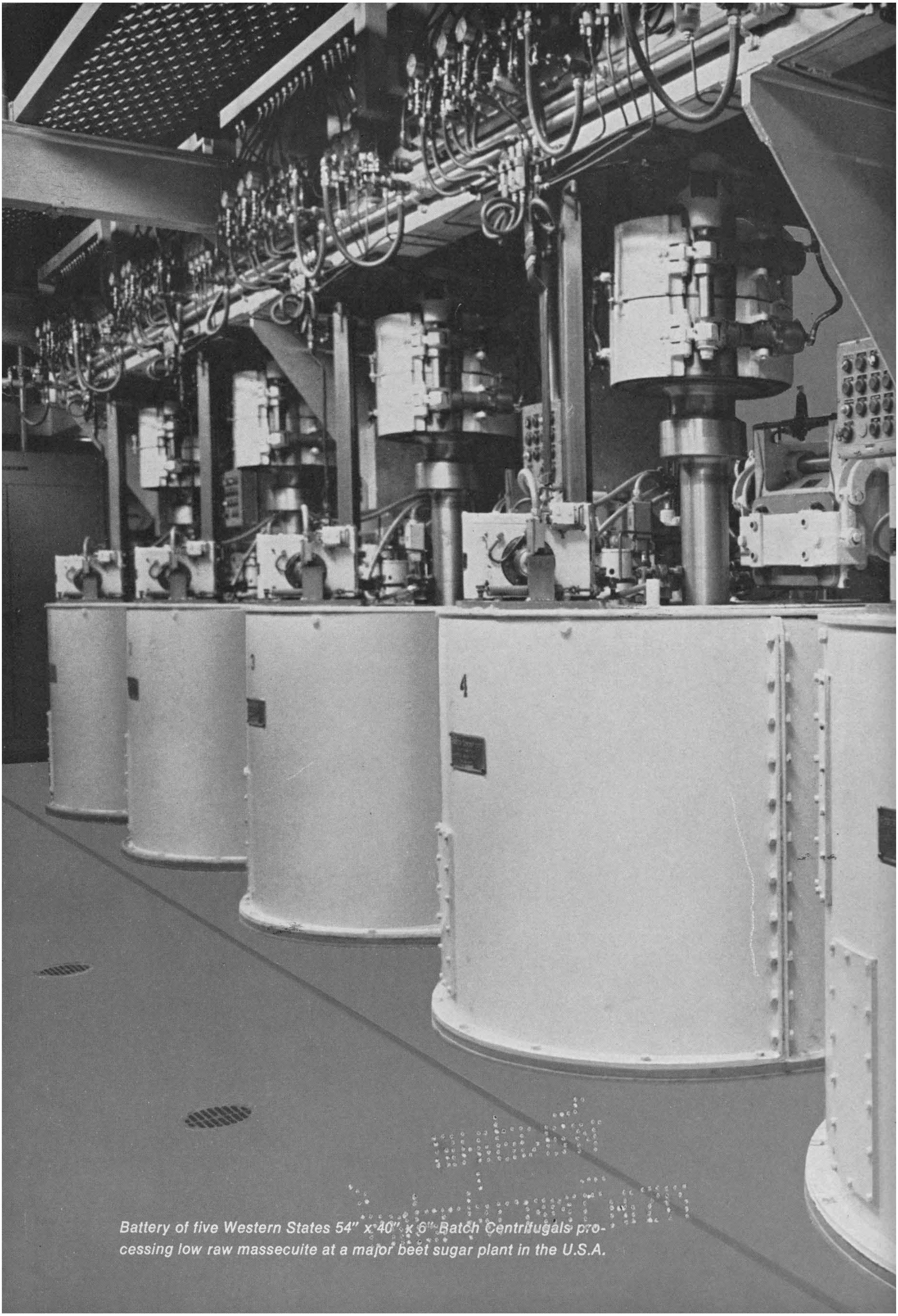
THE

International Sugar Journal

JULY 1970



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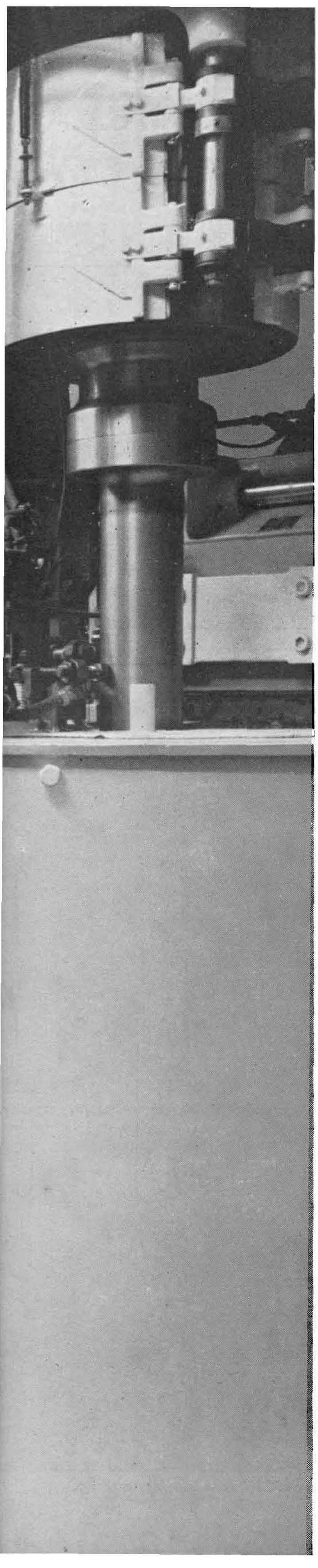

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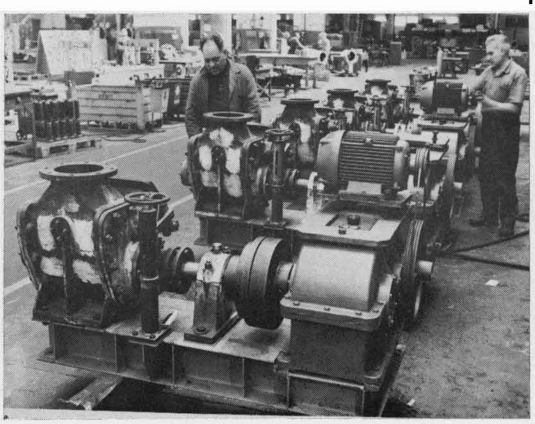
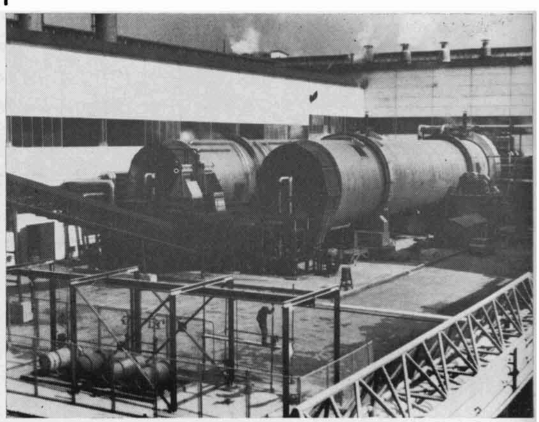
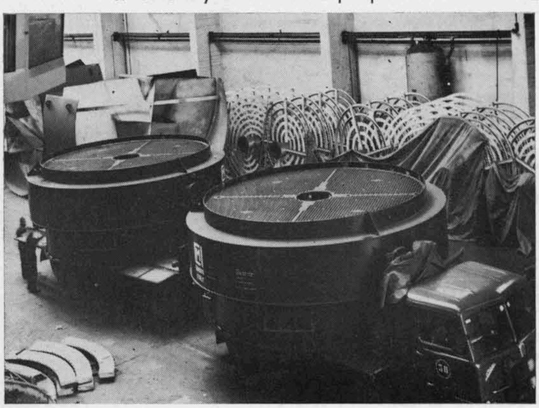


1. Assembly of massecuite pumps.



2. RT diffusers of 6.5m. diameter and 4000/4600 tons of beet/day capacity.



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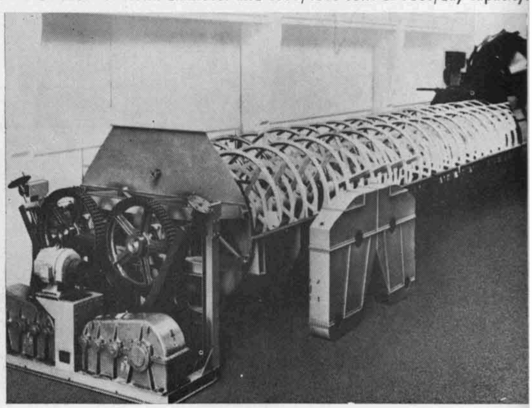

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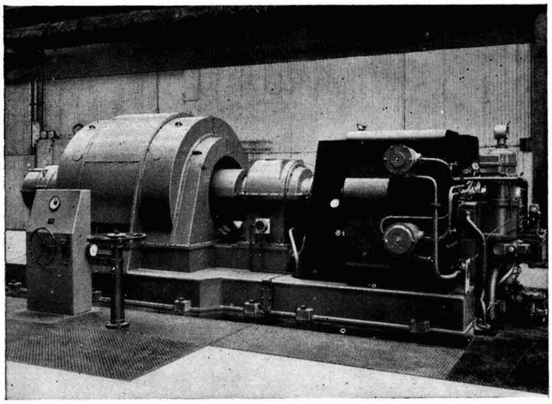

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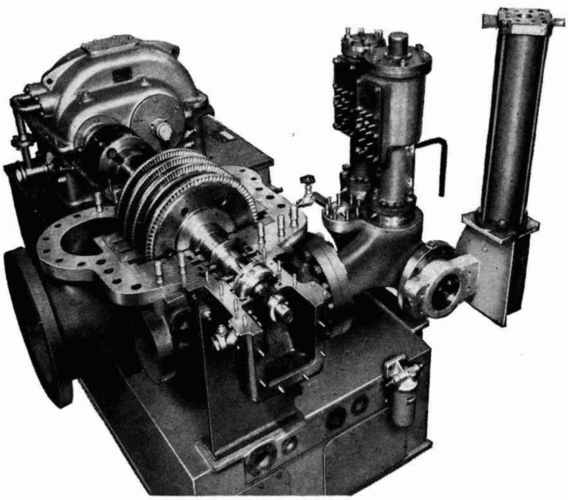

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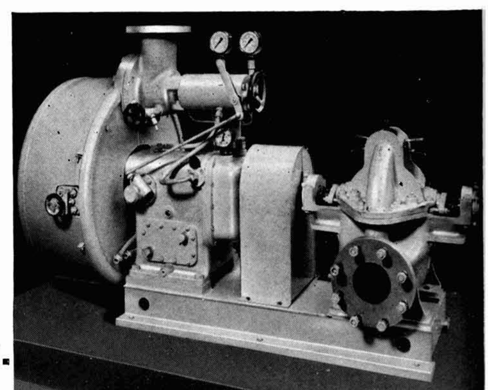

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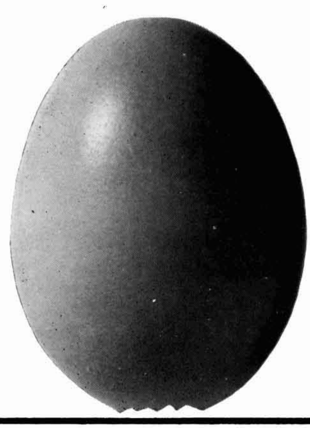

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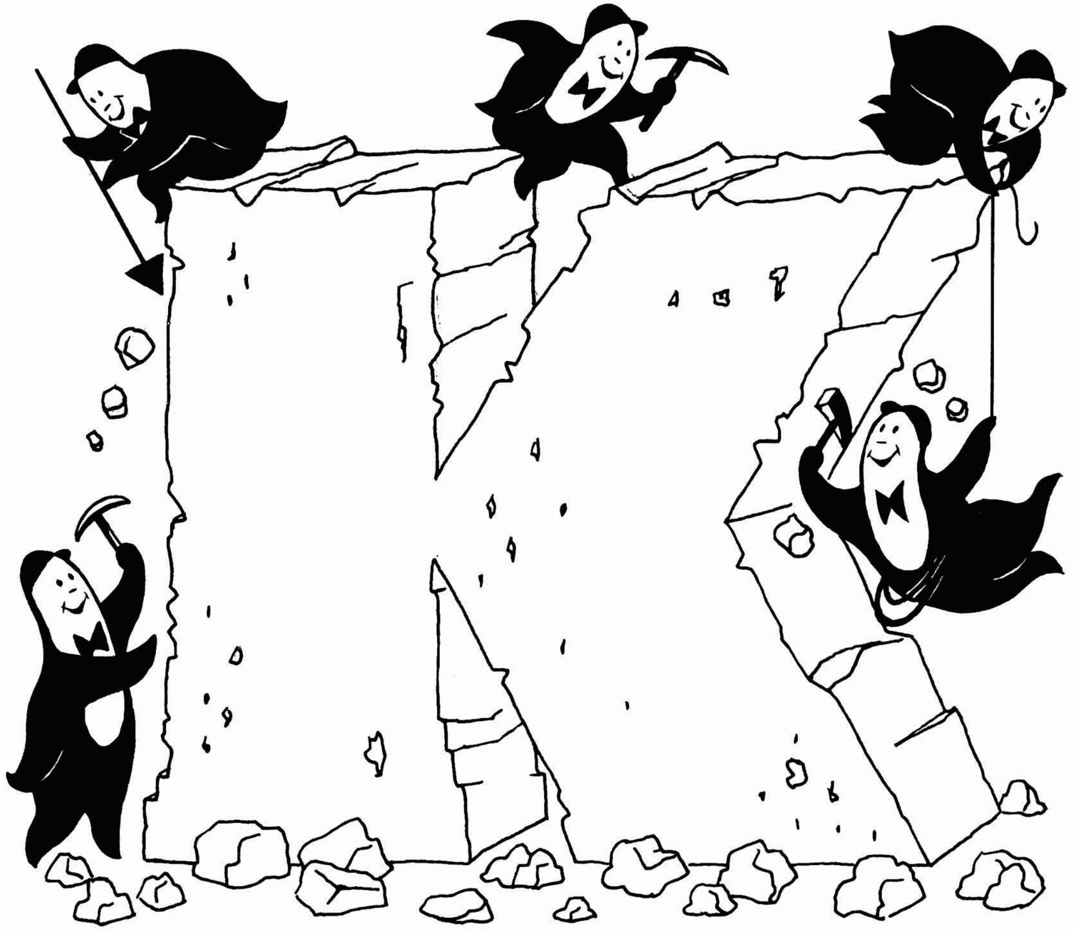

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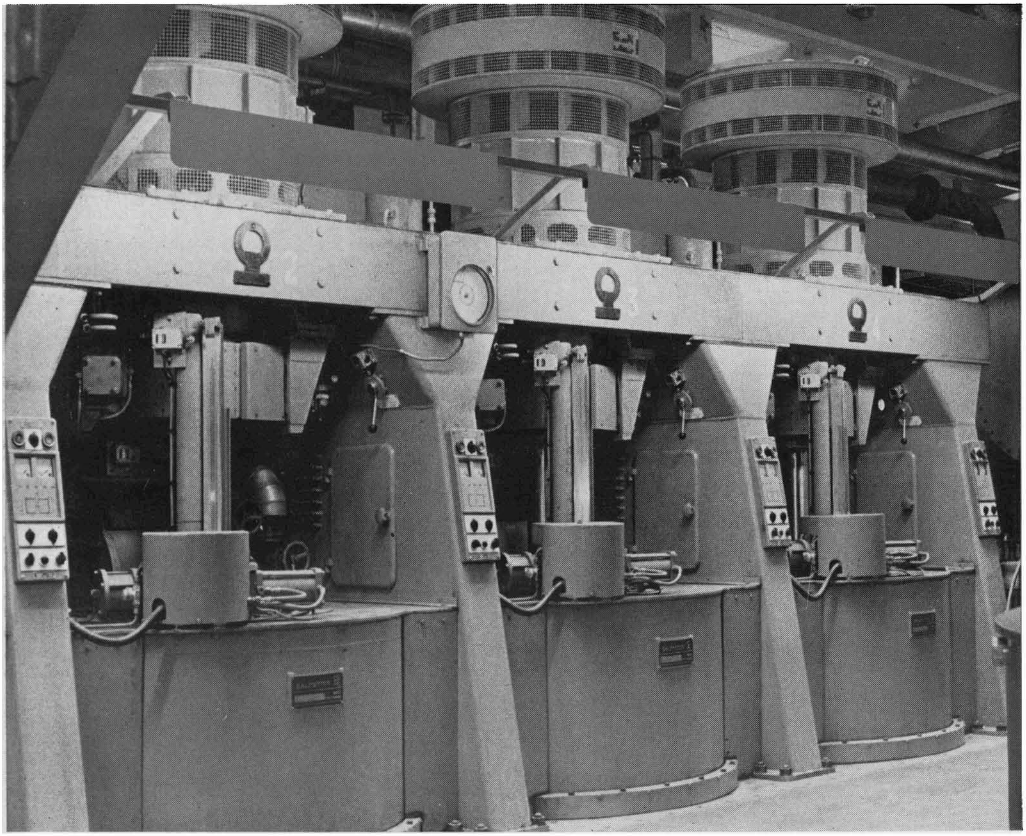

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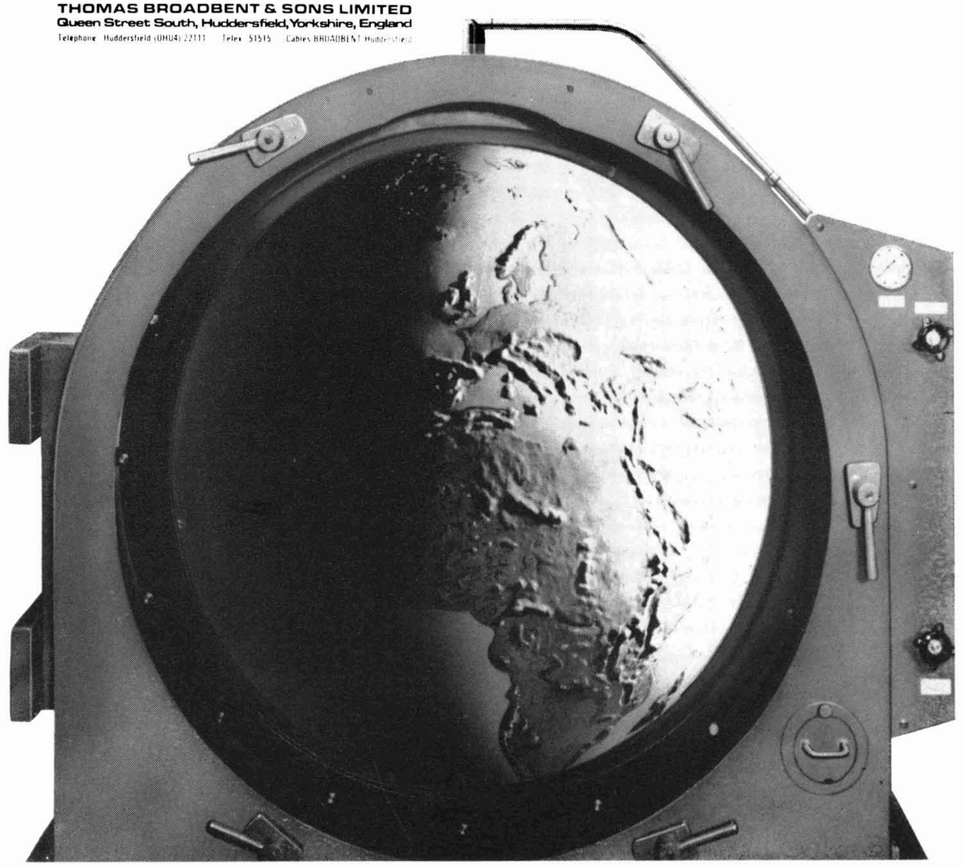

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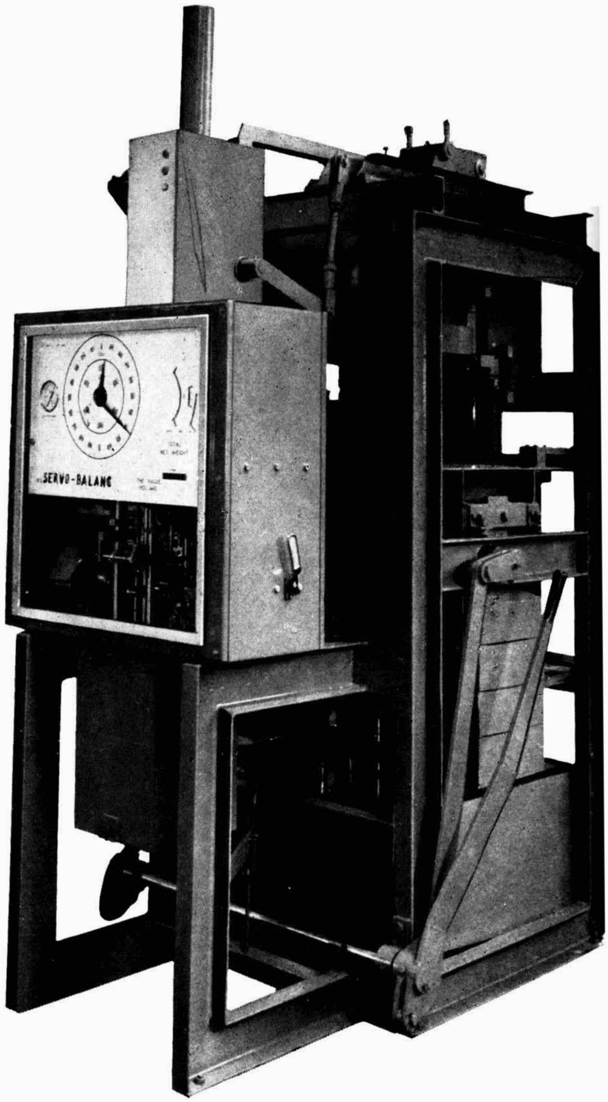

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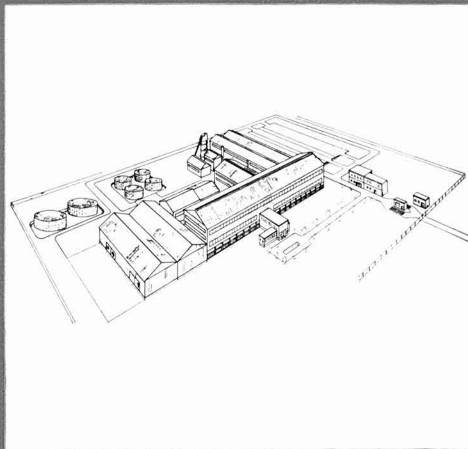

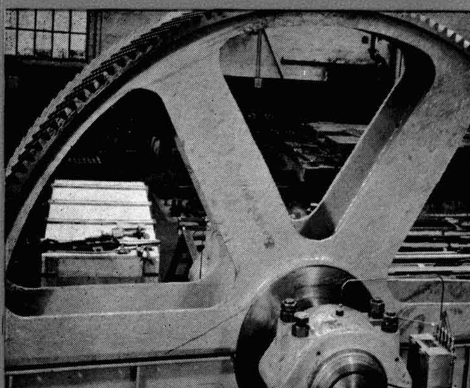

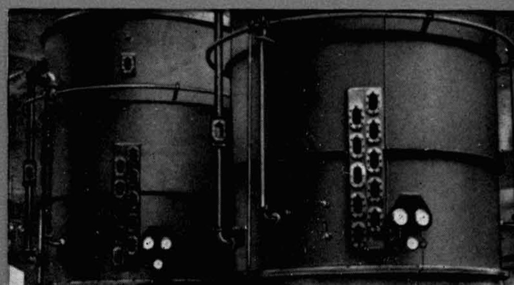

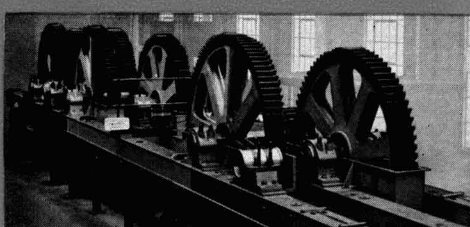

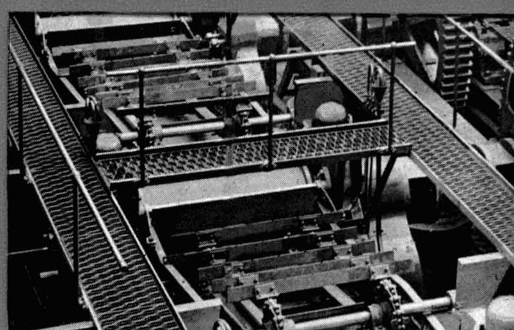

International Sugar Journal

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July 1970

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Le polysaccharide formé dans la canne détériorée fut soumis à l'hydrolyse enzymatique par la pullulanase, un enzyme spécifique pour l'hydrolyse du lien glucosidique α(1–6). De l'identification des produits d'hydrolyse, on a conclu que le polysaccharide consiste principalement en un polymère maltotriose-maltotétrose, dans lequel ces deux oligosaccharides sont présents dans des rapports quasi identiques.

* * *

Décoloration discontinue de liqueur sucrée par résine échangeuse d'ions. D. F. BAGSTER. *p.* 200–203

Des expériences de décoloration discontinue de liqueur de raffinerie ont été menées avec une résine échangeuse d'ions de différentes grosseurs de grain. On a trouve que la vitesse de décoloration initiale est approximativement proportionelle à la surface des grains de résins, tandis que la décoloration finale est plus affectée par la quantité de résine présente dans la liqueur que dans la surface de la résine.

Alterierung von Zuckerrohr nach der Ernte. III. Enzymatische Hydrolyse des gebildeten Polysaccharids. J. BRUIJN. *S.* 195–198

Das in alteriertem Rohr gebildete Polysaccharid wurde der enzymatischen Hydrolyse durch Pullulanase, ein für die Hydrolyse der α(1–6)-glucosidischen Bindung spezifisches Enzym, unterworfen. Aus der Identifizierung der Hydrolyseprodukte wurde geschlossen, dass das Polysaccharid hauptsächlich aus einem Maltotriose-Maltotetrose-Polymeren besteht, in welchem diese beiden Oligosaccharide in nahezu gleichen Mengen vorliegen.

* * *

Diskontinuierliche Entfärbung von Zuckerkläre durch Ionenaustauscherharz. D. F. BAGSTER. *S.* 200–203

Es wurden Versuche durchgeführt, bei denen Raffinadekläre absatzweise mit einem Anionaustauscherharz verschiedener Teilchengrösse behandelt wurde. Es zeigte sich, dass die Anfangsgeschwindigkeit der Entfärbung nahezu proportional der Oberfläche der Harzfüllungen ist, wahrend die Entfärbung gegen Ende mehr durch die in der Kläre vorhandene Harzmenge als durch die Oberfläche des Harzes beeinflusst wird.

Deterioración de caña de azúcar después de cosecha. Parte III. Hidrólisis enzimática del formado polisacárido. J. BRUIJN. *Pág.* 195–198

El polisacárido formado en caña deteriorada se sujete a hidrólisis enzimática por pululanasa, un enzima específica para la hidrólisis del enlace glucosídico α(1–6). De identificación de los productos del hidrólisis el autor concluye que el polisacárido es, en mayor parte, un polímer de maltotriosa y maltotetrosa en que estos dos oligosacáridos existen en proporciones casi iguales.

* * *

Decoloración por carga de licor de la refinería con resina para cambio de iones. D. F. BAGSTER. *Pág.* 200–203

Ensayos sobre decoloración por carga de licor de la refinería se hicen con resina para cambio de aniones, siendo esta resina en botones de varios tamaños. La velocidad de decoloración inicial estuvo aproximadamente proporcional al area superficial de los botones, mientras que la decoloración final se afectó más por la cantidad de resina presente en el licor que por el area superficial de la resina.

THE INTERNATIONAL SUGAR JOURNAL

VOL. LXXII | JULY 1970 | No. 859

Notes & Comments

International Sugar Organization.

The Executive Committee of the ISO met on 26–29th May and, in the absence of its Chairman for 1970 (Mr. SAUZIER), the Committee elected Mr. JONES-PARRY as temporary Chairman.

The Committee again reviewed the market situation in the light of revised estimates of supply and demand prepared by the Statistics Committee. The major change from previous estimates of supplies arose from shortfall declarations made by a number of exporting Members, which totalled 406,000 tons. On the demand side it has been found practicable to make an estimate of the additional net import demand of Japan resulting from the recent prohibition on the use of cyclamates by that country—this additional demand has been provisionally estimated at 200,000 tons.

The Committee adopted the estimates of the Statistics Committee, which considered that total net import demand from the free market in 1970 would be about 8·8 million tons, and that total net exports by non-Members would be about 1,350,000 tons. The Committee also noted that present quotas in effect had been reduced by the declarations of shortfalls and by shipments in excess of 1969 quotas [within the tolerances provided for in Article 32(2)] amounting to 28,000 tons. The Committee further noted that, if no allowance was made for any further shortfalls or possible allocations from the Hardship Fund, these figures implied an "apparent" surplus for the 1970 quota year of some 56,000 tons on the basis of present quotas in effect. The Committee accepted the view of the Statistics Committee that some further shortfalls were likely, in which event the above figures would indicate that at current quota levels a deficit may emerge.

Having regard also to the immediate market situation, the Committee decided:

(*a*) not to re-distribute at this stage any portion of the shortfalls that have been declared;

(*b*) however, should the prevailing price exceed 3·75 cents and the daily price at that time be above 3·85 cents, the Executive Director shall forthwith re-distribute 125,000 tons of the declared shortfalls;

(*c*) if, notwithstanding the re-distribution envisaged in paragraph (*b*) above, the prevailing price is in excess of 3·80 cents at a time when the daily price has exceeded 3·90 cents for five consecutive market days, the Executive Committee shall meet immediately to consider what further action may be necessary, having regard to all relevant factors including the prices then ruling on the London and New York raw sugar exchanges.

Anticipation of quota increases, combined with sales of second-hand cargoes of sugar, mostly from non-ISA-members, had led to a decline in prices which was halted when it was reported, as confirmed above, that quotas were to be kept at their previous levels. The London Terminal price then remained stable at £39 10s per ton up to the time of writing, although E. D. & F. Man[1] believe that it will go higher: "The main feature ahead is that statistically there is not enough sugar for world requirements on present ISA quotas. We are doubtful whether re-allocations of the 400,000 tons shortfall already declared will prove sufficient. We therefore feel that the market must go up to 4 cents (£44 0s per ton) in order that more sugar can be made available. By that time we should have a better idea of the progress of the European beet crop, which has had a far from satisfactory start. There seems to be a substantial increase in buying in the Far East and it could be that, by the time quotas are restored, 100% of the basic tonnages will not provide too much".

* * *

Cuban sugar production.

The Cuban Prime Minister is reported to have acknowledged that the 1970 crop will not reach the planned level of 10,000,000 tons[2]. Output to the 10th June had reached 7,994,599 tons but there appears little prospect of reaching the revised target of 9 million tons by the 15th July.

[1] *General Remarks on the Sugar Situation*, 29th May 1970.
[2] *Public Ledger*, 23rd May 1970.

Dr. CASTRO has attributed the shortfall to insufficient yield of sugar from the cane, mainly resulting from inefficiency in the mills. He blamed the leadership of the revolution for concentrating too much on expanding cane production and ignoring the industrial side of sugar manufacture.

Nevertheless, the current crop is a giant advance compared with the other post-revolution crops which have varied between 4 and 6½ million tons, and the current crop will enable Cuba to fill the Russian sugar quota of 5 million tons for the first time. But, as *The Economist* recently pointed out[1], this triumph has a cost: "A recent article in the Cuban Review *Bohemia* conceded that other sectors of the economy have suffered from neglect and wastage of manpower. Thirty-five years ago, an economic commission recommended as a matter of urgency that Cuba diversify agricultural and industrial production as fast as possible. Under Dr. CASTRO, Cuba has remained a one-crop country entirely vulnerable to pressure from the country it counts on for markets".

* * *

Sugar production in the USSR[2].

Frequent references have been made in recent months to the poor sugar beet harvest in the Soviet Union in 1969/70. So far it has not been possible to arrive at actual figures, but from details of beet deliveries which were published in the March 1970 edition of the Soviet sugar industry journal[3] the measure of the crop failure can be gauged.

Sales of beet to the state for processing in sugar factories amounted to 65·4 million metric tons, compared with 84·2 million tons in 1968/69. It is customary in the USSR for substantial quantities of roots to be carried forward into the new calendar year and processing is sometimes not completed until May. This season only 9·0 million tons remained on 31st December, compared with 23·5 million tons which had to be sliced in the early months of 1969.

No details of production of sugar from the 1969/70 crop are given in the publication other than that the 9·0 million tons of roots carried into 1970 were expected to yield about 995,000 tons of white sugar, which would be equivalent to some 1,080,000 tons in terms of raw value. Better yields will certainly have been obtained from the earlier processed roots but in view of the bad weather conditions it is unlikely that the average of 13% established in recent years will have been exceeded. A 13% yield over the entire crop would produce about 8·5 million tons of sugar, raw value.

In the calendar year 1969 production of sugar, according to the journal, amounted to 9,273,000 tons, white value, from 79·9 million tons of roots. In addition 1,075,000 tons of white sugar were produced from imported raws. Output from beet in the previous season was 9,030,000 tons. The target for 1970 is 8,570,000 tons, but from the tone of the article it appears that this is unlikely to be reached.

European beet prospects.

F. O. Licht K.G. recently published their second estimate of European beet areas[4] with comments on the situation in the individual countries. In total, the estimate is for 6,617,852 hectares which compares with 6,634,211 ha in their first estimate and the 1969 area of 6,584,093 ha. Cold and wet weather in many countries have meant, however, that at the time of the estimate, large proportions of the beet areas were unsown, although the absence of rain in Turkey has meant that the beets there are liable to drought damage. Consequently the outlook is somewhat less favourable than a year ago, when bad weather also delayed sowing, and it seems at least possible that there may be a further fall in European sugar production next campaign.

* * *

Cuban sugar statistics, 1969.

Cuban statistics for 1969 have been published by the International Sugar Organization[5] and are reproduced elsewhere in this issue. Calendar year production is shown as 5,534,180 metric tons, raw value, slightly above the 1968 figure, but this obscures the fact that the 1968/69 crop was a poor one while the 1969/70 crop started in July, much earlier than usual, and has consequently swollen the 1969 figure. Consumption for the year totalled 636,298 tons of which 93,994 tons was for animal feeding; in 1968 the total consumption was given as 681,613 tons of which only 20,052 tons was for animal feeding. Consumption in 1967 is given as 629,498 tons, with no mention of animal feeding, so that over the three years consumption is indicated to have fluctuated in a remarkable manner.

Exports rose to 4,798,817 tons, as against 4,612,923 tons in 1968, the principal recipients being the USSR and Japan, the latter country increasing its purchases from 555,422 tons in 1968 to 1,017,689 tons in 1969, while supplies to the USSR were cut from 1,831,727 tons to 1,352,329 tons. Malaysia, a non-importer of Cuban sugar in 1968, took 104,938 tons in 1969 while North Korean imports rose from 74,910 to 154,851 tons, and those of Morocco rose from 85,635 to 175,760 tons. Singapore, a new customer, took 36,679 tons, while Holland took none, as against 58,520 tons in 1968, and Sweden's imports were reduced from 40,893 to 10,177 tons.

Stocks at the end of 1969 had reached 405,858 tons, as compared with 306,793 tons in 1968 but, as C. Czarnikow Ltd. points out[6], this merely reflects the early start to the 1969/70 campaign. "Indeed, when it is recalled that about 1·3 million tons had been produced by the end of December, the Cuban authorities have every reason to be satisfied that end-year stocks were so low."

[1] 30th May 1970.
[2] C. Czarnikow Ltd., *Sugar Review*, 1970, (966), 71.
[3] *Sakhar. Prom.*, 1970, **44**, (3), 1–7.
[4] *International Sugar Rpt.*, 1970, **102**, (13), 1–5.
[5] *I.S.O. Stat. Bull.*, 1970, **29**, (2), 30–31.
[6] *Sugar Review*, 1970, (962), 53.

Deterioration of sugar cane after harvesting

Part III. Enzymatic hydrolysis of the polysaccharide formed

By J. BRUIJN (*Sugar Milling Research Institute, University of Natal, Durban*)

Introduction

IT was shown in Part II of this series[1] that the polysaccharide formed during the deterioration of sugar cane is a straight chain glucose polymer with 25% (1–6) and 75% (1–4) α glucosidic bonds.

In 1959 Bender, Lehmann and Wallenfels[2] described a similar polysaccharide produced by a mould *Aureobasidium pullulans* (de Bary) Arnoud syn. *Pullularia pullulans* (de Bary) Berkhout, growing on sugar-containing Czapek-Dox media. The polysaccharide was shown to be extra-cellular and was named pullulan. In 1961 the enzymatic hydrolysis of this polysaccharide was described[3]. The enzyme, pullulanase, is produced by a strain of *Aerobacter aerogenes* isolated from an air infected pullulan solution.

The hydrolysis of pullulan with pullulanase resulted in a single product which was identified as maltotriose. Later investigations[4] established that the action of pullulanase was specific for the α (1–6) glucosidic bond and that pullulan is a straight chain maltotriose polymer (molecular weight 235,000) linked in α (1–6) position.

It was decided to use pullulanase for further investigation into the structure of the cane polysaccharide.

Experimental

Production and Isolation of Pullulan

For comparative purposes and as a source of maltotriose, pullulan was prepared in the way described by Wallenfels[2]. It became evident that not every strain of *Aureobasidium pullulans* would produce pullulan. A type culture received from the Centraal Bureau voor Schimmelcultuures in Baarn produced only a small quantity of a mannose polymer, which was not further investigated.

A strain obtained from the Royal Free Hospital School of Medicine in London formed pullulan. The pullulan was produced by inoculating from a malt agar tube into 500-ml round bottom flasks filled with Czapek-Dox medium. This medium contained 10% sucrose as sole carbon source and the pH was adjusted to 7·2. The flasks were plugged with cotton wool and shaken on an orbital shaking machine for seven days at room temperature (25°C). The cells were then separated from the medium by centrifuging. The solution was subsequently filtered through kieselguhr and the polysaccharide was precipitated from the filtrate by addition of 1·2 times its volume of acetone. This was repeated twice. Pure pullulan is obtained as a white voluminous powder. Acid hydrolysis followed by paper chromatography of the hydrolysate showed glucose to be the only basic unit in the polymer.

Preparation and Isolation of Pullulanase

A culture of *Aerobacter aerogenes* received from the Laboratorium voor Microbiologie in Delft did not produce pullulanase. The prepared culture broth did not show any enzymatic activity in pullulan after incubation for three days at room temperature (25°C).

A second strain received from the Royal Free Hospital School of Medicine produced pullulanase.

The *A. aerogenes* was first cultivated in test tubes containing agar slants of pH 7·0 and having the following composition:

Meat extract	3 g
Peptone	3 g
NaCl	0·7 g
K_2HPO_4	0·7 g
Glucose	6 g
Agar	25 g
Water	1000 ml

The agar slants were inoculated and incubated for three days at room temperature. Cells from these slant cultures were used to inoculate flasks containing 250 ml of the above medium without the agar. They were cultivated for two days on the orbital shaker at room temperature.

Flasks containing 250 ml of the main culture medium of pH 6·6 and composition as indicated in Table I were then inoculated with cells from the above media to a concentration of 2·5% per volume. These were shaken for three days at room temperature.

Table I. Main culture medium

$NaNO_3$	5 g
K_2HPO_4	1 g
$MgSO_4$, 7 aq.	0·5 g
KCl	0·5 g
$FeSO_4$, 7 aq.	0·01 g
Maltose	5 g
Peptone	8 g
Water	1000 ml

The activity of the culture liquid was tested as follows:

To 2 ml of a 2% pullulan solution and 7 ml of a phosphate buffer of pH 6·0 was added 1 ml of culture liquid and the mixture was incubated at 40°C. The

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[1] Bruijn: *I.S.J.*, 1966, **68**, 356.
[2] *Biochem. Biophys. Acta*, 1959, **36**, 309.
[3] Bender and Wallenfels: *Biochem. Zeitsch.*, 1961, **334**, 79.
[4] Wallenfels: *ibid.*, 1965, **341**, 433.

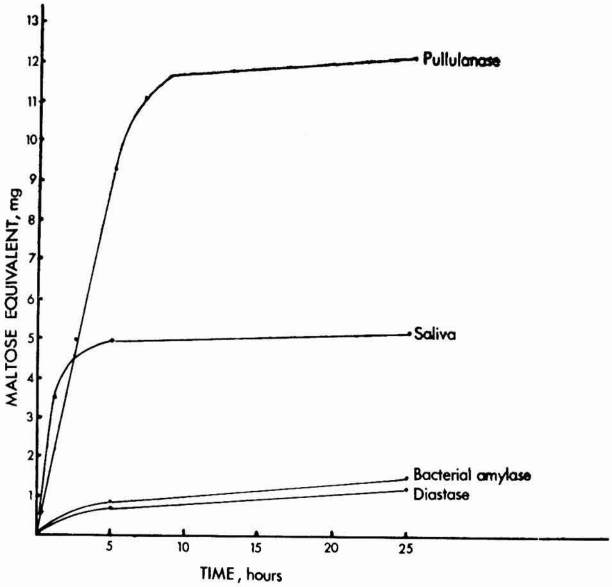

Fig. 1. Rate of hydrolysis of cane polysaccharide with various enzymes

increase in reducing sugar content of the mixture after four hours was determined as maltose using the ferricyanide micro-method of HAGEDORN and JENSEN[5].

One unit of pullulanase[3] is defined as that quantity which produces 1 mg maltose equivalent per hour under the above conditions. The culture liquid showed an enzymatic activity of 50 units/100 ml after three days of shaking.

The medium used results in extra-cellular production of pullulanase. The enzyme was isolated by first centrifuging off the cells at 3000 r.p.m. and filtering the medium through kieselguhr. The clear filtrate was cooled to 4°C. For each 80 ml of culture broth 120 ml of cold acetone were added and the mixture was kept overnight in the refrigerator. The precipitate was centrifuged off and the enzyme extracted from it with 50 ml buffer of pH 6·8*. The remaining precipitate was extracted with another 25 ml of pH 6·8 buffer for a further 12 hours, processed as above and the extracts were combined.

Two independently prepared batches showed pullulanase activities of 6·8 and 6·4 units per ml. In this form the enzyme preparation showed good keeping qualities provided it was stored under refrigeration. Before it was used the enzyme was further purified by an identical re-extraction and precipitation.

Enzymatic Hydrolysis

(*a*) The rate of decomposition of 2% solutions of cane polysaccharide and pullulan by various enzymes was investigated at the optimum pH of the enzyme used. The hydrolyses were carried out at 40°C and the increase in reducing power of the solutions was determined as maltose equivalent by the HAGEDORN and JENSEN method.

The various enzymes used were:

	pH
Malt diastase	5·5
Bacterial α-amylase	6·5
Salivary α-amylase	6·7
Pullulanase	6·0

The results of these enzymatic decompositions are shown in Fig. 1 and Fig. 2 for cane polysaccharide and pullulan respectively.

(*b*) The cane polysaccharide was hydrolysed with pullulanase for chromatographic analysis as follows:

Cane polysaccharide (48·8 mg) was dissolved in 90 ml 0·02 M citrate phosphate buffer of pH 6·0 and boiled for 5 minutes to destroy any possible amylase activity. After cooling, dry pullulanase powder (92·0 mg) was added and dissolved.

The mixture was incubated at 40°C for four hours and all residual enzyme precipitated with 1·6 times the volume of cold ethanol. The solution was kept

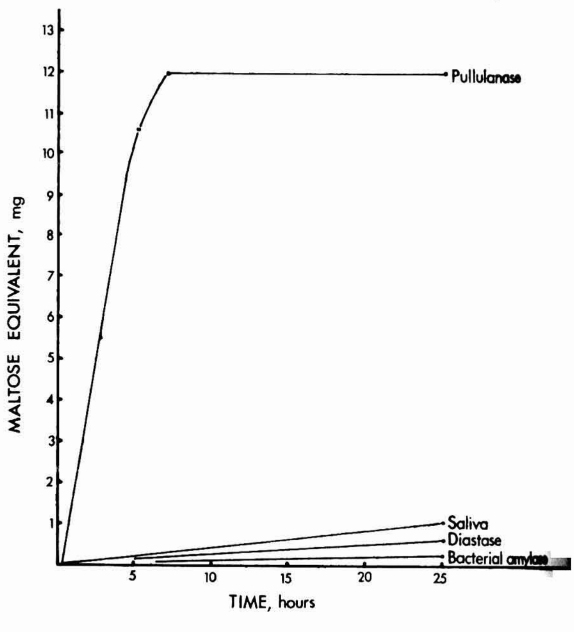

Fig. 2. Rate of hydrolysis of pullulan with various enzymes

[5] BATES: "Polarimetry, Saccharimetry and the Sugars" (US Government Printing Office, Washington) 1942, p. 198.

* Citric acid 0·01 g.mol. per litre, sodium phosphate 0·2 g.mol. per litre is the required ratio for a pH 6·8 solution.

overnight and the precipitate centrifuged off. The supernatant was deionized with 5% (w/v) mixed bed ion exchanger ("Amberlite MB1"), filtered and concentrated *in vacuo*.

Pullulan was hydrolysed by pullulanase by the same method: 1 ml 2% pullulan solution and 10 mg pullulanase powder in 9 ml 0·02 M citrate-phosphate buffer of pH 6·0.

(*c*) For comparative purposes a mixture of a series of α (1–4) D-glucose polymers was prepared by the partial hydrolysis of amylose.

Pure amylose was prepared by precipitation from a slowly cooling heated mixture of a potato starch solution to which *n*-butanol had been added[6]. After separation amylose was partially hydrolysed by heating a 2% solution in 0·1 N sulphuric acid at 105°C for 20 hours. After cooling, an equal volume of ethanol was added, the precipitate filtered off and the clear solution deionized and concentrated *in vacuo* as described before.

(*d*) A few μl of each concentrate was applied to the chromatographic paper (Whatman 3MM). The eluant used was 2:1:1 *n*-butanol:ethanol:water and

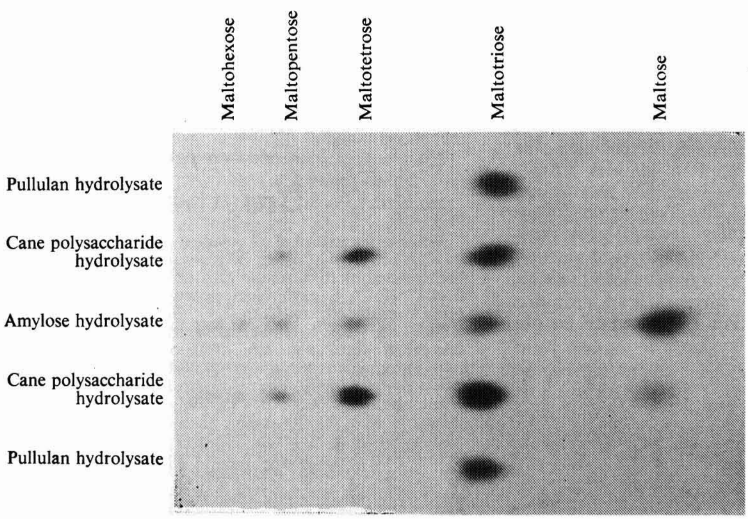

Fig. 3

the chromatogram was run for 60–90 hours in descending mode. The reducing sugars were made visible by dipping the paper into 0·1N silver nitrate in acetone, the paper was air-dried and then dipped into a 1 in 20 dilution of 40% aqueous sodium hydroxide solution in ethanol.

After a water wash the paper was fixed with a sodium thiosulphate fixer and washed for several hours in running water.

The chromatogram is reproduced in Fig. 3.

A chromatogram was quantitatively evaluated by a modification of a method by WHISTLER and HICKSON[7].

Cane polysaccharide hydrolysate (45 μl), hydrolysed by pullulanase and containing approximately 2·5 mg total sugars, was applied along 5 cm of the starting line of the chromatogram. Guide spots were placed at a distance of 4 cm on either side of this section and the paper eluted as described above. The guide strips were cut off and developed with the silver nitrate and sodium hydroxide reagents. With the aid of the two guide strips the positions of the various oligosaccharides on the central portion could be located and cut out. Each portion, which was cut into ten pieces, was placed into a 100 ml beaker, covered with distilled water and left soaking for one hour.

Because cellulose fibres interfere in the subsequent determination the solution of sugars so obtained was filtered through a 0·45μ membrane filter and the paper washed four times with 5 ml aliquots of distilled water and made up to 25 ml or 50 ml in a volumetric flask depending on the concentration of the particular oligosaccharide involved. To 10 ml of this solution, pipetted into a boiling tube, was added 2 ml 10N hydrochloric acid. The tube was placed in boiling water for 25 minutes, 2 drops of 0·005% of bromothymol blue added and the solution neutralized with 10N sodium hydroxide. One drop of 3·5N hydrochloric acid was then added and carefully neutralized with 1N sodium hydroxide. The sample was then titrated according to HAGEDORN and JENSEN.

A strip of paper from the chromatogram between the sugar fractions was treated in the same way as the sample and used as a blank.

The final result, which was expressed in mg of glucose, was corrected to account for the degree of polymerization of the oligosaccharide.

It was found that the cane polysaccharide is made up mainly of maltotriose (49%) and maltotetrose (38%) units. Other α (1–4) glucose polymers accounted for the remaining 13% (see Table I).

From these data it can be calculated that the total amount of α (1–6) links in the molecule is 29·8% which agrees reasonably well with the previous reported

[6] SCHOCH: "Advances in Carbohydrate Chemistry", 1945, **1**, 158.

[7] *Anal. Chem.*, 1955, **27**, 1514.

percentage obtained by periodate oxidation and gas chromatography of the hydrolysate of the methylated polysaccharide.

Purity of the Polysaccharide

A combination of gel chromatography and enzymatic hydrolysis with pullulanase was used to assess the purity of the isolated polysaccharide.

The gel chromatography was carried out on ion agar (5%, 140 microns) prepared according to Andrews[8]. One single peak was obtained and the fractions of the ascending part were combined, as were those of the descending part.

The enzymatic hydrolysis of both these samples with pullulanase resulted in hydrolysates with identical oligosaccharide compositions as the original material (see Table II).

Table II. Percent oligosaccharides in pullulanase hydrolysates of cane polysaccharide

	Maltose	*Malto-triose*	*Malto-tetrose*	*Malto-pentose*	*Malto-hexose*
Hydrolysate of original polysaccharide	5·1	49·8	36·7	6·9	1·5
Gel filtration fractions 45–63	4·3	50·1	38·4	5·6	1·6
Gel filtration fractions 90–120	3·2	49·3	37·1	7·2	3·0

Discussion

Of the two strains of *A. pullulans* used in this work, only one produced the polysaccharide pullulan, the other producing a mannose polymer. A similar discrepancy was encountered during the preparation of the enzyme pullulanase. The two strains of *A. aerogenes* used showed identical indol, Voges Proskauer and citrate reactions but the methyl red reaction of the pullulanase-producing organism was positive, which is abnormal for *A. aerogenes*. In addition this strain produced less gas, when cultivated in lactose broth but a larger hydrogen/carbon dioxide ratio than the inactive strain.

The rate of hydrolysis by pullulanase of both cane polysaccharide and pullulan was identical (see Fig. 1 and Fig. 2) and neither substance was attacked by bacterial α-amylase or diastase. However, unlike pullulan, the polysaccharide from deteriorated cane was partly hydrolysed by salivary α-amylase, thus confirming previous observations by Nicholson and Lilienthal[9]. This behaviour indicates a difference in structure between pullulan and cane polysaccharide.

A further confirmation of this difference was obtained by chromatographing on paper the hydrolysis products obtained by the action of pullulanase. In the case of pullulan, as expected, only maltotriose was obtained, but cane polysaccharide yielded in addition to maltotriose similar quantities of maltotetrose. Small amounts of other glucose polymers (see Fig. 3) were also detected. It appears therefore that the cane polysaccharide is a new α-polyglucan and the name Sarkaran is suggested for it.

The sequence of the oligosaccharides in the cane polysaccharide was not established. Maltotetrose and maltotriose may alternate in a regular pattern or be randomly distributed.

Summary

The polysaccharide formed in deteriorated cane was subjected to enzymatic hydrolysis by pullulanase, an enzyme specific for the hydrolysis of the α (1–6) glucosidic link.

By identification of the hydrolysis products, it was concluded that the polysaccharide is mainly a maltotriose maltotetrose polymer, in which these two oligosaccharides are present in nearly equal ratios.

Acknowledgments

Thanks are due to Professor Dr. K. Wallenfels of the Chemical Laboratory of the University of Freiburg, Germany, for a sample of pure pullulanase; to Professor W. H. Whelan of the Royal Free Hospital School of Medicine in London, England, for a strain of *Aureobasidium pullulans* and a strain of *Aerobacter aerogenes*; and to Professor J. O. Wiken of the Microbiological Laboratory of the Technological University Delft, Holland, for a second strain of *A. aerogenes*.

The assistance of Mrs. A. J. Atkinson, R. E. Buchanan and E. M. J. Swart is gratefully acknowledged.

[8] *Nature*, 1962, **196**, 36.
[9] *Aust. J. Biol. Sci.*, 1959, **12**, 192.

Brevities

Molasses for control of oil pollution of sea water.—A product to help solve the problem of sea-water pollution by oil has been devised by M. Georges Salomone, of France. The product, "Sefoil", is made from molasses, phosphoric acid and other constituents, and forms a stable emulsion with hydrocarbons and water by simple mechanical stirring. It is claimed that the product has no toxic effects on marine fauna or flora. It is also claimed that the product is very inexpensive when produced industrially, at 0·87 francs/kg, equivalent to about 7 US cents/lb. Sixty parts of "Sefoil" have been used for 100 parts of oil. The product has successfully passed tests carried out by the French Museum of Natural History, the Oceanographic Institute and other independent bodies[1].

* * *

Indonesia sugar factory[2].—Construction of the sugar factory at Bone in north-west Macassar, which had been interrupted because of doubts as to its viability, is to be resumed. The factory is estimated to be valued at £1,800,000 and 96% of the equipment for its construction has been supplied by Czechoslovakia.

* * *

Fats by molasses fermentation.—Laboratory[3] and micro-plant experiments have been carried out in Cuba on the production of fats by growth of *Rhodotorula glutinis* on final cane molasses. The experiments were conducted at temperatures of 30, 33 and 37°C and at initial pH of 5·0 and 6·0. The yeast obtained had an average fat content of 65% on solids.

[1] *Compt. rend. Acad. Sci. Paris*, 1969, **269**, 2435–2438; through *I.S.R.F. Memo*, 27th April 1970.
[2] *Agence France-Presse*, 7th March 1970.
[3] *CubaAzúcar*, 1968, (July/Aug.), 43.

International Commission for Uniform Methods of Sugar Analysis

15th Session, 1970

DURING the afternoon of the 10th May 1970, members of ICUMSA from countries all over the world assembled at the offices of the International Coffee Organization in London to register for the 15th Session. Once provided with their documents and name badges, all in a large plastic wallet provided by the British Sugar Bureau, they made their way to a reception offered by the British National Committee.

On the following morning a bus tour of London gave overseas visitors an introduction to the host city and, after lunch, working sessions commenced at the I.C.O. Offices where the Acting President, Dr. A. CARRUTHERS, welcomed delegates and paid tribute to the memories of the late President, Professor J. DUBOURG, and other referees and members of ICUMSA who had died since the last Session in 1966. Delegates stood for a moment in silence before receiving the report of the Referee on Subject 1.

Reports were presented by Referees or their deputies and recommendations were made, and rejected, passed or modified. The recommendations passed for each subject will be published in a subsequent issue of this Journal. Working sessions occupied all the week to the 15th May although on the afternoon of the 13th May a visit was arranged to the Royal Botanic Gardens at Kew where the group photograph below was taken. Also, for the wives of delegates there was an additional outing on the 14th May to Windsor, the Thames-side town whose castle is one of the homes of the British Royal family.

In the evening of the 11th May delegates attended a reception given by the British Sugar Refiners' Association at the Savoy Hotel in London, while on the 12th they were entertained at a reception given by the British Government at Lancaster House where they were received by the Rt. Hon. JAMES H. HOY, M.P., Joint Parliamentary Secretary, Ministry of Agriculture, Fisheries and Food. The Session Dinner, a "City Feast", was given by the British National Committee in the Livery Hall of Guildhall, the ancient reception and banqueting chamber of the Lord Mayor and Corporation of the City of London.

At the Executive Committee meeting on the 15th May the Presidency of Dr. CARRUTHERS was confirmed and other officers elected for the next four years included D. HIBBERT as General Secretary, G. WILSON as Treasurer, D. HIBBERT, R. I. SAVAGE and R. SAUNIER as the Publications Committee, and other members to form Credentials and Finance Committees. The retirement from office was announced of Messrs. WIKLUND, MEADS and CULP, while new Vice-Presidents elected included W. NEWTON, M. MATIC, S. STACHENKO, S. C. GUPTA, C. W. DAVIS, R. DE VLETTER and R. SAUNIER.

The Session broke up with delegates feeling that there had been real achievement attained in respect of most subjects, in spite of a lack of copies of the Referee's reports which had gone astray between Paris and London, and with great appreciation of the efforts of the organizing committee, led by D. HIBBERT, and of the facilities provided by the I.C.O., which included simultaneous translations into English, French and German and had contributed so much to the success of the meetings.

Batch decolorization of sugar liquor with ion exchange resin

By D. F. BAGSTER

(Colonial Sugar Refining Co. Ltd. Research Laboratories, Roseville, N.S.W. 2069, Australia)

Introduction

CONSIDERATION has been given to the use of fine resin for decolorization of sugar liquor. The resins designated as "fine" here were of the order of 0·07 mm and distinct from the ultra-fine resins discussed by SCHULZ and CROOK[1] where diameters were of the order of one micron.

A great disadvantage of fine resins is the high pressure drop across a bed of such small particles. Such a bulk of fine beads does have a high surface area per unit volume or weight and it was felt that advantage might be taken of this by contacting liquor with the resin in a simple stirred vessel.

The relative surface area per unit weight may be estimated using the surface average diameter[2] which is given by

$$d_{sa} = \left(\frac{\sum_{1}^{n} d^2}{n} \right)^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The relative surface areas will be in proportion to the reciprocals of the values of d_{sa}.

Comparisons of decolorization rates were made on three different sizes of Permutit "Deacidite FFIP" resin. The coarsest grade was made by sieving stock resin between B.S. sieves of 22 and 30 mesh. Two finer grades were as supplied with nominal sizes 100 to 200 mesh and through 200 mesh. Table I gives the relevant particle sizes as determined using a travelling microscope for samples of the particular grades.

Table I. Sizes of resin beads

Resin	*Arithmetic mean bead size, mm*	*Surface average bead size, mm*	*Standard deviation, mm*
FFIP 22/30 mesh Water regain 1·5	0·558	0·560	0·051
FFIP 100/200 mesh Water regain 1·5–2·0	0·143	0·147	0·033
FFIP Through 200 mesh Water regain 1·5–2·0	0·074	0·076	0·018

One aim of the present study was to evaluate the effect of a given amount of resin on a given amount of refinery liquor for different sizes of resin. Unfortunately there is no guarantee that the composition of a particular type of resin will be the same from one particle size to another even if the different size fractions are sieved from a single polymerization batch.

The resins used were given a preliminary contact by stirring as a slurry in 10% NaCl solution followed by thorough washing with distilled water.

Water determinations were made on the resins so that a given amount of resin on a dry basis could be added to a known quantity of liquor.

The liquor used for the resin contacting was a refinery syrup which is normally used as a bone char supply material.

Colour measurements were made in terms of the attenuation index, multiplied by 1000 for convenience. Colour values were thus given by

$$A^* = 1000 \frac{-\log T}{bc} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where T = transmittance of the liquor with solids concentration c g/ml in a cell of length b cm. A wave length of 420 nm was used and the pH of the liquor adjusted to 9.

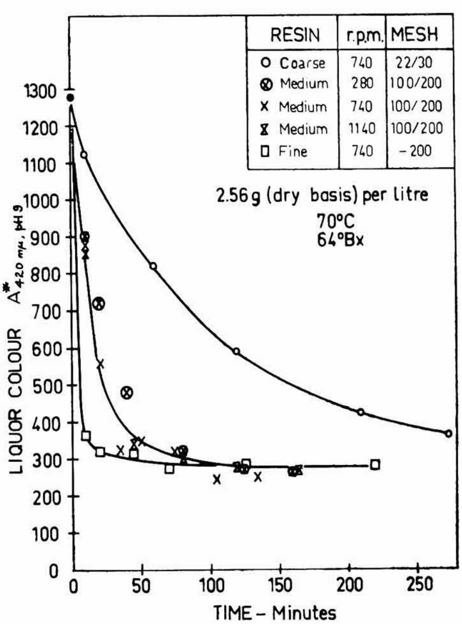

Fig. 1. Batch decolorization—variation of liquor colour with time

[1] *Ind. Eng. Chem., Prod. Res. and Develop.*, 1968, **7**, (2), 120.
[2] IRANI and CALLIS: "Particle Size: Measurement, Interpretation and Application". (Wiley, New York) 1963, p. 43.

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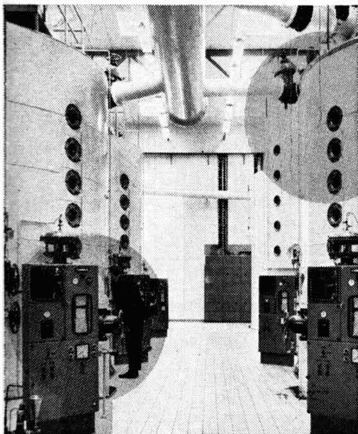
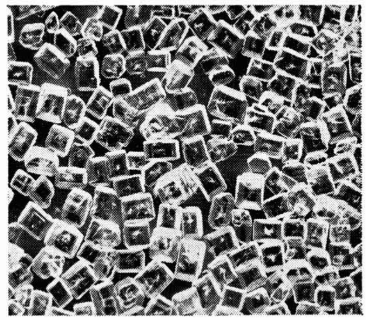
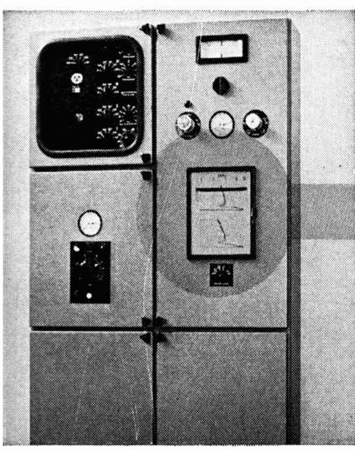
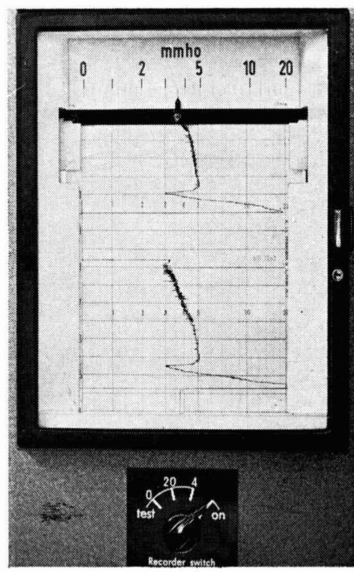




A low content of conglomerates and a uniform grain size constitute an essential prerequisite for producing the best possible sugar from a given juice. In an existing vacuum pan the best results are achieved by keeping the supersaturation in the mother liquor at an optimum during all stages of the strike. By automizing both graining and final boiling the DDS-Pan-Boiling Automatics meet these demands to their full extent, at the same time considerably reducing the labour costs.





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Rate experiments

A set of experiments was performed in which 2·56 g, dry basis, of each of the three resins (coarse, medium and fine) were contacted with a litre of liquor in a one-litre flask. A 3-speed laboratory stirrer was used, at 280, 740 and 1140 r.p.m.

Samples of resin/liquor slurry were withdrawn at known times after pouring in the resin, using a pipette with an enlarged tip. About 30 ml were withdrawn for each sample and the resin was separated by filtering through a mercury filter. The stirred flask was held at 70°C.

Fig. 1 shows the liquor colour as a function of time.

Conclusions reached from these trials were:

1. For the particular geometry of flask and stirrer involved the decolorization rate was independent of stirrer speed above 740 r.p.m.

2. Withdrawal of samples of liquor and resin by the pipette with enlarged orifice left the ratio of resin to liquor in the flask unchanged. This was checked by weighing the dried resin from aliquots withdrawn at the end of the experiments together with a determination of the sucrose pipetted. A similar determination was carried out on what remained in the flask.

3. Fine resin decolorizes much more quickly than coarse; decolorization by through-200 mesh resin in 64°Bx liquor at 70°C apparently ceases after about an hour. Decolorization by 22/30 mesh resin was continuing to be effected after five hours.

The relative rates of decolorization over the first few minutes were very nearly in the same proportion as the relative surface areas. Surface areas of a given mass of differently sized particles are in the ratios of the reciprocals of the surface average particle sizes, and Table II gives the estimated initial decolorization rate with the corresponding relative values of $1/d_{sa}$, taking that for coarse resin as unity.

Table II. Relative decolorization rates compared with relative surface areas

(2·56 g resin per litre of liquor)

Resin	*Relative decolorization rate,* $-dA^*/dt$	*Ratios of surface area*
Coarse	1	1
Medium	2·3	3·8
Fine	9·3	7·4

4. The liquor colour after decolorization had apparently ceased ("equilibrium") was about the same for the three sizes of resin. This fact was surprising and led to further experiments for confirmation under a wider range of conditions. Such a conclusion could mean that colorant molecules are able to penetrate to the centre of the bead and be adsorbed there, so utilizing all the mass of the resin, even in the larger beads.

5. Simple rate laws of the form of equation (3) do not fit the data throughout the decolorization period.

$$\frac{-dA^*}{dt} = k(A^* - A^*_{\infty})^n \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Here A^* is the liquor colour at time t, A^*_{∞} is the final liquor colour, k is a rate constant and n is the order of the rate equation.

Values of n equal to 1, 2 and 3 were tried and the form of equation (3) could not be made to fit the decolorization curves throughout the period of decolorization. A ready explanation is that colorant is not a single molecular species and different compounds will transport or adsorb at different rates; another is that the rate of transport is dependent on the unsteady state conditions within the bead.

Determination of isotherms

A 5 × 3 experiment was next devised in decolorizing another sample of liquor at different resin concentrations for each of the three grades of resin. Resin concentrations of 0·5, 1, 2, 4 and 8 grams (dry basis) per litre of liquor were used. The colours of the liquor after decolorization had apparently ceased are plotted in Fig. 2. Considering that there may be

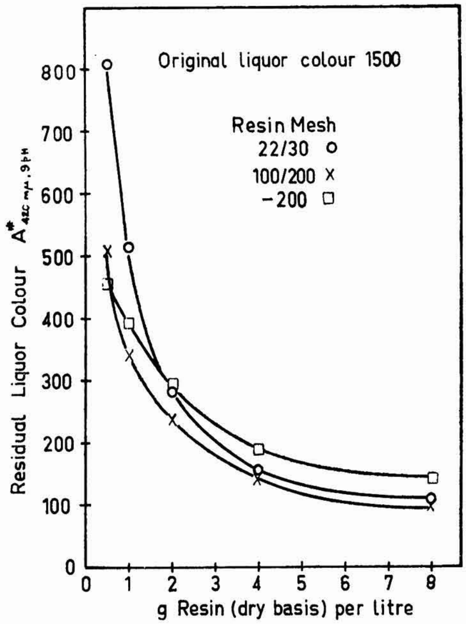

Fig. 2. Batch decolorization—final colours of liquor

differences in resin material from one grade to another it may be said that the "equilibrium" colour was indeed roughly the same for all grades except when less than 1 g/litre was used. The coarse resin then did not remove as much colour as the other two grades. This could be the result of some surface obstruction by adsorbed material being more apparent with the lower surface:volume ratio of the largest beads at lower resin concentration.

The results were plotted in a form corresponding to the more usual method of expressing isotherms. If A^*_F is the residual colour of the liquor (after decolorization had ceased) and A^*_L is the initial liquor colour then a measure of the concentration of adsorbed colour on the resin is $(A^*_L - A^*_F)/G_R$, where G_R is the dry weight of resin per litre. Then a plot of $(A^*_L - A^*_F)/G_R$ in Fig. 3 is analogous to an equilibrium isotherm plot.

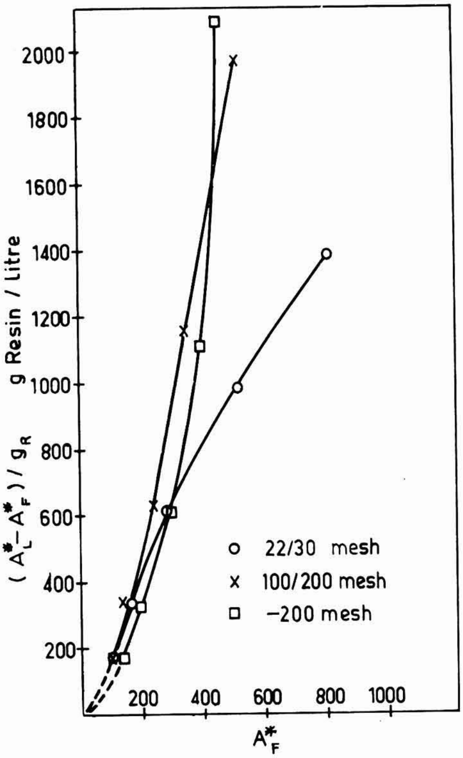

Fig. 3. Distribution of colour, resin and liquor

That the analogy with equilibrium isotherms cannot be taken too far is easily demonstrated by the following experiment. The spent coarse resin from the experiment at 2 g/litre was recovered and washed. It was then added to a litre of pure sucrose solution at 64°Bx and 70°C. Stirring for twelve hours was then found to have raised the colour from 20 to 38, a rise of eighteen units, from resin which had removed over 1200 units of colour from a dark liquor. Of these eighteen units some were perhaps because of thermal instability of the pure sugar, for a blank determination in which pure sucrose liquor was stirred without resin for twelve hours showed a rise of six colour units. Obviously the colour adsorption is practically an irreversible process in sucrose syrups. Of course, reversal or partial reversal occurs in brine solution during regeneration in normal decolorization cycling.

A blank determination on the coloration of the refinery liquor when stirred at 70°C for eighteen hours showed an increase of about 70 units. It is interesting to note that when decolorization by resin had apparently ceased it was not followed by any increase in colour in further contacting such as could be attributed to thermal instability of the liquor. It must be concluded that if colour was being produced by prolonged heating and stirring then the resin was removing it.

The sectioning of resin beads

Some of the coarse resin beads from two of the "equilibrium" experiments discussed above were sectioned across a diameter. The resin sampled was from the experiment at highest resin concentration (8 g/litre) and at lowest concentration (0·5 g/litre), both resin samples being taken after decolorization had ceased.

When the 8 g/litre resin was sectioned and the cross-section examined by microscope it was noticed that the colorants had apparently penetrated as a layer into the bead, leaving a central core uncoloured, as shown in Fig. 4.

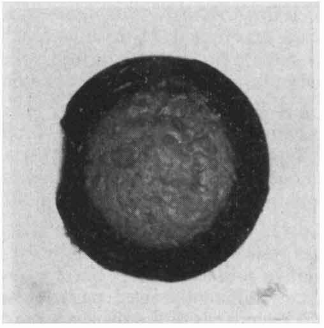

Fig. 4. Photograph of sectioned resin bead, illuminated from above

SCHNEIDER *et al.*[3] have observed such colorant layering and they reported that the relatively sharp demarcation between coloured resin material and uncoloured bead becomes blurred when the resin is regenerated. After repeating cycling the whole bead becomes affected.

Now measurements were made of the thickness of the coloured layer in the 8 g/litre experiment by traversing the cross-section of cut beads with a travelling microscope. Table III lists the resin bead diameters, uncoloured core diameters and coloured layer thickness for the beads examined.

Table III. Thickness of coloured layer in resin beads

Bead diameter, mm	*Uncoloured core diameter, mm*	*Coloured layer thickness t, mm*	*t/r %*
0·439	0·211	0·114	52
0·555	0·326	0·114	41
0·553	0·405	0·074	27
0·509	0·218	0·146	57
0·516	0·277	0·120	47

[3] *I.S.J.*, 1968, **70**, 67.

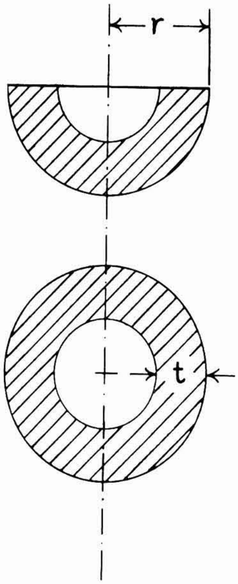

Fig. 5. Thickness of coloured layer in resin bead

Referring to Fig. 5 and Table III it may be seen that the coloured layer thickness t is roughly half the radius of the bead r. However, whereas the colour for this experiment has penetrated only halfway to the centre of the bead, the volume of the uncoloured core relative to the bead volume is given by $[(r - t)/r]^3$ and for $t/r = 0{\cdot}5$ the uncoloured core is only $12\frac{1}{2}\%$ of the total bead volume.

A supposition was made above that if coarse resin gives the same residual colour as fine then the whole of a coarse bead must be available for colour adsorption. This may therefore be roughly correct for, while the colour has penetrated only half way to the centre of the bead, nearly all the volume of the bead lies beyond a sphere of radius half the bead radius and centres at the bead centre.

Resin beads from the 0·5 g/litre experiment were examined in the same way and the whole cross-section was seen to be coloured. Colorant amenable to adsorption after transport through bead material was, with low resin concentration, adsorbed throughout the resin bead.

SCHNEIDER *et al.* developed a theory of penetration of colorant into resin assuming behaviour analogous to that of ground water freezing, i.e. a progression of a boundary behind which there is a uniform concentration C_s. However there is evidence in the present study that the adsorption of colorant does not conform to a simple frozen/not frozen or coloured/not coloured behaviour and the amount of colorant taken up by a given layer of bead material is probably dependent on the colorant concentration. That this is so can be demonstrated as follows:—

Eight grams of coarse resin lowered the colour of a litre of liquor from 1500 to 110, i.e. by 1390 units, as may be seen in Fig. 2. About 87% of the bead material was utilized in doing this. Half a gram of coarse resin lowered the colour of a litre of the same liquor by 690 units and all the resin adsorbed colorant. It is easily shown that in the latter case the colorant concentration in the resin is about seven times that in the former. Hence an assumption of a constant saturation concentration of colorant in bead material is not justified, at least for natural colorants.

Conclusion

In batch decolorization, resins of different particle size decolorize sugar liquor at rates approximately in proportion to the surface area of the particles.

If decolorization is allowed to continue, the ultimate amount of decolorization achieved is roughly independent of particle size unless the resin concentration is less than 1 g of resin, dry basis, per litre of liquor at 64°Bx.

Colorant, at least of some molecular species, has been seen to be able to penetrate to the centre of resin beads of 0·55 mm diameter.

Acknowledgement

The author wishes to thank the Colonial Sugar Refining Co. Ltd. for permission to publish this paper.

Summary

A study of the batch decolorization of refinery liquor by anion exchange resin of different particle sizes has been made. It was found that the initial decolorization rate was approximately in proportion to the surface area of resin beads but that the final decolorization is affected more by the amount of resin material present in the liquor than by surface area.

Brevities

New sugar factories for India[1].—It is proposed to erect four sugar factories, three of them in the cooperative sector, in the Telengana region of Andhra Pradesh, in India. The three cooperative factories will be at Miryalaguda in Nalgonda district, Pochampad in Karimnagar district, and Alampur in Mahboobnagar district. The fourth factory, to be managed by Nizam Sugar Factory Ltd., is to be at Zaheerabad in Medak district. Two cooperative sugar factories are to be built, one at Pusad in Yeotmal district of Maharashtra and the other at Malkapur in Buldhana district. Plans are also being studied for a further seven factories.

* * *

Bagasse paper in Mexico[2].—Kimberley-Clark de México has put into operation a third plant at its Escamela complex in Veracruz, next to its cellulose and paper-coating plants. The new factory, built at a cost of 310 million pesos (£10,500,000), will use bagasse as its main raw material and its annual production of 25,000 tons will include tissue paper, napkins and similar products.

[1] *Sugar News* (India), 1970, **1**, (9), 5, 6.
[2] *Bank of London & S. America Review*, 1970, **4**, 228.

Sugar cane agriculture

The theory and practice of plastic (polyethylene) mulching for spring planting of sugar cane in Taiwan. H. C. Fu, T. P. Su and Y. H. Hsieh. *Taiwan Sugar*, 1969, **14,** (3), 6–9, 28.—Low temperatures and insufficient soil moisture are normally responsible for poor germination and growth during the planting season in Taiwan. How this can be overcome by covering the sets with a strip of thin polyethylene after planting is described and discussed. Most of the young cane shoots break through the thin plastic. Locally-designed hand machines for laying the plastic, one for light soils and another for heavy, are described and illustrated. Some planters in Taiwan already practise plastic mulching of this sort.

* * *

Notice of release of sugar cane variety L.62-96. Anon. *Sugar Bull.*, 1969, **47,** (20), 3.—The variety is a cross between C.P. 52–68 and C.P. 44–154. In 44 tests on light soils it proved to be superior to the industry's most widely grown variety, C.P. 52–68, in yields of sugar per ton and sugar per acre. In heavy soils it consistently outyielded C.P. 52–68 in all of 10 tests. These higher yields were obtained in plant cane and first and second ratoons. Other characteristics of this variety are discussed.

* * *

Common weed species in the Victorias milling district. Anon. *Victorias Milling Co. Expt. Sta. Bull.*, 1968, **15,** (9–12), 2–39.—Notes are given on the common weeds, many of which occur in cane fields, scientific and common names being given. Photographs of 62 weeds are included. The 10 most common weeds in sugar cane include 4 grasses. The worst weed is is considered to be nut grass (the sedge *Cyperus rotundus*). Normally the lowland and poorly drained areas have more weed species than upland areas. The purpose of the bulletin is to acquaint planters with the names of their weeds so that they may be able "to discuss more intelligently with herbicide people their specific weed control problem".

* * *

Keeping track of rats. Anon. *Australian Sugar J.*, 1969, **61,** 187.—Reference is made to telemetry techniques in studying the behaviour and ecology of rats damaging sugar cane in Hawaii. Radio transmitters weighing only one quarter of an ounce were attached to the rats. Subsequent monitoring of signals from free-roaming animals with directional receivers yielded information on the movement patterns and habits of rats in the most precise method available to date. It is hoped that the research findings may be used in methods of controlling rats, which cause an estimated $4·5 million loss in the Hawaiian sugar industry each year.

* * *

Ten years of green cane harvesting. L. G. Vallance. *Australian Sugar J.*, 1969, **61,** 198–202, 206.—The Creber harvester and its cane trashing ability are discussed. It dispenses with pre-harvest burning and conserves the trash for the ultimate benefit of the soil. The machine has a handling capacity from 5000 to 9000 tons of cane a year.

* * *

Speedy cane plant stripper. Anon. *Australian Sugar J.*, 1969, **61,** 202–206.—Some details of the new Massey Ferguson cane-stripper and its potential value in cane planting are given. The machine is tractor operated, trash removal being carried out by an assembly of 5 small rubber-tyred wheels.

* * *

Tackling the rat problem. Anon. *Australian Sugar J.*, 1969, **61,** 206.—Reference is made to the brown rat developing resistance to "Warfarin" and to the promise recently shown by the poisons "Norbormide" and alpha-chloralose, encapsulated in gelatin. The weasel, a natural predator of the rat, and experiments with it in rat control in sugar cane in the Rykuyu Islands are discussed.

* * *

Total irrigation is Bundaberg's big need. Anon. *Producers' Rev.*, 1969, **59,** (7), 13–17.—Rainfall statistics since 1900 show that a pattern of recurring droughts in two or more successive years takes place in this part of Queensland. These are very upsetting to the economy of the district and the cane grower in particular. The only solution is the provision of irrigation for the whole district. The water problem and the long-term plans for its alleviation are discussed.

* * *

Concern over Fiji and ratoon stunting disease. C. H. Hughes. *Producers' Rev.*, 1969, **59,** (7), 21–23.—In the Bundaberg area of Queensland Fiji disease has reappeared after being absent since 1953—a shock for the sugar industry. This disease and RSD are both serious diseases and due to viruses. Eight farms were found to have Fiji disease. It is anticipated that the outbreak will soon be under control. Drought conditions have intensified damage from RSD.

The preparation and operation of a cane transport system. G. HERITAGE, R. BARRATT and G. SMITH. *Producers' Rev.*, 1969, **59**, (7), 31–34.—Constant increases in the volume of chopped cane in Queensland and the need to reduce storage or handling time to a minimum has focused attention on the need for scheduled cane transport to the mills. Details and observations on early experiments are given.

* * *

Cane breeding seen as greatest contribution to sugar industry. N. J. KING. *Producers' Rev.*, 1969, **59**, (7), 57–61.—It is doubtful whether any single factor has made a greater contribution to sugar industry progress than has the science of cane breeding. There is still a vast unexplored range of genetic material which could contain the genes of the future commercial variety. The opinion is expressed that the next 5–7 years will witness further expansion of cane production in Queensland. It will be the responsibility of research workers to see that advances are made in production of new varieties, cane nutrition, disease and pest control, field mechanization, irrigation and water management.

* * *

Cane growers' costs cut by Bureau fertilizer service. O. W. STURGESS. *Producers' Rev.*, 1969, **59**, (7), 67–69.—Queensland cane growers are urged to make greater use of the Fertilizer Advisory Service of the Bureau of Sugar Experiment Stations. In one district only 16% of growers made use of it, yet large sums are spent on fertilizers. Many growers who had taken advantage of the service were eulogistic about it and the money it had saved them.

* * *

Crush bin cane quickly to prevent CCS loss. B. T. EGAN. *Producers' Rev.*, 1969, **59**, (7), 71–73.—It is emphasized that this problem involves the whole of the sugar industry in Queensland and it is only by grower—factory cooperation that it will be solved. Sour storage rot has been present for eight crushing seasons now. A great deal has been learned about it. In fact, Queensland leads the world in research on post-harvest deterioration, but there is still a lot more to learn.

* * *

Fiji again at Bundaberg. C. G. HUGHES. *Producers' Rev.*, 1969, **59**, (7), 85.—Reference is made to recent outbreaks of Fiji disease in Queensland, after an absence of some 16 years, and of the prompt measures taken to contain it. Details are given of the proclamation (No. 47) now in force regarding the disease. It is considered that some fresh outbreaks may be expected but that with the measures in force and with the full cooperation of farmers the disease will once again be stamped out.

* * *

Mechanical harvesting hazards. ANON. *Producers' Rev.*, 1969, **59**, (7), 87.—It is estimated that with some 1820 mechanical harvesters and 400 boom-type cane loaders operating on the cane crop, about 8000 persons, including cane farmers and their families, will be concerned. The danger that can arise with overhead electric power lines, which cross many cane lands and which can so easily foul heavy or tall equipment, is discussed.

* * *

The site of sucrose synthesis in green plants: a biochemical enigma. D. A. WALKER. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969, 6 pp.—Recent research is discussed giving compelling reasons for the belief that chloroplasts possess sucrose synthesizing machinery. Why they should sometimes fail to operate is a mystery but several possibilities warrant further investigation. One is that the enzymes directly concerned undergo allosteric activation or inhibition.

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The rôle of sucrose in green plants. J. EDELMAN. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969, 4 pp.—The writer refers to the widespread occurrence of sucrose in the vegetable kingdom, being present, as far as is known, in all higher green plants; but why sucrose and not some other sugar or carbohydrate? He considers that a likely theory (put forward by ARNOLD in 1968) is that sucrose is a convenient and comparatively unreactive derivative of glucose and that it protects the monosaccharide from metabolic attack during translocation. This rôle might be particularly necessary in plants as the translocatory material passes, at high concentration, through the cytoplasm of each cell of the transport system.

* * *

Plant growth regulators and the accumulation of sucrose in sugar cane. D. W. FEWKES. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969, 4 pp.—Sugar cane is now known to contain representatives of the four main groups of plant growth hormones—auxins, gibberellins, cytokinins and inhibitors. These substances occur as free acids or bases and also as conjugates in which the acid or base is associated with a sugar such as glucose or ribose. Their known distribution and possible function in the sugar cane plant are discussed.

* * *

The movement of sucrose through plant cells. D. C. SPANNER. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969, 3 pp.—The sugar of transport in the plant system is pre-eminently sucrose, while free hexoses like glucose and fructose are apparently never concerned. Possible reasons for this are discussed. The pathway by which glucose moves from the leaves to the growing points of stem and root are the sieve-tubes of the phloem—long lines of elongated cells running parallel with the axis, each terminated by a perforated region known as the sieve-plate. The advances in knowledge of the sieve-plates and their function, made possible by electron microscopy, are discussed.

Fate of applied fertilizer nitrogen as determined by the use of ^{15}N. II. Summer plant and ratoon crops at Hilo, Hawaii. D. T. TAKAHASHI. *Hawaiian Planters' Record*, 1969, **58,** 13–20.—In this report experimental details are given relating to one plant crop and three ratoon crops at one location. Concentration of N was slightly higher in the plant crop which had received 50 lb N per acre, no N having been applied to the ratoons. This suggested that much of the N absorbed by the ratoons came from the release of immobilized fertilizer N from prior applications. Downward movement of N was greater in soils low in organic matter because immobilization by soil microflora was limited. Surface soils rich in organic matter retained large amounts of N.

* * *

Computer technology assists cane testing. J. C. WILLIAMS and T. R. LOUDON. *S. African Sugar J.*, 1969, **53,** (8), 598–607.—The South African sugar belt is served by 20 factories spread across several hundred miles. With the large number of cane growers supplying the factories some 10,500 separate accounts have to be maintained. This has involved a great deal of clerical work. How this will be simplified by the use of computers and the many advantages that will accrue when the take-over is complete is explained in the article.

* * *

Studies in intercropping in sugar cane with groundnuts. K. K. P. RAO and M. RAO. *Indian Sugar*, 1969, **19,** 277–278.—Reference is made to intercropping of cane with other crops in India in recent years. Results are given of experiments with groundnuts as an intercrop at the Sugar Cane Research Station, Anakapalle, during two seasons (1964–66). Under prevailing conditions the experiment was not successful. The groundnut crop appeared to be adversely affected by shading and the frequent irrigation and gave a very poor yield. Cane yield was depressed by 4·41 tons/acre owing to reduction in stalk population caused by the spreading growth of the groundnuts.

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Influence of levels of nitrogen, moisture regime and age of sugar cane crop on the available soil moisture. T. R. SRINIVASAN and A. MARIAKULANDAI. *Indian Sugar*, 1969, **19,** 279–282.—Studies on soil moisture depletion patterns under different N levels, in different phases of crop growth, are reported. Depletion of available soil moisture was quicker at higher levels of N application in all the phases of crop growth. As the level of N increased the quantity of water used increased. Soil moisture depletion was quicker during the active growing stage of the cane than at maturity.

* * *

Parasa bicolor—**a new pest of sugar cane in Uttar Pradesh.** H. SINGH and S. P. SHARMA. *Indian Sugar*, 1969, **19,** 283–287.—The activities of this insect pest on certain other crops, notably rice, elsewhere in Asia are referred to. Damage to cane in Uttar Pradesh, caused by the insect, is recorded for the first time. Information is given on the biology and life cycle of the insect and of the nature of the damage it causes to cane.

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A new strain of *Glomerella tucumanensis* causing red rot of sugar cane. O. S. RANA and S. C. GUPTA. *Indian Sugar*, 1969, **19,** 285–287.—Disease surveys showed that the important commercial sugar cane variety CoS 510 owed its decline to a virulent, new, light coloured, highly sporulating strain of the disease, which has been termed R146. Stress is laid on the importance of testing all released and unreleased varieties with recent and representative collections of the parasite in all its forms, in order to prevent further sudden decline of commercial varieties.

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A brief review of work done on phosphate manuring on sugar cane in the Deccan canal tract of Maharashtra State. K. V. JOSHI. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (Addendum), 6–30.—This review supplies information on the following subjects: soil survey and classification of Deccan canal soils, studies on phosphate uptake, availability of P_2O_5 in different soil types, lysimeter studies, field experiments (1939–44) on P_2O_5 response, placement of phosphate fertilizer to the sugar cane crop, phosphate application through carriers, time and method of phosphate application, and use of calcium phosphate in cane manuring. The writer considers that radiophosphorus experiments should now be used to elucidate the mysteries of phosphate nutrition of sugar cane in Deccan soils.

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Crop-logging and rationalizing fertilizer practice for sugar cane. S. V. PARTHASARATHY, A. S. S. MURTHY and A. SUMASUNDARAM. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (Addendum), 31–49. The history of crop-logging or foliar diagnosis as applied to sugar cane is discussed at some length. At Shakkarnagar crop-logging on the CLEMENTS system was commenced in 1955–56 with the idea of obtaining preliminary data on nutrient and moisture status of the crop at different stages of its growth. The results of this and of later work in the area are discussed, notably in regard to N-P-K and moisture.

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Effect of different diseases on the yield of sugar cane in Maharashtra State. S. K. RUIKAR and G. K. PATWARDHAN. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (Addendum), 50–56.—The following diseases, which are commonly observed in the State, are discussed—grassy shoot disease, twisted top, red sheath disease, sugar cane smut, sugar cane rust, brown spot and yellow spot. Two of the diseases are relatively new to the State (first noticed 1954–5), namely grassy shoot disease and twisted top. Grassy shoot (a virus disease) has assumed serious proportions in some parts of the State. With twisted top disease (cause at present unknown), the young leaves do not emerge normally but get twisted up or tangled. The tip may cease to grow and the stalk develop side shoots with short internodes.

Studies on sugar cane rust in Maharashtra State. S. K. RUIKAR and S. B. DESHPANDE. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (Addendum), 57–60.—An account is given of varietal resistance trials. The variety Co 475 was withdrawn from general cultivation because of its great susceptibility to rust. Experiments on chemical control are reported, 7 fungicides being used. Disease incidence was low in all the fungicidal treatments, "Ziram" and "Ferbam" giving the best results. The economics of such spraying has yet to be worked out.

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Cultivation and chemical methods of weed control in sugar cane. E. A. CERRIZUELA. *La Ind. Azuc.*, 1969, **75**, (905), 127–130.—Weed control methods practised in the Tucumán, Salta and Jujuy areas of Argentina are discussed. Tables are given showing the consumption of herbicides used for combating weeds in sugar cane in these areas. The most extensively used herbicides were TCA, PCP, 2,4-D and "Dalapon". Less commonly used weedkillers were "Atrazine", "Ametrine", "Monura", "Diuron", "Linuron", "Silvex" and 2,4,5-T.

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Sugar research: biological and agricultural. A. J. VLITOS and D. W. FEWKES. *Sugar y Azúcar*, 1969, **64**, (9), 27–29.—In this stimulating article the writers acknowledge the benefit the sugar cane industry has derived from research work on fertilizer requirements, cane breeding, weeds, pest and disease control, mechanization, etc. They argue that the time has now come for more research to be carried out in other, more fundamental fields if the industry is to continue to benefit and progress, and that sugar cane research will have to take on a "new look". What forms this might take are discussed. Work on the sugar cane chloroplasts, where sucrose is initially produced, is regarded as particularly important.

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Preparing for mechanical harvesting. S. W. D. BAXTER. *Sugar y Azúcar*, 1969, **64**, (9), 29–34.—The opinion is expressed that mechanical harvesting will become a "must" in all cane growing countries within a few years, if their sugar industries are to survive. This calls for good ground conditions and provision for well managed transport systems. Improving the ground conditions and lay-out to facilitate the use of mechanical harvesters should be done in advance. The many points that need consideration are discussed.

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Reinforced "Paraquat" treatment for fighting emerged weeds in sugar cane. S. Y. PENG. *Sugar y Azúcar*, 1969, **64**, (9), 35–39.—Under the special conditions prevailing in Taiwan reinforced "Paraquat" treatment for weeds in sugar cane, notably "nut grass" (*Cyperus rotundus*) and Bermuda grass (*Cynodon dactylon*), proved very successful. A knapsack sprayer fitted with a flat nozzle was used for the DPA treatment (direct post-emergence application). Inter-row weeds were covered with a left-to-right motion of the spray lance, without spraying the upper cane leaves. Drenching the weed foliage with the spray was necessary to achieve a satisfactory performance. This weed control technique, employing a formula of "Paraquat" + "Dalapon" + 2,4-D, has been recommended for general use in the autumn-planted cane crops in Taiwan.

* * *

Winds break cane. L. L. LAUDEN. *Sugar Bull.*, 1969, **47**, (21), 4.—Strong winds which varied in intensity from 30 to 70 m.p.h. badly damaged or broke canes of the varieties L 60-25 and CP 61-37 on several farms in Louisiana without inflicting damage on CP 52-68 in the same wind area. Breakage of stalks ranged from 15% on one farm to as high as 50% on another. One reason given for the high percentage rate is that cane growth the week before was exceptionally high, making the cane brittle. The wind resistance of some other varieties is discussed.

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The U.S.D.A. seedling programme: selection for commercial production. R. D. BREAUX and P. H. DUNCKELMAN. *Sugar Bull.*, 1969, **47**, (21), 6–15.—This report summarizes research in the sugar cane seedling programme at Houma, Louisiana, during 1964–68. It is explained why conditions are so much more exacting in Louisiana than in other cane growing countries with climates better suited to cane. More than a million seedlings were potted during the 5 years, but some 70% had to be eliminated because of mosaic susceptibility, the mosaic strains A, B, D, H and later I being used. The remainder were evaluated from agronomic characters in the field and sugar yield. Results are summarized in tables.

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The sugar cane crossing programme and related research at Canal Point, Florida in 1968-69. N. I. JAMES. *Sugar Bull.*, 1969, **47**, (21), 15–18.—Details are given of the present crossing programme, seed production and distribution, photoperiod research and plans for the 1969–70 crossing season. Several new clones have been recommended for crossing for the first time. These will be subjected to various photoperiod treatments to synchronize flowering and overcome male sterility if present.

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Ideas that hold water. G. RENFRO. *Sugarland* (Philippines), 1969, **6**, (4–5), 18–22.—The various methods of treatment of water storage reservoirs to prevent seepage or loss of water are discussed. These include sealing by compaction, with bentonite, chemical additives and the use of flexible membranes (polyethylene, vinyl, butyl rubber, etc.). Bentonite is only suitable for reservoirs or ponds that do not have a widely fluctuating water level.

* * *

The necessity of advanced planning by Government and producers for successful mechanical cane harvesting in Puerto Rico. H. A. WILLETT. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 15–21.—Reference is made to the very successful performance of two Cameco mechanical harvesters on trial in Puerto Rico. The writer states he can see no reason why the whole of the Puerto Rican cane crop should not be mechanically harvested if field conditions are improved for manipulation of the harvesters, e.g. by elimination of large ditches and widening of headlands in some cases.

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Experience of and data concerning mechanical harvesting of cane in the 1967 harvest for the Land Authority of Puerto Rico. J. SÁNCHEZ DERGEN. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico.*, 1967, 22–25. The performance of two American-made sugar cane harvesters (Cameco and Cary) in Puerto Rican cane fields is described and analysed in some detail. Figures are presented in tabular form and relate to performance or cane cut per hour, cost per ton, varieties of cane harvested, etc.

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Conservation irrigation system design. S. M. VISCASILLAS. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 68–72.—Conservation irrigation is described as the application of water according to crop needs and at rates consistent with the intake characteristics of the soil and possible erosion hazards. The various factors to be considered in the design of a conservation irrigation system are considered individually and discussed. They include: adequacy of water supply, area, topography, drainage, soil-plant-water relationship, moisture to be replaced, water application, etc.

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Experience with mechanical cane harvesters at Comunidad Agrícola Bianchi, Central Coloso. T. RUÍZ MERCADO. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 26–31.—An account is given of trials with two J & L mechanical harvesters, models S5000 and T1000. Average cutting capacity was 15·9 tons cane per hr as against 35–50 tons quoted for Louisiana. Broken conveyor chains and cutting disc axles and other breakages accounted for much loss of time. For more efficient use of the harvester changes are needed in field conditions, notably levelling, proper drainage systems and wider rows. Sone of the cane varieties grown were suitable for mechanical harvesting.

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Experience with harvesters at Central Igualdad during the 1967 season. F. DELGADO F. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 32–38.—The two harvesters concerned were the Cameco and the Cary. Factors which affected their cutting efficiency most were as follows: planting the cane on 6–8 inch ridges allows the pick-up attachments to get under fallen cane more easily and to raise it; the stalk clusters should not exceed 20 inches in breadth and they should be well aligned.

* * *

Experience in mechanical cane harvesting at Central Monserrat, Inc. J. ZABATA CALAF. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 39–41.—During the 1967 season two of the latest Cary mechanical harvester units were tried. Modification of the transport equipment was called for. In recent years the estate has been preparing fields for mechanical harvesting but the width of rows has still to be increased. For the next season an Australian Toft machine is to be tried.

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Trials effected with cane harvesters on three farms of Sucn. J. Serrallés de Ponce. F. CARRERAS. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 42–45. The performance of three makes of mechanical harvester (Duncaña, U.S. Sugar Corp. and Cary) under prevailing conditions is described. Results are tabulated under 25 different headings. Mechanical failures were due mostly to breakages of chains and conveyors, often caused by stones which should have been removed. Other recommendations are made such as the joining of fields to give rows as long as possible. The Duncaña and U.S. Sugar Corp. units worked more effectively with heavy yielding cane.

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Bulk handling of sugar cane at Central Aguirre Sugar Company. C. V. RODRÍGUEZ. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 46–48.—Because of labour shortage and the high cost of handling cane, the Central Aguirre Sugar Company commenced to use Kenworth trucks and trailers to deliver cane to the factory some years ago. The idea was to have a system on which future mechanization could be built. At present about 20% of the cane milled is mechanically harvested and it is expected to increase this next season. The method of handling the cane is described.

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Drainage of Puerto Rican sugar cane lands. T. C. LYONS. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1967, 59–61.—The need for drainage of sugar lands in Puerto Rico where there is heavy rainfall of short duration is explained. Hitherto, open surface drains have been mainly used. They have the disadvantage of being frequently blocked by weeds and of being unsuitable for the use of mechanical harvesters. Greater use of closed or underground drains is urged. There is now an American machine (suitable for a D6 tractor) that pulls plastic drain tubing into the soil like a moling plough.

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Ecologic tests of the Phil.59 series varieties in Visayas. E. P. LAPASTORA *et al.* *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 9–17.—Experience in the Philippines has shown that a new variety may perform well in one district but not in others and that there are some varieties that perform well over a wide range of conditions. Results are given of trials with 10 new varieties. Only 2 varieties (Phil. 5911 and Phil.5913) could be recommended for planting in the 9 areas covered in the experiment. Other varieties could be grown in certain areas for which they are suitable. Further work on these lines is needed.

Sugar beet agriculture

On the growing of sugar beet under North Bihar conditions. S. C. SHARMA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (IV), 13 pp.—Small-scale experimental plots were established in 5 areas, the variety of beet used being Maribomagna Poly. Germination varied from 7 to 57%. Irrigation was given from time to time. Yields and sugar content were regarded as satisfactory. There was no serious trouble from pests and diseases.

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American sugar beet industry most efficient in world. V. W. BAIRD. *Sugar J.*, 1969, **32**, (1), 20–21.—The writer states that the USSR may be the largest producer of sugar beet in the world but the United States, the second largest producer, is by far and away the most efficient. Cuba, the world's largest sugar cane producer, requires a 14-month growing season to produce $1\frac{1}{2}$ tons of sugar per acre, whereas the American beet grower produces $2\frac{1}{2}$ tons of raw sugar per acre in just 7 months. With the technical know-how and equipment now available, sugar beet can be produced with no more hours of labour than are involved in the production of other crops such as maize, beans and soya beans.

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Sugar beet productivity in relation to seed size. I. A. YAKIMENKO. *Sakhar. Svekla*, 1969, **14**, (7), 34–36. Monogerm beet seed was divided into three groups according to size or diameter—(*a*) 5–6 mm, (*b*) 4–5 mm, (*c*) 3–4 mm—and sown with or without N-P-K fertilizers. Without fertilizer (*a*) and (*b*) produced seedlings of equal weight but those from (*c*) were lighter. With fertilizer the seedlings were heaviest from (*a*) followed by (*b*) and (*c*). The same dependence on seed size was observed for root size and yield of roots and sugar per hectare.

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Principles of clamp design to give minimum loss of sugar and minimum deterioration of beet in storage. J. F. T. OLDFIELD and J. V. DUTTON. *British Sugar Beet Rev.*, 1969, **38**, 15–17.—Among recommendations on beet storage in clamps is the use of straw covering when frost is imminent, but not earlier than one week after piling (when this is done early) so as to allow heat from the initial rapid beet respiration to dissipate. Temperatures in the range 5–15°C are considered acceptable for the centre of the clamp, but covers should be removed at above 15°C, and at above 20°C the clamp should be opened up to allow it to cool. Temperatures below 5°C would suggest inadequate covering. Insertion of a thermometer in the centre of the clamp for daily checks is recommended where the clamp contains more than 50 tons of beet. The beet in clamps should be healthy and well topped, and the clamp should be of regular shape, the apex-type clamp providing maximum drainage of water.

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New results with combinations of herbicides for weed control in sugar beets. A. VETTER and W. VÖLKER. *Zucker*, 1969, **22**, 414–417.—Results are given of two years of testing of mixed insecticides on sugar beet. Some combinations were beneficial and superior to the use of the herbicides individually. Range and persistency were increased as well as tolerance of the beet. Herbicides used included "Pyramin", "Betanal", "Venzar", BAS 2572 H, BAS 2430 H and CP 52 223.

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Effect of transplanting seedlings of sugar beet on the yield and sugar content of the crop. R. R. PANJE and P. S. GILL. *Indian Sugar*, 1969, **19**, 169–171.—Experiments in the transplanting of sugar beet carried out at the Indian Institute of Sugarcane Research, Lucknow, are reported. The variety of sugar beet used was West German Ero type E. There was little difference in yield of roots between the transplanted plots and those sown *in situ*, respectively 43·65 and 45·9 metric tons. The roots from the transplanted plants were, however, fangy or badly shaped and smaller.

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Sugar beet in France. ANON. *Publ. Inst. Tech. Franç. Betterave Industrielle*, 1968, 325 pp.—An account is given of work carried out by the Institute during 1968, especially in the fields of agronomy and mechanization. Experimental work with insecticides and herbicides (pre- and post-emergence) involving numerous compounds or products is discussed. The use of monogerm varieties is considered, notably Maribo, Dieckmann, Bataille, Lepeuple, Cerges Monomer, Dippe and Blondeau. Results of a widely distributed questionnaire are given.

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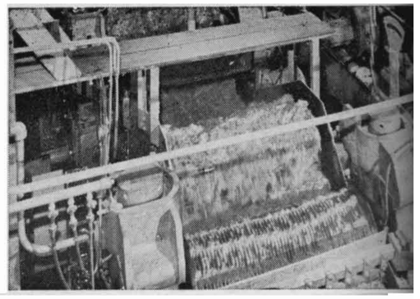
Thirty-eight new hosts of curly top virus. P. E. THOMAS. *Plant Disease Reporter*, 1969, **53**, 548–550.—In a programme to isolate pure strains of curly top virus of sugar beet, 119 species, not previously reported as hosts, were tested. Of these 38 became infected, among which 29 were *Solanaceus*. Details are given of the symptoms exhibited by each species.

Cane sugar manufacture



Indonesia's sugar industry today. H. J. DELAVIER and H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1969, **94,** 507–509.—A survey of the Indonesian sugar industry is presented together with a map showing the locations of the 56 sugar factories in Java and projected factories in Sumatra and Celebes.

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Automatic cane carrier at La Carlota sugar central. M. R. GALEON and E. T. DALIPE. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 94–99.—See *I.S.J.*, 1969, **71,** 340.

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Corrosion and organic coatings for its prevention. V. C. REYES. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 100–102.—The mechanism of corrosion is briefly described and details are given of various types of paint applicable as corrosion inhibitors.

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Industrial engineering work at Victorias. J. P. STO. DOMINGO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 103–104.—See *I.S.J.*, 1969, **71,** 340.

* * *

Mechanized data processing in Biscom. C. O. ORTALIZ. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 105–109.—The IBM data processing system used at Binalbagan-Isabel Sugar Co. in the Philippines to handle the accounts of about 2000 cane growers working about 40,000 ha of cane is described.

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The reduction and control of calcium salts in cane sugar fabrication. J. CASEY. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 232–245.—See *I.S.J.*, 1969, **71,** 82.

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The use of magnesium oxide in cane juice clarification. C. M. MADRAZO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 246–258.—The benefits derived from using "Magox" magnesium oxide in clarification at San Carlos (mainly a reduction in scale formation) are demonstrated with the aid of tabulated data, and the economics of its use are discussed.

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The drought in the San Carlos sugar district and its effects on the overall factory operation. C. M. MADRAZO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 259–265.—A study of the rainfall records for this area of the Philippines, covering a 46-year period from 1914 to 1968 excluding the World War II years, has shown that droughts occur at maximum frequencies of 3 years and may last for 2–3 years. The effects of drought on the performance of San Carlos sugar factory are discussed with the aid of tabulated data. Cane grown under these conditions contains a smaller quantity of mixed juice (because of a higher fibre content) and yields more molasses compared with cane grown under normal conditions.

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Vacuum pan boiling and automation. J. J. QUINTERO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 266–271.—A proposed system for automatic boiling control is described and the operation stages set out. A diagram and schedule sheet are reproduced.

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Industrial waste water of sugar factories in the Philippines. J. M. TIGLAO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 272–274.—Sugar factory effluent treatment by lagooning, in order to reduce river pollution, is discussed and reference made to work at the University of California on the elimination of H_2S gas, formed during anaerobic fermentation, by specific oxidizing bacteria which freely thrive in a sulphide-containing medium and split H_2S into hydrogen and sulphur.

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Participation of the Philippine iron and steel industry in the Philippine sugar industry. A. M. HAIN. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 275–280. The author advocates Philippine manufacture of sugar factory equipment such as is carried out at Victorias Milling Co. Inc. and compares the costs of certain imported items with the costs of the same items produced locally.

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Local foundry products for the sugar industry. J. J. BAUM. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 281–283.—The suggestion is made that the Philippine sugar industry can save itself considerable expenses by buying Philippine-built equipment.

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A mathematical simulation in the sugar industry. A. HILADO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 297–300.—Factory output can be calculated by means of the formula: tons sucrose in raw sugar = tons sucrose in syrup × boiling house recovery. The syrup sucrose content is obtained as the difference between tons sucrose in mixed juice and tons sucrose in filter mud, both of which are obtainable from the weekly work sheet as recommended in the official chemical control methods for Philippine sugar factories. Tabulated results over a week show a difference of less than 1% between calculated and actual tonnages of sugar.

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Inventory management. J. R. A. MONTELIBANO and P. PFIFFNER. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 284–292.—Details are given of the system used at Victorias Milling Co. Inc. to organize maintenance of equipment inventories and rationalize requisitioning, purchasing and usage of stock items.

* * *

Bulk sugar handling in the Philippines. L. YMSON. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 293–296.—The handling of sugar at Guimaras bulk terminal is discussed with particular reference to the financial aspects of commingling, inloading and outloading of sugar and insurance. Problems involved in commingling are discussed.

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Survey of formulae for assessing cane milling capacity and cane milling efficiency. U. C. UPADHIAYA. *Indian Sugar*, 1969, **19**, 265–276, 325–335.—A survey is presented of formulae for estimating cane mill crushing capacities and extractions. The validity of each formula is discussed in turn. It is shown that none of them is reliable over a wide range of factors affecting performance. Four basic criteria are listed which the author considers should be included in any reduced formula for mill efficiency calculation, whether on an extraction basis or on a loss basis.

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The Carl Schenck juice weigher. H. R. HAREL. *Rev. Agric. Sucr.* (Mauritius), 1969, **48**, 63–65.—The construction and method of operation of an automatic juice weigher manufactured by Carl Schenck Maschinenfabrik GmbH, of West Germany, are described.

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Improved bulk storage of raw sugar. A. ACOSTA. *Sugar y Azúcar*, 1969, **64**, (10), 22.—Details are given of the system used at the Gladesview sugar factory of the Atlantic Sugar Association Inc. The warehouse has a capacity of 16,000 tons. Sugar is dropped from a belt conveyor provided with a trolley to small piles for 24-hour storage at 96–106°F, after which it is moved by thrower to a final storage pile where its temperature will be in the range 75–85°F.

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New system for controlling humidity in warehouses which eliminates heating. ANON. *Bol. Azuc. Mex.*, 1969, (233), 22–23.—An account is given of the "Climatic Control System" of Shaw Moisture Meters for use in warehouses[1].

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Processes for filtration of turbid concentrates in the cane sugar industry. H. FROST. *Zeitsch. Zuckerind.*, 1969, **94**, 551–554.—Conventional filtration of clarifier muds is considered unpractical in view of the resultant turbid filtrate which is sent to sulphitation. The "RapiFloc" and "Eimcobelt" filter systems are regarded as too expensive. A proposed method is described, in which the mud passes from a small flow-through clarifier via a mixing vessel to a rotary vacuum filter, from which the filter-cake is continuously removed by means of high-pressure steam fed from a cylinder coupled to the filter. Filter-aid is added to the juice in the clarifier, and conventional filter-cloths are used on the rotary filter. No bagacillo is used as filter-aid. Costs, material requirements and possible throughputs are compared with existing methods of handling clarifier muds.

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Optimum exhaustion of C-strike—its molasses exhaustion index. J. R. ARIOSA M. *CubaAzúcar*, 1968, (May/June), 10–13, 40–43.—Optimum conditions in the final strike are discussed as are its cooling in the crystallizer and reheating. The DOUWES DEKKER formula for judging exhaustion of molasses is used for assessing the performance of Cuban factories but with a modification of the standard from 35·886 to 37·893.

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Experimental determination of the heat transfer coefficient in sugar industry evaporators as a function of the juice level and concentration. J. ZÁVORKA, A. AGUADO and F. VÁZQUEZ. *CubaAzúcar*, 1968, (May/June), 14–24, 43–52.—Experiments were made in the experimental evaporator at the University of Las Villas to relate the heat transfer coefficient with juice height in the evaporator tubes for solutions of different concentrations. The data obtained are recorded in tables and in the form of graphs which show that the coefficient falls with increasing Brix at the same height but also that, with juice of 20, 30 and 40°Bx, it reaches a peak and then falls with increasing height of juice level, the maximum occurring at about 30% of tube height. With 50 and 60°Bx juices, the coefficient continues to rise above this proportion of tube height, but at a slower rate.

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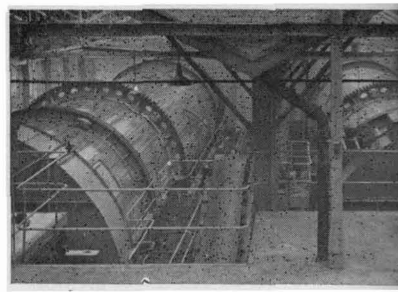
Analysis of sugar cane deterioration in relation to the time it is cut and left in the field. S. M. RODRÍGUEZ S. *CubaAzúcar*, 1968, (May/June), 26–29, 52–54.—Experiments were made in which canes of three varieties were cut, each providing 4 groups comprising 16 samples of 20 canes each. The samples were weighed each day and analysed on successive days, so giving four sets of figures per day per variety which were then used to calculate the loss in sugar content with time. The experiment was carried out in February/March and repeated May/June. In the first, it was found that POJ 2878 and PR 980 cane showed greater losses of almost 21% after 10 days and about 40% after 15 days. With B 42231 cane, the loss was about 15% after 10 days and 30% after 15 days. With POJ 2878 and PR 980 cane, the May/June experiment showed lower rates of loss, viz. 19–20% after 10 days and 33–34% after 15 days, but the rate had slightly increased for the B 42231 cane to 19% after 10 days and 31% after 15 days.

[1] *I.S.J.*, 1969, **71**, 62.

Beet sugar manufacture



Sugar in Yugoslavia. H. HIRSCHMÜLLER and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1969, **94,** 554–557.—A survey is presented of the Yugoslavian beet sugar industry which includes 13 factories and produces nearly all of the country's sugar requirements. Consumption is only 25 kg per caput per year despite the low price of the sugar.

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The explosive property of sugar dust. A. V. DAN'KO and A. M. KOSTENYUK. *Pishch. Prom.*, 1969, (8), 15–22.—The literature on sugar dust explosions is surveyed, including such factors as the upper and lower limits of dust concentration at which an explosion can occur, the effect of oxygen content in the air and of admixtures of incombustible gases, ignition sources, dust dispersion and the moisture content of dust in the air.

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Determination of optimum temperature of cooling and spinning of low-grade massecuite. D. E. SINAT-RADCHENKO and V. D. POPOV. *Pishch. Prom.*, 1969, (8), 125–131.—Formulae and graphs are given and a method described for calculating the optimum cooling and curing temperatures for low-grade massecuite and finding the minimum molasses purity obtainable under these optimum conditions. Worked examples are given.

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Simplified control of continuous twin-scroll trough-type diffuser operation. S. GAWRYCH, R. KACPRZAK and M. RUTKOWSKI. *Gaz. Cukr.*, 1969, **77,** 242–244.—The theory of sugar extraction in a DDS diffuser is analysed mathematically and the relationship between the sugar content in the solid and liquid phases considered. Measurements have shown that the sugar contents in press water and exhausted cossettes (expressed as apparent refractometric Brix) are sufficiently close as to provide a basis for diffusion control.

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Ion exchange membranes in the sugar industry. IV. Results of laboratory and pilot plant tests. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1969, **85,** 230–232.—Details are given of tests in which thin juice was delimed and thick juice demineralized by electrodialysis. Tabulated results indicate the greater reduction in thin juice Ca salts and in thick juice ash obtained by feeding the juices to both dilution and concentration chambers in preference to juice in the dilution and water in the concentration chamber.

Effect of the working conditions in juice purification on thick juice purity. J. HRUBÍŠEK. *Listy Cukr.*, 1969, **85,** 235–237.—Tests at the Sugar Industry Research Institute in Prague on samples from the 61 Czechoslovakian sugar factories showed that fluctuations in thick juice purity could be only partly attributed to variation in raw juice purity, whereas the major cause was fluctuation in juice purification efficiency.

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Operation control of a thin juice demineralization unit and methods used for this. F. PERSCHAK and H. KLAUSHOFER. *Zucker*, 1969, **22,** 608–614.—The methods used to control the operation of the Imacti ion exchange plant at Hohenau sugar factory (West Germany) are described. Thin juice is passed through a strongly acid cation exchanger in H^+ form and then through a weakly or moderately basic anion exchanger. Methods for calculating a number of parameters, including throughput and non-sugar removal, are also given, and details are given of the means used to test the mechanical stability of the resins and their resistance to oxidants.

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Filter-thickeners at Petoháza sugar factory (Hungary). M. CZIRFUSZ. *Cukoripar*, 1969, **22,** 174–177.—The electro-kinetic theory of juice purification is discussed as a prelude to a description of the system used at Petoháza where a thickening-filter station is used to treat 2nd carbonatation juice. Use of the filters has accelerated treatment of the juice compared with conventional clarification and filtration, and check filtration has been eliminated.

* * *

Re-utilization of sugar factory muds after calcination. V. BIZAU. *Sucr. Belge*, 1969, **88,** 405–416, 473–485. At a French sugar factory tests were made on utilization of lime obtained by calcining carbonatation mud from the rotary filters at 1000°C. The results showed that over a period of 22 days up to 27% of the total quantity of lime consumed was made up of lime recovered from the mud. The recovered lime contained 90–93% CaO, and in the tests was found to have no adverse effect on the juice or its processing, although it should be limited to 30% of the lime used, this limitation being imposed by the quantity of CO_2 available for carbonatation. Further tests with experimental plant showed that the use of a rotary dryer to convert the muds to granular form improved calcining in a subsequent rotary kiln. Details of these pilot-scale tests are given, confirming the earlier findings. It was also found possible to recycle CO_2 from the

1st carbonatation vessel through a pre-carbonatation vessel back to 1st carbonatation and to 2nd carbonatation. The factory test scheme used is described and the results discussed in detail.

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Counter-current heat exchangers for cossettes and juice. F. SCHNEIDER, E. REINEFELD and H. P. HOFFMAN-WALBECK. *Zucker*, 1969, **22**, 535–544.—Details are given of the design and operation of BMA and Buckau-Wolf cossette scalders in which the cossettes are heated by recirculated raw juice which is thus cooled and the cossette-juice mixture then fed to the tower diffuser. The system is contrasted with the older one in which the cossettes are heated by a mixture of raw juice and steam. The savings in steam are calculated and the advantages and disadvantages of reducing the raw juice temperature to 23°C instead of the higher temperatures in the older schemes are discussed.

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"Filterperlit", a new filter-aid. R. OSVALD and E. HAVLOVÁ. *Listy Cukr.*, 1969, **85**, 196–201.—Production and application of expanded perlite, three types of which are being produced in Czechoslovakia, are discussed. Of the three, the best for sugar solution treatment is PF-2-H, which has the highest small particle content. Methods for testing the filter-aids are described.

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Method of juice purification with cold defeco-saturation and cold and hot liming. A. K. KARTASHOV, YU. D. GOLOVNYAK, S. L. SHOIKHET, V. A. NAGORNAYA, G. P. PUSTOKHOD, V. Z. SEMENENKO, L. I. ONISHKO and T. I. SHCHUPKO. *Sakhar. Prom.*, 1969, **43**, (9), 22–27. Laboratory and factory tests are reported on a carbonatation scheme in which raw juice at 40–45°C is subjected to pre-defeco-saturation (simultaneous liming and gassing) to pH 8·8–9·0 with 40–50% of the total quantity of lime used in purification. The rest of the lime is added in the next stage (cold liming) after which the juice is heated rapidly to 85°C and held at this temperature for 10–15 min during hot "liming". Conventional 1st carbonatation to pH 10·9–11·2 follows, after which the juice is again heated to 85°C and clarified. Slight variations of the proposed scheme were also tested. Full details are given of the results, which indicate a 15–25% fall in the colour content of sulphitation and thick juice compared with conventional carbonatation and greater thermal stability of the juice in evaporation.

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Tests on a filter with centrifugal mud discharge. V. A. ZAMBROVSKII, YU. V. ANIKEEV, YA. G. ROPOTENKO and V. A. TSYS'. *Sakhar. Prom.*, 1969, **43**, (9), 28–33. A Soviet-built filter is described in which the filter elements are carried horizontally, sloping slightly inwards, on a vertical shaft. Each "disc" element has a perforated top and a closed base, so that juice pumped to the bottom of the filter flows up under pressure and falls onto the pre-coated elements and then down through the central shaft to discharge. After filtration, pre-coat and mud are discharged by spinning the shaft and elements at 270 r.p.m. by means of an electric motor. Intended for treatment of 2nd carbonatation and thick juice, the filter has a daily throughput of juice from 1000 m. tons of beet. A modification to the design of the elements was found necessary in order to reduce turbidity of the filtrate. Performance data are tabulated.

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Features of the design of disc water separators. N. M. DATSENKO, V. P. LYSIKOV and E. T. KOVAL'. *Sakhar. Prom.*, 1969, **43**, (9), 33–38.—Soviet-built beet water separators with discs of special design have proved unreliable in prolonged use. Reasons for their failure are given and a number of recommendations for improved operation are listed.

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Instrument for determining juice filtration rate. Z. S. VOLOSHIN. *Sakhar. Prom.*, 1969, **43**, (9), 39–40.—The arrangement described consists basically of a juice sampling pipe, a filter ribbon and a 250-ml vessel. The time taken for the juice sample to fill the vessel after passing through the ribbon is automatically recorded through a conductimetric sensing element. At the end of each cycle the filter ribbon is automatically wound on and the vessel emptied in readiness for the next cycle. The device has been tested.

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The electric drive and automatic control systems of a Buckau-Wolf centrifugal and industrial test results. P. V. ZOBNIN, K. P. TIMOSHENKO and R. I. BATYREV. *Sakhar. Prom.*, 1969, **43**, (9), 43–46.—Tests in 1967/68 with an automatic 1000-kg capacity Buckau-Wolf centrifugal with 1st massecuite demonstrated the reliability of the machine. The automatic controls are described, and the advantages of the use of a thyristor-controlled drive with a D.C. motor are listed.

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Prevention of corrosion of the convective surface of sugar factory steam boilers. M. L. POLYAK, G. I. AKOPNIK and V. D. YABLONOVSKII. *Sakhar. Prom.*, 1969, **43**, (9), 47–51.—Causes of marked corrosion in the economizer tubes of boilers in a Soviet sugar factory first put into operation in 1964 included absence of pre-heating (for reasons given) and inadequate deaeration of the feed water. Flow schemes are given for condensate cooling and deaeration and feed water heating.

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The effectiveness of cutting beet roots lower. V. A. BULDA. *Sakhar. Prom.*, 1969, **43**, (9), 55–60.—Removing the crowns of beet during harvesting, i.e. 10% of the total root weight (delineated by a cut 20–22 mm from the top of the beet) is shown to have economic advantages for both grower and factory. Detailed balances are presented.

Boiling of magma for 2nd massecuite at Szczecin sugar factory. J. SOLTYSIAK, J. WOLAŃSKI and Z. GROSZKOWSKI. *Gaz. Cukr.*, 1969, **77**, 185–187. Details and advantages are given of the boiling system used at Szczecin sugar factory, Poland, where white sugar is obtained from 1st massecuite, and a refined sugar is boiled on remelted 2nd product sugar, the latter obtained by boiling on 3rd sugar remelted in 1st massecuite run-off.

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Effect of prolonging the (beet) campaign to January on production and quality of sugar at Gdansk sugar factories. B. GOSTAŃSKA. *Gaz. Cukr.*, 1969, **77**, 187–192.—Tabulated data for the three campaigns 1966/67 –1968/69 are presented to show that the quality of beet processed in January is sufficiently poor as to result in sub-standard processing and hence low quality sugar, so that production of consumption sugar in January is often unpractical.

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Development and operation of the carbonate process at Enns sugar factory. J. ELMER, H. HITZEL and E. MOEBES. *Zucker*, 1969, **22**, 545–549, 566–573.—Details are given of the developments at Enns, Austria, where the carbonate ion exchange process[1] is applied to half of the thin juice. In the 1968/69 campaign of 60 days, at an average daily slice of 5171 tons of beet a non-sugar removal of 0·169% on beet was obtained with just one ion exchange combination working 344 cycles. With a Quentin ion exchange unit for molasses included in the scheme, an increase in sugar yield of 0·581% on beet was obtained.

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Preventive measures against sugar dust explosions. III. G. SCHNEIDER. *Zucker*, 1969, **22**, 573–577. Methods of reducing the intensity of dust explosions by relieving the pressure are described and results of experiments on reducing the effects of sugar dust explosions are reported.

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Present state of control in the sugar industry. J. GENOTELLE and R. MICHEL. *Ind. Alim. Agric.*, 1969, **86**, 907–916.—A survey is presented of the types of equipment used for indicating, recording and regulating in the French sugar industry, and processes generally used for control of individual stations are described, with a brief mention of co-ordination between the various stations.

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Flocculation of clays and clarification of sugar factory muddy waters. M. ROCHE. *Ind. Alim. Agric.*, 1969, **86**, 919–923.—In tests on flocculation of a clay suspension to determine the comparative efficiencies of settling aids in the treatment of sugar factory effluent, little difference in settling rate was found between the various proprietary brands at doses of 1 p.p.m. and above. In further tests with three of the flocculants, the clay suspension was settled and the water then filtered through a membrane under vacuum. Addition of flocculant increased the time in one case and reduced it in another, so that no marked influence on mud permeability could be found. However, addition of flocculant to kaolin suspensions undergoing bacterial treatment slowed the process, possibly by adsorbing the bacteria and thus reducing the population.

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The influence of the quality of water for diffusion in the sugar factory. R. PIECK. *Ind. Alim. Agric.*, 1969, **86**, 925–930.—Laboratory diffusion tests have shown that distilled water (condenser water) and deionized water hold a number of disadvantages when used for diffusion, compared with the use of raw (well) water. Where an acid is added to reduce the pH during diffusion and so prevent partial dissolution of pectic matter, SO_2 is preferable to H_2SO_4 or HCl because of difficulties in dosing where a pH regulator is used in conjunction with an acid feed valve. Addition of calcium salts ($CaCl_2$) to diffusion water or exhausted cossettes has been found to raise the dry solids content of pressed pulp considerably, probably as a result of a cation exchange process which also reduces the raw juice colloid content. However, such addition of calcium salts can also cause increase in the ash content of carbonatation juice. Use of well water plus $CaCl_2$ resulted in a much lower filtration time for 1st carbonatation juice than did distilled and ammoniacal water and water saturated with $CaSO_4$, and gave lowest mud volume after 20 minutes' settling. The purities of raw and thick juice were about the same irrespective of the water used for diffusion. The choice of water and chemicals to use for diffusion will be governed by factors specific to each sugar factory.

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Handling in the sugar factory. J. PONANT. *Ind. Alim. Agric.*, 1969, **86**, 975–982.—Mechanical handling of beet and sugar is discussed with brief descriptions of and references to the various pieces of equipment used.

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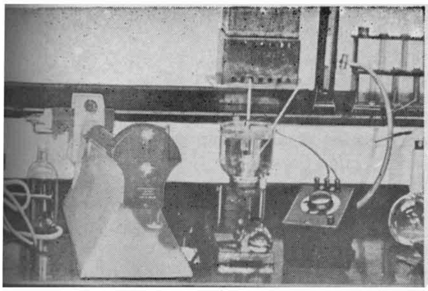
Control of the boiling process at Leopoldsdorf sugar factory (Austria). M. DE MARBAIX, K. DÖRSCH and F. LAABER. *Zucker*, 1969, **22**, 633–638.—In the boiling control system described, supersaturation is determined from the mother liquor boiling point elevation. Accuracy of this determination is ensured by means of a pilot water boiler installed in the vapour space and by precise vacuum control. Since massecuite temperature undergoes local fluctuations in pans fitted with stirrers, as in this case, the conventional measuring equipment has been replaced by a system involving a large-surface measuring cell installed in the downtake which measures the steam pressure (this is dependent on massecuite temperature) and transmits the signal to a transformer which compares it with the pressure in the vapour space. The complete boiling process is described in terms of the control stages.

[1] MOEBES: *I.S.J.*, 1960, **62**, 257.



Laboratory methods & Chemical reports

Qualitative observations on spontaneous combustion of waste molasses. J. P. Shukla, B. D. Kapoor and R. Chandra. *Sharkara*, 1968, **10**, 122–125.—Graphs are given showing the rise in temperature with time when molasses was heated over an open flame. The various phenomena observed at particular temperatures are noted and the effects of adding hot molasses to cooler molasses and of adding amino-acids to molasses discussed. Frothing occurred at 125°C and charring at 250°C. Viscosity fell to a minimum at 100°C, after which it rose sharply, while reducing and total sugar contents fell with increase in temperature from 80°C.

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Automated on-stream analysis. A. J. Ancona, N. Anastasakos and L. Pond. *Proc. 27th Meeting Sugar Ind. Tech.*, 1968, 118–131.—An "AutoAnalyzer" has been used at SuCrest refinery for automatic measurement of pH and invert sugar in all the products from raw sugar melt to pre-evaporated liquor and covering granular carbon and ion exchange decolorization. The pH of granular carbon influent and sweet-water are adjusted automatically. Standard deviation with the "AutoAnalyzer" was $\pm$ 0·003 at 0·25% invert content compared with $\pm$ 0·004 with the Lane & Eynon method used manually, and the coefficients of variation were $\pm$ 1·2% and $\pm$ 1·6%, respectively.

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Symposium on methods of analysing and evaluating final molasses. H. J. Reiche, J. F. Dowling and W. W. Binkley. *Proc. 27th Meeting Sugar Ind. Tech.*, 1968, 154–182.—Methods used to analyse final molasses and evaluate the results and to determine final molasses exhaustion are reviewed.

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Molasses analysis: moisture determination. S. Stachenko. *Proc. 27th Meeting Sugar Ind. Tech.*, 1968, 183–191.—The Karl Fischer method of determining the moisture content of molasses is described.

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Causes of juice coloration during concentration in evaporators. H. Zaorska and S. Zagrodzki. *Gaz. Cukr.*, 1969, **76**, 164–169.—See *I.S.J.*, 1969, **71**, 104–108.

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A new method of evaluating sugar cane for fibre and juice extraction. L. P. Hebert and N. I. James. *Sugar y Azúcar*, 1969, **64,** (9), 42–44.—The fibre content in bagasse and cane was determined by two methods involving crushing in a 3-roller mill followed by (i) cold water diffusion, and (ii) washing in a washing-machine. While no essential differences were found in the values obtained by the two methods, the washing-machine method takes only 2 hr to give the same accuracy as the other method, which takes 60–72 hr. A method for determining fibre content and recoverable sugar using a "Jeffco" cutter-grinder followed by a hydraulic press was compared with one in which juice was extracted in a 3-roller mill. Results were very close for one cane variety but differed with another. Tests with the two methods are discussed.

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Enzymatic hydrolysis of some polysaccharides. R. Bretschneider and J. Čopíková. *Listy Cukr.*, 1969, **85,** 188–191.—Enzymatic hydrolysis of pectin, araban, galactan, dextran and laevan is explained and optimum conditions are given. At an optimum temperature of about 40°C and in acid conditions, 1 g of "Pectinex" preparation per litre of raw juice caused a drop in juice filtrability after 15 minutes' hydrolysis but improved sedimentation. After 30 minutes' hydrolysis both filtration and sedimentation were better than without hydrolysis. A longer period of hydrolysis is technologically undesirable.

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Microbiological purity of Czechoslovakian refined sugars. L. Vokounová. *Listy Cukr.*, 1969, **85,** 192–196.—The populations of mesophiles, thermophiles, osmophilic yeasts, moulds and slime-forming bacteria in refined sugar samples taken from process and from storage were determined and the counts tabulated for granulated, cube and icing sugar.

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Regeneration of adsorbents: bone char and "Synthad". G. W. Muller. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 1–19.—The physical characteristics of bone chars are discussed. Pore size, distribution and volume have been determined with a mercury porosimeter and the results are discussed, as are those physical characteristics that are desirable in service chars. Char regeneration requirements are explained. In a discussion of the article, M. C. Bennett talks about electron microscopy of various forms of char, and photomicrographs are reproduced of bone as a natural material, carbonized bone, new bone char, service chars and the carbon component in new and service chars. The question of the carbon content of chars and its possible relationship with the decolorizing power is also discussed with reference to research work being undertaken by Tate & Lyle Ltd.

The porosity of activated carbon and its relation to cane sugar refining. J. T. TRUEMPER. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 24–34. The relationship between carbon porosity (expressed in terms of total pore volume and pore volume distribution according to pore size) and the rate of adsorption of colouring matter from a sugar liquor is examined. While this relationship and one between porosity and sucrose diffusion into and out of carbon have been well established for batch systems on the basis of diffusion models, further work is necessary for establishing relationships applicable to flow through a granular bed. The measurement of particle density has been found to be a good indication of carbon efficiency by comparison with fresh carbon and hence can be used as a guide to regeneration.

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Laboratory evaluation of ion exchange resins for sugar processing. R. D. MOROZ and J. P. SULLIVAN. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 50–61.—Techniques for use in determining the more important properties of ion exchange resins are described, covering resin shapes, sizes, expansion and contraction characteristics as well as decolorizing and deionizing efficiencies. It is emphasized that wide variation in the characteristics of process liquors used for evaluating the processing properties of the resins makes it necessary to carry out extensive tests, and that laboratory testing is only of use in connexion with previous or subsequent pilot-plant studies.

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Quick starch method of analysis on raw sugars. D. F. CHARLES. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 75–84.—In tests to compare the accuracy of a modification of the Balch method for starch determination with the original Balch method, close agreement was found between the two methods in tests on a filtered 50°Bx raw sugar solution. The new method involves adding an iodine reagent (potassium iodide and potassium iodate) to a clear sugar solution of known solids content and then measuring the spectral absorbance at 560 nm. Reproducibility of the new method, which is considerably more rapid than the Balch method (this uses the same reagent, qualitatively, but is more involved and spectral absorbance is read at 700 nm), has not been determined.

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Separation of colorants from cane sugar. L. FARBER, E. J. McDONALD and F. G. CARPENTER. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 85–104. From high-voltage paper electrophoresis studies, a number of colouring substances occurring in cane juice have been allotted arbitrary numbers based on their fluorescence, and these reference spot numbers subsequently used to follow the various colorants through refinery products from raw to granulated sugar and including bone char. The various extraction techniques used to isolate the colouring substances are described.

Methods for separating sugar colorants. N. H. SMITH. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 105–116.—Various methods used to isolate colouring substances from Hawaiian cane molasses are compared. They include dialysis, gel filtration, precipitation with lead acetate, precipitation of alcohol-insoluble colorants, absorption by bone char followed by elution with an appropriate solvent, and adsorption by ion exchange resins. The optical properties of the fractions are given for each method. Spectral and electrophoretic analysis of the fractions was also carried out and showed that a large number of components were present in the isolated fractions as well as in the source of the colorant.

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The isolation and properties of sugar colorants. K. J. PARKER and J. C. WILLIAMS. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 117–128.—In a study of colouring substances in raw sugars and formed during refining, the colorants were isolated by one of two methods: adsorption on "Amberlite XAD-2" hydrated polystyrene resin, and precipitation of the anionic colorant at pH 7·5 with an aqueous dispersion of dioctadecyldimethylammonium chloride or hexadecyltrimethylammonium bromide (CTAB). The properties of the isolated colorants were then determined, including their absorption spectra in visible, u.v. and i.r. light, type of charge, the net anionic charge and anionic charge density, molecular weight, solubility and structure. Separation by adsorption on active alumina is also briefly described.

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Symposium on raw sugar quality standards. E. J. CULP. *Proc.* 1968 *Tech. Session Cane Sugar Refining Research*, 138–159.—Evaluation of raw sugar refining properties is discussed, mostly from the US refiners' viewpoint but also with some reference to the raw sugar producer.

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Aspects of colloid chemistry of cane juice clarification. P. HIDI. *Sugar J.*, 1969, **32**, (4), 27–32.—See *I.S.J.*, 1969, **71**, 89.

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Polysaccharide-forming micro-organisms in sugar manufacture. III. F. SCHNEIDER, H. P. HOFFMANN-WALBECK and M. A. F. ABDOU. *Zucker*, 1969, **22**, 561–566.—The physiological and biochemical properties of a laevan-producing bacterium, *Corynebacterium beticola*, which occurs in infected sugar beet, are reported, and the effects, individually and mutually, of *C. beticola*, *Pseudomonas fluorescens* and *Leuconostoc mesenteroides* in infected beet are described. A simple scheme is given for differentiating between the three micro-organisms.

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Autocatalytic reaction of sucrose decomposition in the presence of non-sugars. Z. A. MIL'KOVA, S. Z. IVANOV and A. R. SAPRONOV. *Sakhar. Prom.*, 1969, **43**, (9), 11–13.—Laboratory investigations showed that amino-acids and K, Ca and Na acetates had the greatest

buffering (inhibiting) effect on sucrose auto-decomposition, but that the buffering effect of the non-sugars in a complex was lower than the sum total of the individual effects. KCl accelerated sucrose decomposition. With all the non-sugars, the curve of sucrose decomposition *vs.* time for a solution heated on a boiling water bath was S-shaped. Satisfactory agreement was found between experimental data and values obtained by calculation with a previously derived formula. The total inhibiting effect of non-sugars in thick juice was greater than that of the non-sugar complex in green syrup and yellow sugar. Reasons for this are given.

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Reasons for a fall in sucrose crystallization rate in green syrup at 90°C. A. A. GERASIMENKO and Z. B. SHAPOSHNIKOVA. *Sakhar. Prom.*, **43,** (9), 14–15.—A reduction in sucrose crystallization rate when green syrup was heated from 80 to 90°C contrasts with an increase on heating from 70 to 80°C. The phenomena are explained by the fact that the viscosity fell with heating from 70 to 80°C but increased again with heating from 80 to 90°C.

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Causes of crumbling of anion exchange resin granules during refinery syrup decolorization. G. A. CHIKIN, V. M. SOLOV'EVA and L. I. IVANOVA. *Sakhar. Prom.*, 1969, **43,** (9), 16–17.—Microscope studies of the behaviour of granules of AV-16G anion exchange resin through which sugar solution was passed under controlled conditions showed that mechanical damage to the granules was basically caused by quite sharp changes in the volume of the resin bed when saturated with the solution and when the sucrose is displaced from the bed. The bed volume passes quickly through minimum and maximum as a result of the change in the difference between the osmotic pressures of the solutions outside and within the resin bed caused in turn by the rapid increase or decrease in the sucrose concentration in the solution outside the bed. The volume change is more rapid with sucrose displacement than with bed saturation.

* * *

Control of activity of micro-organisms in diffusion. E. A. KHODURSKII amd N. S. CHECHEL'. *Sakhar. Prom.*, 1969, **43,** (9), 41–43.—A rapid method developed by the Sugar Industry Institute in Warsaw, Poland, for determining the extent of bacterial infection in press water and diffusion juice has been applied at one Soviet sugar factory and found to be suitable. The method is based on reduction of triphenyl tetrazolium chloride and coloration of the sample under the effect of the micro-organisms. The range of colour is from rose to beetroot red.

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Research on non-sugar solids. J. C. GONZÁLEZ M. *CubaAzúcar*, 1968, (March/April), 2–9, 34–41.—An account is given of an investigation into non-sugar solids entering the factories in cane and also present in molasses. The analyses were not exhaustive, comprising reducing sugars and non-fermentables, nitrogen, colour, and ash. Data are tabulated for different periods and four sugar factories, and the influence of non-sugars on molasses production is discussed.

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Evaluation of raw and white sugar. M. FRIML. *Cuba-Azúcar*, 1969, (March/April), 21–23, 48–50.—The factors taken into consideration in determining the quality of raw and white sugar in Czechoslovakia are discussed.

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Hardened sugar—its causes and possible solutions. C. MILIÁN S. *CubaAzúcar*, 1969, (March/April), 24–28, 50–54.—Factors affecting the hardening of bagged sugar are listed and discussed separately; these include high moisture content, high bag filling temperature, high atmospheric humidity, and the physical conditions of the sugar store. Recommendations are made for avoiding hardening and data from three sugar factories are tabulated.

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The six quality standards of raw sugar with special reference to Philippine sugars. C. M. MADRAZO. *Proc. 16th Conv. Philippines Sugar Tech.*, 1968, 57–66. The six standards (covering safety factor, ash and osmophilic yeast contents, filtrability, colour and grain size) set by The American Sugar Co. for raw sugar refining quality are discussed and the latest agreed revisions reported. Methods which could be used to improve raw sugar quality so as to meet the requirements are described.

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Natural waxes. IX. Occurrence, isolation and identification of olefins in natural waxes. M. STREIBL and K. STRÁNSKÝ. *Fette Seifen Anstr.*, 1968, **70,** 343–348; through *Anal. Abs.*, 1969, **17,** 2227.—A review is presented of methods used in the separation and identification of olefins. In an experimental method, 0·1–1 g of wax is dissolved in $CHCl_3$, the solution mixed with aluminium oxide (5 times the weight of the wax), and chromatography effected at room temperature on a column of aluminium oxide, with hexane or ethyl ether as eluant. The fractions are monitored by thin-layer chromatography on "Kieselgel G" impregnated with 20% $AgNO_3$ solution, with hexane as solvent. The spots are located by spraying the chromatogram with conc. H_2SO_4 and heating. The olefins in the hydrocarbon fraction can be recovered at 2–3% concentration. The method is exemplified by the fractionation of sugar cane waxes, and by the isolation of 78 mg of mixed *trans*-mono olefins from 200 g of beeswax.

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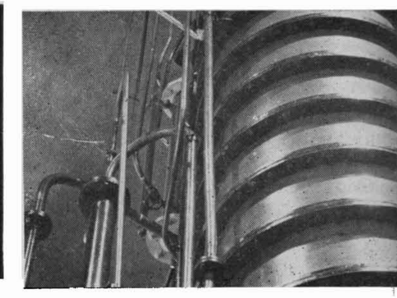
Reasons for increase in juice coloration during evaporation. H. ZAORSKA and S. ZAGRODZKI. *Ind. Alim. Agric.*, 1969, **86,** 951–958.—See *I.S.J.*, 1969, **71,** 104–108.

By-products



Protein levels in molasses-based diets for growing pigs between 20 and 67 kg live weight. N. A. MACLEOD, M. VELAZQUEZ and T. R. PRESTON. *Rev. Cubana Cienc. Agríc.*, 1968, **2**, 201–204.—Tests in which pigs were fed on diets containing different quantities of protein (12, 14, 16 and 18% on dry matter) plus high-test molasses, fish meal and yeast showed that nitrogen retention was better with the two higher protein quantities than with the lower amounts (this is considered to be due to a methionine deficiency at the low protein levels), that N digestibility increased significantly with increasing quantities of protein, while dry matter digestibility was not affected by the differences in the rations.

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Molasses and sugar as energy sources for pigs. N. A. MACLEOD, T. R. PRESTON, L. A. LASSOTA, M. B. WILLIS and M. VELAZQUEZ. *Rev. Cubana Cienc. Agríc.*, 1968, **2**, 205–210.—The mean daily weight gain in pigs initially weighing about 20 kg was 511–586 g, giving a final weight of about 90 kg, when the pigs were fed on a protein supplement and high-test or final cane molasses to which 20, 40 or 60% sugar was added. The high-test molasses diet gave better feed conversion, but there were no differences in edible meat content or fat thickness as between the various diets. It is suggested that molasses plus sugar can be used to replace cereals completely in the diets of fattening pigs.

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Progress of sucrose esters. ANON. *Sugar y Azúcar*, 1969, **64**, (8), 26.—The Nebraska-Snell process for sucrose ester preparation is described[1] and the costs are discussed.

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Microbial protein production from sugar cane bagasse. C. E. DUNLAP and C. D. CALLIHAN. *Sugar J.*, 1969, **32**, (2), 13–16.—A process developed at Louisiana State University to increase cellulose biodegradability was applied to bagasse and raised the levels from 15·1, 26·5 and 30·1% dry cellulose digested in whole bagasse, bagasse pith and fibre to 57·0%, 55·0% and 50·3%, respectively. A cellulolytic micro-organism, of the *Cellulomonas* genus, was found to grow rapidly on the treated cellulose and contained 52·3% crude protein. Rats fed on a diet containing 40% *Cellulomonas* cells showed good weight gains. The cells were non-toxic at all levels tested (up to 76% by weight of the diet).

The world's largest bagasse board industry is started in Pakistan. R. HESCH and H. FRERS. *Bol. Azuc. Mex.*, 1969, (232), 26–42.—A bagasse particle and fibre board plant is being constructed at Crescent Sugar Mills and Distillery Ltd., Lyallpur, West Pakistan. It has been designed by G. Siempelkamp & Co. and has similar features to the plant erected in Réunion[2]. Facilities will include those for the application of veneers, surface coatings, printing and lacquering, and the manufacture of furniture. The layout of the plant is illustrated and described as are the individual items of process equipment, products, etc.

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The chemical synthesis of sucrose phosphates. J. G. BUCHANAN. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969.—The literature on sucrose phosphate esters is briefly reviewed and account given of a technique for synthesis of the 6′ phosphate which may be of interest for inhibition of dental caries, as well as being a naturally-occurring intermediate in one of the biosyntheses of sucrose.

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Utilization of sucrose by the chemist. J. L. HICKSON. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969.—An account is given of research sponsored by the Sugar Research Foundation intended to develop sugar industry diversification by manufacture of chemical derivatives of sucrose such as ester detergents, polymers, plastics, etc.

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Sugar-modified melamine resins. W. FLAVELL and G. L. REDFEARN. *Paper presented to the Sucrose Conference* (Queen Elizabeth College, London), 1969. Sucrose, after inversion, was incorporated at up to 50% in formaldehyde-melamine condensations to produce resins which were compared with resins containing no invert sugar. The properties were in some cases to the advantages of the sugar-modified resins and at the higher sugar levels reduced the cost of the resin, but at the expense of water absorption. Optimum combination of properties was given with around 20% sugar contents.

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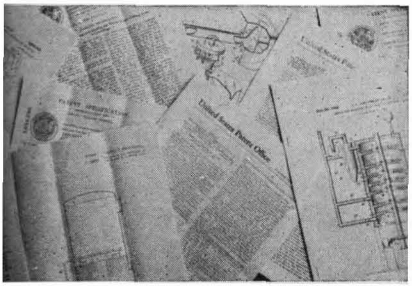
The industrialization of bagasse—with the production of chemical pulp. E. RAMOS. *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1966, 6 pp.—See *I.S.J.*, 1969, **71**, 315.

[1] *I.S.J.*, 1969, **71**, 59.
[2] *ibid.*, 3–6.

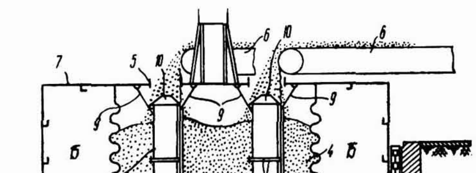


Patents

UNITED KINGDOM

Transportation of raw sugar in a ship. TSENTRALNOE PROEKTNA-KONSTRUKTORSKOE BJURO, of Leningrad, USSR. **1,170,784.** 7th November 1966; 19th November 1969.

After cleaning out the inner hold 14 of a tanker, tubes 8 are lowered through ports 5 in the deck 7 and held by supports 9 at the required distances below the ports 5 and above the tarpaulins 3 covering the bottom 2 of the hold. The tubes 8 are vertical and are constructed of section 11 linked by flanges 12. The upper ends are covered by caps 10 while attached to the side are vibrators 13.



Sugar is loaded into the hold 14 by a conveyor system 6, the vibrators 13 preventing any lodging of sugar and ensuring that the hold is completely filled. The ports 5 are closed and the outer holds 15 filled with water at the temperature of the incoming raw sugar, at which temperature it is maintained during the transport of the sugar so as to prevent caking, moisture migration, etc. When the ambient humidity is the same as that of the loaded raw sugar, the caps 10 may be removed to allow the escape of any pungent gases from the hold. At destination, the ports 5 and caps 10 are removed and suction hoses lowered through tubes 8 to the sugar. The suction removes the sugar while the vibrators 13 ensure that it all falls to the bottom of the hold to be collected.

Increasing the sugar content of cane and sorghum. E. I. DU PONT DE NEMOURS & Co., of Wilmington, Del., USA. **1,170,951.** 31st October 1966; 19th November 1969.—Cane or sorghum is sprayed 10–60 days (20–40 days) before harvesting with a solution containing the free acid or an alkali metal, ammonium or alkaline earth salt of an α-ureidooxycarboxyl compound R-NH-CO-NH-O-CHR′-COOH where R is a C_1–C_6 alkyl radical, a C_2–C_6 alkenyl, phenyl or halo-phenyl (chlorophenyl) radical and R′ is H or a C_1–C_3 alkyl radical (ethyl ureidooxyacetate, methyl or ethyl α-ureidooxypropionate or methyl α-ureido-oxy-*iso*-valerate), the addition being at the rate of 0·2–3·0 lb/acre, using a carrier (oil) and incorporating a herbicide, fungicide, insecticide or fertilizer.

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Plant growth regulants. E. I. DU PONT DE NEMOURS & Co., of Wilmington, Del., USA. **1,170,952.** 17th August 1967; 19th November 1969.—In order to raise its sugar content and to kill weed growth, sugar cane, beet or sorghum is sprayed 10–60 days before harvesting with a solution of a compound R-NH-CO-NH-O-CHR$_1$-CO-Q-R$_2$ where R is H, C_1–C_6 alkyl, C_3–C_6 alkenyl, phenyl or halophenyl, R_1 is H, CH_3 or C_2H_5, Q is O or S and, when Q is O, R_2 is a C_3–C_6 alkenyl, C_3–C_6 alkynyl, C_3–C_8 cycloalkyl, C_3–C_8 cycloalkenyl, C_1–C_6 alkyl or C_3–C_6 alkenyl group which may be singly or multiply substituted with halogen, C_1–C_3 alkoxy, C_1–C_3 alkylthio, C_2–C_5 alkoxycarbonyl, carboxyl, ammonium or alkali metal or alkaline earth metal carboxyl salt, phenyl or mono-, di- or tri-substituted phenyl groups, the substituents being C_1–C_4 alkyl, halogen, nitro, cyano, methoxy, or methoxycarbonyl, while, when Q is S, R_2 is C_1–C_6 alkyl, C_3–C_6 alkenyl, phenyl or mono- or di-substituted phenyl, the substituents being methyl, ethyl, methoxy, halogen or nitro (cyclohexyl α-ureidooxy-propionate, allyl ureidooxyacetate, allyl α-ureido-oxypropionate, *cyclo*-pentyl α-ureidooxypropionate). The solution contains oil as a carrier or a surface-active agent and a liquid carrier other than oil.

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Beet harvester. DNEPROPETROVSKY ZAVOD SELSKO-KHOZAISTVENNOGO MASHINOSTROENIA, of Dnepropetrovsk, USSR. **1,171,440.** 26th March 1968; 19th November 1969.

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 5s 0d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 U.S.A. (price 50 cents each).

Treatment of cane. MONSANTO CO., of St. Louis, Mo., USA. **1,171,516.** 21st July 1967; 19th November 1969.—Cane is treated, 2 weeks to 2 months before harvesting, with 3–7 lb/acre of a nitrilo compound having the formula $[MOOC\text{-}CRR^1]_m N\text{-}[CR^2R^3\text{-}PO(OM^1)OM^2]_n$, in which m and n are 0, 1, 2 or 3 and $(m + n) = 3$, R, R^1, R^2 and R^3 are each H or a C_1–C_4 alkyl, and M, M^1 and M^2 are each H, a C_1–C_4 alkyl or a salt-forming cation [nitrilo N, N-di-(acetic acid)-N-methyl phosphonic acid, nitrilo-N-acetic acid-N,N-bis-(methyl phosphonic acid) or the tri K salt of nitrilo-N,N-di-(acetic acid)-N-(methyl-O-ethyl phosphonic acid)].

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Method and apparatus for determining the relative volume of crystalline solids in a crystalline solution (sugar crystals in a massecuite). HAWAIIAN DEVELOPMENT CO., of Honolulu, Hawaii, USA. **1,174,438.** 30th November 1967; 17th December 1969.—Sucrose crystals are of high electrical resistance compared with the resistance of their mother liquor in a massecuite. Consequently the specific resistance across a gap between two electrodes which contains a mixture of crystals and mother liquor, i.e. a massecuite, will be higher than that between two electrodes spaced apart so that only the mother liquor passes between them. Such a 4-electrode assembly is used and the ratio of specific resistances measured using a Wheatstone bridge circuit to give a measure of crystal content, variable transformers being used to compensate for the different areas and gap between the electrodes.

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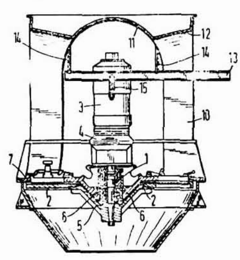
Beet slicer. H. C. RADINGER, of H. PUTSCH & COMP., HAGEN, GERMANY. **1,174,758.** 19th April 1968; 17th December 1969.

To reduce the floor area required for a beet slicer and also its height, the drive motor 3 is mounted centrally above the cutting disc 2 which carries the knives and is coupled through the spur or planetary gear system 4 to the shaft 1 of the disc. The hub 5 of disc 2 is recessed to hold a hub 6 of cover disc 7 and the mounting 8 for shaft 1.



The disc 7 supports the gear system 4 and also the lower end of the charging shafts 10 down which beets are directed to the knives. The inside of shafts 10 are formed by the dome 11 which covers the motor and which has side openings 12 for access to the motor 3. Passing through the openings are beams 13 along which the motor may be brought by means of travelling supports 15 when it is necessary to remove it from the slicer.

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Treatment of spent beet cossettes. BELOIT CORPORATION, of Beloit, Wis., USA. **1,175,565.** 25th August 1967; 23rd December 1969.—See US Patent 3,455,235[1].

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Recovering compositions containing calcium sugar phosphates and inorganic phosphates. COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **1,178,509.** 30th May 1968; 21st January 1970.—An aqueous reaction liquor containing calcium sugar phosphates, inorganic calcium phosphates and calcium chloride[2] is dehydrated (by spray-drying at 100–300°C) to a finely-divided solid (containing 0–20% of water) and the $CaCl_2$ leached out with a solvent (ethanol) to leave the phosphate with less than 0·5% $CaCl_2$ content.

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Removal of filter cake from a filter. SPARKLER MANUFACTURING CO., of Conroe, Texas, USA. **1,179,795.** 28th April 1967; 28th January 1970.—See US Patent 3,447,690[3].

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UNITED STATES

Animal feed supplement containing a salt of sucrose phosphate. J. GAGOLSKI and B. M. SMYTHE, *assrs.* COLONIAL SUGAR REFINING CO. LTD., of Sydney, NSW, Australia. **3,469,989.** 12th July 1965; 30th September 1969.—The feed supplement contains a water-soluble non-toxic salt of sucrose phosphate having (a NH_4 cation or) a mineral element from the group including Ca, Mg, Na, K, Co, Zn, Fe, Cu and Mn (Ca, K or Mg), [and containing a trace metal (other than the phosphate mineral element) complex of Mg, Co, Zn, Fe, Cu or Mn].

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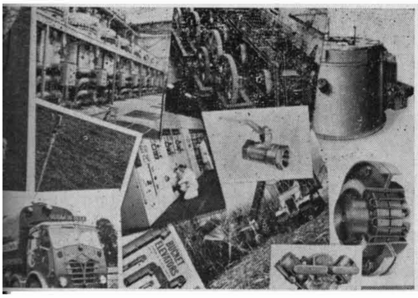
Lixiviating apparatus (Cane diffuser). H. A. BRÜNICHE-OLSEN, of Gentofte, Denmark, assr. A/S DE DANSKE SUKKERFABRIKKER. **3,471,328.** 16th December 1964; 7th October 1969.—The two scrolls of a trough-type cane diffuser are provided on their peripheries with sets of teeth at intervals and are also driven through a linkage whereby their relative speeds are varied during operation of the diffuser. In this way the screw runs of one scroll are moved back and forth, relative to the screw runs of the other scroll, between limits whereby the teeth tear any cane material which may have collected on the shafts of the scrolls. Collection and compaction of this material are prevented and the diffuser capacity and efficiency are enhanced.

[1] *I.S.J.*, 1970, **72**, 187.
[2] See US Patents 3,437,652–3; *I.S.J.*, 1970, **72**, 123.
[3] *I.S.J.*, 1970, **72**, 157.



Trade notices

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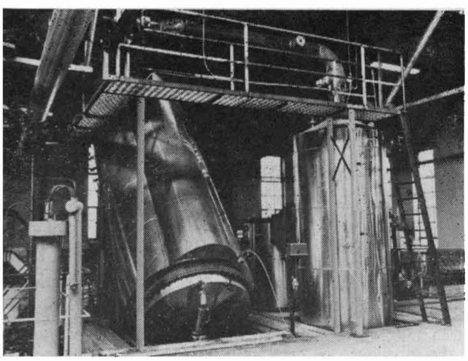
SWS-Dinteloord continuous crystallization. Stork-Werkspoor Sugar N.V., P.O. Box 147, Hengelo (OV.), Holland.

A new system for continuous crystallization of sugar has been developed by Stork-Werkspoor Sugar N.V. and Verenigde Coöperatieve Suikerfabriken G.A. and tested initially on a pilot-plant scale and on a factory scale during the whole of the 1969/70 beet campaign at the Dinteloord sugar factory of VCS, where it has been incorporated into the normal



processing operation. Based on an idea of G. H. DE VRIES, the system consists of a heater, evaporator and crystal generator plus automatic control equipment. It involves crystallization by flash evaporation of the heated thick juice and its subsequent concentration to a pre-determined and closely controlled supersaturation. The crystal generator, which operates under vacuum, is provided with a positive-displacement system for the transporting of the crystals.

In a series of tests the unit boiled 1st product massecuite of 92°Bx, 92–93 purity and 55–57% crystal content from thick juice at the rate of 12 tons/hr. The resultant sugar had a M.A. of 0·57 mm and a C.V. of 0·44. Small conglomerates sometimes formed, but were continuously removed by the internal transport system, obviating the need for periodic shut-downs for cleaning. The only stops were made when an improvement in performance was required, the unit working for 21 days at a stretch. Hence, mild steel can be used in the manufacture of the crystal generator and no special measures have to be taken to prevent conglomeration. There is no need for large thick juice and massecuite receiving tanks, and heat and time losses encountered with batch pan boiling are eliminated. Re-utilization of the vapours from the thick juice concentration and elimination of the need for moving water as normally applied in vacuum pan boiling increase the steam economy, while steaming-out and dissolving of crystal are not required. Fluctuations in thick juice concentration are easily corrected by means of simple automatic control equipment. The system is not yet in its final stage of development (patents have been applied for), although the results already obtained are highly promising.

* * *

R23E transmitting refractometer. Bellingham & Stanley Ltd., 61 Markfield Rd., London N.15, England.

The R23 pan refractometer has been modified as a result of work carried out at the Vancouver refinery of British Columbia Sugar Refining Co. Ltd. in Canada and successfully used in its modified form since 1965 for boiling control. The system incorporates a photo-electric scanning device which produces a millivolt signal that can be used for automatic control of supersaturation. The signal is transmitted to a recorder/controller operating a control valve in the pan steam line; alternatively, the controller output can be connected to a valve in the pan syrup feed line or the action of both valves can be combined. Maximum flexibility of operation of the refractometer is provided by a simple position adjustment of the span covering the supersaturation range 1·0–1·2 (equivalent to 3°Bx), whereby the actual span required may be allocated anywhere in the complete range of the refractometer. Since supersaturation control is carried out at constant temperature, temperature compensation is not incorporated in the refractometer. Once the instrument's optical system has been calibrated, the visual reading of the shadow-light line allows for a check of the performance of the recorder/controller. Solid state circuits and the absence of moving parts ensure trouble-free operation of the refractometer transmitter. Actual millivolt output spans may be easily changed over wide ranges to accommodate most conventional receiver inputs, giving an instrument accuracy better than ±0·1°Bx and a sensitivity greater than 0·05°Bx.

FZ 1000 centrifugal. Salzgitter Maschinen AG, 3327 Salzgitter-Bad, Postfach 1640, Germany.

The FZ 1000 is a vertical-shaft centrifugal in which the basket, measuring 1000 mm high × 1270 mm inside diameter, has no perforations, the holes for passage of the syrup being in the top and bottom "rims". The bottom opening to the basket is sealed inside by a flexible disc which, for discharge purposes, is pressed by pneumatic cylinders against a hood fixed around the shaft, when the bottom opening of the outer casing is left unsealed. Massecuite is fed from a chute onto an angle plate fixed to the central shaft. The centrifugal, designed to treat refined sugar and 1st and 2nd massecuites, has a capacity of 1000 kg and operates at a maximum speed of 1500 r.p.m. For low-grade massecuite treatment the number of perforations in the basket casing is increased and the capacity is 800 kg. Charging of 1st massecuite takes only about 10 sec, and all automatic operations are pneumatically controlled. Two-speed or D.C. motors are available as drives, and a specially designed mechanical brake is incorporated.

* * *

Plant for animal fodder production from urea and molasses. Ulrich Walter, 4006 Erkrath, Bahnstr. 30, Germany.

In an article by V. Ševčík and U. Walter details are given of the plant and technique used to mix urea with molasses, phosphoric acid and water in pre-set proportions to produce an animal feed of high nutritive value. The nitrogen content of the urea can be almost completely utilized in a mixture of optimum composition, utilization of the urea being favoured by the presence of easily assimilable sugars such as sucrose in the molasses. It is important for a number of reasons that the urea be homogenized before mixing, after thorough mixing and heating, with the other ingredients. The process is a batch one so as to ensure precise mixing of the feed. The phosphoric acid is of importance as a feed ingredient, but is also technologically important because of its reducing effect on the molasses viscosity.

* * *

PUBLICATIONS RECEIVED

TUBE DESCALING. Flexible Drives (Gilmans) Ltd., Skatoskalo Works, Millers Rd., Warwick, England.

Details of "Skatoskalo" descaling machines, toolheads and brushes for mechanical cleaning of sugar factory juice heaters, evaporators and vacuum pans are contained in a new leaflet, S 69/4, which is also available in Spanish (S 69S/4). The conclusions drawn by the boiling house superintendent at a Philippine sugar factory on the advantages of using a special toolhead (the TE, which is shown in the leaflet) for evaporator tube cleaning is reproduced.

* * *

"CUSTOMATIC WEIGHFEEDER". Rex Chainbelt Inc Milwaukee, Wisconsin, 53201 USA.

Bulletin 322-1169 describes the electronic control system components and their functions in measuring and controlling material flow through the Rex "Customatic Weighfeeder" which is available with belt widths from 18 to 60 inches and material flow rates up to 60 tons/hr. Accuracy is $\pm\frac{1}{2}\%$. A light-gauge cover is available for protection of material and dust suppression.

RENOLD POWER TRANSMISSION PRODUCTS. Renold Limited, Renold House, Wythenshawe, Manchester M22 5WL, England.

Chains and wheels, gears and gear units, variable-speed systems and couplings, clutches and brakes are featured in a new 12-page brochure published by Renold Limited. The range now includes products of John Holroyd Ltd., Crofts (Engineers) Ltd. and Carter Gears Ltd. as well as those of the parent company. A folded brochure illustrates applications of Renold products, including a sugar cane mill gear unit.

* * *

MECHANICAL HANDLING ENGINEERS' ASSOCIATION BUYERS' GUIDE. Mechanical Handling Engineers' Association, Glen House, Stag Place, London S.W.1, England.

This 166-page Buyers' Guide gives details of members of the Mechanical Handling Engineers' Association in English, French and Spanish with information on their products under the appropriate headings, illustrations showing applications of typical products, approximate monetary exchange rates for a number of countries and a table of measurement conversion factors. The Guide is available free from the Association at the above address.

* * *

MARSHALL MECHANICAL HANDLING. Marshall Conveyors Ltd., Billesdon, Leics., LE7 9ES, England.

This brochure features a number of products manufactured by Marshall for a variety of industries, including bucket elevators, troughed belt conveyors, screw elevators and trough screw conveyors, tubular screw conveyors and bulk storage bins. Among customers of Marshall Conveyors Ltd. are listed the British Sugar Corporation Ltd. and Tate & Lyle Ltd.

* * *

CALLOW EQUIPMENT FOR MECHANICAL HANDLING. Callow Engineering Ltd., Skelmersdale, Lancs., England.

Four new brochures have been produced by Callow Engineering Ltd. giving details of their rotary valves, bulk-carrying vehicles, screw conveyors and bucket elevators. The products are applicable to almost any normal material, including sugar.

* * *

BMA cane diffuser and mill orders.—Braunschweigische Maschinenbauanstalt have received an order from Central Azucarera Don Pedro (Philippines) for a cane diffuser having a daily capacity of 6500 metric tons of cane to be installed in time for the 1970 crushing season. They have also received an order for a cane mill plus turbine drive and reduction gearing to be supplied to Cía. Agrícola e Industrial S.A. for installation at Chanmico sugar factory in El Salvador as well as an order for the supply of two cane mills plus ancillary equipment to Azucarera Guaira in Paraguay.

* * *

Molasses pump order.—The SPP Group Ltd., of Hambridge Rd., Newbury, Berks., England, has received an order worth more than £11,000 for the supply of five variable-speed, diesel-driven "Plenpak" pumping sets to United Molasses Trading Co. Ltd. for the loading of molasses into road vehicles and coasters at Bookers Sugar Estates in Guyana. Manufactured by the Group's Plenty Division, the pumps are of the rotary sliding-vane, positive-displacement type with which running speeds as low as 50–200 r.p.m. are obtainable for the handling of such highly viscous materials as molasses. The capacity of each unit is 160 tons/hr at a pressure up to 90 p.s.i. at a molasses viscosity in the range 50,000–150,000 Saybolt seconds. The pumps incorporate integral relief valves, giving them excellent starting characteristics.

* * *

BMA centrifugal order.—Braunschweigische Maschinenbauanstalt have received an order for 14 continuous and batch centrifugals to be supplied to Tri Gunabina cane sugar factory in Indonesia.

Commission Internationale Technique de Sucrerie

14th General Assembly, Brussels, 1971

THE 14th General Assembly of the C.I.T.S. is to be held in Brussels during the 4th–7th May 1971 and it is anticipated that, as in the case of the successful meetings in London (1957), Frankfurt (1960), Paris (1963) and Falsterbo (1967), that at Brussels next year will provide the same opportunity and interest for all concerned with the latest developments and research in the beet sugar industry.

The principal subject chosen for discussion is: "The elimination of non-sugars during the process with a view to improving sugar quality", while a second major topic will be "Preservation of beets during storage". Papers on other subjects may also be presented.

Everybody interested in problems related to sugar is invited to attend the meetings and applications to do so, clearly indicating the name of the participant and of his employers and his address, should be sent before 1st April 1971 to:

The General Secretary,
C.I.T.S.,
1 Aendorenstraat,
3300 Tienen,
Belgium.

A definitive programme including the list of papers and all required information will be sent to those intending to participate. Papers to be presented (*i*) must be original, (*ii*) may not include advertising nor may they be of a commercial character, (*iii*) should be written in English, French or German and should include a long summary (at least 400 words) in each of these languages, and (*iv*) if not submitted under the direction of a member of the Scientific Committee of the Commission, should be sent in triplicate to the General Secretary at the address above before the 15th February 1971.

The provisional programme for the meeting includes registration of the participants at the Palais des Congrès during the afternoon of the 3rd May, followed by a welcoming reception. From 4th to 6th May will be occupied by working sessions at the Palais des Congrès, apart from an excursion to Bruges and Ghent on the afternoon of the 5th. An optional sugar factory or refinery visit will be arranged for the 7th May, while a separate programme will be arranged for the ladies.

UK sugar surcharge.—In view of the fall in the world price of raw sugar the UK sugar surcharge has been increased from 1d per lb (9s 4d per cwt) to 1¼d per ld (11s 8d per cwt) from the 21st May 1970. All the previous changes in surcharge during 1970 have been reductions in consequence of the steadily rising price, but the fall which has occurred since the last change at the beginning of May has brought about the latest change which is a reversal of the previous trend.

Brazil sugar data[1]

	1969	1968	1967
	(*metric tons, tel quel*)		
Initial stocks	2,548,619	2,756,292	2,381,217
Production	4,173,850	4,162,196	4,275,057
	6,722,469	6,918,488	6,656,274
Exports:			
Algeria	11,353	—	—
Chile	97,829	132,819	80,615
Finland	42,412	—	10,723
France	25,261	54,570	43,220
Germany, West	1,001	—	—
Holland	—	1,502	—
Iraq	12,372	22,651	10,564
Japan	38,422	—	13,049
Lebanon	—	—	10,441
Malaysia	37,299	—	21,428
Morocco	—	107,849	52,214
Sweden	13,365	—	—
Syria	—	8,536	—
Tunisia	—	57,329	51,113
UK	12,083	12,292	18,445
USA	659,539	620,286	590,773
Uruguay	43,992	46,619	47,236
Vietnam, South	76,925	—	29,761
Zambia	—	20,041	21,165
Total	1,071,853	1,084,494	1,000,747
Consumption	3,403,510	3,285,375	2,899,235
Final stocks	2,247,106	2,548,619	2,756,292

Brevities

The late Thomas Theis.—We regret to record the death on the 30th May of Dr. THOMAS THEIS who was killed with his wife in a motor accident. Dr. THEIS, who was 52, became Chief of the Tobacco and Sugar Crops Research Branch of the US Department of Agriculture in Beltsville, Maryland, in 1961. Previously he had worked at the Federal Experiment Station in Mayagüez, Puerto Rico. During his administration at Beltsville, support for sugar cane research programmes was extended considerably through his coordination of industry needs and research efforts.

* * *

Bagasse treatment to eliminate bagassosis danger.—One of the hindrances to the use of bagasse as a raw material for board products to be used in housing, and a danger to the health of workers handling the bagasse, has been the respiratory complaint called bagassosis. This is a severe, sometimes acutely fatal, fibrosing lung disease caused by the dust of mouldy overheated bagasse and it has been recorded among workers making insulation and other bagasse board products in Britain, Puerto Rico, Louisiana, etc. A British engineer, Mr. C. WRIGHT, contracted the disease when working on bagasse, unaware of the danger, and in subsequent treatment at the Brompton Hospital it was shown to be caused by a thermophilic actinomycete named *Thermoactinomyces sacchari*. Applying knowledge gained from studies of a similar disease, "farmer's lung", contracted from mouldy hay, it was found that the micro-organism could be stabilized by maintaining the moisture content below 20% and treatment of the bagasse with 2% propionic acid, an inexpensive, safe and widely used fungicide. The organism normally thrives on the residual sugar content of the bagasse and causes deterioration of the bagasse; the treatment eliminates the deterioration and makes the bagasse safe to handle and consequently a more favourable material for board manufacture. The process has been made the subject of world-wide patent applications by Mr. WRIGHT and BP Chemicals (UK) Ltd., manufacturers of the propionic acid.

[1] C. Czarnikow Ltd., *Sugar Review*, 1970, (963), 60.

C. W. Murray Award

FLETCHER and Stewart Ltd. make an annual award for the best paper submitted on a subject connected with beet or cane sugar technology to commemorate their late President, Mr. C. W. MURRAY*. The panel of judges consists of Mr. N. M. ADAMS, Technical Director of the British Sugar Corporation, Mr. R. R. FOLLETT-SMITH, lately Chairman of Booker Sugar Estates Ltd., and Mr. C. R. D. SHANNON, Consulting Engineer.

Contributors may choose any subject connected with the operation of beet or cane sugar factories including the application of any modern techniques which may improve operating performance.

Fletcher and Stewart have accepted the Panel's recommendation that the 1970 award of £500 be made to Dr. W. R. CRAWFORD, D.Sc., Ph.D., M.Sc., for his paper entitled "Cane Extraction by Milling—The Modern Approach".

Details regarding the preparation and submission of papers for the 1971 award can be obtained from Fletcher and Stewart Limited, Bucklersbury House, 83 Cannon Street, London E.C.4, England.

Brevities

Jamaican Sugar Control Authority[1].—The legislature in Jamaica has set up a Sugar Control Authority, as recommended by the Mordecai Commission, which is to be headed by W. D. ROBERTS, Manager of the Jamaican Cane Farmers' Association, and will have wide powers and functions for arbitrating cane prices, prescribing conditions applying to the delivery, measurement and testing of cane, supervision of arrangements for marketing export sugar, molasses and distilled spirits, prescribing the forms of returns to be furnished by millers, farmers, unions, etc., planning and research and far-reaching advisory functions. The powers of the Authority will be both advisory and executive, with appropriate sanctions.

* * *

Norway sugar imports, 1969[2].—Imports of sugar into Norway during 1969 amounted to 151,517 metric tons, white value, compared with 179,093 tons in 1968. Suppliers included the UK with 36,878 tons (41,377 tons in 1968), Denmark with 34,793 tons (33,948), Finland with 32,224 tons (23,822), Poland with 17,428 tons (31,822), Czechoslovakia with 13,131 tons (15,935), Sweden with 7469 tons (8806), the USSR with 2989 tons (4488), West Germany with 2111 tons (4980), Cuba with 1895 tons (6408), Holland with 1878 tons (3735) and Belgium/Luxembourg with 525 tons (3366), while other countries supplied 196 tons (406).

* * *

Iraq cane sugar factory start.—Hawaiian Agronomics Co. (International) reports that the Amarah Cane Sugar Project in Iraq started operations in February. It is scheduled to provide 100,000 tons/year of refined sugar, one-third from cane grown on a 30,000-acre plantation near the city of Amarah, and two-thirds from imported raw sugar. Annual consumption in Iraq is currently about 250,000 tons of sugar. The project is the result of a contract between the Government of Iraq and the Hawaiian consulting company, a subsidiary of C. Brewer & Co. Ltd., and has converted desert-like saline wasteland into a complete plantation with factory, fields, a village with the necessary amenities, roads and other essential infrastructure. Removal of salt by drainage and flooding has been described in this Journal[3] and averaged 21 tons/hectare, rising to 64 tons/ha from some fields.

Cuban sugar statistics[4]

	1969	1968
	(metric tons, raw value)	
Stocks 1st January	306,793	286,132
Production	5,534,180	5,315,197
	5,840,973	5,601,329
Exports	4,798,817	4,612,923
	1,042,156	988,406
Consumption	636,298*	681,613†
Stocks 31st December	405,858	306,793
Exports		
Albania	—	17,098
Algeria	41,832	43,494
Bahrein	—	—
Belgium/Luxembourg	516	12,859
Bulgaria	205,308	186,431
Canada	79,900	46,739
Ceylon	46,098	68,525
China	444,554	431,108
Czechoslovakia	224,356	193,490
Denmark	2,065	—
Egypt	68,720	65,599
Finland	—	30,267
France	—	20,634
Germany, East	252,508	243,656
Greece	—	34,169
Guinea	—	3,792
Holland	—	58,520
Hungary	16,663	16,574
Iran	—	10,664
Iraq	21,795	53,124
Italy	—	—
Japan	1,017,689	555,422
Korea, North	154,851	74,910
Malaysia	104,938	—
Malta	—	15,482
Mongolia	—	5,193
Morocco	175,760	85,635
Norway	—	10,467
Poland	28,134	20,713
Rumania	69,143	53,552
Singapore	36,679	—
Spain	181,577	175,678
Sweden	10,177	40,893
Switzerland	516	3,443
Syria	87,217	64,133
USSR	1,352,329	1,831,727
UK	42,912	20,065
Vietnam, North	60,129	49,777
Yugoslavia	67,360	75,685
Other Countries	5,091	3,405
	4,798,817	4,612,923

* Includes 93,994 tons used for animal feed.
† Includes 20,052 tons used for animal feed.

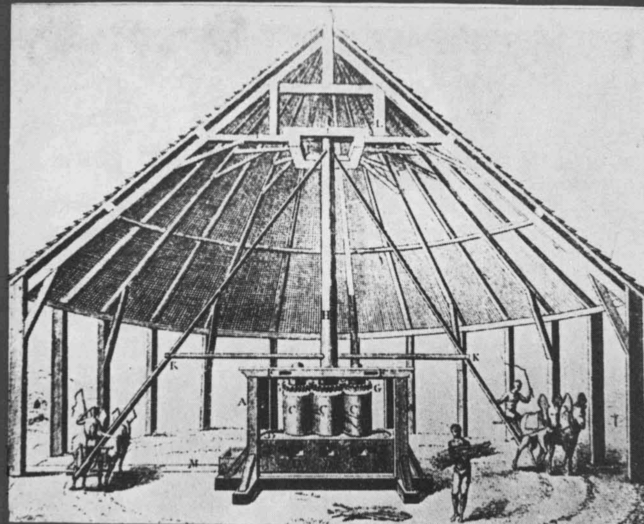
Pakistan sugar expansion finance[5].—The Pakistan Industrial Credit & Investment Corp. will grant foreign currency credits for the building of seven new sugar factories, which will have a total annual capacity of 180,000 tons of sugar.

* CECIL MURRAY was President of Fletcher and Stewart Limited of Derby and Glasgow, the internationally known sugar machinery manufacturers, until his death in November 1965. He joined Fletchers in 1923 as Resident Engineer in the West Indies and came to Derby in 1930 as Director and General Manager, subsequently becoming Managing Director, Chairman and finallly President.

[1] *The Cane Farmer*, March 1970, 1.
[2] C. Czarnikow Ltd., *Sugar Review*, 1970, (962), 54.
[3] *I.S.J.*, 1969, **71**, 6–7.
[4] *I.S.O. Stat. Bull.*, 1970, **29**, (2), 30–31.
[5] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (11). 8.

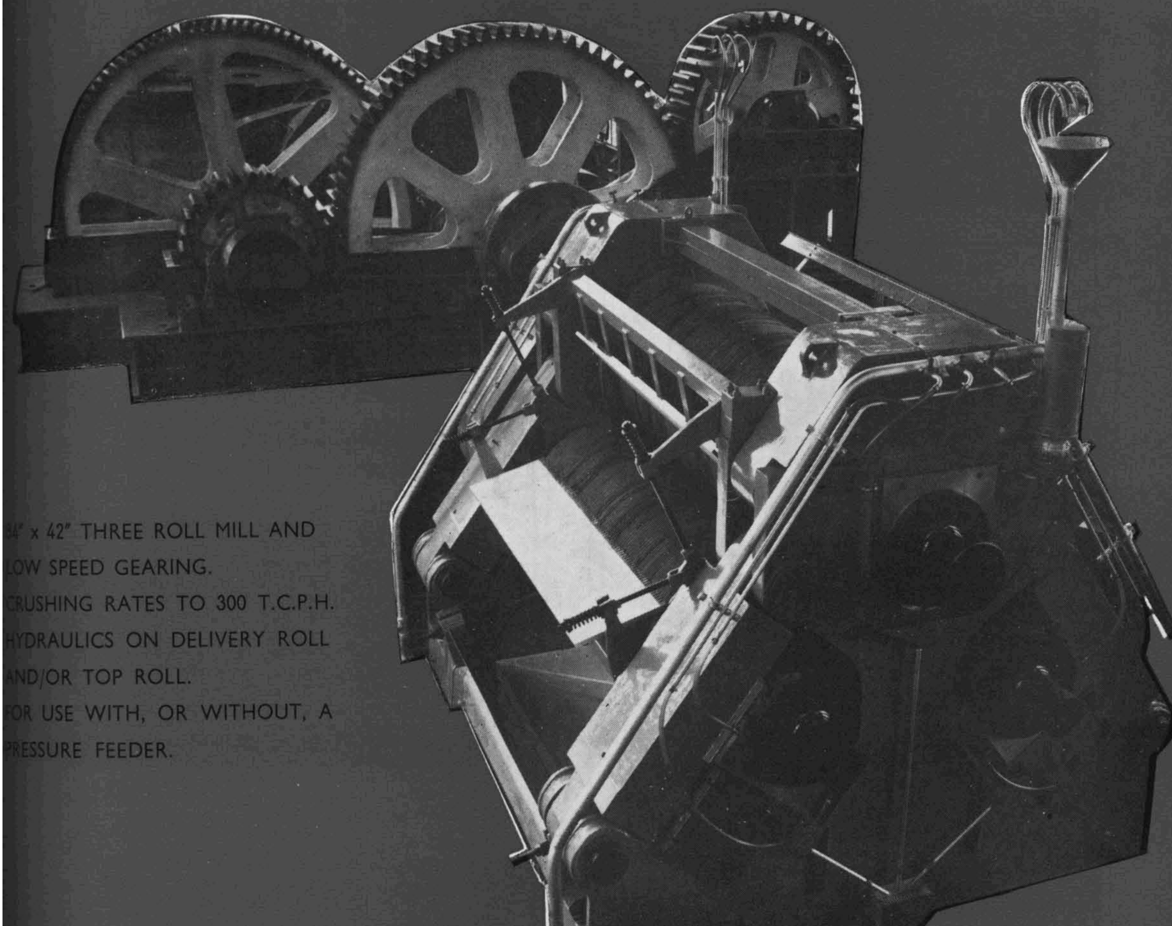
IT IS A FAR CRY FROM THIS 18th CENTURY ANIMAL POWERED HAND FED MILL, TO THE GLEAMING TURBINE DRIVEN MODERN MILL SHOWN BELOW.

From 'Agriculture et Œconomie Rustique', 1762-1772



18th Century mill with metal-covered wooden rolls

WALKERS LTD. HAVE BEEN BUILDING MILLING EQUIPMENT FOR 105 YEARS.



34" x 42" THREE ROLL MILL AND LOW SPEED GEARING.
CRUSHING RATES TO 300 T.C.P.H.
HYDRAULICS ON DELIVERY ROLL AND/OR TOP ROLL.
FOR USE WITH, OR WITHOUT, A PRESSURE FEEDER.

WALKERS LIMITED

CONSULTANTS
DESIGNERS
ENGINEERS

MARYBOROUGH QUEENSLAND AUSTRALIA

Index to Advertisers

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

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.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada, Ltd.
Atlas Chemical Interamerica Inc.
Honeywill-Atlas Ltd.
Lurgi Gesellschaft fur Wärme- und Chemotechnik m.b.H.
Norit N.V.
Pittsburgh Activated Carbon Division.
Suchar.

Air clutches.
Eisenwerk Wülfel.
Farrel Company.
Renold Ltd.

Air compressors.
Peter Brotherhood Ltd.
Cotton Bros. (Longton) Ltd.
Soc. Fives Lille-Cail.
Krupp Stahlexport G.m.b.H.
Nash International Company.

Air compressors, Oil-free.
Peter Brotherhood Ltd.
Nash International Company.

Air conditioning equipment.
A.B. Svenska Fläktfabriken.

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

Air filters.
Buhler Brothers Ltd.
Midland Heating & Ventilation Co. Ltd.
Norit N.V.
A.B. Svenska Fläktfabriken.

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

Air-operated portable stitchers.
Thames Packaging Equipment Co.

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

Ammonia removal from condensates.
Imacti N.V.

Anti-foam agents.
Glovers (Chemicals) Ltd.
Hodag Chemical Corporation.
Schill & Seilacher Chemische Fabrik.

Automatic beet laboratories.
Venema Automation N.V.

Automatic saccharimeters and polarimeters.
O. C. Rudolph & Sons Inc.
Schmidt + Haensch.
Thorn Bendix Ltd.
Carl Zeiss.

Automatic tare rooms.
Venema Automation N.V.

Bag, *see* Sack.

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

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

Bagasse depithing equipment.
Stedman Foundry & Machine Co. Inc.

Bagasse furnaces.
Babcock & Wilcox (Operations) Ltd.
Boiler Construction & Repair Co. Inc.
S.E.U.M.

Bagasse incinerators.
Boiler Construction & Repair Co. Inc.

Bagasse preparation equipment for particle board manufacture.
C F & I Engineers Inc.

Bagasse presses.
C F & I Engineers Inc.
French Oil Mill Machinery Co.
Sucatlan Engineering.

Bagasse stokers.
Boiler Construction & Repair Co. Inc.

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

Bearings and pillow blocks.
Eisenwerk Wülfel.

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

Beet flume equipment.
Dreibholz & Floering Ltd.

Beet harvesters.
Ransomes Sims & Jefferies Ltd.

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

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

Beet pulp presses.
BMA Braunschweigische Maschinenbauanstalt.
Fletcher and Stewart Ltd.
Hein, Lehmann & Co. A.G.
AB. Kockum-Landsverk.
Etablissements F. Moret.
Simon-Heesen N.V.
Stord Bartz Industri A/S.

Beet seed.
A/S De Danske Sukkerfabrikker.

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

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

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

Beet washing plant.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.

Beet washing plant—*continued*
Salzgitter Maschinen A.G.
Sucatlan Engineering.
UCMAS.

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

Belting, Conveyor and elevator.
see Conveyor belting.

Blending machines.
Arenco-Alite Ltd.

Boiler mountings.
Boiler Construction & Repair Co. Inc.

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

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

Boiler water treatment.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Eimco (Great Britain) Ltd.
Fabcon Inc.
The Permutit Co. Ltd.
Robert Reichling & Co K.G.

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

Boilers, Water tube.
Boiler Construction & Repair Co. Inc.
Buckau-Wolf Maschinenfabrik A.G.
Soc. Fives Lille-Cail.
Foster Wheeler John Brown Boilers Ltd.
Marshall, Sons & Co. Ltd.
Murray Iron Works Company.
Newell Dunford Engineering Ltd.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
John Thompson (Design and Contracting Division) Ltd.
Wabash Power Equipment Co.
Yarrow Engineers (Glasgow) Ltd.

Bone char.
British Charcoals & Macdonalds Ltd.

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

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

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

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

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

Burners, Sulphur.
see Sulphur furnaces, Continuous.

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

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

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

Cane carts.
J & L Engineering Co. Inc.
Kingston Industrial Works Ltd.
Martin-Markham Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

Cane cultivation equipment.
J & L Engineering Co. Inc.
Ransomes Sims & Jefferies Ltd.
Rome Industries.
Wyper Brothers Ltd.

Cane diffusers, Continuous.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
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 grapples.
J & L Engineering Co. Inc.
Joseph Westwood & Co. Ltd.

Cane harvesters.
J & L Engineering Co. Inc.
Tate & Lyle Enterprises Ltd.
Wyper Brothers Ltd.

Cane loaders.
Crone & Taylor (Engineering) Ltd.
J & L Engineering Co. Inc.
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.
Stork-Werkspoor Sugar N.V.

Cane shredders.
see Shredders.

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

Cane washing plants.
C F & I Engineers Inc.
Filtres Vernay S.A.
J & L Engineering Co. 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.
C.E.C.A.
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.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Neyrpic.
H. Putsch & Comp.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.

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

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

Cement, Sugar-resistant.
Boiler Construct on & Repair Co. Inc.
Lafarge Aluminous Cement Co. Ltd.

Centrifugal backings.
Associated Perforators & Weavers Ltd.
Fontaine & Co. G.m.b.H.
Krieg & Zivy Industries.
Mundt Perforated Metals Corp.
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.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Hein, Lehmann & Co. A.G.
Krieg & Zivy Industries.
Mundt Perforated Metals Corp.
The Sugar Manufacturers' Supply Co. Ltd.
UCMAS.
The Western States Machine Co.

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

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

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

Centrifugals—Fully automatic batch-type.
BMA Braunschweigische Maschinenbauanstalt.
Thomas Broadbent & Sons Ltd.
Buckau-Wolf Maschinenfabrik A.G.
Escher Wyss Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
AB. Kockum-Landsverk.
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
UCMAS.
The Western States Machine Co.

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

Chain cane slings.
Wheway-Watson Ltd.

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

Char revivifying plants.
Stein Atkinson Stordy Ltd.

Chemical plants.
A.P.V. Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Dorr-Oliver Inc.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Mardon (Engineering) N.V.
Metal Propellers Ltd.
S.P.E.I. Chim.
Wellman 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.
Buckau-Wolf Maschinenfabrik A.G.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Dorr-Oliver Inc., Cane Sugar Division
The Eimco Corporation.
Eimco (Great Britain) Ltd.
Eimco Industriale S.p.A.
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.
The Eimco Corporation.

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

Colorimeters.
Bausch & Lomb Inc.
The Sugar Manufacturers' Supply Co. Ltd.

Complete cane sugar factories.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
Walkers Ltd.

Condensers, Water jet ejector.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Serseg (Seguin-Sergot).
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.
Adequate Weighers Ltd.
Ashworth Ross & Co. Ltd.

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

Conveyor belting.
Scandura Ltd.

Conveyor belting, Wire.
Begg, Cousland & Co. Ltd.
British Wedge Wire Co. Ltd.
N. Greening (Hayes) Ltd.

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

Conveyor idler rollers and pulleys.
Mavor & Coulson Ltd.

Conveyors and elevators.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
The Eimco Corporation.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling 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.
UCMAS.
Walkers Ltd.
Ingeniörsfirman Nils Weibull AB.

Apron conveyors.
Etablissements F. Moret.

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

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

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

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

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

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

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

Pneumatic conveyors.
Buhler Brothers Ltd.
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.
Etablissements F. Moret.
The Triton Engineering Co. (Sales) Ltd.

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

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

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

Coolers, Pellet.
Simon-Heesen N.V.

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

Coolers, Water.
Film Cooling Towers (1925) Ltd.
Metal Propellers 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.
Fabcon Inc.
Hodag Chemical Corporation.

Crystallizers.
Babcock Atlantique.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
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.
Gutehoffnungshütte Sterkrade A.G.
Kingston Industrial Works Ltd.

Crystallizers—*continued*
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
UCMAS.
Walkers Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

Crystallizers, Continuous.
Soc. Fives Lille-Cail.

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

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

Cube wrapping machines.
SAPAL.

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

Decolorizing plants.
Atlas Chemical Industries Inc.
Atlas Chemical Industries S.A.
Atlas Chemical Industries, Canada. Ltd.
Atlas Chemical Interamerica Inc.
BMA Braunschweigische Maschinenbauanstalt.
Honeywill-Atlas Ltd.
IMACTI 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.
William Boby & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
The Eimco Corporation.
IMACTI N.V.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.

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

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

Heat sealers.
The Thames Packaging Equipment Co.

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

Herbicides.
Fisons Ltd., Agrochemical Division.

Hydraulic controls for valves, etc.
Serseg (Seguin-Sergot).

Insecticides.
Fisons Ltd., Agrochemical Division.

Instruments, Process control.
Anacon Inc.
Bailey Meters & Controls Ltd.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Fischer & Porter Ltd.
Hartmann & Braun A.G.
Honeywell Ltd.
Negretti & Zambra Ltd.
G. A. Platon Ltd.
Rotameter Manufacturing Co. Ltd.
Scientific Furnishings Ltd.
Serseg (Seguin-Sergot).
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Ulrich Walter Maschinenbau.
G. H. Zeal Ltd.

Insulation, Thermal.
Lafarge Aluminous Cement Co. Ltd.

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

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

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

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

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

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

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

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

Knives, Milling—Drives.
Farrel Company.
Fletcher and Stewart Ltd.
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.
see also Laboratory instruments, *etc.*

Laboratory instruments.
Anacon Inc.
Honeywell Ltd.
A. H. Korthof N.V.
G. A. Platon Ltd.
Rotameter Manufacturing Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.
Carl Zeiss.
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.
Hartmann & Braun A.G.
Haver & Boecker.
Honeywell Ltd.
Negretti & Zambra Ltd
Rotameter Manufacturing Co. Ltd.
Serseg (Seguin-Sergot).
Siemens A.G.

Lime density meters.
Rotameter Manufacturing Co. Ltd.

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

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

Loading machinery.
Buhler Brothers Ltd.
The Eimco Corporation.

Locomotives, Diesel.
General Electric Company of U.S.A.
Krupp Stahlexport G.m.b.H.

Locomotives, Diesel-electric.
Hunslet Engine Co. Ltd.

Locomotives, Diesel-hydraulic.
Hunslet Engine Co. Ltd.

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

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

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

Meters, Integrating, for liquids.
Hartmann & Braun A.G.

Meters for liquid fuels.
Hartmann & Braun A.G.

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 rolls.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
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.
UCMAS.

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

Mist eliminators.
Begg, Cousland & Co. 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.
Buckau-Wolf Maschinenfabrik A.G.
Amandus Kahl Nachf.
Ulrich Walter Maschinenbau.

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

Packeting machinery.
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.
A.P.V. Co. Ltd.
Babcock Atlantique.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G
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.
Gutehoffnungshütte Sterkrade A.G.
Kingston Industrial Works Ltd.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Walkers Ltd.
Wellman 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.
Buhler Brothers Ltd.
Amandus Kahl Nachf.
Simon-Heesen N.V.
Richard Sizer Ltd.

Perforated metals.
Associated Perforators & Weavers Ltd.
N. Greening (Warrington) Ltd.
Krieg & Zivy Industries.
Mundt Perforated Metals Corp.
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.
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.
Hartmann & Braun A.G.
Honeywell Ltd.
Negretti & Zambra Ltd.
Serseg (Seguin-Sergot).
G. H. Zeal Ltd.

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

Printing machinery—Rotary multi-colour for sugar cartons and bags, etc.
Chambon Ltd.

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

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.
Gutehoffnungshütte Sterkrade A.G.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.
Weir Pumps Ltd.

Beet pumps.
Ateliers de Construction d'Ensival S.A.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.

Boiler feed pumps.
Ateliers de Construction d'Ensival S.A.

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

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

Irrigation pumps.
Allen Gwynnes Pumps Ltd.
Ateliers de Construction d'Ensival S.A.
Farrow & Sons 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.
Buckau-Wolf Maschinenfabrik A.G.
Costruzioni Meccaniche Industriali Genovesi CMI S.p.A.
Soc. Fives Lille-Cail.
A. & W. Smith & Co. Ltd.
Stothert & Pitt Ltd.

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

Molasses pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Comet Pump & Engineering Co. Ltd.
Amandus Kahl Nachf.
Mono Pumps Ltd.
Etablissements F. Moret.
Plenty Divn., SPP Group Ltd.
Stothert & Pitt Ltd.
Ulrich Walter Maschinenbau.

Positive-action pumps.
The Albany Engineering Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
The Comet Pump & 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.
The Comet Pump & Engineering Co. Ltd.
The Eimco Corporation.
Mono Pumps Ltd.
Etablissements F. Moret.
G. A. Platon Ltd.
Plenty Divn., SPP Group Ltd.
Stothert & Pitt Ltd.

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

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

Vacuum pumps.
see Vacuum pumps.

Railway, *see* Locomotives *and* Track.

Rectifiers.
ACEC.

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

Steam turbo-alternator sets.
ACEC.
W. H. Allen, Sons & Co. Ltd.
Peter Brotherhood Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
General Electric Company of U.S.A.
A.G. Kühnle, Kopp & Kausch.
Murray Iron Works Company.
Stork-Werkspoor Sugar N.V.
Wabash Power Equipment Co.

Steel framed buildings.
William Bain & Co. Ltd.

Stokers—Bagasse burning spreader type.
Buckau-Wolf Maschinenfabrik A.G.

Storage vessels, Stainless steel.
A.P.V. Co. Ltd.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
Metal Propellers Ltd.
St. Mary Iron Works Inc.
S.E.U.M.
Stork-Werkspoor Sugar N.V.

Strainers.
Lancaster & Tonge Ltd.
Serseg (Seguin-Sergot).

Sugar agronomy consultancy services.
Hawaiian Agronomics Company (International).
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.
Hawaiian Agronomics Company (International).
Tate & Lyle Technical Services Ltd.
Walkers Ltd.

Sugar factory design and erection (Cane and Beet).
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
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.
Lucks + Co. G.m.b.H.
Mardon (Engineering) N.V.
The Mirrlees Watson Co. Ltd.
St. Mary Iron Works Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
UCMAS.

Sugar machinery, General.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gutehoffnungshütte Sterkrade A.G.
Kingston Industrial Works Ltd.

Sugar machinery, General—*continued*
The Mirrlees Watson Co. Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
UCMAS.
Walkers Ltd.

Sugar refinery consultancy services.
Hawaiian Agronomics Company (International).
Tate & Lyle Technical Services Ltd.

Sugar refinery design and erection.
Fletcher and Stewart Ltd.
Tate & Lyle Technical Services Ltd.

Sugar silos.
Buhler Brothers Ltd.
A/S De Danske Sukkerfabrikker.
Soc. Fives Lille-Cail.
John Laing & Son Ltd.
Lucks + Co. G.m.b.H.
Henry Simon Ltd.
The Tills Engineering Co. Ltd.
UCMAS.
Ingeniörsfirman Nils Weibull A.B.

Sugar tabletting machinery.
Goka N.V. Machine Works.
Stansteel Corporation.

Sugar throwers and trimmers.
Buhler Brothers Ltd.
Crone & Taylor (Engineering) Ltd.
Fletcher and Stewart Ltd.
GEC-Elliott Mechanical Handling Ltd.

Sulphur furnaces, Continuous.
Maschinenfabrik H. Eberhardt.
Stork-Werkspoor Sugar N.V.

Switchgear.
ACEC.

Temperature recorders and controllers.
The British Rototherm Co. Ltd.
Chemap A.G.
Hartmann & Braun A.G.
Honeywell Ltd.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
G. H. Zeal Ltd.

Test sieves, B.S. and A.S.T.M.
Endecotts (Test Sieves) Ltd.
N. Greening (Hayes) Ltd.
Haver & Boecker.
A. H. Korthof N.V.

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

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

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

Tissues, Lens cleaning.
see Lens cleaning tissues.

Track and track accessories.
Krupp Stahlexport G.m.b.H.

Tractors.
John Fowler & Co. (Leeds) Ltd.
J & L Engineering Co. Inc.

Tractors, Crawler.
The Eimco Corporation.
John Fowler & Co. (Leeds) Ltd.

Trailers.
J & L Engineering Co. Inc.
Lufkin Foundry & Machine Co.
Martin-Markham Ltd.
Ransomes Sims & Jefferies Ltd.
Tate & Lyle Enterprises Ltd.

Tube brushes, Wire.
Rotatools (U.K.) Ltd.

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

Tube expanders.
Rotatools (U.K.) Ltd.

Tube fittings.
A.P.V. Co. Ltd. (*stainless steel*).
Serseg (Seguin-Sergot).
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.
Birmingham Battery Tube Company.
Soc. Fives Lille-Cail.
Kamani Tubes Private Ltd.
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.
Ateliers de Construction d'Ensival S.A.
The Comet Pump & Engineering Co. Ltd.
Cotton Bros (Longton) Ltd.
Soc. Fives Lille-Cail.
Fletcher and Stewart Ltd.

BUYERS' GUIDE—ADDRESS LIST

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

Adequate Weighers Ltd.,
Bridge Road, Sutton, Surrey, England.
Tel.: 01–642 6666/8. *Cable:* Adegrate, London.
Telex: 24416.

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.,
Tumba, Sweden.
Tel.: 0753/31100. *Cable:* Alfalaval, Tumba.
Telex: altumba s.

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

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

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

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

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

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.

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

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.

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

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.

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

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

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

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

Bausch & Lomb Inc., Analytical Systems Division,
820 Linden Avenue, Rochester, N.Y., 14625 U.S.A.
Tel.: (716) 385-1000.
Telex: 716-97-8231.

Begg, Cousland & Co. Ltd.,
Springfield Wire Works, 636 Springfield Rd., Glasgow S.E., Scotland.
Tel.: 041–554 1017.
Telex: 77445.

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 20111/23691.
Cable: Bema, Braunschweig.
Telex: Bema Bswg. 0952840.

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

Boiler Construction & Repair Co. Inc.,
Corujo Industrial Dev., Hato Tejas, Bayamon, Puerto Rico 00618.
Tel.: 785-1550. *Cable:* Boilerco, Bayamon.

Booker Merchants Distillery Services,
Bucklersbury House, 83 Cannon Street, London E.C.4, England.
Tel.: 01–248 8051. *Cable:* Bookmerch, London E.C.4.
Telex: 23605.

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

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

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

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

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

British Wedge Wire Co. Ltd.,
Academy Street, Warrington, Lancs., England.
Tel.: Warrington 34421. *Cable:* Wedco, Warrington

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

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

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

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

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

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

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

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

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

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

Chemap A.G.,
Alte Landstrasse 415, 8708 Männedorf/ZH, Switzerland.
Tel.: (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.

The Comet Pump & Engineering Co. Ltd.,
Johnson Road, West Croydon, Surrey, CR9 2ND England.
Tel.: 01-684 3816. *Cable:* Comet, Croydon.
Telex: 21127.

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.: Asta 6130. *Cable:* Sukkerfabrikker, Copenhagen.
Telex: 5530 Sukker KH.

Davy & United Instruments Ltd.,
Darnall Works, Sheffield S9 4EX, England.
Tel.: Sheffield 49971. *Cable:* Motor, Sheffield, Telex.
Telex: 54296.

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

The Deister Concentrator Co. Inc.,
901-935 Glasgow Avenue, Fort Wayne, Ind., 46801 U.S.A.
Tel.: (219) 742-7213. *Cable:* Retsied, Fort Wayne.

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: 415-364-0963.

Dicalite/GREFCO Inc., International Division,
630 Shatto Place, Los Angeles, California, 90005 U.S.A.
Tel.: (213) DU1-5081. *Cable:* Dicalite, Losa.
Telex: 67-4224.

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. *Clicing:* Slicing, Dereham.
Telex: 97357.

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.

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

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

Eimco Industriale S.p.A.,
Strada Cerca, 20067 Tribiano (Milano), Italy.
Tel.: 9064 234/5/6/7. *Cable:* Eimcoit, Milano.
Telex: 2023-32606.

Eisenwerk Wülfel,
Eichelkampstrasse 4-10, P.O.B. 270 160, 3 Hannover, Germany.
Tel.: 86011. *Cable:* Eisenwerk, Hannover.
Telex: 09-22730.

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.

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

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

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

Fischer & Porter Ltd.,
Eagle Star House, Elmsgrove Rd., Harrow, Middx., England.
Tel.: 01-427 6466. *Cable:* Flowrator, Harrow.
Telex: 262478.

Fisons Ltd., Agrochemical Division,
Harston, Cambridge CB2 5HU, England.
Tel.: (022) 022 312. *Cable:* Fisons, Harston.
Telex: 81123.

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

A. Friedr. Flender & Co.,
4290 Bocholt, Postfach 139, Germany.
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 1, Lancs., England.
Tel.: 051-ROY 2245. *Cable:* Flexotube, Liverpool.

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

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

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

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.

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

General Electric Company of U.S.A.,
159 Madison Avenue, New York, N.Y., 10016 U.S.A.
Tel.: (212) 750-4272. *Cable:* Ingeco, New York.
Telex: 62845 Western Union.

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. Machine Works,
Postbus 3530, Koestraat 2a, Amsterdam C, Holland.
Tel.: Amsterdam 222255/6. *Cable:* Kagodam, Amsterdam.
Telex: 14173.

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

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

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

N. Greening (Hayes) Ltd.,
Britannia Works, Printing House Lane, Hayes, Middlesex, England.
Tel.: 01-573 3961. *Cable:* Greenings, Hayes, Middlesex.

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

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

Hartmann & Braun A.G.,
6000 Frankfurt 90, Postfach 900507, Germany.
Tel.: 7991. *Cable:* Hartmannbraun, Frankfurtmain.
Telex: 4-14-071.

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

Hawaiian Agronomics Company (International),
P.O. Box 3470, Honolulu, Hawaii, 96801 U.S.A.
Tel.: 536–4461. *Cable:* Agronomics, Honolulu.
Telex: (WUI) Agronom 634130; (ITT) Agron 7430173; (RCA) C. Brewer 723326.

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

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

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

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

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

Hunslet Engine Co. Ltd.,
Leeds LS10 1BT, England.
Tel.: 32261.
Telex: 55237.

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

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

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

Isopad Ltd.,
Barnet By-Pass, Boreham Wood, Herts., England.
Tel.: 01–935 2817. *Cable:* Isopad, Borehamwood.
Telex: 261761.

J & L Engineering Co. Inc.,
P.O. Box 620, Jeanerette, La., 70544 U.S.A.
Tel.: (318) 276-6314. *Cable:* Jalenco, Jeanerette.
Telex: 58–6400.

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.

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

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

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

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

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

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

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

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

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

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 Lafarge Ldn.

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

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

Lancaster & Tonge Ltd.,
Statham Street, Manchester 6, England.
Tel.: 061–736 1484. *Cable:* Pistons, Manchester.

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

Lucks + Co. G.m.b.H.,
33 Braunschweig, P.O. Box 382, Germany.
Tel.: 0531 5971. *Cable:* Baulucks, Braunschweig.
Telex: 09-52713 luco d.

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

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

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

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

Marshall, Sons & Co. Ltd.,
Brittania Works, Gainsborough, Lincs., England.
Tel.: Gainsborough 2301.
Telex: 56134.

Martin-Markham 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, Phone, Glasgow.
Telex: 778109.

Metal Propellers Ltd.,
74 Purley Way, Croydon CR9 3BG, Surrey, England.
Tel.: 01–684 3611. *Cable:* Metaprops, Croydon.
Telex: 25635.

Midland Heating & Ventilation Co. Ltd.,
Bedford Rd., Camp Hill, Birmingham 11, England.
Tel.: 021–772 3781.

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

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

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

Etablissements F. Moret,
33 Ave. Faidherbe, 02 St. Quentin, France.
Tel.: 62-50-93.

Mundt Perforated Metals Corp.,
53 Fairmont Avenue, Jersey City, N.J., U.S.A.
Tel.: (201) 333-6200. *Cable:* Mundt, New Jersey.
Telex: JCY 774.

Murray Iron Works Company,
Burlington, Iowa, U.S.A.
Tel.: (319) 754-6541. *Cable:* Murrayiron, Burlington.
Telex: 46-8448.

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.

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

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

Nordiska Maskinfilt AB.,
S-301 03 Halmstad 1, Sweden.
Tel.: 10 40 00. *Cable:* Nordiskafilt, Halmstad.
Telex: 3558.

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 3213. *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.

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

Rosin Engineering Co. Ltd.,
15/17 St. Cross St., Hatton Garden, London E.C.1, England.
Tel.: 01–242 9361–3.
Telex: 338078.

Rotameter Manufacturing Co. Ltd.,
330 Purley Way, Croydon CR9 4PG, England.
Tel.: 01–688 3816. *Cable:* Rotaflo, Croydon.
Telex: 24292.

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) 227-6510. *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.

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.

Sankey Green Wire Weaving Co. Ltd.,
Thelwall, Warrington, Lancs., England.
Tel.: 0925-61211. *Cable:* Sanco, Warrington.

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

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

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

Schabaver,
Zone Industrielle de Mélou, 81 Castres, France.
*Tel.:*59-00-49. *Cable:* Schabaver, Castres s/Agout.
Telex: 51786.

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.: 748 6031. *Cable:* Polarisation, Berlin.
Telex: 183 343 suhfo d.

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

Scientific Furnishings Ltd.,
London Road South, Poynton, Stockport, Cheshire, SK12 1LJ, England.
Tel.: Poynton 2215/6/7/8. *Cable:* Design, Poynton.

Serseg (Seguin-Sergot),
4 Place Félix Eboué, 75 Paris 12e, France.
Tel.: 344.29.59/345.29.59. *Cable:* Sersegman, Paris.
Telex: 22.631 Serseg Paris.

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

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

Shirtliff Bros. Ltd.,
Icknield Way, Letchworth, Herts., England.
Tel.: 2161. *Cable:* Shirtliff, Letchworth.

Siemens A.G.,
Bereich Mess- und Prozesstechnik,
7500 Karlsruhe 21, Postfach 211080, West Germany.
Tel.: (0721) 5951. *Cable:* Wernerwerkmess, Karlsruhe.
Telex: 7826851.

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

Sigmund Pulsometer Pumps Divn., SPP Group Ltd.,
see SPP Group Ltd.

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

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

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

Richard Sizer Ltd.,
Cuber Works, 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: 65088 Spechim.

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

Stabilag Engineering Ltd.,
11-12 Mark Rd., Hemel Hempstead, Herts., England.
Tel.: Hemel Hempstead 4481.
Cable: Stabilag, Hemel Hempstead.

Stansteel Corporation,
5071 South Boyle Avenue, Los Angeles, California, 90058 U.S.A.
Tel.: (213) 585-1231. *Cable:* Stansteel, Los Angeles.
Telex: 674737.

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

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

Stella-Meta Filters,
Laverstoke Mill, Whitchurch, Hants., England.
Tel.: 0256-82 2360. *Cable:* Stellameta, Whitchurch, Hants.
Telex: 85145.

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.: Hengelo 54321. *Cable:* Stowesugar, Hengelo.
Telex: 44485.

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

A.B. Svenska Fläktfabriken,
P.O. Box 20 040, S-104 60 Stockholm 20, Sweden.
Tel.: Stockholm 23 83 20. *Cable:* Flaktfabriken, Stockholm.
Telex: 10430 flakt s.

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.,
28 City Road, London, E.C.1, England.
Tel.: 01-606 7387/8. *Cable:* Pakitup, London.

Thermix Industries Ltd.,
see Newell Dunford Engineering Ltd.

Thibodaux Boiler Works Inc.,
P.O. Box 32, Thibodaux, La., 70301 U.S.A.
Tel.: (504) 446-1363. *Cable:* Thibworks, Thibodaux.

John Thompson (Design and Contracting Division) Ltd.,
Ettingshall, Wolverhampton, England.
Tel.: 0902-41121. *Cable:* Watertube, Wolverhampton.
Telex: 33-212.

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: 33353.

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

Triangle Valve Co. Ltd.,
P.O. Box 38, Wigan, Lancs., England.
Tel.: Wigan 82631.
Telex: 67539.

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

UCMAS Union des Constructeurs Belges de Matériel de Sucrerie Soc. Coop.,
4 Rue du Trône, Bruxelles 5, Belgium.
Tel.: (02) 13 84 90. *Cable:* Ucmascoop, Bruxelles.
Telex: 22-328 a b r bruxelles.

Venema Automation N.V.,
Smirnoffstraat 3–5, Groningen, Holland.
Tel.: 050-23538. *Cable:* Venapp, Groningen.

Wabash Power Equipment Co.,
2701 W. Peterson Ave., Chicago, Ill., 60645 U.S.A.
Tel.: (312) 271-9600. *Cable:* Wapeco, Chicago.

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.: Malmö 73495. *Cable:* Nilswei, Malmö.
Telex: 32226.

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.

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

Joseph Westwood & Co. Ltd.,
Napier Yard, West Ferry Rd., Millwall, London, E.14, England.
Tel.: 01-987 1043. *Cable:* Westwood, London E.14.

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

Wiegand Karlsruhe G.m.b.H.,
7505 Ettlingen, Einsteinstr. 9–15, Germany.
Tel.: (07243) 751. *Cable:* Wiegandapparate, Ettlingen.
Telex: 07 826 765.

Wire Weaving Co. Ltd.,
Anholtseweg 10, P.O. Box 2, Dinxperlo, Holland.
Tel.: 441. *Cable:* Draadweverij, Dinxperlo.
Telex: 45211.

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.

Yarrow Engineers (Glasgow) Ltd.,
Steam & Process Plant Division,
Scotstoun, Glasgow W.4, Scotland.
Tel.: 041-959 1207. *Cable:* Yarrow, Glasgow.
Telex: 77357 Yarrow Glasgow.

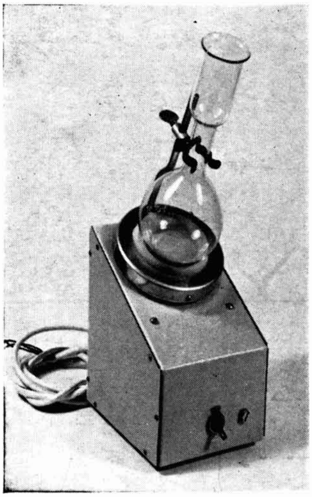
Yorkshire Imperial Metals Ltd.,
P.O. Box 166, Leeds LS1 1RD, Yorkshire, England.
Tel.: 0532-701107. *Cable:* Yorkimp, Leeds.
Telex: 55-311.

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

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

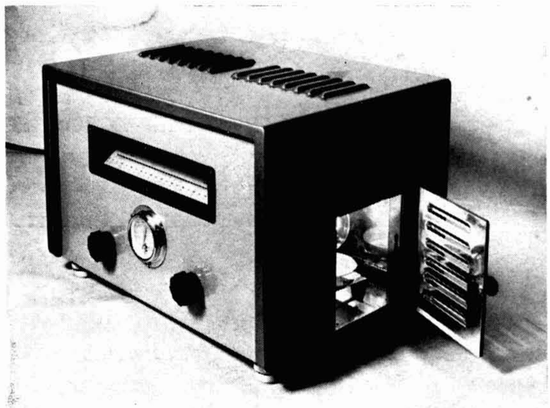
Suma Products

SUGAR ANALYSIS



ROTARY DISSOLVING MACHINE

The action of this rotary dissolving machine is such that frothing and air trapping are either eliminated or reduced to the minimum while at the same time dissolving rapidly by a gentle wavy action. By its use the analyst may either speed up his work or devote himself to other duties until solution is complete. The angle of inclination and speed of rotation are so chosen that the solid material is held against the side of the flask on rotation and the solvent in contact with it is constantly changed. In the case of sugar analysis it was found that 26 grams of sugar are completely dissolved in 30 ml of distilled water in a 100-ml flask in 3½ minutes, without producing any frothing or trapping air bubbles in the solution. The dissolver operates from 200/250 or 100/125 volts single phase A.C. of 50 or 60 cycles.



Type CB

MOISTURE BALANCE

The type CB automatic moisture balance illustrated here, is used for determining rapidly the moisture content of sugar. The balance is capable of an accuracy of $\pm 0.05\%$ when 10 grm samples are used.

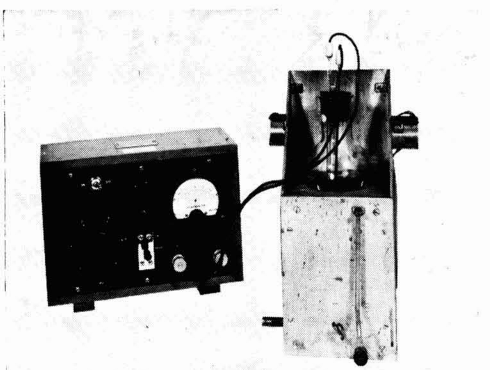
Heating is by infra-red lamp built into the equipment giving a maximum temperature of 130°C regulated by means of a resistance knob outside the body of the balance.

A luminous spot projected on to a scale ranged 0/20% gives the moisture content directly at any instant of drying. The balance equipment is magnetically damped and is highly accurate.

Determinations can be made in from 5 to 30 minutes depending on the temperature and the nature of the product under test. This short duration is due to the penetration of the rays into the sample and not simply surface heating action.

All that is necessary is for the 10 grm sample to be weighed into the aluminium dish which is placed in the oven. The lamp is switched on, temperature adjusted and the spot read from time to time. As soon as two consecutive readings agree, the moisture content can be read directly on the scale.

Please state single phase voltage and frequency when ordering.



REDUCING SUGAR ESTIMATION

(Electrometric end point detector)

The instrument comprises a battery-powered circuit embodying an on/off switch, a potentiometer which permits a range of mV potentials to be applied across two electrode terminals, a sensitive galvanometer with centre zero and a press knob for checking the battery output.

The electrode system comprises a copper rod of ⅛ inch (3.18 mm) diameter which is connected to the positive terminal on the instrument panel and a platinum wire electrode connected to the negative terminal, both of sufficient length to permit adjustment so that they are always immersed in the solution under test. These electrodes are held in a rubber bung. Also fitted through the bung are a jet for the admission of the titration solution and a bent glass tube to act as a steam outlet. The bung is then introduced into the neck of a 250 ml flat bottomed flask.

For analytical comparison with the standard Lane & Eynon modified procedure, see *I.S.J.*, June 1965, p. 173.

STANDARD POLARIMETERS FOR SUGAR ANALYSIS, also available according to requirements

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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