table IV gives comparative analysis of four different types of deteriorated beet with three samples of normal beet taken at the same times. In the case of the water-logged beet there were no normal beet available at the same site for comparison.

Table IV. Comparative analyses of normal beet and beet suffering different forms of deterioration

Site		*Beet sample*	*Sugar* %	*Invert,* g/100S	*Levan,* g/100S	*Dextran,* g/100S
1.	A.	Frosted, from unprotected top of clamp..	12·8	3·90	1·3	0·9
	B.	Normal, straw-protected	16·5	0·28	<0·1	<0·1
2.	A.	Exposed and wilted, from top of clamp ..	17·5	2·59	<0·1	Not Detmnd.
	B.	Sample with clamp rot, from interior....	16·6	3·11	<0·1	Not Detmnd.
	C.	Normal sample, from interior of clamp ..	16·3	0·73	<0·1	Not Detmnd.
3.	A.	Waterlogged and under water............	7·0	18·2	<0·1	<0·1
	B.	Waterlogged but not under water	8·2	5·4	<0·1	<0·1
4.	A.	Overheated by trash in factory pile	11·34	3·53	Not Detmnd.	Not Detmnd.
	B.	Normal beet from factory storage pile	16·60	0·36	Not Detmnd.	Not Detmnd.

In 5 out of the 16 clamps (Group A), out of a total of 400 samples taken, there were no samples with invert levels above 0·8 per 100S. This is indicative of very good clamping conditions producing very little deterioration. Any increase in invert content makes the task of producing high-grade sugar more difficult and some inversion during storage is probably inevitable but in these 5 clamps, under good storage conditions, the beet were stored for an average of 37 days with an average increase in invert of only 0·24 per 100 sugar. In a further 5 clamps (Group B), out of a total of 250 samples taken, none had invert levels in excess of 1·0 g per 100S. Of the remaining 6 clamps with samples containing invert in excess of 1·0 per 100S (Group C), three were reported as suffering frost damage and three were not. In this latter group there was evidence of higher than normal clamp temperatures owing to trash and soil and possibly in one case to the rapid rate of building the clamp. The worst damage was suffered at Brigg where 22 out of 50 samples had invert levels above 1·0 per 100S as a result of frost damage caused by inadequate covering.

It is concluded that the invert level in well-clamped beet does not exceed 0·8 per 100S but that even in trial clamps built under controlled conditions invert levels in excess of this occur owing to frosting and overheating.

Analysis of the frosted beet from site 1 showed, typically, high levels of levan and dextran gums together with high invert and a low sugar content. It is clear that the loss of sugar from the frosted beet is not limited to the amount of invert and gums produced. About 20% of the sugar in the beet was lost as a result of frost damage but the invert and gums represent only about 6% of the initial sugar in the beet. This loss of sugar from frosted beet does not appear to be generally appreciated, particularly by growers who do not cover their clamps and is referred to again in the next section.

The beet suffering clamp rot and those which were wilted at Site 2 both had high levels of invert but no detectable gums. The wilted beet and the clamp rotted beet contained similar amounts of invert but the different effects of the enzymes responsible for this inversion are indicated by the different kestose contents; chromatography of the press juices showed the wilted beet to contain 0·3 g kestose per 100S while the clamp rotted beet contained 1·2 g per 100S.

The beet which were waterlogged and under water from site 3 were black throughout and had a high level of invert but no detectable gums. The cause of degradation in this case is not known, but it would seem possible that with lack of oxygen the beet tissue undergoes anaerobic degradation. The upper portions of the roots of the beet from the same site which were waterlogged but not under water appeared quite healthy but the lower portions were black. The high level of invert in these beet makes them unsuitable for processing.

In October and early November 1969, during warm weather, piles of beet were seen to be steaming in the factory yard at site 4. The piles were approximately 30 feet high and steaming occurred at intervals along the apex. Temperatures up to 50°C were measured and were found to be mainly associated with pockets of trash and dirt left by the automatic belt unloader at the unloading points in its traverse of the length of the flume. Unloading usually commenced on a Tuesday afternoon and by Thursday steam could be seen. The beet were flumed out on Saturday and the samples of beet were taken just before fluming out. The overheated beet were blackened but not gummy and analysis showed marked inversion and loss of sugar compared with the normal beet from the same pile.

The overheated beet are not considered suitable for processing because of their high invert level and it has been recommended that new installations for large-scale storage should incorporate some means of removing trash and dirt before piling so that overheating caused by its degradation and the lack of ventilation is minimized.

SECTION 2

The Freezing and Thawing of Beet

Beet freezing

It is generally accepted that tissue damage due to freezing is caused by the formation of ice crystals within plants. However, it is evident from a recent review[4] of freezing injury in plants that it is a complex process biologically.

Both the sugars and the non-sugars will depress the freezing point of the cell fluids to an extent depending on their concentrations, and it would be possible to calculate this depression if all the cells in any one beet contained fluid of the same composition. However it is known that even the average composition varies regionally within the beet and some cells in any one region contain far more sugar than other cells in the same region. The composition of individual cells can differ considerably from the average composition and hence different cells in the same beet may freeze at different temperatures.

The present investigation has been an attempt to obtain preliminary information on beet and therefore the experiments have been carried out in a relatively simple fashion and it has not been possible to cover the full practical range of sugar content and purity.

The temperature at which some beet froze has been determined by inserting thermocouples inside individual roots and then placing the roots in a cold room or refrigerator. The temperatures registered by the thermocouples were read at intervals during cooling and the results plotted against time as shown in Figs. 1 and 2.

Fig. 1 records temperatures measured at intervals after placing six beet of differing weights in a deep freeze cabinet at a temperature of —13°C. Curve A represents the cooling at the centre of a very large beet weighing 1825 g while the cooling at the centre of a smaller beet weighing 813 g is recorded in curve B. Examination of curve B shows that after 2 hours, cooling ceased for 1 hour at the temperature of —2°C. This represents the onset of freezing. That the temperature subsequently fell to —2·4°C and levelled off again is considered to be caused by slight instrument fluctuation. During the period between 2 and 5½ hours it is deduced that only ice formed and complete solidification of the juice constituents had not occurred since this would be shown by a further sharp fall to the temperature of the deep freeze. Curve C was the rate of cooling 1 cm below the surface of the smaller beet, which is clearly more rapid than A or B.

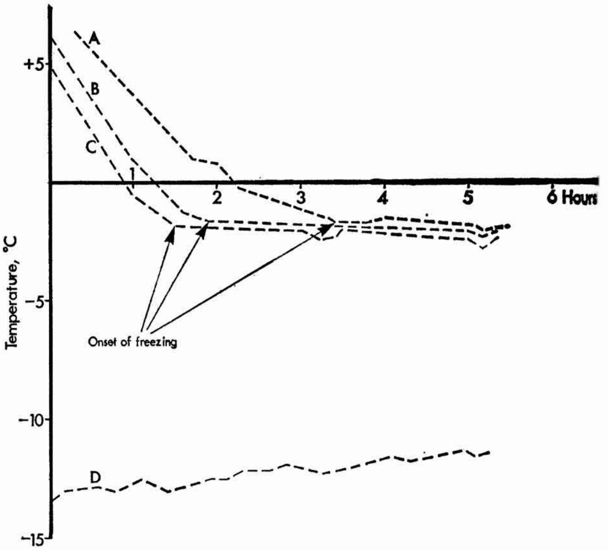

Fig. 1. Cooling and freezing of beet in an environment of —13°C to —11°C. A—temperature at centre of 1825 g beet; B—temperature at centre of 813 g beet; C—temperature at 1 cm below surface of 813 g beet; D—temperature of environment.

In summary, the curves show that freezing commences at about —2°C at the centres of two beet and the surface of one. The same result was obtained for four other beet examined at the same time. When the beet are transferred from an environmental temperature of 5°C to 6°C to one of —13°C, freezing commences in the outer layers in approximately 90 minutes, at the centre of an average beet in approximately 2 hours and at the centre of a large beet in 3½ hours.

Fig. 2 shows a similar experiment carried out in a cold room at —5°C. The cooling curves are representative of six beet and again show that freezing commences at —2°C. In this case freezing commenced

[4] Mazur: *Ann. Rev. Plant Physiol.*, 1969, **20**, 419.

at the centre of average-sized beet 3 hours after transfer from a temperature of 6°C to a temperature of −5°C.

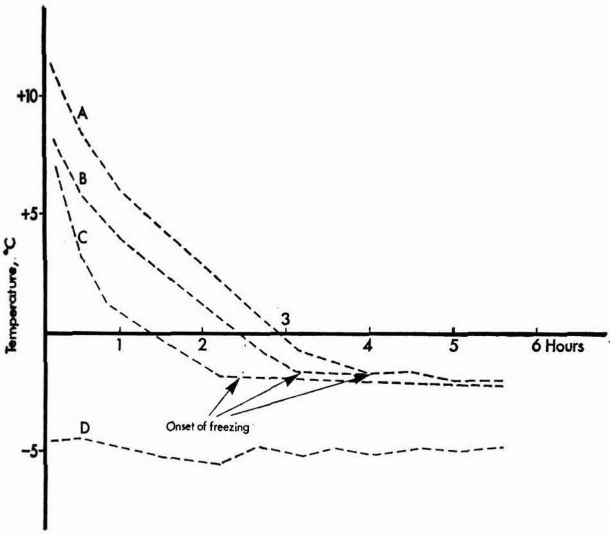

Fig. 2. Cooling and freezing of beet in an environment of −5°C. A—temperature at centre of 863 g beet; B—temperature at 1 cm below surface of 863 g beet; C—temperature at centre of 342 g beet; D—temperature of environment.

It is concluded that prolonged exposure to temperatures below —2°C would most probably lead to frost damage.

The thawing of beet

(a) *Physical loss of juice.*—Although freezing commences at about —2°C complete solidification does not occur until just below this temperature, though beet which have been left at —2°C for 14 days have been found to be visually completely solidified internally.

The significance of the actual temperature reached by beet on their subsequent degradation was observed in a simple comparative experiment in which one set of six beet were left at about —15°C for 60 hours, by which time internal temperatures of between —13°C and —16°C were measured. The beet were transferred to 20°C to thaw and after about 7 hours had reached 0°C when a physical loss of juice began to occur. In 24 hours a total of 196·5 g of juice had exuded from a total initial weight of 5935 g of beet; this represented a physical loss of 3·6% of the total sugar in the beet.

In contrast to this experiment, which is given as an example of an extreme condition of beet disintegration following severe frosting, an experiment was conducted under less severe frost conditions by freezing beet at —6°C. On thawing at 20°C for 24 hours there was a physical loss of only 11·6 grams of juice from a total of 3446 grams of beet. The physical loss of juice from beet after thawing is likely to be of this order or less under frost conditions in this country.

(b) *Inversion after thawing.*—The physical loss of sugar in the juice is small compared with the inversion loss which occurs during the period immediately following thawing.

Table V. Days after clamp construction at trial sites when air temperatures of —2°C and below were recorded

Trial	—2°C	—3°C	—4°C	—5°C	—6°C	—7°C	—8°C	—9°C
Bardney	8, 13, 17, 26, 35	14, 27, 37	6, 7	3, 8				
Brigg	12, 13, 32, 34	6, 12	22, 23	3, 4, 5, 24, 26	10			
Bury	7, 8, 9, 21	20						
Cantley	2, 14			3				4
Ely	3	11, 13	5, 7		12		6	
King's Lynn	5, 9, 11, 23, 24, 34, 35, 36		4, 10, 39	3, 31				
Newark	5, 17	18						
Nottingham	9, 26, 32	22, 30		13, 24, 31	25			
Peterborough	3, 9	2, 7, 8						
Selby	3, 8, 9	2, 30	31					
Spalding	6, 10, 14, 26	8, 15, 16, 27	9	42, 43, 44				
York	6, 12, 13, 14, 32	7, 8	24					

Table V shows the air temperatures of −2°C and below measured at clamping trial centres during 1969 together with days after clamping when the temperatures were measured.

It will be seen that all centres had air temperatures of —2°C and below and at 7 of the centres these were recorded within 3 days of completion of the clamps and at the remaining centres within 5 to 9 days, thus making the ready availability of straw or similar protection an essential at every site during clamp construction.

Table VI shows the invert content of beet at different periods after thawing had commenced.

50–60 lb samples of beet had been frozen at different temperatures in nylon sacks and each determination was carried out on cossettes produced from a 10 lb sample.

The results are not considered as being completely comprehensive but the following conclusions have been drawn:

1. Very little inversion occurs during freezing as

Table VI. Levels of invert in beet after freezing at different temperature and thawing at 13° to 15°C

Temperature at which frozen	*Duration of freezing (days)*	*Days of thawing* 0	1	2	3	4	7	11
		Invert, g/100S						
—2°C	14	0·58	0·75	—	0·65	—	2·25	5·71
—3°C	4	0·69	—	—	—	2·40	7·3	—
—3°C	7	0·60	—	—	—	1·30	9·1	—
—3°C	9	0·64	—	—	—	0·54	4·0	—
—4°C	7	0·69	—	—	—	2·94	—	—
—5°C	7	0·47	—	1·3	—	9·1	—	—
—5°C	7	0·69	—	2·4	—	6·8	—	—

shown by the invert levels measured immediately (column 0).

2. Inversion occurs more rapidly the lower is the temperature at which the beet have been frozen. Thus, after freezing at —5°C, beet reach an invert level of 1·3—2·4 in 2 days whereas beet frozen at —3°C take 4 days to reach a similar invert level. The slowest inversion was observed in the beet frozen at —2°C. These beet were found to be frozen solid inside by cutting open and examining visually after 14 days at —2°C.

3. All samples were virtually unprocessable within 7 days of the commencement of thawing.

The polarization of the beet dropped sharply during thawing so that on average for all experiments a polarization loss of 2·0 (from 14·0 to 12·0) was measured within 7 days of the commencement of thawing.

(c) *Gum formation.* The cossettes produced for measurement of invert on the thawed beet were used to prepare raw juice in the laboratory micro-battery. The raw juice samples were analysed for levan and dextran and the results obtained for juices from both fresh beet and thawed beet are given in Table VII together with the invert concentrations in the beet.

It will be seen that, as expected, the concentrations of levan and dextran in raw juices produced from fresh beet were very low. In thawed beet, one sampl at 1·3 g invert /100S had a noticeable level of 0·4 dextran /100S but apart from this result the level o gums did not become significant until a beet inver level of 2·0 g /100S was exceeded.

Table VII. Comparison of the invert level in beet and the leve of gums in raw juice

	Beet invert, g/100S	*Raw juice gums* *Levan, g/100S*	*Dextrar g/100S*
A. Fresh Beet	0·47	<0·05	0·1
,, ,,	0·58	0·1	<0·05
,, ,,	0·60	<0·05	0·1
,, ,,	0·69	<0·05	0·1
B. Thawed Beet	0·48	0·05	<0·05
,, ,,	0·65	0·1	0·2
,, ,,	0·75	<0·05	<0·05
,, ,,	1·25	0·05	0·1
,, ,,	1·30	0·05	0·1
,, ,,	1·30	0·1	0·4
,, ,,	1·40	0·1	0·2
,, ,,	2·14	0·4	0·1
,, ,,	2·25	0·1	2·0
,, ,,	2·40	2·5	1·3
,, ,,	2·40	0·8	1·5
,, ,,	2·94	0·4	2·0
,, ,,	3·23	0·5	0·8
,, ,,	5·71	0·5	5·5
,, ,,	6·80	1·3	2·5
,, ,,	7·30	4·5	6·0
,, ,,	9·10	1·0	12·0

(*To be continued*)

Cuban Sugar Technologists Association 39th Congress

THE 39th Congress of the Asociación de Técnicos Azucareros de Cuba was held during the 5th–17th October, a total of 750 technologists participating. There were 83 foreign participants, including 49 who are working in Cuba and 34 visiting the country in order to take part in the Congress.

The last, who included a representative of this *Journal*, gathered in Havana and on the 5th October departed by air to the second city of Cuba, Santiago, where they visited the University of Oriente as well as being taken on a sight-seeing visit. During the following week they returned to Havana by way of Holguín, Camagüey and Cienfuegos, visiting the Urbano Noris sugar factory (formerly San Germán), Antonio Guiteras (formerly Delicias) and Panama factories (formerly Vertientes). All three are larg factories with double tandems and have crushin capacities of 12–15,000 t.c.d. At Urbano Noris a ne Škoda tandem was being installed with steam turbine and gearing also from the Czechoslovakian mi suppliers, while at Antonio Guiteras a new A. & W Smith tandem had been installed with Peter Brother hood steam turbines driving through David Brow gearboxes. The Smith contract had also included ful instrumentation assembled in panels in a contro cabin located above and between the two tandems.

At the Panama mill, new steam turbines an gearing (also from Brotherhood and Brown) had bee fitted but the mills were old, one tandem bein entirely of Hamilton mills and the other a mixture o

Hamilton and Fulton mills. In the three factories there was also a considerable amount of equipment supplied in recent years from East Europe, in particular East Germany, and including power generators and turbines, boiler houses, etc., while a number of rotary vacuum filters supplied by Filtres Vernay S.A. was also in evidence.

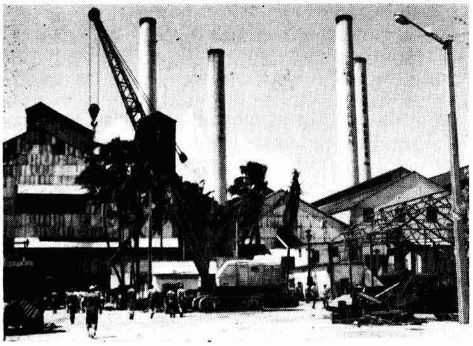

Fig. 1. Central Urbano Noris

Where foreign exchange was available for new equipment it was obviously being installed, but a considerable amount of cannibalization of plant and repairs with Cuban-made parts is necessary to keep the older equipment functioning. That these efforts were succeeding, to the extent that Cuba produced a record 8·6 million tons in the 1969/70 harvest, was clearly a source of pride and satisfaction to the factory personnel. However, instrumentation was lacking since no spare parts have been available for the meters and gauges for several years, and, without equipment for weighing of cane, juice, bagasse, etc., it was difficult to understand how it was possible to calculate the extraction figures claimed for the mills.

The foreign visitors were interested to see the Cienfuegos bulk sugar terminal which is believed to have the largest capacity of any so far built, at 100,000 tons. Sugar brought to the terminal from the factories, in Rumanian-built rail cars with centre-hinged opening floors, is discharged into hoppers feeding a belt conveyor system which carries it to a weigh-tower with a Servo-Balans raw sugar scale. The weighed sugar is transported to the top of the parabolic-section store and is directed by ploughs from the upper conveyor belt onto the pile of sugar. It is recovered by discharging through central floor hoppers which supply two conveyor belt systems which pass through

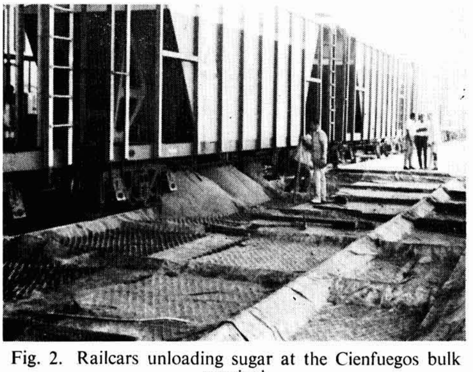

Fig. 2. Railcars unloading sugar at the Cienfuegos bulk terminal

further weighers to loading gantries at the end of the loading dock; these gantries swing out and down into the receiving ship's holds and can load at the rate of 750 tons/hour, so that a cargo can now be loaded in one day instead of the 15 days previously needed for bagged sugar. In addition, the labour required is reduced from 300 to only 50 men.

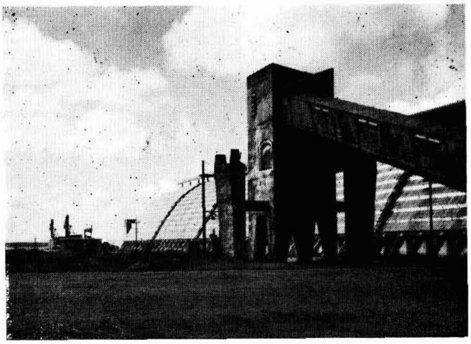

Fig. 3. Silo, weighing tower and loading gantries at the Cienfuegos terminal

A visit was also arranged to the Zapata Peninsula National Park, which includes a museum devoted to the original Indian inhabitants of the island some of whom were able to escape slaughter by the early Spanish colonizers by hiding in the swampy area now forming the Park. In addition, an area of the Park is devoted to the breeding of thousands of crocodiles which are farmed for the sake of their valuable skins.

Fig. 4. Zapata Peninsula National Park

The second part of the Congress commenced the day after returning to Havana and was located in the Havana Libre hotel (formerly the Havana Hilton) where facilities for simultaneous translation were provided at the opening and closing sessions and in the largest section meetings devoted to sugar manufacture. The Congress was opened by the Association's Chairman, Ing. RAFAEL PEDROSA PUERTAS, and an address was given on the origin, development, organization and achievements of the Sugar Cane Research Institute of the Academy of Sciences by its Director, Lic. LEOVIGILDO FERNÁNDEZ CHAVIANO, who described the work carried out on cane breeding, fertilization, etc.

The three major tasks facing the Ministry of the Sugar Industry were outlined by Vice-Minister MIGUEL URRUTIA ALVAREZ, namely the rehabilitation and improvement of existing sugar factories, mechanization of agriculture, and training of workers in the industry, all to permit attainment of the full potential of the land, factory equipment and work-force.

The meetings of the various sections then continued through the week, with two special symposia on cane diffusion and on mechanization of cane harvesting, loading and cleaning. In addition, a number of visitors were able to see the facilities of ICIDCA (Instituto Cubano de Investigaciones de los Derivados de la Caña de Azúcar) and its work on bagasse pulp and paper manufacture, cane wax, furfural production, molasses fermentations of various types, etc. as well as development of analytical methods, kenaf utilization, etc. They were also able to visit Pablo Noriega sugar factory (formerly Occidente) which is used as a large-scale experimental plant for research on factory processes.

There, Ing. ROBERTO PÉREZ VEGA, Vice-Director of ICIDCA, described the proposed development of the mill as a new "research township". The mill is to be modernized, with a special line from raw juice to refined sugar, equivalent to 100 tons of cane per day. New equipment and processes can be run on this pilot scale and compared directly with results achieved using juice from the same cane going through the normal process in the main 900 tons/day equipment. The new techniques can also be applied on the larger scale, so providing two intermediate stages between the laboratory and the bigger 12,000 t.c.d. sugar factories.

In addition, the cane lands around the factory will be so designed as to allow experimental work on cane varieties, cultivation techniques, harvesting, cane cleaning, etc., with rapid evaluation of their results when the cane is processed in the factory. This will require a large number of technologists for

Fig. 5. Henderson cane harvester

field and factory, and a township will be developed with housing, educational, medical and leisure facilities. It was hoped that the project will be completed within five years.

A special performance of the Cuban National Ballet was arranged for participants in the Congress, and also a visit to the spectacular Tropicana open-air restaurant and night club. A visit was also arranged to see a Henderson cane harvester in action; unfortunately part of its elevator mechanism broke just before the party arrived and it was not possible to repair it in time to allow delegates to see it working before they had to return to Havana for the closing ceremony, in which Ing. PEDROSA summarized the Congress and the Minister for the Sugar Industry, Ing. MARCOS LAGE, made the closing address.

Abstracts of the papers presented at the Congress will be published in this *Journal* in due course.

Sugar cane research in South Africa

Annual Report of the Experiment Station of the South African Sugar Association, 1968-69

A NOTABLE feature of the Station's activities has been the increase in extension work rendered possible partly by the appointment of additional staff for the work. It is pointed out that the growing enthusiasm with which the industry has responded to the efforts of the Station's Extension and Advisory Services during the past two years has been a source of considerable gratification for all concerned. The year under review has been particularly encouraging in this regard as it has seen the implementation, on a substantial scale, of a number of recommendations concerning production techniques and management, which is evidence of the effectiveness of the extension methods adopted by the Station. As an example, the value of heat treatment of seed cane against ratoon stunting disease is now widely recognized and many growers purchase heat-treated seed, utilize the heat treatment tank facilities which exist at mills, or have constructed their own or group installations for on-farm treatment of seed cane. A range of heat treatment tanks of varying capacities and employing different methods of heat application is becoming available commercially and a guide to the standards of performance required for effective heat treatment has been published by the Station for the information of intending purchasers.

A sugar cane smut eradication campaign has been started by cane growers in the Eastern Transvaal, with the Station's guidance, in the hope of eliminating this troublesome disease from their rich cane growing areas.

The widespread interest and enthusiasm displayed by growers in response to the Station's current campaign for the improvement of production techniques and labour organization are symptomatic of the good relationships that exist today between the Station staff and the industry. The demands of the industry are constantly changing and the Experiment Station is fully aware of its responsibilities for the future in this regard. While extension and related services have now become and will remain a major part of the Station's activities, the need for research and innovation is not being overlooked. The research programme is kept continually under review and further changes in emphasis and direction to meet forseeable industrial requirements, both in the short and long term, will be made if and when required.

A new sub-station has been established in the T.M.S. Mistbelt region as part of the Station's policy of selecting seedlings in the environment for which they are ultimately intended. A variety trial with released varieties has been established at this station.

Cane breeding and flowering induction

It is well known among sugar cane breeders that a member of the staff of the Station pioneered techniques for the induction of flowering in sugar cane. Restricted facilities for crossing procedures have until recently restricted the use made of these techniques. The completion of a new glasshouse complex at the Station has now favourably altered the position and further work is now being undertaken to develop techniques which will permit the regular supply of fertile flowers of a wide range of parent varieties for the breeding programme each year. The recent investigations conducted in a temporary photo-period house erected in the glasshouse confirmed the general feasibility of the technique. The practical details of the procedures involved now remain to be perfected, prior to going into large scale operation. Experience has now shown that a separate photo-period house will have to be provided alongside the glasshouse, as the two operations, flower induction and controlled hybridization, overlap to such an extent that it is not practical to use the glasshouse for both purposes.

In order to determine what effect older leaves have on flowering in sugar cane, all leaves below the first fully opened leaf were removed from 186 varieties. Although initiation may have been encouraged in some cases, normal flowering could not take place in many varieties, owing to what seemed to be the development of severe iron chlorosis. This was apparently induced in the new leaves as a result of defoliation. Plants grown in metal containers on trolleys could readily be transferred to a light chamber or glasshouse for photoperiod or heat treatment. The plants receiving the photo-period treatment were left outside until after dark, and then wheeled into the darkroom where they were subjected to a fixed, artificial dawn at 6 a.m. In this way they experienced decreasing day-lengths, equivalent to those of Hawaii and Fiji during the period when flowers initiate in those countries. Other plants were moved into the heated glasshouse at night, but only after it could be assumed that whatever flower bud initiation was to occur had taken place. This treatment was designed to determine the effect of temperature on the emergence of tassels. The experiments are not yet concluded but some varieties which have not flowered before in South Africa have clearly initiated inflorescences following the photo-period treatment.

Variety selection work was carried out at eight stations or sub-stations, representing various environmental conditions. During the year 332 crosses were made using 92 parent varieties. The fuzz from 432 tassels was harvested and stored in a deep-freeze chamber. Inflorescences were initiated in a large number of varieties in the breeding plots but not all of them emerged. High temperatures at the appropriate time may have favoured bud differentiation, while an ensuing cold snap may have inhibited later development of inflorescences.

More than 160,000 seedlings were raised during the season. The average number of seedlings obtained from the fuzz of individual tassels was high. Fertilizer applied to the seedlings when they were very young and the use of mobile glasshouse trolleys for gradual early hardening-off of the young plants ensured high survival rates. Very little damping-off was experienced and transplanting was started two weeks after the seed had been sown.

Cane variety situation

The variety N:Co 376 continues to increase in popularity and during 1968-69 it constituted 44½% of all the cane sent to the mills. N:Co 310, while still a widely grown variety in Pongola and in North Zululand, declined further in overall popularity and now represents only 19% of the total cane crushed.

The changes in popularity of cane varieties grown since 1940 are shown in a diagram. Although N:Co 310 continues to decline in popularity it has remained the mainstay in some areas. The increasing use of heat treatment, accompanied by other improvements in the production of seed cane, may lead to some revival of its popularity in some other areas. The choice of N:Co 376 as a substitute for N:Co 310 continues and N:Co 293 is making an increasing contribution, mainly because of its popularity at higher altitudes. N:Co 382 appears to have reached a peak and the proportion of N.50/211 has started to decline. A new variety known as N.6 was released during 1968-69 It seemed to do well although its sucrose content was usually lower than that of N:Co 376. Since release it has proved to be susceptible to leaf scald and it has also been infected with smut in areas where the incidence of the disease is high.

Deep tillage

Five experiments were planted in 1967 and 1968 to compare deep ploughing and sub-soiling with the more conventional methods of land preparation, the experiments being on clay, loam and sandy soils. Growth measurements so far indicate no responses to the deep tillage treatments in any experiment except that on sand, where there was a 15% height advantage for deep ploughing (38 inches) compared with the conventional ploughing (10 inches). The indications to date are that deep tillage is not justified except possibly in shallow soils on top of shale, when shattering of the sub-soil hastens its breakdown and the formation of a greater effective rooting area.

The results from a series of experiments on the effects of conventional sub-soiling in the inter-rows of ratoon crops on a number of different soils showed, somewhat surprisingly, that more often than not, yields were not affected at all by the operation and that deep sub-soiling could in fact cause a depression in yield. Out of eleven experiments harvested, seven gave no response, three gave significant depressions in yield and only one a small but statistically significant increase. It was concluded that sub-soiling in dry soils soon after harvest presumably caused extensive damage to the existing root system which nullified such possibly beneficial effects as improved soil aeration, the creation of a greater effective rooting depth and improved acceptance of rainfall or irrigation water.

Effects of silica

The results of field experiments with silica slag on two acid soils are reported. Treatments included the use of ground dolomite limestone and a coarsely textured local slag, these being broadcast and rotavated into the soil before planting. On the one soil, a fine sandy clay (pH 4·65, organic matter 13·4%), there was a good response to both limestone and slag but the other soil did not respond to either treatment. It was thought that the different results were due to the difference in the available calcium contents of the two soils, i.e. 249 p.p.m. Ca and 104 p.p.m. Ca.

Pot experiments were carried out to study the effects of various silica-containing materials on cane growth on a Natal Midlands soil (71% clay and pH 4·3). Each pot received a basic dressing of fertilizer, equivalent to 100 lb N, 150 lb P and 100 lb K. Subsequently the following materials were applied separately at levels of 2, 4 and 8 tons per acre—calcium metasilicate; blast furnace slag; sodium metasilicate; metasilicate slag (Hawaii), Portland cement; and lime.

Calcium chloride was added to all pots to raise the Ca status above the critical level. The yield results indicated that marked responses were obtained from all sources of silica except sodium silicate, which increased exchangeable Na in the soil.

Another experiment was designed to compare the effects of lime and metasilicate slag. Results again showed the superiority of the silica treatment compared with lime. It appears that the addition of materials containing soluble silica to some of the acid soils of the Natal Midlands could bring about marked improvements in crop yields.

Effects of wattle brush ash and filter cake on soil fertility

In the Natal Midlands sugar cane growing on sites where wattle brush has been burned has often been found to give much higher yields than cane grown on adjacent areas where no brush has been burned. Analyses of soils from twenty such pairs of sites revealed statistically significant differences in pH values, Al, Ca, P, and to a lesser extent Mg, Si and K contents. Pot experiments were therefore carried out on several Midland soil series to determine the factors responsible for the yield effects. The greatest responses were obtained with wattle ash and/or lime in the presence of superphosphate. Addition of aluminium salts depressed cane growth and resulted in the appearance of phosphorus deficiency symptoms. The main reason for improved yields, from either wattle ash or lime amendments, seems to be increased utilization of phosphorus at the higher soil pH values. This is brought about by the reduction in the concentration of the soluble aluminium which is responsible for high P fixation.

Pot experiments were conducted to study the effects of filter cake from the sugar mill on soils and on cane plants. The soils were obtained from a sandy area where the cane growth was very poor, and from an adjacent area where the cane was in a much better condition. Results from the first ratoon crop showed that soil sterilization did not improve yields, but that cane growth was much better on both sands when filter cake was used with them. The soils were subject to microscopic examination at intervals following the initiation of the experiment. The presence of filter cake was responsible first for a large increase in the numbers of non-spore-forming bacteria, and then an accumulation of various fungi, including *Neurospora crasse*, *Trichoderma viride*, *Aspergillus* sp., and *Penicillium* sp. Spore-forming bacilli and actinomycetes increased in numbers. Parasitic fungi such as *Fusarium* and *Pythium* were absent. Saprophytic nematodes increased in numbers, but scarcely any parasitic nematodes were observed.

Cane harvesting on steep hillsides

Much of the cane produced in Natal is grown in hilly country. Is is considered that requirements to mechanize the handling of cane on slopes too steep for infield grab loaders very according to daily cutting rates. For farms cutting about 40 tons of cane a day, only the cheapest systems can be justified. A prototype machine being tested for use in such circumstances comprises a winch designed to pull a 500–600 lb chained cane bundle up the slope, and a basket-type trailer into which the winch rope hauls the bundle. The winch, which is hydraulically operated, is fitted to the side of the trailer, and the cable passes from this over the body and down the hillside. The winch is detachable and can be placed on either side of the trailer, or it can be transferred to another trailer.

Varietal tolerance to herbicides

A trial was carried out in order to screen a number of released cane varieties for differential tolerance to "Diuron", "Bromacil" and 2,4-D, applied at low and high rates over the foliage. Although no variety showed complete tolerance to any chemical, even at low rates of application, an index of relative tolerance was established. The varieties N:Co 310 and N.55/805 showed the greatest tolerance to the chemicals used, and N:Co 376 and N.50/211 the least tolerance. N:Co 376 was the most susceptible to 2,4-D and N:Co 382 and N.50/211 to "Bromacil".

Pre- and post-emergence herbicides

C.P.50144 ("Lasso") and "Urox B" showed greatest promise among pre-emergence herbicides. Both gave better weed control over a longer period of time than the standard treatment employing 2,4-D and "Diuron". C.P.50144 was outstandingly good for control of grass weeds, the species present in the trial being *Eleusine indica*, *Setaria verticillata* and *Digitaria ascendens*. Its activity against *Cyperus esculentus* was also highly rated. C.P.31675 controlled *Cyperus rotundus* (nut grass), but this chemical is no longer being produced. C.P.44939 seems to control both species of *Cyperus* when applied at rates greater than 3 lb of the product per acre. None of the chemicals appeared to suppress cane growth significantly.

"Ametryne" in the form of "Gesapax 80" (at 5 lb a.i./acre) proved to be the most outstanding post-emergence herbicide. It gave excellent control of grass weeds, severely suppressed the growth of *Cyperus esculentus* but was ineffective against *Cyperus rotundus*. High rates of "Ulox B" killed all weeds but also severely damaged the sugar cane. Lower rates failed to give adequate weed control.

Leaf scald and leaf scorch

During the year the potentially troublesome disease known as leaf scald (caused by a bacterium *Xanthomonas albilineans*) was identified on commercial cane in Swaziland. It has since been recorded elsewhere. An outline is given of varietal susceptibility or resistance, as known at present. The new variety, N.6, only recently released, is susceptible. The main commercial varieties, N:Co 376 and N:Co 310, are resistant to leaf scald, as is the new variety N.55/805, while so far N.51/539 appears to be fairly resistant. Reports from Rhodesia indicate that N.52/219, a variety which was withdrawn at the pre-release stage of testing in 1963 in South Africa, shows good field resistance to the disease. Both field and laboratory studies of this problem are being undertaken at the present time. Inoculation tests with different isolates indicated that there are several different strains of the disease, which are being studied.

Leaf scorch, caused by the fungus *Stagonospora sacchari*, was first observed in 1967 on N:Co 376 on the North Coast of Natal. Subsequently it was found in the Midlands and on the South Coast. The fungus was isolated from the red to dark brown spots found on the infected leaves, as well as from border lesions on badly affected leaves. The occurrence of the disease depends upon climatic conditions and is not considered to be of major importance.

Cane pests

Increasing attention was paid to nematodes during the year. The erratic responses obtained from soil fumigation with nematicides in areas suspected to be heavily infested with nematodes have militated against the more frequent use of these chemicals in commercial cane production. Routine counts of nematodes in soil samples submitted by growers from many parts of the cane belt and more detailed studies of the seasonal fluctuation of nematode populations, their distribution in the soil profile and the different species present, have served to indicate the extent and complexity of the problem. Work in this particular field has now been intensified, and the screening of new types of commercially available nematocides is to be undertaken as a routine procedure to test their efficiency in cane production.

In connexion with nematode population studies, an area of poor coastal sand at the Central Field Station had been planted with the nematode resistant grass *Eragrostis curvula* for almost three years. Regular sampling showed that the root-knot nematodes (*Meloidogyne* spp.) had practically disappeared from the area although other plant nematodes such as *Trichodorus* and some *Hoplolaims* were not affected.

With regard to insect pests there were no major changes in the situation during the year. Numicia (*Numicia viridis*) continued to claim a good deal of the entomologists' time. In general, numbers of Numicia were substantially lower than in previous years, although a few heavy but very localized outbreaks did occur, and for the first time conspicuous symptoms of Numicia damage were noted in certain fields in the Komatipoort area in the Eastern Transvaal. Hymenopterous egg parasites were more prevalent in the latter area than in the previous year, possibly as a result of the stocks of parasites released by the Entomologists during 1968. Several hundred acres of Numicia-infested sugar cane in the northern part of Swaziland were treated with "Endosulphan 5%" dust at rates of 15 and 30 lb per acre on the decision of the management concerned. The treatments were effective in reducing the numbers of insects but it is still not possible to assess whether such action is warranted economically.

The other common pest of cane, *Perkinsiella insignis*, appeared to be more plentiful and warrants more attention. Preliminary investigations on the insect indicated that populations reach a peak during May and June. Its eggs are parasitized by at least two hymenopterous species while the adults and nymphs are occasionally parasitized by a Dryinid species.

Other matters

Other matters dealt with in the report include farm planning, drainage and irrigation, mechanization, information service, education, soil surveys, fertilizers, plant physiology, agronomy (several headings), chemistry, microbiology, weather conditions, and programme research.

F.N.H.

The International Sugarmark

The Comité Européen des Fabricants de Sucre have chosen the design illustrated to be the International Sugarmark. Intended for use on sugar packets and containers of various kinds, it will guarantee a minimum polarization of 99·7°S with no artificial additives present and a quality as defined by Codex Alimentarius Provisional Standard A for White Sugar and the Draft Provisional Standard for Powdered Sugar. It will also symbolize the qualities of pure sugar (sucrose) and will identify the product to the consumer.

pure sugar

The design was chosen as a result of an International Design Competition announced early in 1970[1] and was submitted by Mr. ROGER J. SIMMONS, of Yeovil, Somerset, England, whose entry was among the three winning designs selected from 211 UK entrants as the British entry in the International Competition. Thus, Mr. SIMMONS receives a prize of £150 for the British entry and £1000 for winning the international competition.

The International Sugarmark depicts the letter "A", as a mark of high quality, incorporated in a continuous line representing a spoonful of sugar. Below will appear the words "pure sugar" or their equivalent in French, German or Spanish.

[1] *I.S.J.*, 1970, **72**, 33.

Sugar cane agriculture

Land preparation. R. ARANETA. *Sugarland* (Philippines), 1969, (9), 16–18.—The deep-rooted nature of sugar cane, compared with many other crops, must be taken into account in soil preparation. Depth of ploughing must vary with the nature of the soil, whether deep or shallow. On shallow soils, or where hard-pan is present, deep ploughing may actually prove detrimental. The value of subsoiling on many Philippine cane lands is stressed and the best method of achieving this discussed.

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Prices and specification of some trucks for hauling sugar cane. ANON. *Sugarland* (Philippines), 1969, (9), 20–21.—Details are given of the following makes of motor truck used for cane—Toyota, GMC, International, Bedford, Hino, Isuzu, Dodge, Ford and Chevrolet.

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Does Johnson grass mosaic go to sugar cane? I. L. FORBES and M. GIAMALVA. *Sugar Bull.*, 1969, **48,** 70. When sugar cane mosaic symptoms were first observed in Johnson grass it was assumed that this grass (a bad sugar cane weed), when infected, would be a source of infection for sugar cane. Extensive inoculation tests now indicate that this may not be so, for experimentally it has proved difficult or impossible to infect sugar cane with mosaic disease from Johnson grass.

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Salting in irrigation areas. G. N. EVANS. *Producers Rev.*, 1969, **59,** (12), 33–35.—It is pointed out that many of the great irrigation areas of the ancient world were eventually destroyed by salting, i.e. the build-up of soluble salts on the surface and in the root zone of plants to toxic levels. In modern times it is particularly liable to take place in the more arid regions. With the increase in irrigation now taking place, it is desirable to assess the possible dangers. The various factors that contribute to salting are discussed, these varying in significance from one area to another. What may be done to control salting is considered.

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The caterpillar or looper, ***Mocis latipes*****, a cane pest.** M. ABARCA RUANO. *Bol. Azuc. Mex.*, 1969, (237), 4–8.—This pest may be troublesome in cane fields in the Gulf of Mexico in the rainy season. In addition to sugar cane it attacks maize, rice and pasture grasses, and can strip a field in quite a short time. Details are given about the insect and its life history.

Studies on the relationship between moisture stress, internal processes and growth in the sugar cane plant. A. H. KHAN and R. SAMANIEGO. *West Pakistan J. Agric. Res.*, 1969, **7,** (2), 13–20.—Results of post-graduate work at the University of the Philippines is here summarized. Potted cane plants were subjected to three different soil moisture regimes, i.e. when relative turgidity in the plants fell below 90%, 80% and 70% respectively. Optimum growth was observed when plants were watered at 90% relative turgidity. The relative growth rate fell from 13 to 7 cm when the relative turgidity was brought down to 70%. Degree of stress developed within the plant was a fair index of plant growth. The number of stomata and stomatal size did not decrease under decreasing moisture stress conditions. The assumption that a hormonal phenomenon is in operation as well is considered to be a good subject for further study.

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Control of nut grass in sugar cane. S. D. FASIHI and H. ALI. *West Pakistan J. Agric. Res.*, 1969, **7,** (2), 115–118.—Results obtained by using the herbicide "Ansar 529" are recorded. Rates varied from 1 to 6 lb per acre. Aerial parts of the weed were completely destroyed and with the higher rates fresh shoots did not appear for 30 days. This also applied to many other weeds.

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Intercropping in sugar cane. B. G. BATHKAL, C. P. PATIL and S. B. JADHAV. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc.* (*India*), 1969, (1-Agriculture), 1–6. An account is given of intercropping on plant and ratoon cane at the Agricultural College Farm, Kolhapur, during two seasons, the inter-crops used being hybrid maize, hybrid sorghum, groundnut and radish. Intercropping decreased cane yield, this effect being greatest with tall crops such as maize and, to a considerably lesser extent, sorghum, especially in plant cane. Intercrops reduce cane yield mainly through their effects on cane tillering.

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Studies on twisted-top disease of sugar cane in Maharashtra State. S. K. RUIKAR, V. V. SHINGATE and N. B. SHAIKH. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc.* (*India*), 1969, (1-Agriculture), 7–12.—This disease has assumed serious proportions in recent years, particularly with the cane variety Co 419 and more recently Co 833 which was released for cultivation in 1962. A brief account is given of work done on the disease at the Sugar Cane Research

Station, Padegaon. Tests have not given any conclusive evidence as to the cause of the disease, which is seasonal.

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Thoughts on the ideal sugar cane variety. V. P. VAIDYA. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (1-Agriculture), 31–34.—It is stressed that in India today the need is not so much for more and more research with sugar cane but rather the practical application of it. What is needed is the actual adoption of the scientific method and techniques evolved through research and experiment. The cane variety question, as it applies in the Deccan and has applied in the past, is discussed at some length.

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Sugar cane development in Goa. M. V. DIVEKAR. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (1-Agriculture), 54–56.—The natural advantages of Goa, such as abundant water from the rivers and their tributaries, are discussed. Cane cultivation in the past has been restricted and has been largely for chewing and for jaggery production. Plans for greatly extended cultivation and a modern sugar mill are discussed. The cane variety Co 740, introduced a few years ago, has become very popular.

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Spraying against scale insects in Walchandnagar. D. S. DESHPANDE. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (1-Manufacturing), 95–97. In 1968/69 cane was severely attacked by the scale insect *Targonia glomerata*, all types of sugar cane crop being affected. Colonies of scale insect on at least half of the length of the cane were observed. Damage worked out at 6% and in extreme cases 15–20%. In the following year spraying with the systemic insecticide "Dimethioate 30%" by helicopter was carried out. Nymphs, crawlers and adults were destroyed in considerable numbers but not the eggs, another spraying being considered necessary.

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Control of Johnson grass on drainage ditchbanks in sugar cane. R. W. MILLHOLLON. *Weed Sci.*, 1969, **17**, 370–373; through *Biol. Abs.*, 1970, **51**, (1), 507. Reports of trials with several herbicides are given, the standard method of control being by means of sodium chlorate (600 lb/acre). MSMA at 3·6 lb/acre or "Dalapon" at 7·4 lb/acre gave equally efficient control. Subsequent seedling growth (12 months later) was controlled with various pre-emergence treatments using "Fenac", "Bromacil", TCA + MSMA or post-emergence application of MSMA, "Dalapon" or sodium chlorate. Ditchbanks treated with MSMA were rapidly colonized by Bermuda grass (*Cynodon dactylon*).

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The value of variety selection at Mackay Sugar Experiment Station. D. GARIOCH. *Cane Growers' Quarterly Bull.*, 1970, **33**, 81–83.—Prior to 1942 most varieties grown in the central district did not originate from the Bureau of Sugar Experiment Stations, whereas from 1942 to 1960 nine Q varieties from the Mackay Station were approved for commercial planting. Two of these, Q 28 and Q 50, started a new era in cane production in the area and were responsible for a 50% increase in cane yield per acre. The performances of subsequent varieties such as Q 58, Q 63 and Q 68 and of the much newer varieties Q 87 and Q 88 are discussed.

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Overhead irrigation at Bundaberg. S. O. SKINNER. *Cane Growers' Quarterly Bull.*, 1970, **33**, 102–104. This is a general discussion of overhead irrigation, its advantages and disadvantages. Main reasons for its growth in the Bundaberg district are the prevalence of sloping terrain unsuited to surface irrigation and the great improvement in recent years in the efficiency of spray equipment. Main disadvantages are the high cost of equipment and underground mains, the moving of spray lines and the adverse effect of wind.

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Weed control in sugar cane. D. LÓPEZ. *Bol. Azuc. Mex.*, 1969, (238), 4–5.—The use of 2,4-D, "Dowpon" and "Tordon" in controlling weeds in Mexican cane fields is discussed.

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Photoperiodic control of flowering in the Florida sugar cane breeding program. N. I. JAMES. *Sugar y Azúcar*, 1970, **65**, (1), 28–33.—This paper reports the results of three experiments aimed at inducing flowering in sparse or normally non-flowering clones at Canal Point, Florida. Gradually decreasing the photoperiod from 13 to 12½ hr in 35 days, holding it to a constant 12½ hr for 30 days, and then gradually decreasing the photoperiod to 12 hr in 30 days (Schedule 1) resulted in the earliest emergence of the first flower for clones C.P. 46-115 and C.P. 57-603. The largest number of flowers emerged and the largest percentage of stalks flowered with this schedule. Results are given of other schedules that suited other varieties.

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The use of aircraft in some sugar cane areas. P. C. MACINTYRE and W. KIER. *Sugar y Azúcar*, 1970, **65**, (1), 36–37.—The successful, in fact indispensible, use of aircraft on certain Trinidad sugar estates is described. Modern light aircraft are now used to control weeds, suppress insects, apply fertilizer, sow pastures and control crop fires. In Trinidad, as in other tropical countries, weed growth can be very rapid after rain. Large areas need to be treated in a short time and only aircraft can do this. In modern measures to control the cane froghopper the timing of spraying has become very critical. Again only aircraft can cover the large area to be treated in a limited time.

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Transmission by maize seed of sugar cane mosaic. P. BAUDIN. *Rev. Agric. Sucr. Maurice*, 1969, **48**, 277–278.—Transmission of virus diseases through seed is rare, which makes the present communication

all the more interesting. Its possible economic importance in Malagasy is stressed, for mosaic is common in some districts.

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The practice of sugar cane irrigation. L. S. KUO. *Taiwan Sugar*, 1969, **14**, (6), 9–14.—The methods used by Taiwan cane farmers on both level and sloping ground are described.

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The use of herbicides with sugar cane. M. ABARCA and J. DELGADO. *Bol. Azuc. Mex.*, 1969, (239), 26–41. This is a general discussion on modern chemical weedkillers and their use with sugar cane. All aspects of the subject are dealt with, including both pre- and post-emergence herbicides and the use of hand and power sprays.

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Understanding the soil. ANON. *Victorias Expt. Sta. Bull.*, 1969, **16**, (1 & 2), 1–16.—A general account of the soil is given, in simple terms, for the cane farmer. Discussion is concerned with function of the soil, soil profile, soil texture, soil structure, chemistry of the soil, what happens when fertilizer is added, soil acidity and liming.

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Techniques in planting. A. V. SOBREPEÑA. *Sugarland* (Philippines), 1969, **6**, (10), 14–16.—Two basic methods of planting sugar cane setts in the Philippines are described, the one for the dry season, the other for the wet season. With both methods 3-eye setts are used at a rate of 3000/ha. In the dry season the setts are laid flat in the trench, whereas in the wet season they are put in at an angle of 45°.

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Foliar diagnosis and fertilizing of sugar cane. I. Position and age of sample leaves. F. A. FOGLIATA. *Rev. Ind. Agric.* (Tucumán), 1969, **46**, 1–34; through *Soils and Fertilizers*, 1970, **33**, 190.—It was found that 5 month-old leaves gave the best correlation between leaf N content and N fertilizing. There was little correlation between applied P fertilizer and P content of leaves, internodes or juice. Leaf content gave good correlation only with soil exchangeable K.

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Soluble and total silicon in sugar cane. R. L. FOX, J. A. SOLVA, D. L. PLUCKNETT *et al. Pl. Soil*, 1969, **30**, 81–92; through *Soils and Fertilizers*, 1970, **33**, 191.—Soluble Si (extractant 2% trichloroacetic acid) content gave a useful indication of the Si status of cane and varied less than did total Si. Soluble Si was highest in young tissue, particularly in the terminal part of the stalks. Slag applications affected total Si more sensitively in leaf blades than leaf sheaths, but the reverse was true with soluble Si.

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Classification of Mexican sugar cane soils. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1969, (240), 4–22.—This has been compiled from the works of other authors who have dealt with Mexican soils. The authors are named. The various States (16) and the sugar estates or factories located in them are separately listed.

The new variety N 6. ANON. *S. African Sugar J.*, 1970, **54**, 105.—Details are given about the field performance of this variety in 1968. It was developed from a cross between Co 421 and C.P. 36/85. It is considered likely to prove of greatest value in the main coastal belt at medium to high altitudes and to be unsuited to the coastal sands and productive areas of the north (Pongola). It has proved susceptible to leaf scald. Its reaction to other diseases is given.

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The eradication of submerged weeds in farm dams. ANON. *S. African Sugar J.*, 1970, **54**, 119.—The use of 80% wettable "Diuran", mixed with builders' sand in a ratio of 1:10, is very effective against anchored submerged weeds. The sand causes the herbicide to sink to the bottom of the dam, where it is taken up by the plant roots. The eradication of weeds in this way results in the elimination of all rooted plants in the dam. Unfortunately the herbicide also kills fish, and later restocking may be necessary. Floating weeds such as water hyacinth and Kariba weed (*Azolla* or water fern) may be controlled by spraying with 2,4-D and "Paraquat", respectively.

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Effect of potash spraying on ripening and the retention of juice quality. ANON. *Ann. Rpt. Research Dept., Sugar Manuf. Assoc. (Jamaica) Ltd.*, 1968, 16.—The results of field experiments are recorded in which potassium chloride and sulphate were sprayed on the foliage of two varieties of cane (B 51410, aged 40 weeks and B 41227, aged 44 weeks) at different rates and concentrations. None of the treatments had any beneficial effects on cane quality with B 41227 and if anything caused depression of sucrose. With B 51410 there appeared to be some benefit after 4 weeks but most of it had disappeared after 8 weeks.

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Cooperative irrigation trials. ANON. *Ann. Rpt. Research Dept., Sugar Manuf. Assoc. (Jamaica) Ltd.*, 1968, 50–53.—Trials run by the Department in co-operation with two estates are recorded. These were to test the relative efficiency of sprinkler irrigation and systems of surface irrigation, i.e. the twig and main system, interrupted long line system and graded long line system. The twig and main system was superior to the other surface irrigation treatments. In certain areas sprinkler irrigation was a good as the best surface irrigation treatments but on average it seemed inferior, the cane stands lacking uniformity. Under Jamaican conditions wind can have a serious effect on sprinkler irrigation. This raises the question of the possibility of establishing wind-breaks.

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Use old tyres to save stream bank erosion. ANON. *Producers' Rev.*, 1970, **60**, (1), 39.—Photographs illustrate how old motor vehicle tyres, strapped together in the form of a mat, were effectively used to protect an eroding stream bank at low cost. In time the tyres become covered with silt which they hold and a cover of vegetation becomes established.

Sugar beet agriculture

Persistent effects of seedling treatment on growth of sugar beet in pots. S. A. W. French and E. C. Humphries. *Ann. Appl. Biol.*, 1969, **64,** (1), 161–175. The environment of sugar beet seedlings, or growth substances applied to seedlings, continues to influence growth when the plants are transferred to other environments. Sugar beet seeds were germinated at 20°C in 8, 16 or 24-hr photoperiods of constant light intensity, with different amounts of total radiation. When the seedlings had two leaves (15 to 18 days old) they were transferred to large pots in a glasshouse. Some seedlings were treated with 2-chloroethyl trimethyl ammonium chloride. The treatment affected areas of individual leaves throughout the growing period. Plants raised in 24-hr photoperiod had the largest leaves, and those in 8-hr photoperiod the smallest.

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Plant density and yield of sugar beets in an arid environment. F. E. Robinson and G. F. Worker. *Agron. J.*, 1969, **61,** (3), 441–443; through *Field Crop Abs.*, 1970, **23,** 67.—Sugar beet was grown in an arid area under sprinkler irrigation with a square placement of seed at populations of 27,000, 108,000, 430,000 and 1,722,000 plants/ha. Maximum yield of sucrose was at about 100,000 plants/ha.

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Up-to-date field spraying techniques. E. Grütte. *Zucker*, 1969, **23,** 76–81.—Recent developments in beet field spraying techniques are described as well as common defects in some modern field sprayers. Spray regulation and control are discussed, special importance being attached to the reliability of pressure control. The possibility of sprayer use by growers on a cooperative basis or by contract operators is discussed.

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Further studies on sugar beet cultivation at farms of the Belapur Company Ltd., Harigaon Dist., Ahmednagar (Maharashtra State). S. R. Khandekar and D. C. Karhadkar. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (1), 13–30.—Results of further trials and experiments with sugar beet, on a larger scale, are given. On the whole, yields and results obtained were satisfactory. Difficulties that arose are discussed. Planting time is important as is maintenance of adequate soil moisture. Magna Poly and Maribo Resista Poly were the varieties grown. Trials with a wider range of varieties are needed. Cut-worms, caterpillars and rats caused some damage. A fungus disease (*Sclerotium*) was noticed. Cracking of the roots was found to be due to the sun and could be avoided by covering with soil.

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Sugar beet—retrospect and prospect in Maharashtra. J. R. Kalde, B. C. Cogate and K. D. Auti. *Proc. 23rd Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (1), 57–68.—Successful small scale cultivation of sugar beet in northern India is referred to. The difficulties facing large scale or commercial cultivation in Maharashtra State are discussed. These include fuel problems, sugar cane supplying its own fuel in the form of bagasse. There is need for earlier maturing varieties to enable two crops to be grown in a year and for local seed supplies.

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Further investigations on the susceptibility of sugar beet to eelworm (*Heterodera schachtii*). W. Steudel and R. Thielemann. *Zucker*, 1969, **23,** 106–109.—An account is given of field trials in the Rhineland (near Elsdorf) using granulated "Carbamoyloxim" to control or reduce nematode infestation. Damage from the pest arises mainly in the beginning of the growing season. It was found that about 90% of the damage could be prevented by applying the nematicide immediately after sowing or a little later. Sowing time is therefore important in connexion with nematode damage, the end of March and beginning of April being the best time. Field conditions at the time of sowing may be important. The trials are to be continued.

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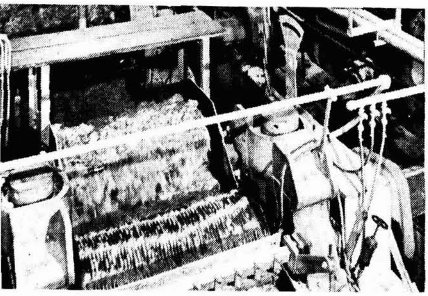
Screening sugar beet for resistance to *Heterodera schachtii*. D. L. Doney and E. D. Whitney. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15,** 546–552.—Resistance to nematodes has been found to exist in some species of *Beta*, other than *Beta maritima* or sugar beet, but interspecific breeding has proved to be extremely difficult and so far the incorporation of this resistance into the cultivated sugar beet has not been achieved. Screening for qualitative resistance in sugar beet has not been successful but screening for different levels of quantitative resistance has achieved moderate success. Results of experiments with the latter are recorded. A technique was developed for counting white females of the sugar beet nematode at the interface between soil and clear plastic vials in which test plants were inoculated with nematode larvae. The roots are not disturbed by this method.



Cane sugar manufacture

Polarographic studies on surface active substances generating foam in sugar manufacturing operations. Study of the efficiency of (the) clarification process. N. A. RAMAIAH and S. R. TRIVEDI. *Sharkara*, 1969, **11**, 120–124.—Details are given of a polarographic method of estimating the content of foam-producing surface-active matter in cane juice. It is based on determining the amount of juice, added to the electrolyte solution, required to reduce the oxygen diffusion current to a minimum. Comparison of the surfactant contents in cane juice after sulphitation, carbonatation and defecation with the quantity in untreated raw juice showed that defecation has almost no effect, sulphitation reduces the content, while carbonatation increases it.

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Theory and applications of infra-red sensing. A. FISHMAN. *Rpts.* 1969 *Meeting Hawaiian Sugar Tech.*, 93–104.—The theory and potential uses of infra-red instrumentation are discussed and application of thermography to industry is illustrated by a number of examples, in some cases a thermogram being compared with a photograph of the same subject. Also considered is the application of infra-red radiometry to temperature measurement and remote sensing of natural resources.

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Sterilization of juices in mills. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (242), 34–39.—Attention is drawn to the extent of infection of juice by micro-organisms which can develop during the milling process, and of the losses which result from this contamination, not only by sucrose destruction but also through difficulties in clarification. The beneficial effect of chlorination at the mills is discussed and indicated by analyses of juices from tandems with and without chlorine application.

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Water treatment in sugar factories. R. VELÁZQUEZ R *Bol. Azuc. Mex.*, 1970, (243), 43–48.—The reactions involved in the various treatments of raw water for use in sugar factory boilers are tabulated; they cover the effects of heat on bicarbonates, the use of lime and soda ash, caustic soda, phosphates, coagulation reactions with aluminium sulphate, sodium aluminate, etc., etc.

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Deterioration of sugar cane in storage and its prevention by spraying with chemicals. ANON. *N. S. I. News* (India), 1970, **5**, (3), 8–9.—Spraying with formalin was found in tests to reduce the rate of deterioration of cane stored for 7 days, the purity being about 10 units higher than that of untreated stored cane.

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The use of standardized container bags in inland transportation of sugar in Taiwan. S. W. LEE. *Taiwan Sugar*, 1970, **15**, (1), 11–14.—As an intermediate step between elimination of the use of gunny bags (each having a capacity of 100 kg) and bulk handling and transportation of raw sugar, the Taiwan Sugar Corporation has made a study of the use of large flexible "container bags". These are made of high-grade plastic and have each a capacity of 2 metric tons of sugar. The bags are easily filled with sugar, tied at the top with an easily handled knot, and at the docks are lifted by crane to allow the sugar to be poured into the ship's hold for bulk shipment. The advantages and disadvantages of the system, including monetary savings, are discussed.

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Experiences with the Darnall electric massecuite heater. R. H. RENTON. *Proc. 43rd. Congr. S. African Sugar Tech. Assoc.*, 1969, 156–158.—Details are given of experiments at Darnall with electric resistance heating of *C*-massecuite to raise its temperature from 100°F to 140°F before curing. After failure of the first heater (an annular type with three electrodes spaced apart by insulator blocks) through breakdown of the insulator blocks and inadequate temperature control, a second was tried in which the electrodes took the form of plates, each segmented into five separate plates. Because of faults in the fixing and insulation of the plates, as well as temperature control snags, the segmented electrodes were replaced with single plates and a 300-hp motor installed to provide 3-phase voltage variable from 120 to 400 V, compared with the factory supply of 550 V applied to the first two heaters. The third heater proved more promising, although fine temperature control was still difficult because of rapid variation in massecuite conductivity with temperature. Full comparative investigation of the results is still to be carried out.

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Process plant installations at South African sugar factories. G. N. ALLAN. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 177–189.—Details are presented of specific items of equipment at 13 South African sugar factories which supplied the data in a questionnaire sent out by the author. The information covers cane preparation equipment, mills, diffusers, juice heaters, filters, clarifiers, evaporators, vacuum pans, crystallizers, centrifugals, steam generation plant and power plant.

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The Mutual Clarification Project. Progress Report No. 1. E. J. BUCHANAN, W. S. GRAHAM, L. M. S. A. JULLIENNE and M. MATIC. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 190–198.—The purpose of the Mutual Clarification Project, launched in 1968, is basically to collect analyses and performance data on a mean weekly basis from South African sugar factories. However, of the 15 factories which agreed to participate in the project, only three submitted a significant number of weekly data sheets in 1968–69. The results from these factories are discussed. It is concluded that clarification efficiency is very important for sugar quality, carry-over of suspended matter in the clear juice causing an increase in the suspended matter in sugar and possibly reducing the sugar filtrability. Of methods used to reduce the starch content in clear juice or syrup, addition of certain enzymes to evaporator thick juice seems to be particularly effective. The comparison revealed certain sources of inefficiency at the three factories, demonstrating the potential value of the project.

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Aspects of flotation clarification of mixed juice. M. MATIC. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 199–205.—Work conducted by the Sugar Milling Research Institute in South Africa on Rabe vacuum flotation clarification of mixed juice is summarized. A gradual improvement in impurities removal was observed with increase in pH from 7 to 11, the improvement being marked at pH 9 in the case of starch, phosphate, silica and, to a certain extent, protein. However, there was also a sharp increase in the (Ca + Mg) content, and a greater volume of precipitate was formed at the higher pH values. At any pH, vacuum flotation was more effective than simple defecation in removal of starch and silica, the removal of the other impurities being of a similar order with both processes. The turbidity of the juice increased with fall in the amount of flocculant used (from 20 to a minimum of 3 p.p.m.), although even at 3 p.p.m. the juice clarity was very good. In the absence of flocculant, there was no or only partial flotation. Exceptions to this, which particularly occurred at high pH, were apparently due to juice quality. The turbidity of juice preserved with mercuric chloride decreased with time after flotation, while that of a similar batch of unpreserved juice increased with time, possibly because of partial hydrolysis of starch in the unpreserved juice which, because it was "soluble", could not be removed by flotation. Small amounts of precipitate formed in juice allowed to stand, particularly after heating. Analysis of scale in juice heaters and evaporators showed that two-thirds of the heater scale and half of the evaporator scale was composed of organic material, mainly protein, while calcium and phosphate were the main inorganic constituents. Hence, clear juice after flotation should be heated to boiling to precipitate the protein, and subsequently settled. Differences in the settling mechanism with normal defecation muds and the secondary precipitate in vacuum flotation muds were observed. Flotation at high pH followed by carbonatation was found to give very good starch removal, but the amount of residual calcium even after carbonatation was high. The use of dispersed air to effect flotation was tested in an attempt to increase clarification efficiency. Preliminary results, which are discussed in some detail, indicated that the method did not have any advantage over normal high-temperature vacuum flotation since additional settling of secondary precipitate was still required.

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Displaceability index. R. G. MARKHAM. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 230–232. A method of determining the Displaceability Index (D.I.), which is a direct measure of the availability of sucrose in diffuser bagasse (called by PAYNE[1] the "leachability index"), was developed and used in conjunction with particle size analysis to relate the degree of bagasse preparation to the rate of extraction. The method involved adding 3000 g of water to 500 g of bagasse, rotating the mixture at 20 r.p.m. for 30 min in a sealed plastic container housed in a special frame (which can accommodate 6 such containers) driven by electric motor, removing 100 ml of the extract, clarifying this with 0·2 g of basic lead acetate, filtering and determining the pol in the conventional way. A separate sample of bagasse was analysed for pol and moisture by standard methods. All the samples were then sieved through a series of 7 screens with openings ranging from 12·7 mm to 0·35 mm, the mean particle size being taken as the 50% line when % undersize was plotted against screen size on semi-log paper. D.I. is given by

$$\frac{\frac{J}{100 - J}(3000 + 5M)}{5P} \times 100\%,$$

where J = pol of extract, M = moisture % bagasse, and P = pol % bagasse. A linear relationship between D.I. and log mean particle size was established. However, although a mean particle size of 0·59 mm should theoretically result in 100% sucrose availability, the degree of bagasse fineness necessary for this would lead to many other problems, including poor percolation, and would not be practical.

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Experience with SCR equipment. F. M. LOHNING. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 157–169.—Thyristor drives for sugar centrifugals are discussed in some detail, including types of converters, drive system protection, regulating circuitry, current rating, voltage rating, network harmonic currents, reliability of drive equipment, setting-up and commissioning. While the article is concerned primarily with centrifugal drives, mention is also made of other applications.

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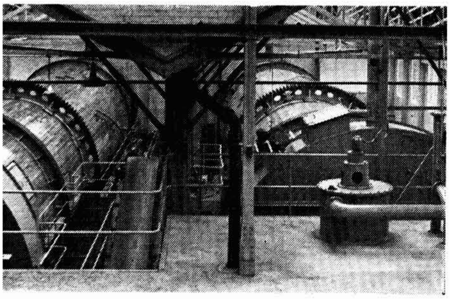
[1] *I.S.J.*, 1962, **64**, 16.



Beet sugar manufacture

Flow measurements with a float-type flowmeter. T. CHOMICZ and G. GUZYŃSKI. *Gaz. Cukr.*, 1970, **78,** 91–95.—The principles of operation, design, calibration and application of float-type flowmeters as used in the sugar industry are discussed.

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Fouling of ion exchangers used for treatment of sugar juices, especially for complete demineralization, and possible methods of regenerating contaminated exchangers. F. PERSCHAK. *Zucker*, 1970, **23,** 309–316. With the aid of data from the literature, difficulties encountered in the treatment of water and sugar juice demineralization are described. Problems involving the thin juice demineralization plant at Hohenau sugar factory included the occurrence of amphoteric properties in the resin, whereby the NaOH regenerant was difficult to wash out, so that the pH and ash content of the treated juice at the start of juice percolation through the resin were too high. Tests to find a method of countering this phenomenon are described. A gradual increase in resin contamination took place parallel with a drop in beet quality. Numerous tests have been carried out on regeneration methods, and a successful technique for continuous regeneration of cation exchangers found. A method is described for recovery of substances irreversibly adsorbed (under normal regeneration conditions) and considered from their reactions to be probably peptide-pectin complexes. The fouling of resin in deliming, decolorizing and Quentin molasses treatment processes is discussed and methods of removing the impurities are reported. Laboratory tests to find optimum purification conditions are recommended.

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Sugar solution decolorization with synthetic ion exchange resins. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1970, **86,** 72–74.—Decolorization of sugar solution by treatment with anion exchange resin in Cl^- form was investigated. Within certain limits treatment with a strongly basic resin, such as "Amberlite IRA 401 S", "Wofatit ES" standard porous and "EA 60" macroporous resins, gave a linear relationship between log extinction of the treated solution and the chloride content. No differences in efficiency due to the differences in porous structure were found. The relationship between colorant concentration and chloride content was not linear in the case of "Wofatit EZ" polycondensate resin based on aromatic amines. In this case, the quantity of chloride exchanged for colorant to give the same decolorizing effect as the other resins was considerably smaller.

Control in carbonatation. M. BOSNJAK. *Sugar J.*, 1970, **32,** (11), 36–37.—While the amount of CaO added to raw juice has a marked effect on carbonatation efficiency up to a certain point, after which any further increase in the quantity has no greater effect, the most important factor in 1st carbonatation is the final alkalinity of the juice. The factor most affecting the alkalinity (pH) is the milk-of-lime flow, which should be kept constant, as should the CaO content, so that the CO_2 gas flow and pH might be maintained at a steady level, lime kiln operation smooth, and surging problems in the carbonatation tank and clarifiers reduced (particularly in the Dorr-Oliver system).

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Boiling 1st product massecuite from concentrated syrups. G. S. BELOSTOTSKII, N. K. SAVCHUK, V. I. MEL'NIK, YU. D. KOT, L. G. BELOSTOTSKII, V. A. SHESTAKOVSKII and A. K. SUSHCHENKO. *Sakhar. Prom.*, 1970, **44,** (4), 48–51.—At Turbovskii sugar factory (USSR) boiling 1st massecuite on syrup of about 70°Bx without the addition of water or juice drinks has increased pan throughput by 10% and slightly reduced the colour of the resultant sugar without any adverse effect on crystal size distribution compared with results using drinks. At the required supersaturation just before nucleation the massecuite temperature is raised to 84–86°C, powdered sugar is injected for seeding, and after nucleation and setting of the grain the temperature reduced to 82–80°C. The first syrup drink must be of somewhat higher temperature than that of the massecuite. After a further period of boiling, the temperature is raised to 86–90°C, fresh syrup introduced, the massecuite heavied-up, and further drinks fed at intervals until ¾ of the pan is filled with massecuite, during which period the temperature is gradually reduced to 79–78°C. Towards the end of boiling raw washings are introduced and the massecuite finally brought to 92·5–93·0°Bx. Other advantages mentioned involve evaporator operation and include a 2·3% saving (on weight of beet) in steam through use of a higher Brix syrup, and a 1·7% saving through elimination of water drinks.

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Rate of sucrose crystallization from raw syrup and its electrodialysis products. A. P. KOZYAVKIN, L. D. BOBROVNIK and K. D. ZHURA. *Izv. Vuzov, Pishch. Tekhnol.*, 1970, (2), 171–174.—Investigations showed that the sucrose crystallization rate K in raw syrup after electrodialysis was lower than in untreated raw syrup of the same purity because of the increase in the concentration of non-dissociated substances which masked the crystal surfaces and prevented sucrose deposition on them. To overcome this, the electrodialysates were treated with an anion exchange resin in Cl^- form, with the result that the values of K rose. The resultant high purity syrup could be boiled to massecuite at a rate similar to that at which 1st massecuite is boiled on normal factory syrup.

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The relationship between the extraction of sucrose and the extraction of some non-sugars. P. W. van der Poel, N. H. M. de Visser, W. A. Fenstra, M. A. M. de Schutter and J. Konings. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—In experiments with a laboratory diffuser[1], carried out with the aim of finding relationships between sucrose and non-sugars extraction and between extraction and thin juice apparent purity, attention was concentrated on chloride and (K + Na) as representative of melassigenic non-sugars. Two (K + Na) fractions were found: one containing 85% of the total quantity of K and Na salts in the cossettes which was extracted at a relatively high rate, and one containing the remaining 15% of the salts, which was extracted with greater difficulty than sucrose and does not normally participate in the diffusion process but is adsorbed by the cell walls or is accompanied by anions which migrate only with difficulty through the cell walls. Because of the difference between sucrose and (K + Na) extraction, qualitative agreement between the Silin equation of sucrose extraction and (K + Na) extraction was possible only after a correction was made for the 15% fraction, whereas no correction was needed to establish qualitative agreement between the equation and chloride extraction, which proceeds parallel with sucrose. Equations are derived for calculation of the K and Cl percentages remaining in the exhausted cossettes in terms of the sucrose loss in pulp. From the relationship between (K + Na) and sucrose extraction, it is suggested that the extracted sucrose can be split between molasses sucrose and white sugar.

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Evaporator heat balance calculations using a digital computer. I. S. Higgins. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—Details are given of the technique used to write a digital computer programme for use in obtaining heat balances for the evaporators at all 18 British Sugar Corporation sugar factories. Suitable empirical equations were developed for specific heat of juice, specific heat of water, total heat of steam and boiling point elevation, and the data input includes digits which allow for differences in operation between factories and permit the programme to be routed through a loop specific to a particular factory. The computer, fed with the programme and the requisite data, calculates the total heat of each vapour calculated from the specified temperatures and then calculates the quantity of vapour used by each juice and water heater as well as the sum total of vapour demand per evaporator effect. A material and heat balance is then carried out by the computer for each effect. At the 4th effect of a quintuple-effect evaporator a check is made to see if sufficient vapour is being generated to satisfy the demands of the heaters. If there is a deficiency, the vapour usage by the vacuum pans is reduced until a balance is achieved, the reduction being only about 0·1% on beet at each step. The programme is then looped into the 5th effect and the final Brix of the thick juice leaving the evaporator is calculated and compared with the actual Brix. If the value is too high or too low, a small amount of vapour (about 0·1% on beet) is transferred to another grade until a Brix equilibrium is established. The information is then printed-out in sheet form, one sheet per effect, and finally as a computer-generated flow diagram.

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Fire and explosion hazards of handling dusts. D. H. Napier. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—In a treatment of the subject of dust explosions generally the author discusses the various factors involved, including particle size, dust concentration, additions to the dust-air mixture, primary and secondary explosions, smouldering combustion and sources of ignition. Preventive measures are listed.

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Pitting corrosion of stainless steel evaporator tubes in the British Sugar Corporation Limited. M. E. Giles and N. Reed. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—From a series of experiments conducted on stainless steel evaporator tubes in which serious pitting was discovered it was deduced that the corrosion was unlikely to have been caused by sugar juices, alkali solution used for descaling or by condensate water. On the other hand, both of the visually different types of pitting found appeared to be associated with the use of HCl for descaling, and mechanisms for each type of pitting are proposed. Copper, which occludes within the calcareous scale formed on the tube, has been shown to provide the required cathodic reaction for pitting, while inadequate rinsing after descaling with HCl leads to residual surface chloride followed by pitting caused by the depolarizing reaction of oxygen reduction. Pitting can be avoided by using sulphamic acid to remove the scale and this is recommended.

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Screw-type water separator. A. S. Gal'perin. *Sakhar. Prom.*, 1970, **44**, (5), 32–34.—Details are given of a unit of local design constructed at a Soviet sugar factory for separation of water, leaves and other beet debris. It consists basically of a sloping trough carrying a screw rotating at 9 r.p.m. and is located before the beet washer. It has operated successfully for 5 years.

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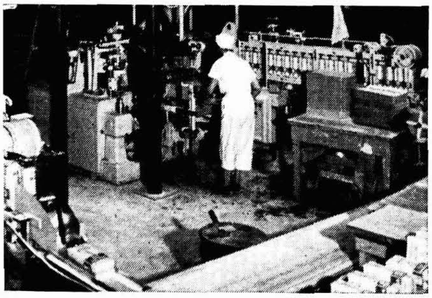
[1] *I.S.J.*, 1960, **62**, 95–97.



Sugar refining

Revere's new carbonatation system is on stream. W. A. Bemis. *Sugar y Azúcar*, 1960, **65,** (4), 28–30. Details are given of the carbonatation system which started operations in November 1969 at Revere sugar refinery in Charlestown, Mass., USA. Designed by Tate & Lyle Technical Services Ltd. for a throughput of 50 tons of melt solids/hr with provision for a 130% peak flow, the scheme is controlled from a central panel and incorporates a Wallace & Tiernan lime slaker and six A. & W. Smith "Rota" filters of 1250 sq.ft. filtering area, the muds from which are treated by two Shriver ALP-type automatic filters. Significant improvements in both process and product are claimed, although a number of disadvantages are also listed.

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Florida's refined sugar storage silo built to Swedish design. Anon. *Sugar y Azúcar*, 1970, **65,** (4), 34–36. A refined sugar silo of 30,000 tons capacity under construction at Moore Haven for the Glade County Sugar Growers Cooperative is described. The silo, built by the Western Hemisphere licencees of the Nils Weibull AB-designed SSA-Weibull conditioner and blender, is intended to hold sugar at 68°F and 70% R.H., under which conditions the sugar moisture content is maintained constant at about 0·03%. Warm or cold air is circulated in the space between the steel wall of the silo and an outer wall of rigid urethane insulation developed by the Celotex Corp. and known as "Technifoam" Environment Control Board.

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An introduction to pneumatic conveying with particular reference to granular sugar. J. W. Tills. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—The advantages of pneumatic conveying systems and the more important factors to be considered in the design of such systems are discussed, particularly the minimum air velocity necessary to maintain stable conveying of material throughout the whole conduit configuration, the maximum permissible material : air ratio and particle mass. Descriptions are given of the various types of pneumatic systems, including negative-pressure conveying (normally used for materials of exceptionally low bulk density or of a floccular nature); medium-pressure systems (particularly applicable to materials in the intermediate bulk density range); positive-pressure conveying—the most commonly used system which is divided into medium-pressure systems with airlock and without airlock; combined negative- and positive-pressure conveying, which permits material to be withdrawn efficiently from a non-pressurizable container or silo and discharged into a customer reception hopper of conventional design; and dense phase conveying, in which the material is conveyed in a series of slugs or piston-like formations spaced apart by injections of compressed air. The application of pneumatic conveying to granulated sugar is considered in some detail, attention being called to a number of factors requiring particular consideration. Diagrams are presented of the various systems described.

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Development of white sugar boiling systems. A. P. Neilson. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—Three methods of boiling granulated sugar massecuites have been examined: (1) straight boiling, in which the 1st strike is boiled from white liquor, the 2nd strike from 1st strike run-off, and the 3rd strike from 2nd strike run-off, no blending of syrups being used; (2) in-boiling, whereby a series of strikes are boiled starting with the 1st strike boiled on straight white liquor. The run-offs from this and all succeeding strikes are blended with incoming white liquor. When the sugar colour has reached a preset level, the syrup is sent to remelt boiling, the massecuite purged and a new series of strikes commenced; (3) back-boiling, involving a series of strikes but in which the run-off is added to the vacuum pans instead of the pan supply tank. Each strike is started on white liquor and finished on syrup from the preceding strike, until the sugar colour is such that remelt boiling is applied and a new series started. Data are presented showing various balances and analyses.

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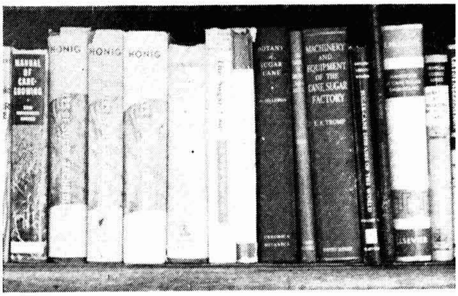
Development of supersaturation controls for white pan boiling. A. P. Neilson and A. D. Chapman. *Paper presented to the 20th Tech. Conf. British Sugar Corp.*, 1970.—Further work on automatic pan boiling control at The British Columbia Sugar Refining Co. Ltd. refinery in Vancouver is described[1], including a simple device designed to regulate the addition of steam to control supersaturation during the critical growing period following graining. The use of a Bellingham & Stanley pan refractometer for supersaturation control is also described[2], this system having been applied with great success with both cane and beet sugar white sugar pans.

[1] *See I.S.J.*, 1965, **67,** 149.
[2] *I.S.J.*, 1970, **72,** 221.

New books



F.O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1970 (International sugar economic yearbook and directory). H. AHLFELD. xlviii + 400 + 64 pp.; $8\frac{1}{2} \times 11\frac{1}{2}$ in. (F. O. Licht K.-G., 2418 Ratzeburg/Lbg., P.O. Box 90, Germany). 1970. Price: 116s 0d.

A review of such a well-known work as Licht's directory seems almost superfluous. However, for those readers unacquainted with the book, a general outline is in order. Besides information on EEC sugar marketing regulations, German and other sugar organizations, the world's major sugar importers and exporters, reports from sugar machinery manufacturers, a Buyers' Guide listing manufacturers of sugar factory equipment, an English-German glossary of technical terms, etc., there are four articles (in German and English) entitled "Sucrochemistry" (by V. PREY), "Continuous crystallization" (by G. WITTE), "Bagasse as raw material for the particle board industry" (by R. HESCH), and "Machine plants and building firms in the service of the sugar industry" (a review by H. J. DELAVIER). A 64-page statistical supplement on world sugar is separately housed in a pocket attached to the inside back cover, while the rest of the book is devoted to details of the world's sugar factories and refineries, separated into beet and cane. The information has been updated as much as possible by approaching all those concerned throughout the world and making any necessary changes. Unfortunately, such a system is completely dependent on the cooperation of the sugar manufacturers, and if they fail to supply the latest information, the publisher should not be blamed. However, despite the inevitable minor faults, this latest edition is up to the high standard of previous editions and is well worth the money.

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Plantation crops. 298 pp., $7 \times 9\frac{1}{2}$ in. (The Commonwealth Secretariat, Printing Section, Marlborough House, London S.W.1, England.) 1970. Price: 40s 0d.

"Plantation crops" is a review, one of a series, aimed at presenting in convenient form up-to-date summaries of production, international trade and consumption for a group of allied commodities, with particular reference to the part played by the British Commonwealth countries. The present edition (No. 13) contains information on sugar, covering the period 1962–68 in most cases but also touching on 1969 in some aspects. It covers production of cane and beet sugar, exports from certain countries, imports into principal importing countries, the relative value of sugar exports to total exports in certain countries, UK trade in sugar, the disposal of world sugar, national and world consumption and prices. A further section gives details of various agreements relating to sugar trade, including the ISA, the Commonwealth Sugar Agreement, the US Sugar Act of 1948, the Anglo-Irish Sugar Agreement, the Afro-Malagasy Sugar Agreement and bilateral agreements between Cuba and the USSR and Mainland China. The UK and EEC sugar policies and price arrangements of beet and sugar are also dealt with separately. An appendix gives details of sugar import and export duties for various countries. There is a lot of information on sugar in this book that is not easily available elsewhere, but a certain amount of searching is needed, since there is no subject index.

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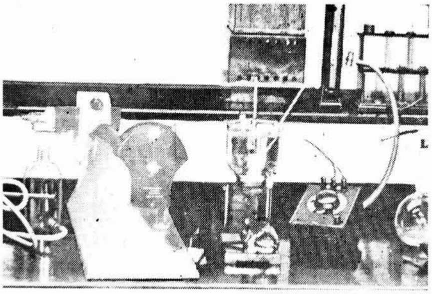
Test sieve data. Ed. J. W. MULLIN. 96 pp.; $5\frac{1}{4} \times 8$ in. (Endecotts (Filters) Ltd., London S.W.19, England.) 1970.

As one of the world's largest manufacturers of test sieves, Endecotts (Filters) Ltd. have accumulated a considerable amount of valuable information on sieves and sieve testing techniques. In 1963 some of this material was gathered into a small publication entitled "Manual of test sieving", which proved to be very popular. Now a new edition has been produced under the editorship of Professor J. W. MULLIN of University College, University of London. The material has been updated, particularly the section concerning standard sieve scales. There are eight sections in all: "Scope of test sieving", "Terminology of test sieving", "Standard sieves", "Sampling", "Techniques of test sieving", "Data analysis", "Particle size", and "Industrial screening", plus tables of useful data, information on the SI international unit system and a catalogue section, giving details of some of the equipment available from Endecotts. It is pointed out that the manual is intended for the ordinary use of test sieves, not for the specialist, for whom other sources in the literature are recommended. The book is clearly printed and well arranged, and is probably unparalleled as a reference work on the subject.



Laboratory methods & Chemical reports

Determination of the sucrose content of sugar cane by the hydraulic press method of analysis. M. Hoarau. *Rev. Agric. Sucr. Maurice*, 1969, **48**, 246–255.—See *I.S.J.*, 1969, **71**, 328–333.

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The effect of some non-sugars on the kinetics of sucrose decomposition. Z. A. Mil'kova, S. Z. Ivanov and A. R. Sapronov. *Gaz. Cukr.*, 1970, **78**, 6–7.—See *I.S.J.*, 1970, **72**, 28.

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The determination of sucrose solubility in molasses as a criterion of low-grade work. W. Partale, R. Rube, H. Schiwek and T. Cronewitz. *Zucker*, 1970, **23**, 155–167.—A method is described which has been developed for determination of the saturation coefficient of molasses as a measure of exhaustion. The method is based on the non-sucrose:water ratio and involves achieving saturation from an initial undersaturated state. Apart from the saturation coefficient, other molasses parameters are also obtainable; the values obtained for all the factors are valid for a much longer period than with previous methods, so that the number of analyses required over a given long period is reduced. The effects of non-sucrose substances on the molasses and on low-grade work are discussed, as are various factors introduced by the authors as measures of low-grade work and molasses behaviour.

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Nucleation of sucrose solutions. G. Pidoux. *Ind. Alim. Agric.*, 1970, **87**, 45–47.—Nuclei in supersaturated solutions of sucrose arise from protonuclei or molecular aggregates during the latent period of pre-crystallization, these aggregates being believed to be formed through hydrogen bonds between sucrose and water molecules. It is supposed that the aggregates are heavier than free molecules and are subject to sedimentation, and that when their concentration reaches a certain level they will amalgamate to form the crystal nuclei. This is indicated as an explanation for the phenomenon whereby a practically stable supersaturated solution will produce crystals relatively quickly when subjected to treatment in a supercentrifuge.

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Determination of sucrose, glucose and fructose contents by spectrochromatography. I. F. Bugaenko and Le Bak Tuet. *Sakhar. Prom.*, 1970, **44**, (3), 8–11.—One-dimensional descending paper chromatography was used to separate the sugars in molasses solution. The solvent used was 4:1:1 butanol:acetic acid:water, while the spots were developed with a reagent consisting of 5:5:1 v/v/v 4% diphenylamine in 96% ethanol: 4% aniline in 96% ethanol:conc. orthophosphoric acid. Quantitative determination of the sugars involved clarification of the molasses solution with lead acetate, filtering and spotting of the filtrate on the chromatogram, together with a standard sugars mixture. The paper was then cut into strips and the optical density of the spots measured spectrophotometrically at 420 nm. The values were then read off calibration graphs.

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Production of chemically pure sucrose. I. P. Orobinskii and S. Z. Ivanov. *Sakhar. Prom.*, 1970, **44**, (3), 19–20.—One kg of refined sugar or analytical-grade sucrose is dissolved with heating in 500 ml of freshly-produced twice-distilled water which has been adjusted to pH 7·8–8·0 with sodium carbonate. The solution is poured into a Kjeldahl flask and evaporated over a water bath (55–60°C) *in vacuo* to 78–80°Bx (refractometric), 1000 ml of absolute alcohol added, and the solution filtered under vacuum through a glass filter. The filtrate is poured into a porcelain dish and thoroughly mixed with a glass rod. Crystals start to form within 12–15 min and crystallization is complete after 20–25 min. The crystals are filtered off with filter paper and washed with hot absolute alcohol, spread on filter paper, partially dried and then completely dried in a vacuum cupboard at 55–60°C. The purity is then determined by measuring the optical density spectrophotometrically in u.v. light at 240–420 nm, using for this 100 ml of an aqueous solution containing 0·01665 g/mole.

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Effect of temperature and supersaturation on the sucrose crystallization rate in pure and impure solutions. G. Mantovani, F. Fagioli and C. A. Accorsi. *Zeitsch. Zuckerind.*, 1970, **95**, 123–126.—The effects of various non-sugars and non-sucrose sugars on sucrose solubility and crystallization rate (without stirring) were determined at 45°C and compared with earlier results obtained at 25°C[1,2]. Sucrose solubility values obtained at 15, 25, 35 and 45°C were also compared with values obtained by other authors as were the empirical formulae derived. In pure solution the sucrose crystallization rate increased with rise in temperature, the increase being greater with increase in supersaturation. Differences in the rate caused by various selected additives remained almost pro-

[1] Mantovani: *I.S.J.*, 1967, **69**, 345.
[2] Mantovani *et al.*: *ibid.*, 1968, **70**, 249.

portional to the increase in supersaturation. At low supersaturations the "crystal growth reaction" was of an apparent order greater than 1. Values of the activation energy calculated from the results obtained with stirred solutions agreed with those obtained with unstirred solutions.

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The microbial infection of white sugar. I. Tóth-Zsiga. *Zeitsch. Zuckerind.*, 1970, **95**, 126–132.—After a brief survey of microbiological research and the standards set for white sugar in Hungary, a description is given of the microbiological methods used at individual process stages in the sugar factory. The fate of thermophiles and the considerable numbers of bacteria occurring in conglomerates and irregular crystals are discussed, and sources of infection and the prevention of infection through the use of suitable disinfectants indicated.

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Estimation of the processing quality of diffusion juices as a dispersed system. R. Bretschneider, I. Bohačenko and B. Kaliková. *Listy Cukr.*, 1970, **86**, 12–16. A membrane filtration method and a gel filtration method have been devised for determination of coarse dispersed substances and colloidal dispersed substances, respectively, in raw juice. Both are briefly described. Mathematical evaluation of results obtained for colloidal substances has demonstrated the accuracy of the gel filtration method. Juices from BMA and DDS diffusion were found to contain greater quantities of the two types of dispersed impurity than did juice from a battery diffuser.

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Sampling and analysis of cane deliveries. J. H. Payne. *Ind.-Agric. Research & Management Newsletter*, 1969, **9**, (4), 3–4.—The impact of mechanical handling and harvesting on the traditional methods of assessing the value of cane is discussed, and it is asserted that the concept of clean cane is no longer valid, that it is impossible to obtain a representative sample for extraneous matter measurement, and that methods based on empirical formulae or relationships such as the Java Ratio are not applicable. The only practical method is that of taking a mechanical sample, followed by its direct analysis, coupled with application of a recovery formula derived from theory or practice. Such a procedure is the pol-ratio method developed in Hawaii, and a detailed account is given of the weighing, sampling, sub-sampling and analysis techniques employed.

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Chemical problems in the sucrose industry. K. J. Parker. *Sucr. Belge*, 1970, **89**, 119–126.—See *I.S.J.*, 1970, **72**, 184.

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Determination of reducing matter in sugar beet. I. M. Friml and R. Čejková. *Listy Cukr.*, 1970, **86**, 29–34.—At an invert content of 10–15 mg/50 ml the Ofner method gave values which were 2·2–2·3% lower than the true invert content in pressed juice. The discrepancy was as much as 5·6% at about 5 mg invert. Statistical evaluation showed that good reproducibility and accuracy are obtainable if the amount of test solution used is such as to require 8–15 ml of the iodine solution used in titration. Tests in which the strongly alkaline reagent used in the Somogyi method was replaced with the moderately alkaline reagent used in the Ofner method showed that difficulty in establishing the end-point in titration was caused by tartaric acid formation as a result of the greater quantity of HCl needed to precipitate the iodine. However, the differences with both methods were within the limits of experimental error

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Enzymatic determination of L,D-lactic acid. H. Bourzutschky and W. Mauch. *Zeitsch. Zuckerind.*, 1970, **95**, 180–182.—The use of D- and L-lactate dehydrogenase to determine lactic acid in molasses was tested and the results compared with values obtained by a modification of the Barker & Summerson method using a solution of *p*-hydroxydiphenyl in dilute NaOH. While reasonably good agreement was obtained between the chemical method and two variants of the enzymatic method (one-stage determination of D- and L-lactic acid with combined D- and L-lactate dehydrogenase, and addition of two separate determinations) in the case of beet molasses solutions, the darker colour of cane molasses solutions and their very low lactic acid concentration caused a systematic error to occur in the simultaneous enzymatic determination, although the difference between the combined values of the separate determinations and the results obtained by the chemical method averaged only 2%.

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The development of microbiology in the sugar industry. I. Tóth-Zsiga. *Cukoripar*, 1969, **22**, 105–107; 1970, **23**, 61–63.—The history of the development of microbiology in the sugar industry is outlined with references to the literature from the end of the 19th Century up to the end of World War II.

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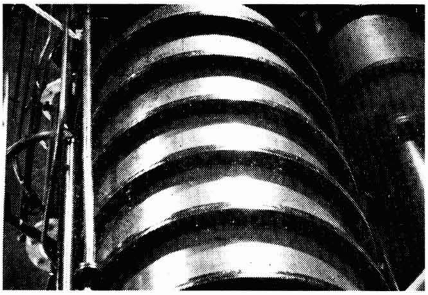
Application of nitrite reagent paper. O. Krieger. *Cukoripar*, 1970, **23**, 64–65.—Filter paper saturated with equal proportions of two solutions is dried ready for use in the determination of nitrite as a guide to the microbial population in beet sugar factory products. The two solutions are: (i) 1 g of sulphanilic acid + 30 g tartaric acid dissolved in 100 ml of 30% acetic acid, and (ii) 0·3 g α-naphthylamine boiled in 70 ml water which is filtered, 30 g tartaric acid dissolved in it, and the solution made up to 100 ml. The paper is dipped in the test sample, dried at 80–90°C and the nitrite found by comparing the colour of the paper, which turns red, with that formed by dipping the treated paper in standard KNO_3 or $NaNO_2$ solutions. Results obtained with the paper are tabulated.



By-products

Hydrogenation of sugars in the presence of solid sold. M. YAMAGUCHI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 68–77.—The effect of solid acids, e.g. silica-alumina, activated clay and acid clay, on the hydrogenation of sugars was studied. The acids, which are insoluble in water and stable at high temperatures, were found to be good hydrolytic agents, resulting in simultaneous hydrolysis and hydrogenation to yield the sugar alcohols of the corresponding monosaccharides from oligo- and polysaccharides. The hydrogenation proceeded smoothly and, in contrast to the use of acids in solution such as HCl, H_3PO_4 or oxalic acid, the activity of the hydrogenation catalyst was not lowered. The reaction temperature of sucrose hydrogenation was lowered from 150° to 100°C. Hydrogenolytic splitting of C-C bonds took place at 170–180°C with all catalysts tested except copper-plated Raney nickel; the latter consequently resulted in less formation of propylene glycol and glycerol in the hydrogenation products.

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Clarification of final molasses using surface-active agents. F. ONDA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1969, **21**, 78–87.—A number of surface-active materials were found capable of clarifying and raising the true purity of refinery final molasses; however, only one is permitted as a food additive by the Japanese Ministry of Health and Welfare, namely "Aronvis S", a sodium polyacrylate made by Nihon Junyaku Co. Ltd. Optimum conditions for its use were found to be 40°Bx molasses dilution, 2·0 initial pH, room temperature, 1·0 p.p.m. "Aronvis S" dosage, and centrifuging at 4000 r.p.m. for 10 minutes; this gave a rise of up to 5·63 units of purity in refinery final molasses. In the case of cane molasses the dosage necessary rose to 3 p.p.m. "Aronvis S".

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Fermentative utilization of sugar cane bagasse. C. E. DUNLAP and C. D. CALLIHAN. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, **16**, 82–90.—See *I.S.J.*, 1970, **72**, 218.

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A study of the process of bleaching bagasse dissolving pulp. V. LOPUJÁ, M. DE LA BARRERA and G. OCAMPO. *Sobre Deriv. Cana Azúc.*, 1968, **2**, (3), 53–66.—In tests to establish an optimum method for bleaching bagasse pulp for viscose rayon manufacture, the pulp was prepared by the sulphate process with pre-hydrolysis of the bagasse. Of various multi-stage bleaching methods investigated, the system giving optimum pulp brightness and chemical composition was Cl_2-NaOH-Cl_2-NaOH-NaClO-HCl-SO_2. Chemicals consumption was: 1·5% NaOH, 1·8% Cl_2, 1·0% HCl and 1·0% SO_2 on pulp dry weight. Results obtained in pilot plant-scale tests agreed with those in laboratory tests.

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The use of urea in cattle fodder. C. HELLER. *Zeitsch. Zuckerind.*, 1970, **95**, 241–242.—The "Dorma" process of manufacturing animal fodder from a mixture of beet pulp, urea, phosphate and molasses[1,2] is referred to and the advantages of feeding urea to cattle discussed.

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Possibility of utilization in Cuba of furfural and some of its derivatives. Y. OLGUÍN M. *Bol. Ofic. A.T.A.C.*, 1969, **24**, 221–230.—A survey is made of the technical and chemical derivatives of furfural, with 55 references to the literature, and it is concluded that these offer economic benefits to Cuba since furfural may be obtained from vegetable material containing pentosans, e.g. bagasse.

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Intensive beef production from sugar cane. VIII. Effect of rumen inoculation and different levels of forage on the performance of Brahman bulls fattened on high levels of molasses/urea. A. ELIAS, T. R. PRESTON and M. B. WILLIS. *Rev. Cubana Cienc. Agríc.*, 1969, **3**, 19–23. **X. The effect of breed and protein supplement on rumen fermentation in bulls given high levels of molasses/urea.** A. ELIAS and T. R. PRESTON. *ibid.*, 25–32.

(VIII) Trials showed increasing daily intake with increasing levels of forage but no effect on daily live weight gain or carcass characteristics. Inoculation of the rumen with digesta from an animal adapted to the fattening diet had no effect on any trait studied. The trials confirmed that the optimum amount of forage in a fattening system based on molasses/urea is $\not>$1·5 kg/100 kg live weight.

(X) Trials with Brahman and Brown Swiss × Brahman cattle showed high rumen pH and more protozoa in the former but there were no consistent differences due to the type or level of protein feed supplement. The Brahmans ate less and the results indicate that they are less suitable for intensive feeding systems.

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[1] UK Patent 1,091,264; *I.S.J.*, 1968, **70**, 189.
[2] BOEGER: *I.S.J.*, 1970, **72**, 121.

Patents

UNITED KINGDOM

(Lining bars for a) Bagasse press. ROSE, DOWNS & THOMPSON LTD., of Kingston-upon-Hull, England. **1,192,761.** 11th March 1968; 20th May 1970.—Lining bars surrounding the screw of a bagasse press permit passage of moisture between them but not the bagasse particles which are thus compressed against the bars on their passage through the press. The bars are consequently subject to wear in spite of being faced with special alloys. Wear may be reduced by lining the surface of the bars with a non-metallic lining in the form of a ceramic, glass or vitreous enamel (which comprises a high percentage of alumina and a compatible vitrified ceramic material, e.g. a clay, bentonite and/or dolomite or, alternatively, which comprises at least 70% silica and the balance alumina, CaO, Na_2O, K_2O and/or an oxide of boron). Particles of an extremely abrasion-resistant material (silicon carbide) may be embedded in the softer ceramic matrix, and the facing may be bonded to the metal body of the bar by means of an adhesive, with corresponding steps in their length to prevent separation by shearing forces.

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Beet thinner. NATIONAL RESEARCH DEVELOPMENT CORPORATION, of London S.W.1, England. **1,193,963.** 5th June 1967; 3rd June 1970.

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Beet harvesters. ROOT HARVESTERS LTD., of Peterborough, Northants., England. **1,194,827.** 17th August 1967; 10th June 1970.

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Preparation of calcium sugar phosphates. STAUFFER CHEMICAL CO., of New York., N.Y., USA. **1,195,585.** 6th July 1967; 17th June 1970.—A solution of a sugar (sucrose) (galactose, arabinose, ribose, xylose, maltose, lactose, raffinose or glucose) in water containing CaO, $Ca(OH)_2$ or $CaCO_3$, at a temperature between —10° and 30°C (0–20°C) is treated (with agitation) with $POCl_3$, the materials being in about stoichiometric proportions. After sufficient time for the required degree of conversion, the solution is clarified in a centrifugation zone, $CaCl_2$ removed and the purified solution spray-dried.

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Dialysis of sugar phosphorylation reaction solutions. STAUFFER CHEMICAL CO., of New York, N.Y., USA. **1,195,586.** 6th July 1967; 17th June 1970.—The reaction solution (see previous abstract) is subjected to 3-stage dialysis against water at $<$ 30°C (15–25°C) through a membrane of parchment or regenerated cellulose, whereby $\not>$80% of the $CaCl_2$ is removed (to restrict loss of phosphate) and the product liquor contains $\not>$ 0·5% w/w of $CaCl_2$ on solids.

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UNITED STATES

Beet harvester. M. W. VERPLANKE, of Ijzendijke, Holland. **3,483,928.** 15th September 1966; 16th December 1969.

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Beet weed control. L. EBNER, of Stein, Argan, Switzerland, *assr.* CIBA LTD. **3,488,182.** 11th June 1968; 6th January 1970.—The pre-emergence herbicide used is N-4-trifluoromethylphenyl N,N′-dimethyl urea.

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Sugar extraction. D. T. A. HUIBERS, of Berkeley Heights, N.J., USA, *assr.* THE LUMMUS CO. **3,489,606.** 28th December 1965; 13th January 1970.—Before sugar extraction, the (sub-divided) raw material (cane or beet) is subjected to high-energy radiation (from an electron accelerator, from ^{60}Co) whereby a dosage of at least 0·1 megarad (0·5–5·0 megarad) is received (at intervals of between about 0·1 and 10 sec).

* * *

Method of producing cellulose. K. GERULL, of Port-au-Prince, Haiti, *assr.* H. THOMASSET. **3,489,742.** 2nd May 1967; 13th January 1970.

Vegetable material, e.g. sugar cane, is passed through a cutter 1 and crusher 2 and introduced through opening 15 into retort 3 which is provided with an acid- and chlorine-proof lining. Retort 3 and a similar retort 5 are connected by conduits 21, 23 and are both connected by pipes 20, 24 and 22 to a gas receiver 4, retort 5 also being charged with the raw material through opening 16. A stainless steel conduit 8 leads from gas receiver 4 to a condenser 6, an outlet valve 7 being provided for withdrawing hydrogen gas. Steam inlets 17,18 are provided so that the material in the retorts supported on the perforated plates 9,10, may be heated up to about 300°F. A sodium chloride solution of about 10% concentration is treated with sufficient sodium carbonate and bicarbonate to precipitate any Mg or Ca salts and the latter separated by sedimentation

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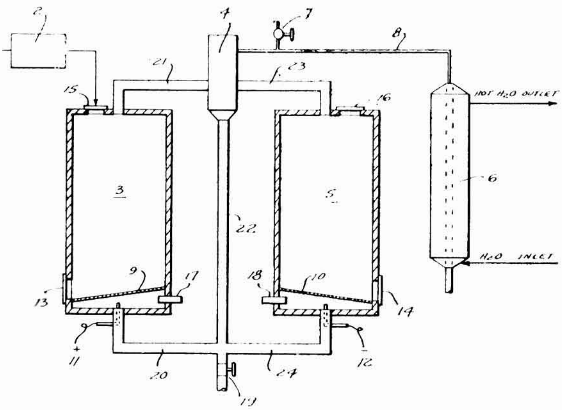
and filtration. The Mg and Ca-free brine is charged into the retorts and the connecting pipes 20, 22, 24.



Electrodes 11, 12 are provided beneath the retorts and, on passage of a direct current, generate caustic soda and hydrogen in the cathode-side retort and chlorine in the anode-side retort. These chemicals digest the vegetable materials to produce cellulose and, after a suitable time, the current is reversed so that the material is treated alternately with the caustic soda and chlorine. When the cellulose has reached the required purity the current is shut off and the liquor drained and settled to remove the lignin content, while the cellulose in the retorts is removed, washed and dried.

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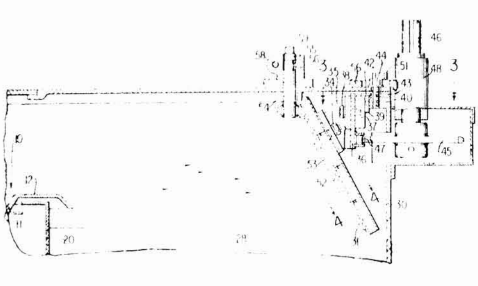
Anticrusting apparatus for continuous sugar centrifugal. W. GRIESELHUBER, of Hamilton, Ohio, USA, *assr.* THE WESTERN STATES MACHINE COMPANY. **3,490,947.** 10th July 1967; 20th January 1970.

Sugar discharged over the rim 12 of a conical basket in a continuous centrifugal is thrown against a slowly-rotating annular partition 30 which is lined with a thin layer of polytetrafluoroethylene and bolted to brackets spaced around its outer side. The brackets are bolted to carrying rings 36, 37 which have supporting lips 42 which slide over the annular rail or bearing ring 39 fixed to flange 40 at the upper end of the curb wall.



A roller chain 47 encircles the lower part of carrying ring 36, and a pinion 45, driven by shaft 46 and supported by bearing 48, rotates and so causes the partition to rotate at, e.g., 1·6 r.p.m. It thus moves continuously past a number of spaced flexible blades 52 mounted on stationary arms 53 held by pins 54 and clamps 55 in the top wall of the curb. The partition 30 serves to deflect the discharged sugar into the annular chamber 28 with minimum crystal damage while its rotation against the blades 52 keeps it clean of accumulated sugar.

* * *

Cane ripening. L. G. NICKELL and T. TANIMOTO, of Honolulu, Hawaii, USA, *assrs.* HAWAIIAN SUGAR PLANTERS' ASSOCIATION. **3,493,361.** 11th January 1968; 3rd February 1970.—Cane yield is increased by application, about 2–9 weeks before harvest, of a quaternary amine salt in the form of Me_3NRX, where R is 2-chloroethyl, 2-bromoethyl or 2,3-*n*-propylene and X is Cl or Br (chlorocholine chloride, 2-bromoethyl trimethyl ammonium bromide, 2,3-*n*-propylene trimethyl ammonium chloride). The material may be applied in water as a carrier, i.e. as a 0·1–2% a.i. solution (containing 0·1–2% of a non-ionic surface-active material) applied at the rate of 5–10 gal/acre.

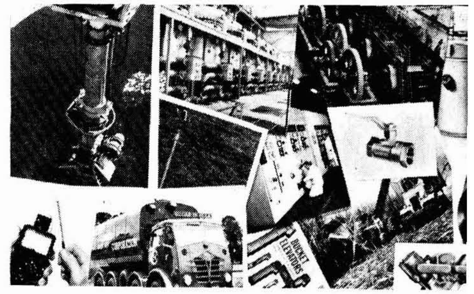
* * *

Preparation of water-soluble sugar phosphate complexes. D. H. NAPPER and B. M. SMYTHE, *assrs.* THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, NSW, Australia. **3,494,916.** 28th February 1967; 10th February 1970.—An appropriate base (a Ca base) is added to neutralize an acidified aqueous solution comprising at least one sugar (sucrose) phosphate anion and an inorganic phosphate anion; this composition comprising (a) at least one salt of a phosphate ester of a sugar (sucrose, glucose, fructose, maltose or lactose) and (b) a phosphate of a normally water-insoluble multivalent metal (Ca, Cu, Fe, Al, Sn, Pb, Zn, Mn or Ni). The composition is such that at least 2% of (b) is soluble in water under ambient conditions when total concentration of the composition exceeds 5% w/w. The multivalent metal cation may be provided by the base or may be in the acidified solution. The product may be maintained as a solution or converted to the solid state.

* * *

Automatic control system for continuous centrifugal rotors. C. R. STEELE, R. J. MORRONI and T. J. MORRONI, of Denver, Colo., USA, *assrs.* AMERICAN FACTORS ASSOCIATES LTD. **3,497,386.** 29th September 1965; 24th February 1970.—The control system includes an adjustable self-closing valve in the massecuite feed inlet, a pneumatic transducer mechanism for opening the valve to a selected setting when actuated, sensing devices in the motor circuit and one electric circuit control actuated by the sensors which govern the transducer so as to set the feed valve to maintain a constant load on the motor and to close the valve during excessive motor overload. Another circuit deactuates the pneumatic mechanism when the motor is not under load, such as when the coupling between motor and centrifugal breaks.

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.

The "Wey" slide valve. The Reiss Engineering Co. Ltd., 2 Dalston Gardens, Stanmore, Middx., England.

The "Wey" slide valve has a number of features which make it particularly suitable for numerous applications in the sugar industry, where it has proved highly successful and has been widely used by sugar machinery manufacturers for use with lines and containers for beet and bagasse pulp, raw and refined sugar, massecuite, molasses, vapour and vacuum lines, water and effluent, dust, chemicals, filters, screens, thickeners, etc. Available for pressures up to 40 p.s.i., it can be manually, pneumatically or electrically operated, has no seat pocket (thus avoiding accumulation of deposits and ensuring tight closure of the valve), has complete hermetic seal against pressure or vacuum, has an internal seal (repackable without dismantling) instead of a stuffing box, built-in O-rings instead of joint rings and a robust 4-pillar construction. It can be mounted in any position—vertically, horizontally or inclined—without affecting performance. The knife-edged valve blade is of stainless steel, while a special synthetic rubber seal grooved into the body ensures that the slide is guided throughout its travel without any flutter. If required, scraper blades can be fitted to keep the slide clean. The elastic sealing strip embedded in a groove of the valve housing and against which the blade seats snugly is made of a suitable erosion-, corrosion- and temperature-resistant material. Any deposits in the slide guides are forced by internal contouring into the flow stream when the valve is closed.

* * *

Cartridge filter. Stella-Meta Filters Ltd., Laverstoke Mill, Whitchurch, Hants., England.

A new cartridge filter has been designed by Stella-Meta Filters for use with practically any liquid having a low solid content (including sugar juices and water). It consists basically of a vessel containing a number of precision-wound filter cartridges made of cotton or synthetic fibre and is made in a range of throughputs from 3600 to 43,200 gal/hr at a 5-micron rating (1080–19,960 gal/hr at a 1-micron rating). Cartridges having a polypropylene core can withstand temperatures up to 60°C, while stainless steel cores are required for higher temperatures. Rated operating pressure is 100 p.s.i. The liquid is fed at the bottom of the vessel and passes up through the windings, the filtrate then collecting in a discharge chamber at the lower end of the cartridges and flowing out through an outlet at the base. Free access is provided to the top cover for cartridge replacement, which is required when a marked pressure drop and flow reduction becomes apparent. Cartridge replacement is easy and rapid. The filters are designed for most filtration duties where solids recovery is not required and can be used for polish filtration of process liquors. Of advantage is the small amount of floor space occupied by the filters, the largest of which, containing 432 cartridges, has a diameter of only 36 in (approximately 1 m).

* * *

PUBLICATIONS RECEIVED

MARDON (ENGINEERING) N.V. Mardon (Engineering) N.V., Metelerkampweg 18, Brummen, Holland.

A recently-published brochure gives information on the activities of Mardon (Engineering) N.V. and describes how a project is set up. A table showing the numerous derivatives obtainable from sucrose is included. The company's activities include the design and equipment of complete beet and cane sugar factories, yeast plants and molasses alcohol distilleries as well as many other types of chemical plants, including those for manufacture of lactic and acetic acids, calcium lactate, sorbitol, mannitol, dextran, CO_2, etc.

* * *

BUCKAU-WOLF "TECHNIK". Maschinenfabrik Buckau R. Wolf AG, D 4048 Grevenbroich, Lindenstr. 43, Postfach 69, Germany.

Issue No. 5 of "Technik" contains, in its section on sugar, information on the Buckau-Wolf beet tail slicer developed as a result of investigations over a number of years, culminating in an experimental machine installed in a French sugar factory in 1967. The slicer can treat 200 tons of beet tails per day and permits good diffusion of the sliced tails even at a pol content as low as 0·9%.

* * *

"SUGAR BULLETIN". A. & W. Smith & Co. Ltd./The Mirrlees Watson Co. Ltd., 1 Cosmos House, Bromley Common, Bromley, BR2 9NA, England.

Issue No. 11 (1970) of "Sugar Bulletin" carries (in English and Spanish) information on the cane sugar factory under construction for Rahmania Fauji Sugar Mills Ltd. in West Pakistan. A list is given of the equipment for the factory, which is designed to produce 300 tons of refined sugar per day using simple defecation and remelt carbonatation, compared with the double carbonatation or double sulphitation process used by all other Pakistan factories producing direct consumption sugar. Also mentioned is an order for six steam turbines to drive the shredder and five 84-in mills complete with gearing to be supplied to Ingenio Independencia S.A., in Mexico, and the Passi sugar factory built by Mirrlees in the Philippines.

World sugar production estimates 1970/71[1]

BEET SUGAR	Campaign	Estimate 1970/71	1969/70
EUROPE		metric tons, raw value	
Belgium/Luxembourg	Sept./Jan.	580,000	687,184
France	,,	2,611,100	2,782,219
Germany, West	,,	2,081,000	2,114,508
Holland	,,	690,000	780,800
Italy	July/Oct.	1,236,000	1,415,554
Total E.E.C.		*7,198,100*	*7,780,265*
Austria	Sept./Jan.	325,000	357,162
Denmark	,,	314,444	311,111
Finland	,,	57,778	55,763
Greece	July/Oct.*	183,000	149,422
Ireland	Sept./Jan.	152,000	150,137
Spain	July/March	874,000	770,869
Sweden	Sept./Jan.	248,889	210,589
Switzerland	,,	60,000	62,899
Turkey	Aug./Feb.	652,174	544,922
United Kingdom	Sept./Jan.	1,000,000	955,650
Yugoslavia	Aug./Jan.	458,300	568,152
Total West Europe		*11,523,685*	*11,916,911*
Albania	Aug./Jan.	17,000	16,000
Bulgaria	,,	235,000	220,000
Czechoslovakia	Sept./Jan.	780,000	731,500
Germany, East	,,	500,000	450,000
Hungary	,,	288,889	449,371
Poland	,,	1,649,000	1,527,000
Rumania	Aug./Feb.	380,000	438,037
USSR	Sept./Jan.	9,500,000	9,049,910
Total East Europe		*13,349,889*	*12,881,818*
Total Europe		24,873,574	24,798,759
OTHER CONTINENTS			
Afghanistan	Nov./Feb.	9,000	7,901
Algeria	June/Nov.*	10,000	9.980
Azores	June/March	11,000	10,000
Canada	Oct./Dec.*	140,000	138,321
Chile	April/June†	224,800	226,419
China	Jan/Dec.†	800,000	750,000
Iran	Oct./March	560,000	508,889
Iraq	,,	5,000	5,000
Israel	May/July†	35,000	32,225
Japan	Oct./Feb.	337,903	330,217
Lebanon	June/Nov.*	10,000	10,000
Morrocco	May/Aug.†	110,000	45,000
Pakistan	June/July†	26,700	25,110
Syria	May/June†	30,000	30,000
Tunisia	May/April	6,000	5,592
United States	July/June	3,039,053	3,077,154
Uruguay	May/April	45,000	37,000
Total Other Continents		5,399,456	5,248,808
TOTAL BEET SUGAR		30,273,030	30,047,567

CANE SUGAR	Campaign	Estimate 1970/71	1969/70
EUROPE			
Spain	March/Sept.	50,000	49,000
NORTH AND CENTRAL AMERICA			
British Honduras	Dec./June	62,500	67,882
Costa Rica	,,	150,000	145,000
Cuba	Nov./July	5,750,000	8,529,000
Dominican Republic	Nov./Sept.	1,180,000	1,043,257
Guadeloupe	Jan./June†	185,000	173,200
Guatemala	Dec./June	200,000	194,207
Haiti	,,	68,000	65,000
Honduras	,,	70,000	70,000
Martinique	Jan./June*	45,000	41,662
Mexico	Nov./July	2,383,000	2,363,262
Nicaragua	Dec./June	150,000	142,000
Panama	,,	77,500	70,565
Puerto Rico	Jan./July†	454,000	417,303
Salvador	Nov./June	150,000	125,000
USA—Mainland	Oct./June	1,157,000	971,560
Hawaii	Jan./Dec.†	1,075,000	1,059,405
West Indies—Antigua‡	Jan./June†	12,000	7,112
Barbados‡	,,	160,000	156,386
Jamaica‡	,,	400,000	376,580
St. Kitts‡	,,	38,000	27,202
Trinidad‡	,,	245,000	219,512
Total North and Central America		14,012,000	16,265,095
SOUTH AMERICA			
Argentina	July/Dec.*	995,776	997,757
Bolivia	May/Sept.†	125,482	123,939
Brazil‡	June/May	4,960,000	4,315,000
Colombia	Jan./Dec.†	874,570	752,221
Ecuador	June/Jan.	300,000	270,000
Guyana‡	Oct./June	370,000	360,520
Paraguay	July/Nov.*	46,000	42,393
Peru‡	Jan./Dec.†	750,000	750,000
Surinam	Aug./May	17,000	17,000
Uruguay	May/April	10,000	10,000
Venezuela	Sept./Aug.	475,000	443,000
Total South America		8,923,828	8,071,830
AFRICA			
Angola‡	May/March	75,000	70,000
Cameroun	April/Sept.*	15,000	12,330
Congo (Brazzaville)	May/Nov.*	90,000	95,283
Congo (Kinshasa)	,,	48,000	45,000
Ethiopia	Nov./June	115,000	108,000
Ghana	April/Sept.*	24,000	22,000
Kenya	July/June	150,000	135,000
Madeira	March/Sept.*	3,457	3,337
Malagasy	July/June	115,000	100,000
Malawi	May/Nov.*	20,000	20,094
Mauritius‡	July/Jan.	615,000	708,056
Mozambique‡	May/Nov.*	260,000	230,000
Nigeria	,,	32,173	30,480
Réunion	July/Jan.	224,000	259,890
Rhodesia	May/Nov.*	145,000	130,000
Somalia	Dec./April	50,000	46,000
South Africa	May/April	1,550,000	1,653,791
Sudan	Dec./June	110,000	100,000
Swaziland	May/Dec.*	155,000	156,613
Tanzania	July/June	100,000	95,000
Uganda	,,	170,000	164,901
UAR (Egypt)	Dec./June	515,000	491,050
Zambia	May/Nov.*	44,000	33,767
Total Africa		4,625,630	4,710,592
ASIA			
Afghanistan	Oct./April	12,000	11,000
Burma	Nov./April	95,000	90,000
Ceylon	Nov./June	11,000	10,000
China	Jan./Dec.†	2,350,000	2,250,000
India, excl. khandsari	Oct./July	4,500,000	4,700,000
Indonesia	May/Dec.*	750,000	720,000
Iran	Oct./April	61,000	60,266
Japan & Ryukyu Isl.	Nov./June	310,000	303,219
Nepal	Oct./April	10,000	10,000
Pakistan	Nov./May	760,871	773,900
Philippines	Nov./July	2,256,390	1,923,222
Taiwan	Nov./June	734,000	748,387
Thailand	Oct./April	470,000	467,000
Total Asia		12,320,261	12,066,994
OCEANIA			
Australia	May/Dec.*	2,650,000	2,275,000
Fiji	,,	400,000	322,000
Total Oceania		3,050,000	2,597,000
TOTAL CANE SUGAR		42,981,719	43,760,511
TOTAL BEET SUGAR		30,273,030	30,047,567
TOTAL SUGAR PRODUCTION		73,254,749	73,808,078

[1] F. O. Licht. *International Sugar Rpt.*, 1970, **102**, (32), 1–4.
* 1970, 1969
† 1971, 1970
‡ tel quel

Brevities

USSR 1969/70 beet campaign results[1].—The sugar beet area in 1969 amounted to 3,384,300 hectares. Sugar beet processed reached 63,190,000 tons and sugar production 8,145,000 tons, white value, equivalent to 9,050,000 tons, raw value. Thus the beet yield reached 18.67 tons/hectare based on beet processed to sugar; the actual harvest yield will have been higher, however, because of the beets used for other purposes. Extraction amounted to 14·32% and the yield of sugar to 2·67 tons/hectare.

* * *

Cuban sugar production target 1970/71.—The 1970/71 crop started in Cuba in Camagüey Province on the 20th November and it is reported[2] that the Prime Minister, Dr. CASTRO, has set the production target at 7,000,000 tons, compared with the 1969/70 target of 10,000,000 tons.

* * *

C. W. Murray award panel.—On 30th September 1970, Mr. N. M. ADAMS retired from the position of Technical Director of the British Sugar Corporation Ltd. On the same date he relinquished his position as a member of the Panel on which he had served since October 1968. Mr. T. RODGERS, his successor as Technical Director, has agreed to serve on the Panel in his place. Details regarding the preparation and submission of papers for the 1971 award can be obtained from Fletcher and Stewart Ltd., Bucklersbury House, 83 Cannon Street, London EC4N 8EJ, England, and those wishing to compete should write to that address.

* * *

World sugar industry expansion prospects[3].—Between 1950 and 1966, German industry supplied 83 sugar factories in 23 countries, including 61 factories in developing countries. According to Prof. A. BUCH, the possibilities for machinery suppliers remain great since, on a basis of the regular increase of world consumption arising from population growth, there will be a requirement during the next ten years of 900 new sugar factories of 2000 tons daily capacity on average, half of them processing beet and half cane.

* * *

Sugar silo in France[4].—A Danish firm of engineering consultants, C. Ostenfeld & W. Jonson, has received an order from Sucrerie Centrale de Cambrai, of Escaudoeuvres, near Lille, for plans for what will be the largest sugar silo in the world. With a capacity of 35,000 tons, i.e. about half the annual production of the sugar factory, the silo will have a diameter of 36 m and a height of 50 m, and will be built of pre-stressed concrete. The Danish firm was responsible for the design of the hitherto largest silo of 30,000 tons capacity which is also in France.

* * *

New Indian cane varieties[5].—The Central Sugar Cane Breeding Institute at Coimbatore, Tamil Nadu, has evolved a new variety of cane, designated Co 6806, which performs better than the standard Co 419 variety in both yield and quality and is also highly resistant to smut disease. A new cane variety has also been released for planting in the eastern districts of U.P. Designated Co 62403, it has evolved after seven years of research and trials at the Sugar Cane Research Station at Gorakhpur, and is a high-yielding variety with medium thick, erect, solid and hard stalks, and it is resistant to rot, smut, wilt and allied diseases.

* * *

New Indian sugar factories[6].—A new sugar factory to cost Rs. 25 million (nearly £1,300,000) has been sanctioned by the Indian Government for erection at Dharbandoda in Ponda Taluka, in Goa. It will have a capacity of 1200 tons of cane per day. Another cooperative sugar factory is to be set up at Chiplum in Ratnagiri district, also of the same capacity.

US sugar supply quota 1971

	short tons, raw value
Domestic Beet	3,263,333
Mainland Cane	1,186,667
Hawaii	1,180,000
Puerto Rico	1,140,000
Virgin Islands	15,000
Philippines	1,126,020
Argentina	57,331
Australia	194,965
Bahamas	10,000
Bolivia	5,548
Brazil	466,048
British Honduras	11,953
British West Indies	164,079
Colombia	49,317
Costa Rica	54,865
Dominican Republic	466,048
Ecuador	67,811
Fiji	42,784
French West Indies	51,614
Guatemala	46,234
Haiti	25,892
Honduras	5,548
India	77,986
Ireland	5,351
Malagasy	9,206
Mauritius	17,872
Mexico	476,527
Nicaragua	54,865
Panama	34,522
Peru	371,729
Salvador	33,905
South Africa	57,406
Swaziland	7,041
Taiwan	81,235
Thailand	17,872
Venezuela	23,426
	10,900,000

Puerto Rico sugar factory closures[7].—No agreement has been reached on various proposals to keep Central Aguirre open and, as a consequence, both the Aguirre and Cortada mills are to be closed. They had crushing capacities of 6800 and 1950 tons/day, respectively. A third mill owned by the company, Central Machete, was closed after the 1967 crop. Central Guánica was recently acquired by the Puerto Rico Government from Gulf and Western Inc. for $3,000,000; the former owners had decided to abandon production because of rising labour costs and lack of land which would guarantee sufficient cane supply to justify expenditure on the required modernization of the mill. The Government also owns Centrals Cambalache, Fajardo and Juncos.

* * *

Morocco sugar production 1969/70[8].—Morocco produced 155,000 metric tons of sugar, raw value, during the 1969/70 campaign, covering about half of her requirements. The remainder is to be supplied by Cuba and Poland.

* * *

Argentina sugar exports, 1969[9].—Exports of sugar from Argentina fell from 133,092 metric tons, raw value, in 1968 to 58,098 tons in 1969. The principal destination was the USA with 37,260 tons (103,837 tons in 1968), while Uruguay received 16,188 tons (22,578 tons in 1968) and South Vietnam 4650 tons (0). In 1968, the balance of exports (6677 tons) went to Chile.

[1] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (31), 6.
[2] *The Times*, 9th December 1970.
[3] SCHUMACHER: *Technic International*; through *Sucr. Franç.*, 1970, **111**, 441.
[4] *Zucker*, 1970, **23**, 620.
[5] *Indian Sugar*, 1970, **20**, 267.
[6] *Sugar News* (India), 1970, **2**, (2), 6, 8.
[7] *Sugar y Azúcar*, 1970, **65**, (9), 44.
[8] *Agence France-Presse*, 15th August 1970.
[9] *Lamborn*, 1970, **48**, 162.

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BUYERS' GUIDE

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

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

Accumulators, Steam.
see Steam Accumulators.

Activated carbon.
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Imacti N.V.

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Soc. Fives Lille-Cail.
H. Putsch & Comp.

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

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

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Salzgitter Maschinen A.G.
Sucatlan Engineering.

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

Belting, Conveyor and elevator.
see Conveyor belting.

Blending machines.
Arenco-Alite Ltd.

Boiler tube brushes, Spiral and expanding.
Elliott Division of Consolidated Pneumatic Tool Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

Boiler tube cleaners, Air and electric.
Elliott Division of Consolidated Pneumatic Tool Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

Boiler water treatment.
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.

Boilers, Water tube.
Babcock & Wilcox Ltd.
Soc. Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd.
S.E.U.M.
Stork-Werkspoor Sugar N.V.

Bone char.
British Charcoals & Macdonalds Ltd.

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

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

Bulk storage hoppers.
Fletcher & Stewart Ltd.
T. Giusti & Son Ltd.
W. J. Jenkins & Co. Ltd.
The Tills Engineering Co. Ltd.

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

Bunker discharge equipment.
Redler Conveyors Ltd.
The Triton Engineering Co. (Sales) Ltd.

Burners, Sulphur.
see Sulphur furnaces, Continuous.

Calciners, Fluidized bed.
Rosin Engineering Co. Ltd.

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

Cane cars and trailers.
Fletcher and Stewart Ltd.
Martin-Markham (Stamford) Ltd.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.

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

Cane conveyor drives.
Edwards Engineering Corporation.

Cane cultivation equipment.
Ransomes Sims & Jefferies Ltd.
Wyper Brothers Ltd.

Cane diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Costruzioni Mecchaniche Industriali Genovesi CMI S.p.A.
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Extraction De Smet S.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Sucatlan Engineering.
Walkers Ltd.

Cane harvesters.
Tate & Lyle Enterprises Ltd.
Wyper Brothers Ltd.

Cane loaders.
Crone & Taylor (Engineering) Ltd.
F. W. McConnel Ltd.
Tate & Lyle Enterprises Ltd.

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

Cane planters.
J & L Engineering Co. Inc.
Wyper Brothers Ltd.

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

Cane shredders.
see Shredders.

Cane trash shredders.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Gruendler Crusher & Pulverizer Co.

Cane washing plants.
C F & I Engineers Inc.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.

Cane washing tables.
J & L Engineering Co. Inc.
Tate & Lyle Enterprises Ltd.

Carbon, Decolorizing.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft für Wärme- und Chemotechnik m.b.H.
Norit N.V.
Pittsburgh Activated Carbon Division.
Suchar.
The Sugar Manufacturers' Supply Co. Ltd.

Carbon decolorizing equipment.
Norit N.V.

Carbon decolorizing systems.
Norit N.V.
Suchar.

Carbon reactivation.
Norit N.V.

Carbonatation equipment.
BMA Braunschweigische Maschinenbauanstalt.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Castings.
E. Green & Son Ltd.
Kingston Industrial Works Ltd.
Stork-Werkspoor Sugar N.V.

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

Cement, Sugar-resistant.
Lafarge Aluminous Cement Co. Ltd.

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

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

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

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

Centrifugals and accessories.
ACEC.
Alfa-Laval AB.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Hein, Lehmann & Co. A.G.
Manlove Tullis Group Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
The Sugar Manufacturers' Supply Co Ltd.
The Western States Machine Co.

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

Centrifugals, Continuous.
Alfa-Laval AB.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Hein, Lehmann & Co. A.G.
Salzgitter Maschinen A.G.
Western States Machine Co.

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

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

Chain cane slings.
Wheway-Watson Ltd.

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

Char revivifying plants.
Stein Atkinson Stordy Ltd.

Chemical plants.
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
John Dore & Co. Ltd.
Dorr-Oliver Inc.
T. Giusti & Son Ltd.
Mardon (Engineering) N.V.
S.P.E.I. Chim.
Wellman Incandescent Furnace Co. Ltd.,Swenson Equipment Division.

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

Clarifiers.
Alfa-Laval AB.
BMA Braunschweigische Maschinenbauanstalt.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Dorr-Oliver Inc., Cane Sugar Division
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.

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

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.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

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

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

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

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

Conveyor belting.
Lewis & Tylor Ltd.
Scandura Ltd.

Conveyor chains.
Ewart Chainbelt Co. Ltd.
Fletcher and Stewart Ltd.
W. J. Jenkins & Co. Ltd.
Renold Limited.
A. & W. Smith & Co. Ltd.
Wheway-Watson Ltd.

Conveyor idler rollers and pulleys.
Mavor & Coulson Ltd.

Conveyors and elevators.
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
Kingston Industrial Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Sucatlan Engineering.
Walkers Ltd.
Ingeniörsfirman Nils Weibull AB.

Belt and bucket elevators.
Crone & Taylor (Engineering) Ltd.
W. J. Jenkins & Co. Ltd.
Maver & Coulson Ltd.
Redler Conveyors Ltd.

Belt conveyors.
Crone & Taylor (Engineering) Ltd.
W. J. Jenkins & Co. Ltd.
Mavor & Coulson Ltd.

Bucket elevators.
Crone & Taylor (Engineering) Ltd.
W. J. Jenkins & Co. Ltd.
Mavor & Coulson Ltd.
The Mirrlees Watson Co. Ltd.
Redler Conveyors Ltd.

Chain and bucket elevators.
Crone & Taylor (Engineering) Ltd.
W. J. Jenkins & Co. Ltd.
Mavor & Coulson Ltd.
Redler Conveyors Ltd.

Chain conveyors.
Crone & Taylor (Engineering) Ltd.
W. J. Jenkins & Co. Ltd.
Mavor & Coulson Ltd.
Redler Conveyors Ltd.

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

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

Pneumatic conveyors.
Redler Conveyors Ltd.
The Tills Engineering Co. Ltd.

Scraper conveyors.
W. J. Jenkins & Co. Ltd.
Mavor & Coulson Ltd.

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

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

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

Coolers, Fluidized bed.
Rosin Engineering Co. Ltd.

Coolers, Pellet.
Simon-Heesen N.V.

Coolers, Sugar.
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd.
Hygrotherm Engineering Ltd.
W. J. Jenkins & Co. Ltd.
Manlove Tullis Group Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.

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

Cranes.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Soc. Fives Lille-Cail.
John M. Henderson & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Stothert & Pitt Ltd.
Wheway-Watson Ltd.

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

Crystallizers.
BMA Braunschweigische Maschinenbauanstalt.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Crystallizers, Continuous.
Soc. Fives Lille-Cail.
Stork-Werkspoor Sugar N.V.

Cube-making machinery.
Goka N.V. Machinefabriek.

Cube sugar moulding, ranging and packeting plant.
Goka N.V. Machinefabriek.

Cube wrapping machines.
SAPAL.

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

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

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

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

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

Diatomaceous earth, *see* Filter-aids.

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

Distillery plant, *see* Alcohol plant.

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

Drives, Variable speed.
Renold Limited.

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

Dryers.
BMA Braunschweigische Maschinenbauanstalt.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hygrotherm Engineering Ltd.
W. J. Jenkins & Co. Ltd.
Manlove Tullis Group Ltd.
The Mirrlees Watson Co. Ltd.
Rosin Engineering Co. Ltd.
Salzgitter Maschinen A.G.
S.E.U.M.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
van den Broek's Machinefabriek N.V.
Ingeniörsfirman Nils Weibull AB.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Dryers, Fluidized bed.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

Dust control equipment.
Dust Control Equipment Ltd.
Tilghman Wheelabrator Ltd.
The Tills Engineering Co. Ltd.
Westinghouse Brake and Signal Co. Ltd.

Dust sleeves and bags.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
Samuel Hill Ltd.
P. & S. Textiles Ltd.
Tilghman Wheelabrator Ltd.

Economizers.
E.Green & Son Ltd.

Effluent treatment.
Dorr-Oliver Inc., Cane Sugar Division.
Film Cooling Towers (1925) Ltd.
The Permutit Co. Ltd.
Werkspoor Water N.V.

Effluent treatment chemicals.
Glovers (Chemicals) Ltd.

Electric motors.
ACEC.
Weir Pumps Ltd.

Electric power generators.
ACEC.
General Electric Company of U.S.A.
Stork-Werkspoor Sugar N.V.

Electric tube cleaning machines.
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

Electronic equipment.
ACEC.
Honeywell Ltd.

Engineering design and contracting services.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
John Laing Construction Ltd.
Mardon (Engineering) N.V.
The Mirrlees Watson Co. Ltd.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.

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

Engines, Steam.
Soc. 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.
St. Mary Iron Works Inc.

Enzymes.
A.B.M. Industrial Products Ltd.

Evaporator additives.
Allied Colloids Manufacturing Co. Ltd.
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.
C F & I Engineers Inc.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
S.P.E.I. Chim.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Evaporators, Falling film.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Expanders, Tube.
see Tube expanders.

Fans, Induced and forced draft.
Stork-Werkspoor Sugar N.V.

Filling machines.
Arenco-Alite Ltd.

Filters.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Plenty Divn., SPP Group Ltd.
S.P.E.I. Chim.
Sucatlan Engineering.
Werkspoor Water N.V.
Wire Weaving Co. Ltd.

Automatically controlled filters.
Chemap A.G.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.

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

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

Diatomite filters.
Chemap A.G.
The Mirrlees Watson Co. Ltd.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.

Filter presses.
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Manlove Tullis Group Ltd.

Filter thickeners.
A/S De Danske Sukkerfabrikker.
Dorr-Oliver Inc., Cane Sugar Division.
Ets. Gaudfrin.
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.
The Permutit Co. Ltd.
Rapid Magnetic Ltd.
Stockdale Engineering Ltd.

Leaf filters.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.

Plate and frame filters.
Manlove Tullis Group Ltd.
Stork-Werkspoor Sugar N.V.

Pressure filters.
BMA Braunschweigische Maschinenbauanstalt.
Chemap A.G.
Dorr-Oliver Inc., Cane Sugar Division.
Ets. Gaudfrin.
The Mirrlees Watson Co. Ltd.
The Permutit Co. Ltd.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.
Suchar.

Rotary vacuum filters.
BMA Braunschweigische Maschinenbauanstalt.
Dorr-Oliver Inc., Cane Sugar Division.
Filtres Vernay S.A.
H. Putsch & Comp.
Stockdale Engineering Ltd.

Filter aids.
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Glovers (Chemicals) Ltd.
Kenite Corporation.
Sil-Flo Incorporated.
The Sugar Manufacturers' Supply Co. Ltd.

Filter cloths.
Associated Perforators & Weavers Ltd.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
Samuel Hill Ltd.
P. & S. Textiles Ltd.

Filter leaves.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.

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

Filter pulp.
J. Barcham Green Ltd.

Filter screens.
Associated Perforators & Weavers Ltd.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc.
Endecotts (Test Sieves) Ltd.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
Haver & Boecker.
Krieg & Zivy Industries.
The Longwood Engineering Co. Ltd.
J. & F. Pool Ltd.
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.
A. Friedr. Flender & Co.
Renold Limited.

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

Flocculants.
Allied Colloids Manufacturing Co. Ltd.

Flowmeters.
Alfa-Laval AB.
Auriema Ltd.
Honeywell Ltd.
Negretti & Zambra Ltd.
G. A. Platon Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.

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

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

Gearing, *see* Reduction gears.

Gearmotors.
David Brown Gear Industries Ltd.
Renold Ltd.

Granulators, *see* Dryers.

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

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

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

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

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

Heat exchangers, Tubular.
Alfa-Laval AB.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.

Heat exchangers, Tubular—*continued*
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
E. Green & Son Ltd.
Kingston Industrial Works Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
S.P.E.I. Chim.

Heat sealers.
The Thames Packaging Equipment Co.

Instruments, Process contròl.
Bailey Meters & Controls Ltd.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Honeywell Ltd.
Negretti & Zambra Ltd.
G. A. Platon Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.
Westinghouse Brake and Signal Co. Ltd.
G. H. Zeal Ltd.

Insulation, Thermal.
Lafarge Aluminous Cement Co. Ltd.

Ion exchange plants.
BMA Braunschweigische Maschinenbauanstalt.
IMACTI N.V.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Werkspoor Water N.V.

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

Irrigation equipment.
Agricultural Services Divn., SPP Systems Ltd.
Dreibholz & Floering Ltd.
Even Products Ltd.
Farrow Irrigation Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

Juice heaters.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

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

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

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

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

Knives, Milling.
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

Knives, Milling—Drives.
Farrel Company.
Fletcher and Stewart Ltd.
General Electric Company of U.S.A.
Stork-Werkspoor Sugar N.V.

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

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

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

Lens cleaning tissues.
J. Barcham Green Ltd.

Level indicators and controllers.
Haver & Boecker.
Honeywell Ltd.
Negretti & Zambra Ltd
Ronald Trist Controls Ltd.

Lime slaking equipment.
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Maschinenfabrik H. Eberhardt.
Rosin Engineering Co. Ltd.
Stork-Werkspoor Sugar N.V.

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

Locomotives, Diesel.
General Electric Company of U.S.A.

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

Magnetic separators
Electromagnets Ltd.
Fletcher and Stewart Ltd.
Industrial Magnets Ltd.
Rapid Magnetic Ltd.
Ulrich Walter Maschinenbau.

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

Microbiocidal agents.
Glovers (Chemicals) Ltd.

Mill hydraulics.
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.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Milling plant.
BMA Braunschweigische Maschinenbauanstalt.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
Farrel Company.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.

Mixing machines.
Arenco-Alite Ltd.
Plenty Divn., SPP Group 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.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Kingston Industrial Works Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.

Packeting machinery.
Brecknell, Dolman & Rogers Ltd.
Thomas C. Keay Ltd.
SIG Swiss Industrial Company.

Packeting machinery for individual sachets.
SIG Swiss Industrial Company.

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

Pan circulators.
C F & I Engineers Inc.

Pans, Vacuum.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Parcelling machines.
SIG Swiss Industrial Company.

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

Pelleting presses for dried pulp.
Amandus Kahl Nachf.
Simon-Heesen N.V.
Richard Sizer Ltd.

Perforated metals.
Associated Perforators & Weavers Ltd.
Ferguson Perforating & Wire Co.
Krieg & Zivy Industries.
J. & F. Pool Ltd.
Ulrich Walter Maschinenbau.

Pipe fittings.
see Tube fittings.

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

Pipework installation.
Blundell & Crompton Ltd.

Polythene bag sealers.
The Thames Packaging Equipment Co.

Power plants.
W. H. Allen, Sons & Co. Ltd.
General Electric Company of U.S.A.
Stork-Werkspoor Sugar N.V.

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

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

Pressure feeders.
Walkers Ltd

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

Pressure vessels.
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
E. Green & Son Ltd.
St. Mary Iron Works Inc.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Process computers.
General Electric Company of U.S.A.

Pulley blocks.
Wheway-Watson Ltd.

Pulp screens.
Associated Perforators & Weavers Ltd.

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

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

Beet pumps.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.

Boiler feed pumps.
Howard Pneumatic Engineering Co. Ltd.
Sigmund Pulsometer Pumps Divn., SPP Group Ltd.

Centrifugal pumps.
ACEC.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Peter Brotherhood Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

Corrosion-proof pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V.-Mitchell Craig Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Drum Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
Sigmund Pulsometer Pumps Divn., SPP Group Ltd.
Simonacco Ltd.
Stothert & Pitt Ltd.

Dosing pumps.
A.P.V.-Mitchell Craig Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Fabcon Inc.
Howard Pneumatic Engineering Co. Ltd.
The Permutit Co. Ltd.

Filtrate pumps.
BMA Braunschweigische Maschinenbauanstalt.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
Sigmund Pulsometer Pumps Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

Gas pumps.
George Waller & Son Ltd.

Irrigation pumps.
Allen Gwynnes Pumps Ltd.
Farrow Irrigation Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer pumps Divn., SPP Group Ltd.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

Massecuite pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Soc. Fives Lille-Cail.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.

Membrane pumps.
Saunders Valve Co. Ltd.

Molasses pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Drum Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Amandus Kahl Nachf.
Mono Pumps Ltd.
Plenty Divn., SPP Group Ltd.
Stothert & Pitt Ltd.
Ulrich Walter Maschinenbau.

Positive-action pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Drum Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
Plenty Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

Rotary pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Drum Engineering Co. Ltd.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
G. A. Platon Ltd.
Plenty Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

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

Sump pumps.
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

Vacuum pumps.
see Vacuum pumps.

Railway, *see* Locomotives *and* Track.

Raw sugar scales, Fully automatic.
N.V. Servo-Balans.

Rectifiers.
ACEC.

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

Refinery equipment.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Norit N.V.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stein Atkinson Stordy Ltd.
Stork-Werkspoor Sugar N.V.
Suchar.
Tate & Lyle Enterprises Ltd.

Refractometers.
Bellingham & Stanley Ltd.
A. H. Korthof N.V.
Schmidt + Haensch.
Thorn Bendix Ltd.
Carl Zeiss.

Refractory bricks.
GR–Stein Refractories Ltd.

Refractory cement.
GR–Stein Refractories Ltd.
Lafarge Aluminous Cement Co. Ltd.

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

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

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

Sack closing machines.
Chronos-Werk, Reuther & Reisert K.G.
Thomas C. Keay Ltd.
Reed Medway Sacks Ltd.
Sack Fillers Ltd.
The Thames Packaging Equipment Co.

Sack counting equipment.
The Thames Packaging Equipment Co.

Sack filling machines.
Chronos-Werk, Reuther & Reisert K.G.
Haver & Boecker.
Thomas C. Keay Ltd.
Reed Medway Sacks Ltd.
Sack Fillers Ltd.
Richard Simon & Sons Ltd.
Ingeniörsfirman Nils Weibull AB.

Sack openers.
Thames Packaging Equipment Co.

Sack printing machines.
Thomas C. Keay Ltd.

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

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

Screens, Centrifugal, *see* Centrifugal screens.

Screens, Filter, *see* Filter screens.

Screens, Rotary.
Associated Perforators & Weavers Ltd.
The Longwood Engineering Co. Ltd.
J. & F. Pool Ltd.

Screens, Vibrating.
BMA Braunschweigische Maschinenbauanstalt.
Electromagnets Ltd.
Fletcher and Stewart Ltd.
Haver & Boecker.
Hein, Lehmann & Co. A.G.
Carl Schenck Maschinenfabrik G.m.b.H.
The Sugar Manufacturers' Supply Co. Ltd.
The Triton Engineering Co. (Sales) Ltd.
see also Juice strainers and screens.

Screens, Wire.
Associated Perforators & Weavers Ltd.
Dorr-Oliver Inc., Cane Sugar Division.

Sedimentation accelerators.
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Glovers (Chemicals) Ltd.
Hodag Chemical Corporation.

Sedimentation tanks and clarifiers.
BMA Braunschweigische Maschinenbauanstalt.
Werkspoor Water N.V.

Sewing threads, Heavy grade.
Thames Packaging Equipment Co.

Ship loading installations.
Babcock & Wilcox Ltd.
Crone & Taylor (Engineering) Ltd.
Fletcher and Stewart Ltd.
Stothert & Pitt Ltd.
Tate & Lyle Enterprises Ltd.

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

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

Silos.
The Tills Engineering Co. Ltd.
Ingeniörsfirman Nils Weibull AB.

Slats for slat conveyors.
William Bain & Co. Ltd.
Ewart Chainbelt Co. Ltd.

Spectropolarimeters.
Bellingham & Stanley Ltd.
O. C. Rudolph & Sons Inc.

Spraying and dusting machinery.
Cooper Pegler & Co. Ltd.

Sprockets.
Ewart Chainbelt Co. Ltd.
Renold Ltd.

Stainless steel pipelines, Large diameter.
Welding Technical Services Ltd.

Starch removal enzymes for cane juice.
A.B.M. Industrial Products Ltd.

Steam accumulators.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.

Steam storage equipment.
see Steam accumulators.

Steam superheaters.
Babcock & Wilcox Ltd.
Foster Wheeler John Brown Boilers Ltd.
Stork-Werkspoor Sugar N.V.

Steam turbines for mill drives, etc.
W. H. Allen, Sons & Co. Ltd.
Peter Brotherhood Ltd.
A. F. Craig & Co. Ltd.
Elliott Division of Carlyle Air Conditioning Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
General Electric Company of U.S.A.
The Mirrlees Watson Co. Ltd.
A. & W. Smith & Co Ltd
Stork-Werkspoor Sugar N.V.

Steam turbo-alternator sets.
ACEC.
W. H. Allen, Sons & Co. Ltd.
Peter Brotherhood Ltd.
Elliott Division of Carlyle Air Conditioning Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
General Electric Company of U.S.A.
Stork-Werkspoor Sugar N.V.

Steel framed buildings.
William Bain & Co. Ltd.

Storage vessels, Stainless steel.
John Dore & Co. Ltd.
Elliott Division of Carlyle Air Conditioning Co. Ltd.
T. Giusti & Son Ltd.
St. Mary Iron Works Inc.
S.E.U.M.
Stork-Werkspoor Sugar N.V.

Sugar agronomy consultancy services.
Tate & Lyle Technical Services Ltd.

Sugar detector.
Bailey Meters & Controls Ltd.

Sugar factory consultancy services.
Bookers Agricultural & Technical Services Ltd.
C F & I Engineers Inc.
Tate & Lyle Technical Services Ltd.
Walkers Ltd.

Sugar factory design and erection (Cane and Beet).
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
A. F. Craig & Co. Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
John Laing Construction Ltd.
Mardon (Engineering) N V.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Sugar machinery, General.
Babcock & Wilcox Ltd.
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Walkers Ltd.

Sugar refinery consultancy services.
Tate & Lyle Technical Services Ltd.

Sugar refinery design and erection.
Fletcher and Stewart Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

Sugar silos.
A/S De Danske Sukkerfabrikker.
Soc. Fives Lille-Cail.
John Laing Construction Ltd.
Henry Simon Ltd.
The Tills Engineering Co. Ltd.
Ingeniörsfirman Nils Weibull A.B.

Sugar tabletting machinery.
Goka N.V. Machinefabriek.

Sugar throwers and trimmers.
Crone & Taylor (Engineering) Ltd.
Fletcher and Stewart Ltd.
Redler Conveyors Ltd.

Sulphur furnaces, Continuous.
Cocksedge & Co. Ltd.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.

Switchgear.
ACEC.

Temperature recorders and controllers.
Auriema Ltd.
The British Rototherm Co. Ltd.
Chemap A.G.
Honeywell 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.
Endecotts (Test Sieves) Ltd.
Haver & Boecker.
A. H. Korthof N.V.

Test sieve shakers.
Endecotts (Test Sieves) Ltd.
Haver & Boecker.

Thermometers.
The British Rototherm Co. Ltd.
Honeywell Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
G. H. Zeal Ltd.

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

Tissues, Lens cleaning.
see Lens cleaning tissues.

Tractors.
J & L Engineering Co. Inc.

Trailers.
J & L Engineering Co. Inc.
Lufkin Industries Inc.
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

Tube brushes, Wire.
Elliott Division of Consolidated Pneumatic Tool Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Rotatools (U.K.) Ltd.

Tube cleaners, Rotary (Electric and air).
Elliott Division of Consolidated Pneumatic Tool Co. Ltd.
Flexible Drives (Gilmans) Ltd.
Flexotube (Liverpool) Ltd.
Rotatools (U.K.) Ltd.
see also Scale removal and prevention.

Tube expanders.
Elliott Division of Consolidated Pneumatic Tool Co. Ltd.
Rotatools (U.K.) Ltd.

Tube fittings.
T.I. Stainless Tubes Ltd. (*stainless steel*).
Yorkshire Imperial Metals Ltd. (*copper, brass and plastic*).

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

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

Tubes, Stainless steel.
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.
Cotton Bros (Longton) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
The Mirrlees Watson Co. Ltd.
Nash International Company.
A. & W. Smith & Co. Ltd.
Tilghman Wheelabrator Ltd.

Vacuum pumps, Oil-free.
Drum Engineering Co. Ltd.
Nash International Company.
Tilghman Wheelabrator Ltd.
George Waller & Son Ltd.

Valves.
Chemap A.G.
Honeywell Ltd.
G. A. Platon Ltd.

Ball valves.
Saunders Valve Co. Ltd.

Diaphragm valves.
Negretti & Zambra Ltd.
Saunders Valve Co. Ltd.

Diverter valves.
The Tills Engineering Co. 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.
Saunders Valve Co. Ltd.
TI Stainless Tubes Ltd.

Vibrating feeders.
Electromagnets Ltd.
Haver & Boecker.
Carl Schenck Maschinenfabrik G.m.b.H.
The Triton Engineering Co. (Sales) Ltd.

Vibrators.
Electromagnets Ltd.
The Triton Engineering Co. (Sales) Ltd.

Water cooling towers.
Film Cooling Towers (1925) Ltd.
Foster Wheeler John Brown Boilers Ltd.

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A.B.M. Industrial Products Ltd.,
Woodley, Stockport, Cheshire, England.
Tel.: 061-430 2277/4391. *Cable:* Chrievan, Stockport.
Telex: 667835.

ACEC Ateliers de Constructions Electriques de Charleroi SA.,
Boite Postale 4, 6000 Charleroi 1, Belgium.
Tel.: 07/36.20.20. *Cable:* Ventacec, Charleroi.
Telex: Acec Charleroi 51.227.

Agricultural Services Divn., SPP Systems Ltd.,
see SPP Group Ltd.

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

Alfa-Laval AB.,
Box 1008, S-221 03 Lund 1, Sweden.
Tel.: 046-14 0320. *Cable:* Alfalaval, Lund.
Telex: 3145.

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

W. H. Allen, Sons & Co. Ltd.
Queens Engineering Works, Bedford, England.
Tel.: Bedford (0234)-67400. *Cable:* Pump, Bedford, Telex.
Telex: 82486.

Allied Colloids Manufacturing Co. Ltd.,
Low Moor, Bradford, England.
Tel.: 671267. *Cable:* Colloidal, Bradford.
Telex: 51646.

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

A.P.V.-Mitchell Craig Ltd.,
Glenburn Rd., College Milton North, East Kilbride, Glasgow, Scotland.
Tel.: East Kilbride 25461. *Cable:* Propumps, Glasgow.
Telex: 77755.

Arenco-Alite Ltd.,
Pixmore Avenue, Letchworth, Herts., England.
Tel.: Letchworth 3965-9/3384. *Cable:* Aral, Letchworth.
Telex: 82368.

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

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

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

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

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

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

Auriema Ltd.,
23-31 King Street, London W.3, England.
Tel.: 01-993 1461. *Cable:* Auriema, London W.3.
Telex: 933723.

Babcock & Wilcox Ltd.,
Haddon House, 2/4 Fitzroy Street, London W1P 5AD, England.
Tel.: 01-388 0331. *Cable:* Babcock, London S.E.1.

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

William Bain & Co. Ltd.,
Lochrin Works, Coatbridge, Lanarkshire, Scotland.
Tel.: Coatbridge 23471. *Cable:* Lochrin, Coatbridge.
Telex: 778809.

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 6001/3838. *Cable:* Blundell, London, E14 8HA.

BMA Braunschweigische Maschinenbauanstalt,
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: Braunschweig (0531) 82011. *Cable:* Bema, Braunschweig.
Telex: 952 456.

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.

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

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

The British Rototherm Co. Ltd.,
Kenfig Industrial Estate, Nr. Port Talbot, Glamorgan, S. Wales.
Tel.: Tonkenfig 551/2/3.
Telex: 493431.

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

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

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

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

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

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

Chronos-Werk, Reuther & Reisert K.G.,
P.O. Box 117, Frankfurter Strasse 85–95, 5202 Hennef-Sieg, Germany.
Tel.: (02242) 2381/8. *Cable:* Chronos, Hennef-Sieg.
Telex: 883 304.

Cocksedge & Co. Ltd.,
P.O. Box 41, Grey Friars Rd., IP1 1UW, England.
Tel.: 56161.

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

Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.,
16161 Genova-Fegino, Corso F.M. Perrone 23, Italy.
Tel.: 44.12.61 (Centralino). *Cable:* Cmi, Genova.
Telex: 27318 Cmi Ge.

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, Scotland.
Tel.: Paisley 2191. *Cable:* Craig, Paisley.
Telex: 778051.

Crone & Taylor (Engineering) Ltd.,
Sutton Oak, St. Helens, Lancs., England.
Tel.: St. Helens 20021–6. *Cable:* Crontaylor, St. Helens.
Telex: 627110 Chamcom Liverpool.

A/S De Danske Sukkerfabrikker,
(The Danish Sugar Corporation).
Langebrogade 5, Copenhagen K, Denmark.
Tel.: (01) AS 6130. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 5530 Sukker KH.

Diamond Shamrock Chemical Company, Resinous Products Division,
P.O. Box 829, 1901 Spring Street, Redwood City, Calif., 94064 U.S.A.
Tel.: (415) 369-0071. *Cable:* Daco-West, Redwood City.
Telex: 910 389-5412.

John Dore & Co. Ltd.,
51–55 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.

Drum Engineering Co. Ltd.,
Edward Street Works, Bradford BD4 7BQ, England.
Tel.: Bradford 683131. *Cable:* Drumphone, Bradford.
Telex: 51141.

Dust Control Equipment Ltd.,
Thurmaston, Leicester LE4 8HP, England.
Tel.: Syston (0537–23) 3333 *Cable:* Dust, Leicester.
Telex: 34500.

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

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

Electromagnets Ltd.,
Bond Street, Hockley, Birmingham 19, England.
Tel.: 021–236 9071.
Telex: 339192.

Elliott Division of Carlyle Air Conditioning Co. Ltd.,
15 Portland Place, London W.1, England.
Tel.: 01–637 1591. *Cable:* Carell, London.
Telex: Carell, London 25969.

Elliott Division of Consolidated Pneumatic Tool Co. Ltd.,
CP House, 97–104 Uxbridge Rd., London, W5 4BR England.,
Tel.: 01–567 3411. *Cable:* Caulking, London.
Telex: 21311.

Endecotts (Test Sieves) Ltd.,
Lombard Road, London S.W.19, England.
Tel.: 01-542 8121/2/3. *Cable:* Endtesiv, London S.W.19.

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.: 024–260 227. *Cable:* 43316 Winchcombe.
Telex: 43316.

Even Products Ltd.,
Evesham, Worcs., WR11 4TS, England.
Tel.: Evesham 6633/4.

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.

Fabcon Inc.,
314 Public Square Building, Cleveland, Ohio, 44113 U.S.A.
Tel.: (216) 621-2344. *Cable:* Fabcon, Cleveland.

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

Farrow Irrigation Ltd.,
Welland Road, Off London Road, Spalding, Lincs., 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.: Williams 1-8876. *Cable:* Ferguson, Providence.

Film Cooling Towers (1925) Ltd.,
Chancery House, Parkshot, Richmond, Surrey, England.
Tel.: 01–940 6494/9; 7558/9. *Cable:* Aloof, Richmond, Surrey.
Telex: 27451.

Filtres Vernay S.A.,
19 rue Louis-Ducroize, 69 Villeurbanne, France.
Tel.: (78) 84.91.17. *Cable:* Nervay, Lyon.
Telex: 34.300 F Vernay.

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

A. Friedr. Flender & Co.,
4290 Bocholt, Postfach 139, Germany.
Tel.: (02871) 921. *Cable:* Flender, Bocholt.
Telex: 0813841.

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

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

Flexotube (Liverpool) Ltd.,
25 Hope Street, Liverpool, L1 9BL England.
Tel.: 051-709 3345. *Cable:* Flexotube, Liverpool.

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

Foster Wheeler John Brown Boilers Ltd.,
P.O. Box 160, Greater London House, Hampstead Rd., London N.W.1, England.
Tel.: 01-388 1212. *Cable:* Rewopsteam, London.
Telex: 263984.

French Oil Mill Machinery Co.,
1035 West Greene Street, Piqua, Ohio, 45356 U.S.A.
Tel.: (513) 773-3420. *Cable:* French, Piqua.

Ets. Gaudfrin,
1 Bureau de la Colline St.-Cloud, 92 St.-Cloud, France.

General Electric Company of U.S.A.,
159 Madison Avenue, New York, N.Y., 10016 U.S.A.
Tel.: (212) 750-4271. *Cable:* Ingeco, New York.
Telex: 62845 WU/224698 RCA/420631 ITT.

T. Giusti & Son Ltd.,
202-224 York Way, Kings Cross, London N.7, England.
Tel.: 01-607 5021. *Cable:* Giustison, London N.7.

Glovers (Chemicals) Ltd.,
Wortley Low Mills, Whitehall Rd., Leeds 12. Yorkshire, England.
Tel.: 0532-637847. *Cable:* Glokem, Leeds.

Goka N.V. Machinefabriek,
Postbus 3530, Keizersgracht 526, Amsterdam C, Holland.
Telex: 14173 Goka nl.

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

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

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

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

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

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

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

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

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

Honeywell Ltd.,
Charles Square, Bracknell, Berks,. England.
Tel.: Bracknell 24555. *Cable:* Honeywell, Bracknell, Telex.
Telex: 847064.

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

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

Hygrotherm Engineering Ltd.,
Whitworth House, 115 Princess Street, Manchester M1 6JR, England.
Tel.: 061-236 5323.
Telex: 668703.

IMACTI Industrieele Maatschappij Activit N.V.,
(AKZO Chemische Divisie N.V.),
Postbus 240c, Amsterdam, Holland.
Tel.: 60821. *Cable:* Activit, Amsterdam.
Telex: 11652 Imac NL

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

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

W. J. Jenkins & Co. Ltd.,
Retford, Nottinghamshire, England.
Tel.: Retford 2231. *Cable:* Jenkins, Retford.
Telex: 56122.

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

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

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

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.: 05 561/3111. *Cable:* Original, Einbeck.
Telex: 0965612.

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

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

Lafarge Aluminous Cement Co. Ltd.,
Lafarge House, 207 Sloane Street, London S.W.1, England.
Tel.: 01–235 4300. *Cable:* Cimenfondu, London S.W.1.
Telex: 262387 Ldn.

John Laing Construction Ltd.,
Park House, 207/211 The Vale, Acton, London W.3, England.
Tel.: 01–749 0912. *Cable:* Laing 01–749 0912.

Lewis & Tylor Ltd.,
Gripoly Mills, Sloper Road, Cardiff, CF1 8TD, Wales.
Tel.: Cardiff 26301. *Cable:* Belting, Cardiff.
Telex: 497202.

The Longwood Engineering Co. Ltd.,
Parkwood Mills, Longwood, Huddersfield, England.
Tel.: Huddersfield 53120. *Cable:* Engco, Huddersfield.

Lufkin Industries Inc.,
P.O. Box 849, Lufkin, Texas, 75901 U.S.A.
Tel.: 634-4421. *Cable:* Luffo, Lufkin.
Telex: 713–632–3103.

Lurgi Gesellschaft für Wärme- und Chemotechnik m.b.H.,
6 Frankfurt (Main), Lurgihaus, Germany.
Tel.: 1571. *Cable:* Lurgiwaerme, Frankfurt.

Manlove Tullis Group Ltd.,
Clydebank, Dunbartonshire, Scotland.
Tel.: 041–952 1861.

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

Martin-Markham (Stamford) Ltd.,
Lincolnshire Works, Stamford, Lincs., PE9 1UN, England.
Tel.: Stamford 2621/4. *Cable:* Marktrac, Stamford.

Mavor & Coulson Ltd.,
47 Broad St., Bridgeton, Glasgow S.E., Scotland.
Tel.: 041–554 1800. *Cable:* Prodigious, Glasgow.
Telex: 778109.

F. W. McConnel Ltd.,
Temeside Works, Ludlow, Shropshire, England.
Tel.: Ludlow 2345. *Cable:* Powerarm, London.

The Mirrlees Watson Co. Ltd.,
Cosmos House, 1 Bromley Common, Bromley BR2 9NA, Kent, England.
Tel.: 01–464 5346. *Cable:* Mirwat, Bromley, Kent.
Telex: 2-2404.

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

Montecatini Edison S.p.A.,
Dipi/Sezione Kastel, Largo Donegani 1/2, 20100 Milano, Italy.
Tel.: Milano 633–6334. *Cable:* Gabbroind, Milano.
Telex: MI 31-415.

Nash International 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.

Norit N.V.,
2de Weteringplantsoen 15, P.O. Box 1720, Amsterdam C, Holland.
Tel.: Amsterdam 239911. *Cable:* Norit, Amsterdam.
Telex: 12317.

The Permutit Co. Ltd.,
Pemberton House, 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., 15203 U.S.A.
Tel.: (412) 923-2345. *Cable:* Pitcarb, Pittsburgh.
Telex: 086739.

G. A. Platon Ltd.,
Wella Road, Basingstoke, Hampshire, England.
Tel.: (0256) 26661.
Telex: 85107.

Plenty Divn., SPP Group Ltd.,
see SPP Group Ltd.

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, Telex, Haslingden.
Telex: 63127 Neotex Hasden.

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

Ransomes Sims & Jefferies Ltd.,
Orwell Works, Ipswich, England.
Tel.: Ipswich 72222. *Cable:* Ransomes, Ipswich, Telex.
Telex: 98174.

Rapid Magnetic Ltd.,
Lombard St., Birmingham 12, England.
Tel.: 021–722 1137. *Cable:* Magnetism, Birmingham.
Telex: Chamcom Bham 338024/Magnetism.

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

Reed Medway Sacks Ltd.,
Larkfield, near Maidstone, Kent, England.
Tel.: Maidstone 7-7777. *Cable:* Satchelsac, Larkfield.
Telex: 96148.

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.

Resindion S.p.A., Divn. of Sybron Corp.,
Via Roma, 20082 Binasco, Italy.
Tel.: 905.54.38/905.57.73. *Cable:* Resindion, Binasco.

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

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.,
43/45 Pembroke Place, Liverpool L3 5PH, England.
Tel.: 051–709 6117/2682. *Cable:* Scalewell, Liverpool 3

O. C. Rudolph & Sons Inc.,
P.O. Box 446, Caldwell, New Jersey, 07006 U.S.A.
Tel.: (201) 227-6810. *Cable:* Measoptic, Caldwell.

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

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

Salzgitter Maschinen A.G.,
Postfach 1640, 3327 Salzgitter-Bad, Federal Republic of Germany.
Tel.: (053 41) 3921. *Cable:* Samag, Salzgitter-Bad,
Telex: 95445 smg d.

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.: Cwmbran 2044. *Cable:* Saunval, Newportmon.
Telex: 49241.

Scandura Ltd.,
P.O. Box 19, Cleckheaton, Yorkshire, England.
Tel.: Cleckheaton 5711. *Cable:* Scandura, Cleckheaton.
Telex: 51106.

Carl Schenck Maschinenfabrik G.m.b.H.,
6100 Darmstadt, Landwehrstrasse 55, Germany.
Tel.: 06151/8821. *Cable:* Schenck, Darmstadt.
Telex: 0419 441.

Schill & Seilacher Chemische Fabrik,
2000 Hamburg 74, Moorfleeterstr. 28, Germany.
Tel.: (0411) 73 16 66. *Cable:* Struktol, Hamburg.
Telex: 0212932.

Schmidt + Haensch,
Berlin 62, Naumannstrasse 33, Germany.
Tel.: 784 6031. *Cable:* Polarisation, Berlin.
Telex: 183 346 suhfo d.

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

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

S.E.U.M.,
62 Corbehem, France.
Tel.: (20) 88-70-40. *Cable:* Seum, Corbehem.

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

Sigmund Pulsometer Pumps Divn., SPP Group Ltd.,
Oxford Road, Reading, RG3 1JD, England.
Tel.: (0734) 28551. *Cable:* Sigmeter, Reading.
Telex: 84189.

Sil-Flo Incorporated,
407 E. Main St., 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 N.V.,
P.O. Box 25, Boxtel, Holland.
Tel.: (04116) 2751.
Telex: Simhe 50243.

Richard Sizer Ltd.,
Cuber Works, Cornwall Street, Hull, England.
Tel.: Hull 23155. *Cable:* Sizer, Hull, Telex.
Telex: 52236.

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

Sparkler Manufacturing Company,
101 Cartwright Rd., Conroe, Texas, 77301 U.S.A.
Tel.: (713) 756-4471. *Cable:* Spafiltco, Conroe.
TWX: 910-880-4183.

S.P.E.I. Chim.,
106 Rue d'Amsterdam, Paris 9e, France.
Tel.: 744-73-79. *Cable:* Rectifpast, Paris.
Telex: 65688 Spechim.

SPP Group Ltd.,
Hambridge Road, Newbury, Berks., England.
Tel.: Newbury 2363. *Cable:* Plenty, Newbury.
Telex: 84110.

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

Stein Atkinson Stordy Ltd.,
Westminster House, Kew Rd., Richmond, Surrey, England.
Tel.: 01–940 4861. *Cable:* Metasteina, Richmond.
Telex: 262324.

Stockdale Engineering Ltd.,
Rock Bank, Bollington, Macclesfield, Cheshire, SK10 5LB England.
Tel.: Bollington 2521. *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.,
Lower Bristol Road, Bath, BA2 3DJ, England.
Tel.: Bath 63401/63041. *Cable:* Stothert, Bath.
Telex: 44311.

Strachan & Henshaw Ltd.,
Ashton Works, Ashton Vale Rd., Bristol 3, England.
Tel.: Bristol 664671. *Cable:* Stelhoist, Bristol.
Telex: 44170.

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

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

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.

Thorn Bendix Ltd.,
Beech Avenue, New Basford, Nottingham NG7 7JJ, England.
Tel.: (0602) 76123. *Cable:* Bendelec, Nottingham.
Telex: 37142.

T.I. Stainless Tubes Ltd.,
Green Lane, Walsall, Staffs., England.
Tel.: 021-92 21222. *Cable:* Tistan, Walsall, Telex.
Telex: 33387.

Tilghman Wheelabrator Ltd.,
Wright Street, Broadheath, Altrincham, Cheshire, England.
Tel.: 061-928 4242.
Telex: 668945.

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

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

The Triton Engineering Co. (Sales) Ltd.,
Kingsnorth Industrial Estate, Wotton Road, Ashford, Kent, England.
Tel.: Ashford (Kent) 25133. *Cable:* Triton, Ashford, Kent.

W. van den Broek's Machinefabriek N.V.,
Driebergen-R, 9-11 Stationsweg, Holland.
Tel.: 0 3438-5114. *Cable:* Vdbro, Driebergen.
Telex: Vdbro nl 47337.

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

George Waller & Son Ltd.,
Phoenix Iron Works, Stroud, Glos., England.
Tel.: 045-388 2301.

Ulrich Walter Maschinenbau,
4006 Erkrath, Bahnstrasse 30, Germany.
Tel.: Düsseldorf 642060.
Telex: 858 6526.

Ingeniörsfirman Nils Weibull AB.,
Box 184, 20121 Malmö 1, Sweden.
Tel.: (0451) 14115/(040) 158142. *Cable:* Nilswei, Malmö.
Telex: 32226/4486.

Weir Pumps Ltd.,
Albany House, Petty France, London, S.W.1, England.
Tel.: 01-785 4861. *Cable:* Weirgroup, London S.W.1., Telex.
Telex: 22556.

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.

Werkspoor Water N.V.,
de Boelelaan, 14 Amsterdam, Holland.
Tel.: 441966. *Cable:* Werkwater, Amsterdam.
Telex: 14004.

The Western States Machine Company.
Hamilton, Ohio, U.S.A.
Tel.: (513) 894-4758. *Cable:* Wesmaco, Hamilton, Ohio.

Westinghouse Brake and Signal Co. Ltd.,
Marine & Industrial Controls Division,
Chippenham, Wiltshire, England.
Tel.: Chippenham 4141. *Cable:* Westinghouse, Chippenham.
Telex: 44677.

Wheway-Watson Ltd.,
Industrial Estate, Bellshill, Lanarkshire, Scotland.
Tel.: Bellshill 2437. *Cable:* Parts, Bellshill.
Telex: 77-667-Code !II (through Chamber of Commerce).

Wire Weaving Co. Ltd.,
Anholtseweg 10, P.O. Box 2, Dinxperlo, Holland.
Tel.: 1841. *Cable:* Draadweverij, Dinxperlo.
Telex: 45211 mddpl nl.

Wright Rain Ltd.,
Ringwood BH24 1PA, Hants., England.
Tel.: Ringwood 2251. *Cable:* Wrightrain, Ringwood, Telex.
Telex: 41206.

Wright Rain Africa (Pvt.) Ltd.,
35 Birmingham Road, Box 3237, Salisbury, Rhodesia.
Tel.: Salisbury 25810. *Cable:* Wrightrain, Salisbury.

Wright Rain Irrigation (Pty.) Ltd.,
P.O. Box 1318, Pietermaritzburg, Natal, South Africa.
Tel.: Pietermaritzburg 22691.

Wyper Brothers Ltd.,
P.O. Box 9, Bundaberg, Queensland, 4670 Australia.
Tel.: 2411.

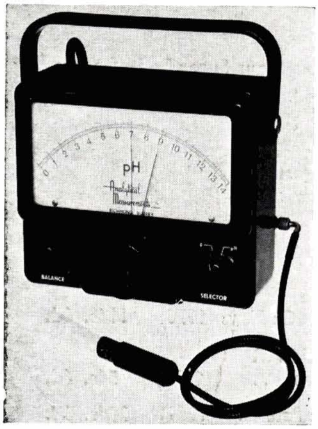
Yorkshire Imperial Metals Ltd.,
P.O. Box 166, Leeds LS1 1RD, Yorkshire, England.
Tel.: 0532-701107. *Cable:* Yorkimp, Leeds.
Telex: 55-311.

G. H. Zeal Ltd.
Lombard Rd., Merton, London S.W.19, England.
Tel.: 01-542 2283/6. *Cable:* Zealdom, London S.W.19.
Telex: 929519.

Carl Zeiss,
7082 Oberkochen, P.O. Box 35/36, West Germany.
Tel.: (07364) 201.
Cable: Zeisswerk, Oberkochen, West Germany.
Telex: 7-13-213

Suma Products

INSTRUMENTS FOR JUICE EXAMINATION



pH

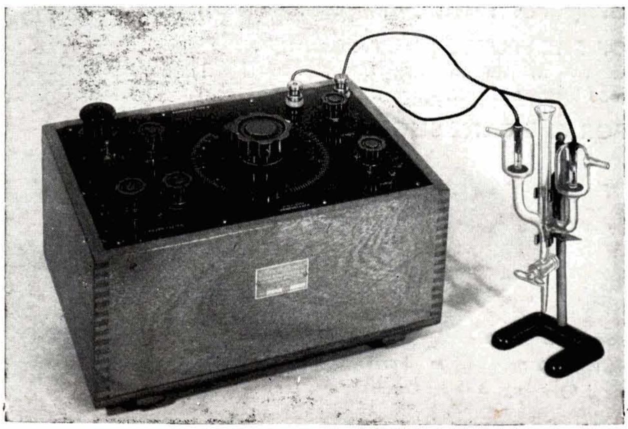
The illustrated model 700 has a scale length of 7 in from 0 to 14 pH with a readability of 0·02. This instruments is supplied with the exclusive polythene shielded pH probe unit. The amplifier is a printed circuit high output electronically modulated unit with a single operating control giving an accuracy and overall stability of better than 0.05 of a pH Unit. Operating the instrument is so simple that untrained personnel can make pH determinations with no danger of damaging sensitive components. The instrument is plugged into the mains supply, standardized with the buffer solution and is then ready to operate. An adjustable index pointer is provided so that frequent buffer checks are eliminated.

Other models available.

Colloids

Colloids in juices retard boiling, increase viscosity, hamper efficient work in the centrifugals, and generally reduce the capacity of the factory. They should be removed during the clarification stage to prevent these difficulties in the sugar house.

The **COLLIMETER** is the first instrument to permit comparison of the colloid-removing efficiency of alternative clarification procedures. This is done on the basis of the quantity of a standard dyestuff required to bring a sample in a cataphoresis cell to the iso-electric point as observed through the microscope.



Ash

The Type H **SALOMETER** for electronic determination of the ash content of sugar products retains the well-known characteristics of previous models, such as knife-edge accuracy, simple magic-eye tuning, and also is provided with temperature compensation (2% per°C), a main dial calibrated in micromhos for simplified calculation, a new power factor system to extend its range, and a special quick-action electrode system

The Sugar Manufacturers' Supply Co. Ltd.

196-204 BERMONDSEY STREET, LONDON, S.E.1, ENGLAND

Telephone: HOP 5422 *Cables:* "Sumasuco, London S.E.1"

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