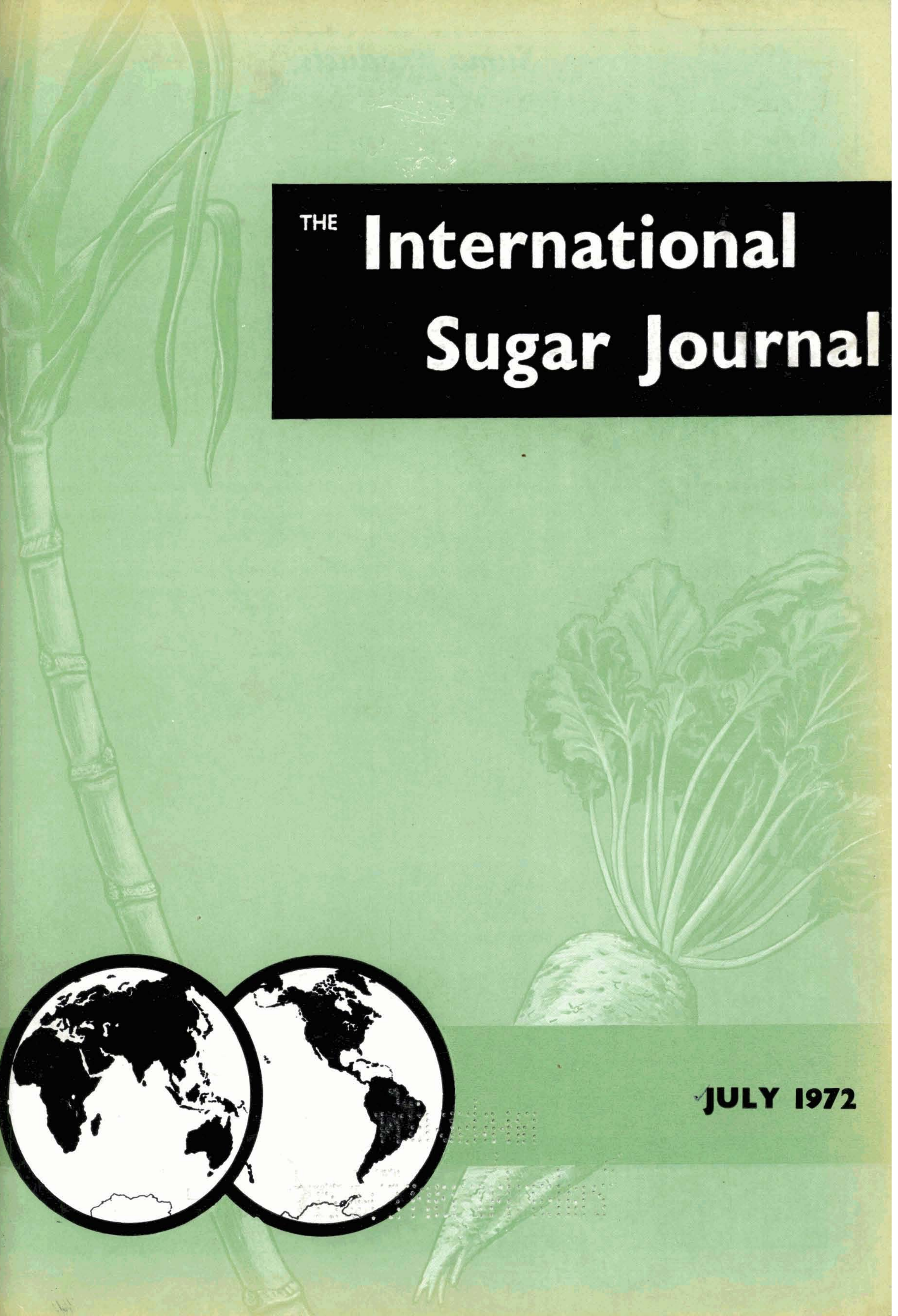
THE

International Sugar Journal



JULY 1972

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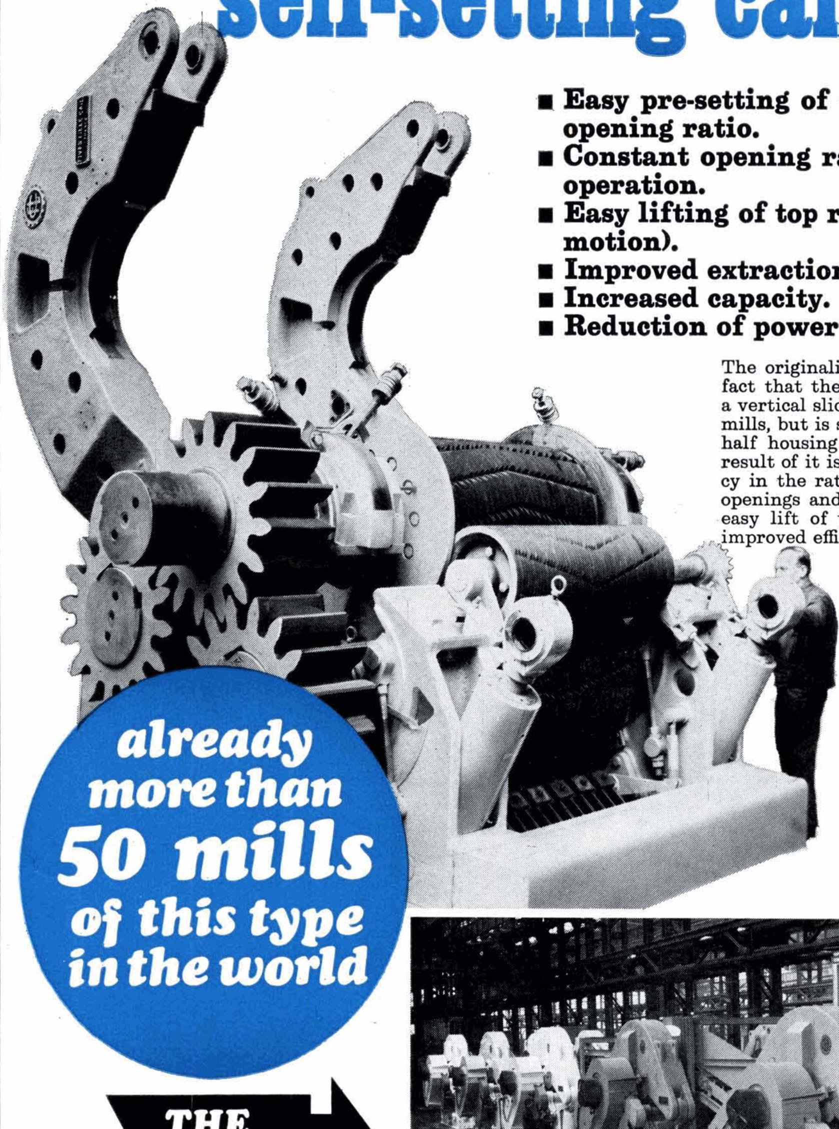

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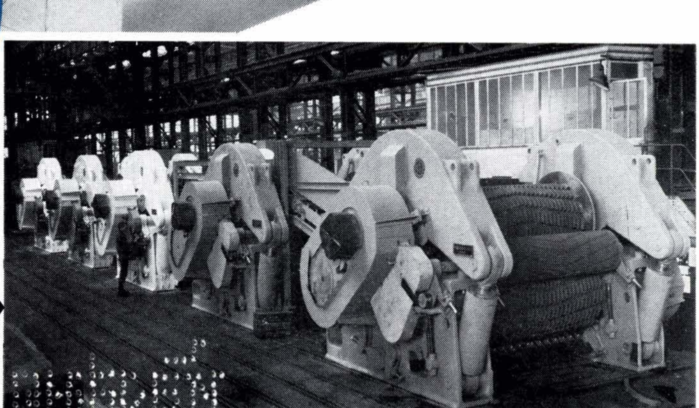

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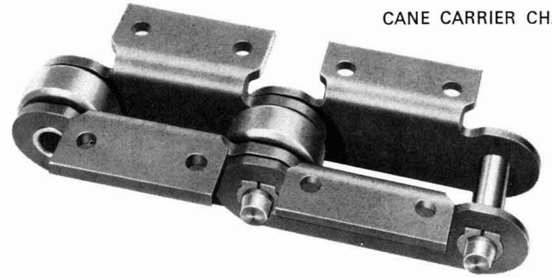

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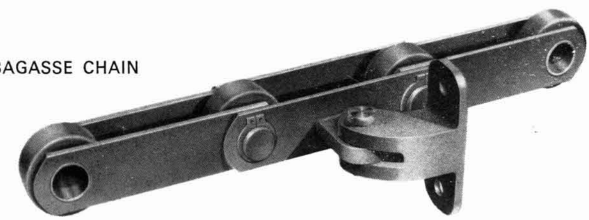

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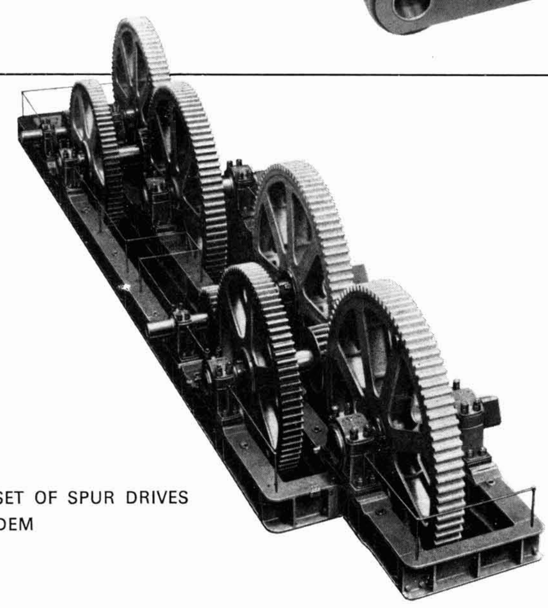

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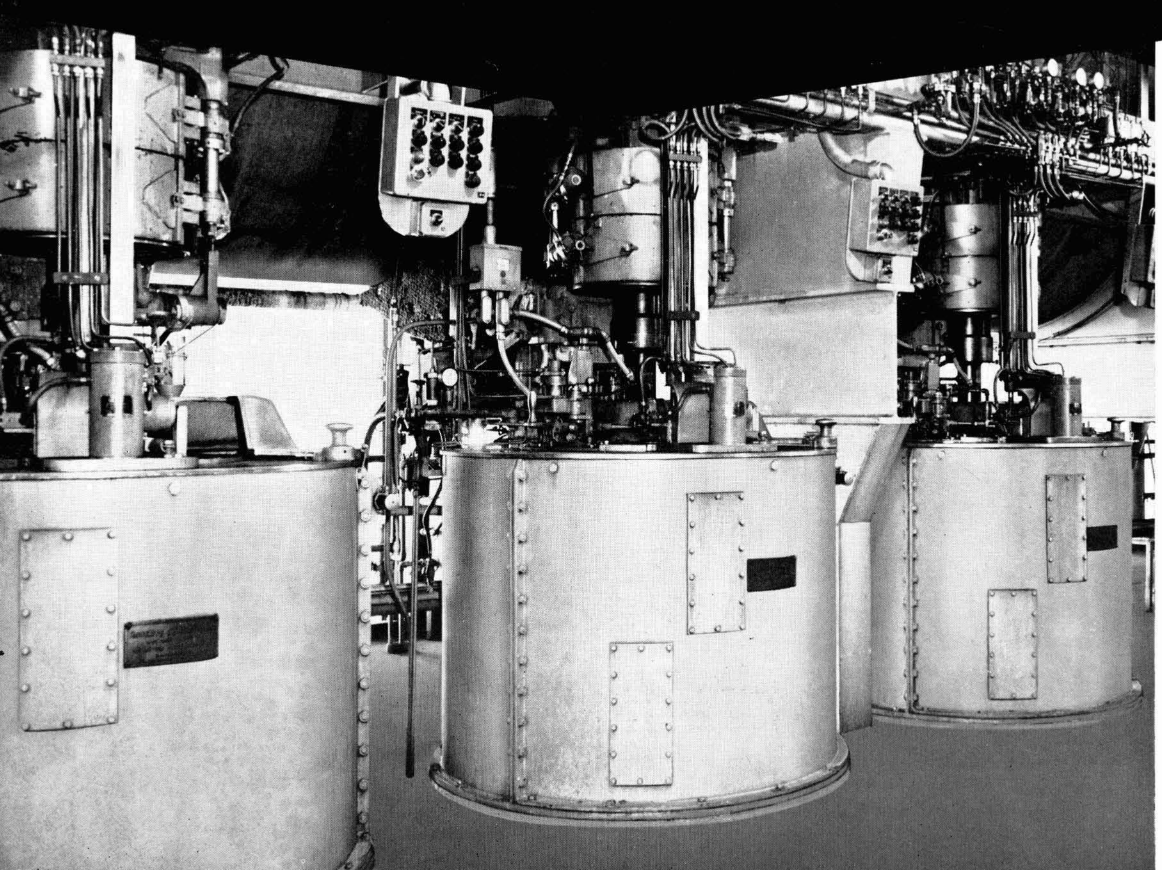

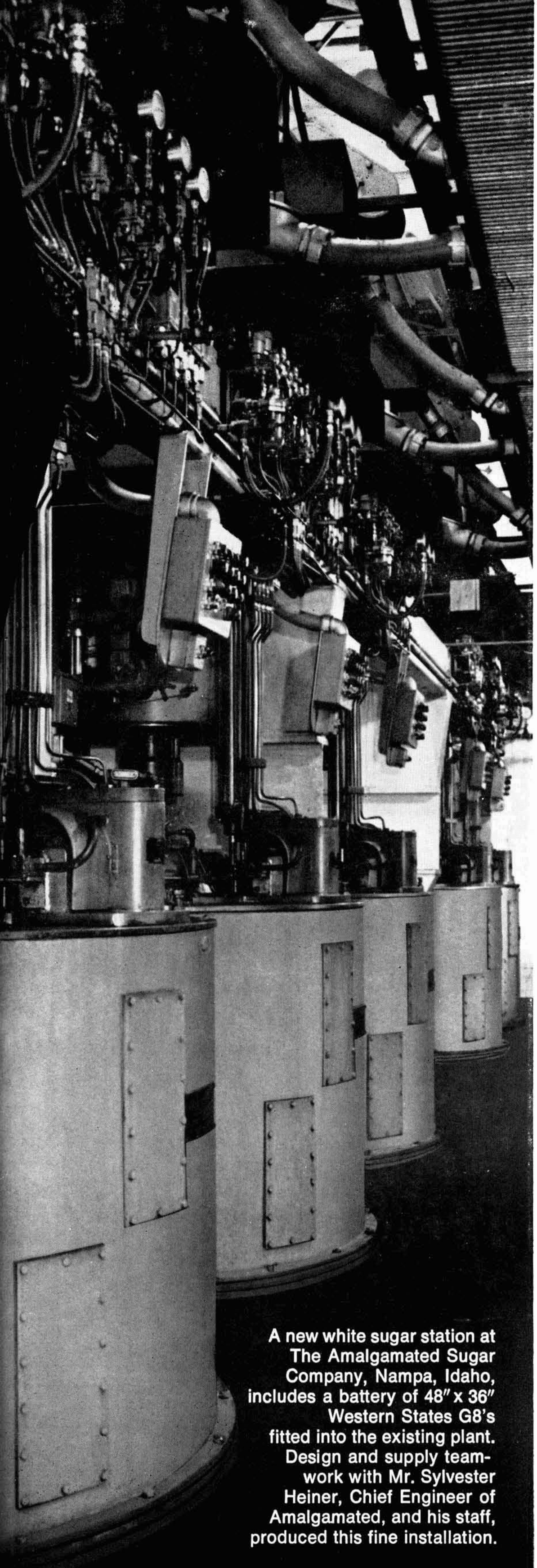

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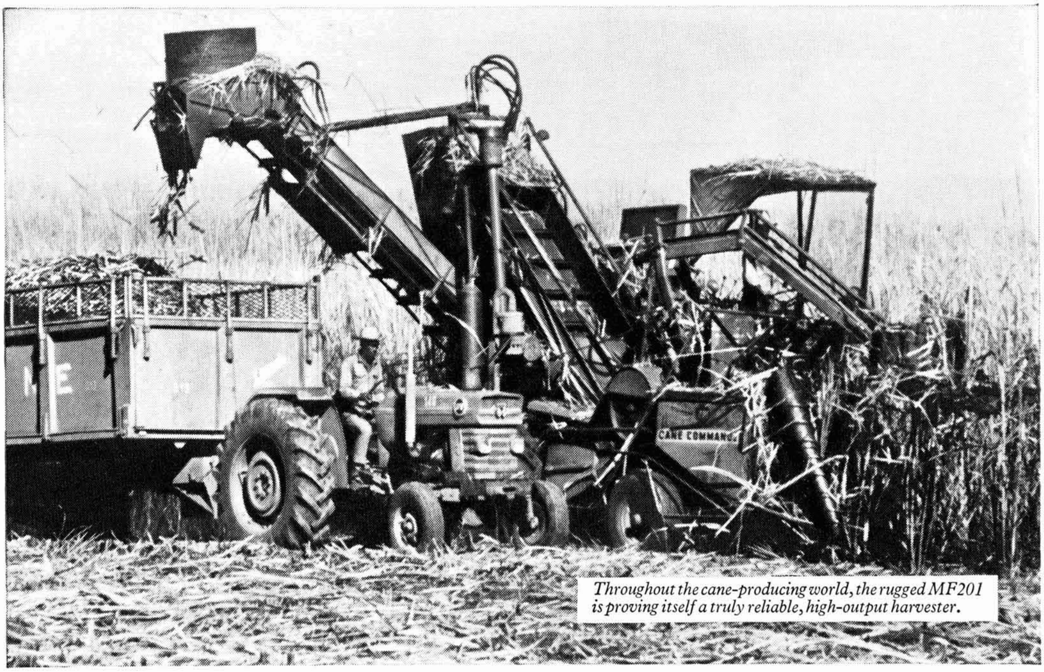

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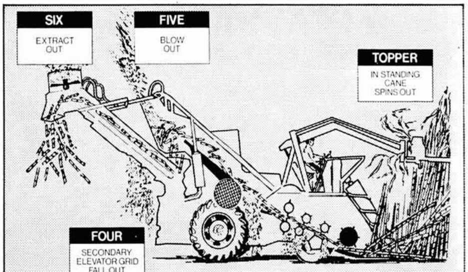

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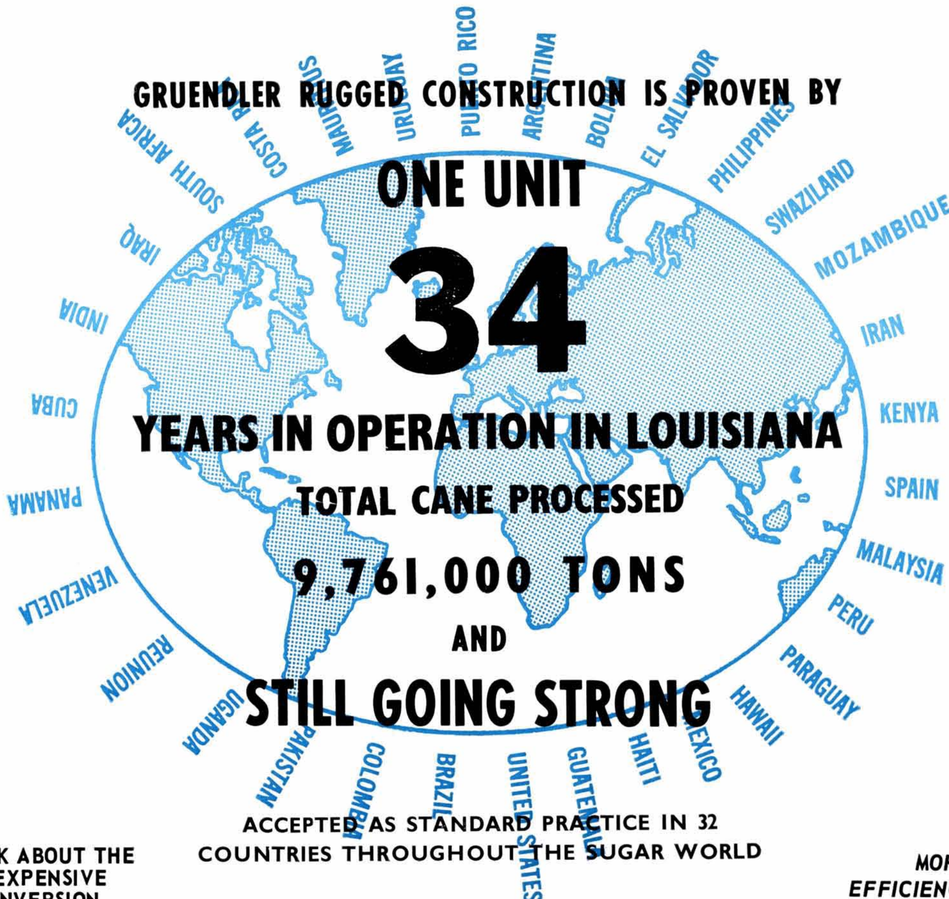

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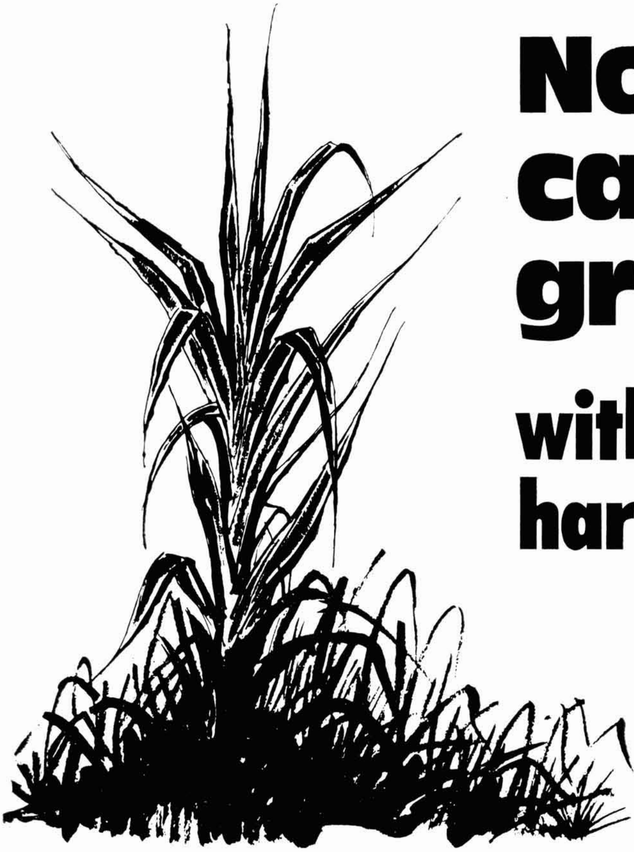

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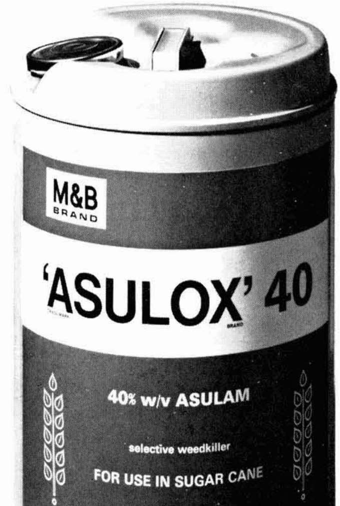

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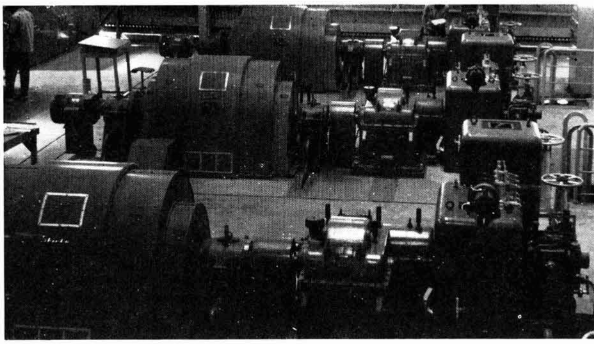

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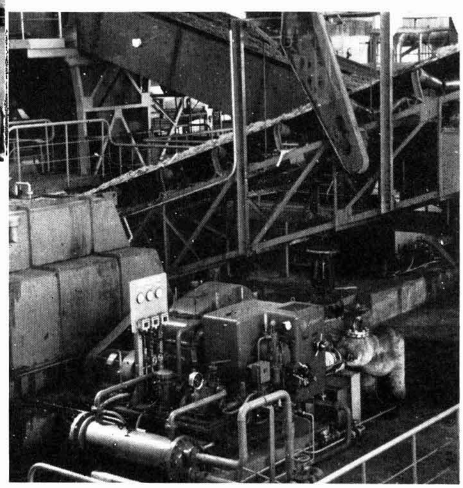

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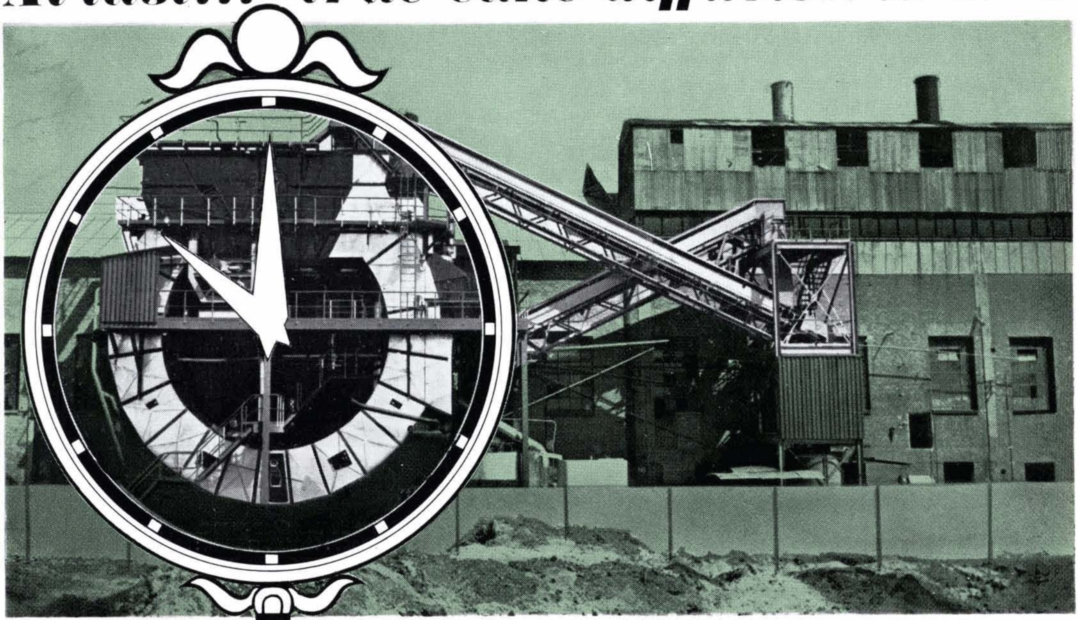

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July 1972

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Caractéristiques du comportement spectrophotométrique et mesure de la coloration en solution de sucres commerciaux. 1ère Partie S. K. D. AGARWAL et D. S. MISRA. *p.* 195–197

Dans une tentative d'établir un système plus rationnel pour l'évaluation de la coloration de sucre commercial, on a effectué une série d'essais sur des sucres détériorés sur lesquels des mesures spectrophotométriques ont été faites dans les régions de l'ultra-violet et du visible du spectre et les pics d'absorption notés.

* * *

Revue de quelques travaux récents sur la maturation chimique de la canne à sucre. R. A. YATES. *p.* 198–203

On décrit une méthode, basée sur des essais effectués en serre et sur champs, pour l'évaluation préliminaire d'un certain nombre de produits chimiques physiologiquement actifs au point de vue des concentrations, quantités et conditions d'emploi pour la maturation de la canne. On obtint une bonne corrélation avec le produit CP. 41845, le meilleur agent de maturation sous des conditions d'humidité, et avec le produit "Pesco 1815", une composition efficace sous des conditions de sécheresse prononcée. Un mélange d'acide gibberilique et de "Dalapon" a donné des résultats positifs au cours des essais d'orientation mais des essais supplémentaires sur champs sont requis. L' "Ethrel" (acide 2-chloroéthylphosphonique) fut le seul produit qui donna des résultats complètement différents (contraires) au cours d'essais effectués sur champs de ceux obtenus au cours des essais d'orientation.

* * *

Evaluation du rendement de l'atelier de cristallisation. B. L. MITTAL. *p.* 203–205

Après une brève discussion des manières d'exprimer le rendement de l'atelier de cristallisation, l'auteur explique le concept de la pureté virtuelle des mélasses. Une formule qu'il a dévelopée pour le calcul de la récupération réduite dans l'atelier de cristallisation est comparée à celle dérivée par GUNDU RAO. On montre, à l'aide de quatre exemples, que la première formule est la meilleure des deux.

Charakterisierung des spektrophotometrischen Verhaltens und Bestimmung der Farbe in Lösung von Handelszuckern. Teil I. S. K. D. AGARWAL und D. S. MISRA. *S.* 195–197

In dem Bestreben, ein rationelleres System zur Farbbestimmung an Handelszuckern auszuarbeiten, wurde eine Reihe von Versuchen an in ihrer Qualität geminderten Zuckern durchgeführt, bei welchen spektrophotometrische Messungen im ultravioletten und sichtbaren Bereich durchgeführt und die Absorptions-Peaks aufgezeichnet wurden.

* * *

Uebersicht über einige neuere Arbeiten über die chemische Reifebeschleunigung bei Zuckerrohr. R. A. YATES. *S.* 198–203

Es wird eine Methode zur vorläufigen Beurteilung einer Anzahl physiologisch aktiver Substanzen hinsichtlich Konzentration, Menge und Anwendungsbedingungen bei der Reifebeschleunigung von Zuckerrohr beschrieben, die auf Gewächshaus- und Feldversuchen beruht. Eine gute Korrelation wurde mit CP.41845, dem besten Reifebeschleuniger unter feuchten Bedingungen, und mit "Pesco 1815", einer wirksamen Mischung unter einigermassen trockenen Bedingungen, erhalten. Eine Mischung von Gibberellinsäure und "Dalapon" zeigte bei der Voruntersuchung gute Resultate, jedoch ist ein weiterer Test auf dem Feld notwendig. "Ethrel" (2-Chloroäthylphosphonsäure) war die einzige Verbindung, bei der die Feldversuche von der Voruntersuchung völlig abweichende (entgegengesetzte) Resultate ergaben.

* * *

Beurteilung der Leistung eines Zuckerhauses. B. L. MITTAL. *S.* 203–205

Nach einer kurzen Diskussion der Möglichkeiten, die Leistung eines Zuckerhauses auszudrücken, erklärt der Autor den Begriff der wahren Melassereinheit. Eine Gleichung, die zur Berechnung eines vereinfachten Zuckerhausschemas aufgestellt wurde, wird mit einer von GUNDU RAO abgeleiteten Formel verglichen. An Hand von vier Beispielen wird gezeigt, dass die vom Autor abgeleitete Gleichung die bessere ist.

Caracterización de comportamiento espectrofotométrico y medición de color en solución de azúcares comerciales. Parte I. S. K. D. AGARWAL y D. S. MISRA. *Pág.* 195–197

En un conato de establecer una sistema más racional de evaluación del color de azúcar comercial, se ha conducido una serie de experimentos con azúcares deteriorados, de que se han obtenido medidas espectrofotométricas en las zonas ultravioleta y visible del espectro y se han apuntado los picos de adsorción.

* * *

Una revista de trabajos de los ultimos años sobre maduración de caña de azúcar con agentes químicos. R. A. YATES. *Pág.* 198–203

Se describe un método, usando ensayos en campo y en invernáculo, para la selección preliminar de varios fisiologicamente activos productos químicos con respecto a concentraciones, cantidades y condiciones de uso en la maduración de la caña de azúcar. Una buena correlación se obtuve con CP.41845—el mejor agente madurante sobre condiciones mojados—y con "Pesco 1815", una mezcla eficaz sobre condiciones relativamente secas. Con una mezcla de ácido giberelico y "Dalapon" se obtuvieron resultas positivas en ensayos de selección pero se requieren ensayos adicionales en campo. "Ethrel" (ácido 2-cloroetilfosfónico) fué el solo compuesto que dió resultas completamente diferente (adversas) en ensayos en campo que esas de los ensayos de selección.

* * *

Valoración de la eficiencia de la casa de cocción. B. L. MITTAL. *Pág.* 203–205

Después ha discutado medios para expresar la eficiencia de la casa de cocción, el autor explica el concepto de pureza virtual de melaza. Compare une fórmula que ha desarrollado para calcular recuperación reducido de la casa de cocción con uno derivado por GUNDU RAO, y demuestra, con cuatro ejemplos, que la suya es la mejor.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIV | JULY 1972 | No. 883

Notes & Comments

International Sugar Organization.

The spring meeting of the International Sugar Council took place on the 24th–26th May in London. It was preceded by meetings of several ISO committees, the Statistical Committee from the 15th to the 17th May, the Executive Committee on the 18th May and the Consumption Committee on the 23th May.

F. O. Licht K.G. noted[1] that these meetings would bring no decisions as to any actions by the ISO in respect of the present sugar market situation. "According to Article 48 of the International Sugar Agreement, all quotas are to become inoperative if, and as long as, the prevailing price exceeds 5·25 cents per pound. The price level exceeded this level early in January this year and therefore the quotas for 1972 became inoperative. If the prevailing price moves below 5·00 cents per pound, quotas in effect shall be established at levels which do not in aggregate exceed 115% of the total of basic export tonnages, unless the Council desides otherwise. The present price level is still considerably above this limit and therefore no actions may be taken according to the provisions of the Agreement. It is, however, a question whether the price ranges fixed in the Agreement in 1968 are too much on the low side. Therefore these price ranges are worth deliberation on the occasion of the renegotiations of the International Sugar Agreement.

"The Agreement expires at the end of 1973. Therefore consideration will be given to the necessary steps to provide for the continuation of the Agreement. In fact it may not be denied that the present Agreement has worked much better than any preceding ones; however, there are certainly still some important matters which should be considered at the renegotiations of the Agreement. Above all it would be appreciated if the Agreement were placed on a broader basis. The British Minister of State for Foreign and Commonwealth Affairs has recently expressed the hope that it would be possible for the enlarged EEC as a whole to become a party to the Agreement."

After the meetings, the following press communiqué was issued:

The eighth session of the International Sugar Council ended on the 26th May 1972.

In the course of its three-day meeting the Council reviewed the reports on the discharge by Members of their obligations in 1971 and on the operation of supply commitments under Article 30 in 1972. The Council adopted the report of the Statistics Committee. Net import requirements of the free market in 1972 were estimated at 10·9 million tons, some 1·6 million tons more than the estimate made last November.

It was estimated that the supplies likely to be available to the free market from Members and non-Members would be insufficient to meet this estimate of net import requirements; on the basis of an unofficial estimate the apparent gap might be of the order of ¾ to 1 million tons.

It was pointed out, however, that, as the Council estimates apply to the whole of the calendar year, it is difficult in the present circumstances of the market and at this stage of the year to estimate with any degree of finality the ultimate demand/supply position for the year as a whole, since much will depend on crops still to be harvested in the second half of the year. Moreover, because of the possibility of a curtailment of consumption and a reduction in importers' stocks, import requirements may be reduced.

The Council noted that the current International Sugar Agreement will expire on 31st December 1973. The Council accordingly considered the arrangements to be made for the negotiation of a new Agreement to come into effect on 1st January 1974. It decided to invite the Secretary-General of UNCTAD to convene a negotiating conference in 1973. The Council considered that the conference should be in two parts, the first in the early summer and the second in September 1973. The precise dates for the conference will, however, now be considered by the Secretary-General of UNCTAD.

The next session of the International Sugar Council will be held on 15th–17th November 1972.

The deficit forecast by the Statistical Committee is in line with that forecast by trade sources. C. Czarnikow Ltd.[2] point out, however, that an overall deficit is not an impossibility.

[1] *International Sugar Rpt.*, 1972, **104**, (13), 1.
[2] *Sugar Review*, 1972, (1077) 97.

"Supply and demand must be balanced by the end of the year and the apparent deficit will disappear. The tight supply position and the concomitant high prices will no doubt lead to some countries' requirements falling below currently calculated levels, while from experience we should expect stocks in some quarters to be reduced well below what might in normal circumstances be considered the reasonable minimum. Meanwhile it would not be surprising if some sugar should appear from unusual or unexpected origins.

"There have been suggestions that the present ISA should be extended for one or two years so that it might eventually be renegotiated at a time when the USA and the EEC were also reconsidering supply arrangements. For a number of reasons this has been considered unacceptable and a full negotiating conference will be held next year. Some anomalies have been shown to exist in the current Agreement and these will have to be eliminated. The operation of the Agreement at its various trigger points has also worked well enough, but it can be expected that these will be adjusted, not only to take note of the recent currency revaluations but also to reflect the rapid world-wide inflation which has taken place during the past few years. Considerable thought can be expected to be given to these problems in the course of the next twelve months before the first part of the conference is held next year."

* * *

UK Sugar Board

In our last issue we reported the reduction of the distribution payment by the UK Sugar Board to £8 per ton with effect from the 16th May; the following day the payments were reduced again to £2 per ton. With reduced prices on the world market the distribution payments were later raised, to £4 per ton with effect from the 25th May and to £8 per ton from the 1st June. The last was the tenth change of rate since distribution payments were introduced on the 1st February and the need for so many indicates the fluctuations in world market prices which have required adjustment of the rate to maintain the home prices of refined sugar within the desired range.

* * *

US sugar supply quotas, 1972

On the 27th April a deficit of 4273 short tons, raw value, was declared by the US Department of Agriculture against the quota for Haiti. This quantity was reallocated among a total of 19 other Western Hemisphere suppliers.

On the 2nd June the US all-commodities wholesale price index announced by the US Dept. of Labour was announced and its increase raised the sugar guide price to 9.00 cents/lb at the same time, raising the limits of the "price corridor" which provide trigger points for adjustment of the supply quota. Since the domestic spot price of sugar on the New York market was 8·60 cents this was below the new floor level of 8·64 cents, and by the 5th June a 7-day average below had been established. The Department of Agriculture announced a cut in the overall quota from 12 to 11·8 million short tons, raw value; however, it also took the opportunity of declaring shortfalls of nearly 100,000 tons which were reallocated. The size of the shortfalls eased the effect of the quota reduction so that the markets were not affected as they might otherwise have been.

The former quotas and the changes resulting from the reallocations and shortfalls are tabulated below.

	Previous quotas	*Shortfalls/Reallocations* 27th April	5th June	*Revised quotas*
	(short tons, raw value)			
Domestic Beet	3,500,000	—	—	3,500,000
Mainland Cane	1,677,667	—	−34,667	1,643,000
Hawaii	1,218,238	—	—	1,218,238
Puerto Rico	205,000	—	−30,000	175,000
Philippines	1,407,970	—	− 6,209	1,401,761
Argentina	84,111	+ 109	− 1,522	82,698
Australia	210,483	—	+ 314	210,797
Bahamas	29,687	+ 38	−29,725	0
Bolivia	7,147	+ 9	− 7,156	0
Brazil	606,921	+ 784	−10,986	596,719
British Honduras	37,383	+ 47	− 675	36,755
Colombia	74,766	+ 97	− 1,355	73,508
Costa Rica	97,672	+ 98	− 1,374	96,396
Dominican Repub.	703,677	+ 908	−12,739	691,846
Ecuador	89,609	+ 116	− 1,623	88,102
Fiji	46,121	—	+ 69	46,190
Guatemala	82,820	+ 84	− 1,174	81,730
Haiti	34,085	−4,273	—	29,812
Honduras	17,609	+ 17	− 239	17,387
India	84,277	—	+ 126	84,403
Ireland	5,351	—	—	5,351
Malagasy Republic	12,579	—	+ 18	12,597
Mauritius	31,027	—	+ 47	31,074
Mexico	622,315	+ 803	−11,266	611,852
Nicaragua	70,918	+ 92	− 1,285	69,725
Panama	46,729	+ 60	− 3,289	43,500
Paraguay	7,147	+ 9	− 129	7,027
Peru	434,300	+ 561	− 7,863	426,998
Salvador	47,278	+ 61	− 855	46,484
South Africa	59,539	—	+ 89	59,628
Swaziland	31,027	—	+ 47	31,074
Taiwan	87,632	—	+ 131	87,763
Thailand	19,288	—	+ 28	19,316
Uganda	15,513	—	−15,513	0
Venezuela	67,619	+ 87	− 1,225	66,481
West Indies	226,496	+ 292	−20,000	206,788
	12,000,000		−200,000	11,800,000

Israel sugar imports, 1971[1].—In 1971, Israel imported a total of 165,668 metric tons of sugar, raw value, most of which (92,167 tons) came from the EEC. Other suppliers included Mozambique with 31,044 tons, Turkey with 16,767 tons and Rumania with 11,189 tons.

* * *

EEC sugar quota request[2].—The EEC's 18 African associates have asked the Community for an annual sugar quota of 50,000 tons from next year at preferential prices, according to informed sources in Brussels. This quota has been requested to compensate for the advantages which Commonwealth sugar producers will enjoy next year through continued preferential access to the British market. The EEC Commission is at present considering the request which would chiefly benefit the Malagasy Republic, the only big-scale exporter among the associated African states.

[1] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (11), ix.
[2] *Public Ledger*, 22nd April 1972.

Spectrophotometric behaviour characterization and measurement of colour in solution of commercial sugars

By S. K. D. AGARWAL and D. S. MISRA

PART I

INTRODUCTION

IN spite of the attention given to the measurement of the colour of sugars in the past many years, visual appearance to the human eye is still a criterion for judging the quality and colour of sugars. Though procedures have been laid down for the measurement, there is still confusion since no acceptable scientific basis could be established. Stammer colorimeters are still in use for the measurement of the colour of the raw sugars. According to BRIEGHEL-MÜLLER and BRÜNICHE-OLSEN[1], the colour measured in degrees Stammer may be converted to the extinction coefficient of the blue mercury line (436 nm) by multiplying by a factor of ten.

Colour vision has been recognised for many years as a tri-dimensional quantity and a system of measurement embodying these properties was defined and adopted by the International Commission on Illumination[2] in 1931 involving measurement and plotting of the coordinates and computing colour therefrom.

The influence of scattering offered maximum interference in evaluating the colour or the attenuancy. PETER and PHELPS[3] preferred measurement at 560 nm for the attenuancy to correlate to the light-dark aspects of the colour of the sugar solutions. It was also felt that the Lambert-Beer law was applicable when stable transparency was produced by vigorous clarification of the solutions of the sugars to eliminate the influence of scattering. ZERBAN and SATTLER[4] therefore recommended "Celite" filtration of the sugar solution to make it free from light-scattering particles. The present method of colour measurement was adopted by the US National Committee of ICUMSA in 1953, accepted by ICUMSA for international usage, and is in vogue even today.

It involves dissolving the sugar in hot distilled water to 50% solids concentration and measuring the attenuancy at 420 and 720 nm and indicating the colour index as equal to $1000[(A_c)_{420} - 2\,(A_c)_{720}]$. However there is no particular scientific evidence for subtracting twice the attenuancy at 720 nm from that at 420 nm for eliminating the influence of scattering and therefore there is still wide reluctance in accepting this. It is the purpose of the present investigations to give a scientific backing to the colour that is measured and select such wavelength(s) as may be least influenced by the turbidity shown by commercial sugars in solution.

Since in the measurement of the colour only the characteristic component inherent in the system is to be measured, only such methods should be adopted that may correlate the spectrophotometric readings with the constituent responsible for the colour. Moreover the colour intensity should either vary with the concentration either linearly or according to a calibration curve which might be established to give the relationship free from the influence of other interfering substances present. For this, the wavelength of maximum absorption of the colouring constituents of the sugars, i.e. of the functional groups characteristic of the colouring matter present in the sugars, must be chosen for the colour measurement.

Aliphatic aldehydes and ketones have very characteristic absorption spectra with maximum absorption at about 280 nm; this may be taken as a criterion[5] for the presence of aldehydic and ketonic groups. The presence of such groups has been demonstrated by the authors[6] while studying the composition of sugar colouring constituents using chromatography, since the colour constituents of the caramel could be developed by reaction with silver nitrate.

EXPERIMENTAL

The spectral properties of commercial sugars were studied in the ultra-violet and visible regions in a 1-cm cell using a Beckman DU spectrophotometer and in the visible region alone by using a Unicam SP 350 DG spectrophotometer. The desired quantities of the sugars were dissolved in known amounts of water as given in the text or the figures, and the measurements were made after filtering the solutions through Whatman No. 1 filter paper. Only those commercial sugars which clearly showed colour were taken; these included deteriorated sugars which had been initially white consumption sugars but which had developed colour owing to long storage over many years, raw sugars and gur (jaggery).

Molasses and cane juices were also examined. The juices examined included raw cane juice which was heated to boiling and filtered through Whatman No. 1 filter paper, and also juices clarified by simple defecation and sulphitation. The clarified juices were also passed through ion-exchange resins ["Amberlite IRA 900" (Rohm and Haas Co., USA) and "Deacidite K" (Permutit Co. Ltd., England)] so that the colour alone might be absorbed; this was

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1 *Proc. 11th Session ICUMSA*, 1954, p. 58.
2 *Proc. Int. Comm. Illumination* 1931 (Cambridge Univ. Press, 1932).
3 *Nat. Bur. Standards Tech. Paper*, 1927, (338).
4 *J.A.O.A.C.*, 1953, 1093.
5 "Physical Methods of Organic Chemistry" Vol. II. (Interscience Publishers Inc., New York) 1946, p. 818.
6 AGARWAL and MISRA: Unpublished work.

later eluted either with hydrochloric or formic acids and neutralized for examining the special behaviour of the colour isolated from the juices.

Results and Discussions

Studies in the ultra-violet region

Figs. 1 to 3 give typical UV spectra of deteriorated sugars, raw sugars and gur respectively. The concentrations were so chosen that the full UV spectrum could be examined. Only four samples of each are shown in the figure though spectra were recorded for about 15 samples of each type, in order to ensure that the behaviour illustrated was typical. It may be seen that the curves show either a maximum at 270 to 280 nm or tend to show a continuous fall but at a lower rate of fall in optical density at or near these wavelengths.

Obedience to Beer's law was examined at 270 nm for sugars which had well-defined peaks and also for those where the peaks were not well marked. It may be seen that the colour measurements could be made in the concentration range 0 to 20%, 0 to 4% and 0 to 0·4% in the deteriorated sugars, raw sugars and gur respectively since the inherent colour in the products varied. Only one peak was observed in all such products in all the concentration ranges. The presence of such a peak was observed by the authors[6] in the case of caramels also. No melanoidin showed a peak in this region.

As explained earlier, the presence of characteristic groups can be located by the observance of this peak and therefore either melanoidins are present in such low concentrations that the caramel spectrum camouflaged the melanoidin spectrum or they are absent in such products. As explained, the peak at

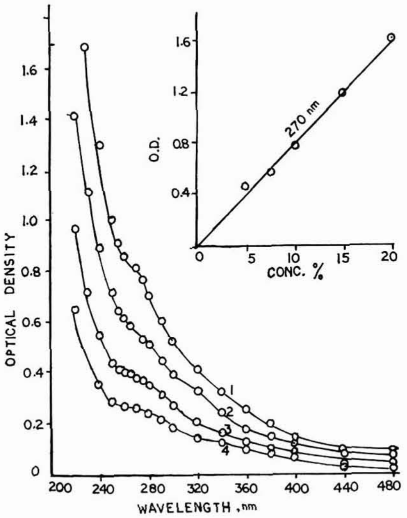


Fig. 1. Spectra of deteriorated sugars (Beckman DU spectrophotometer) in 10% solution. Inset shows obedience to Beer's law.

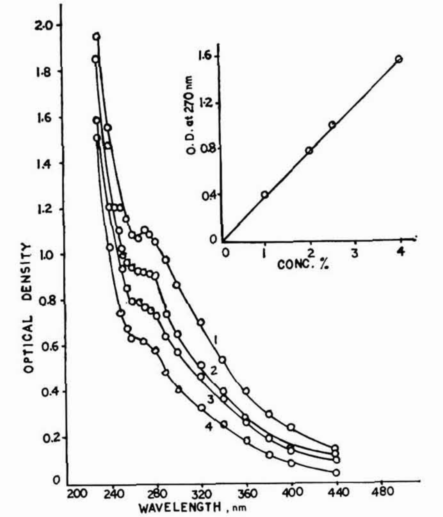


Fig. 2. Spectra of raw sugars (Beckman DU spectrophotometer). Curves 2 and 4—3% concentration, curves 1 and 3—2% concentration. Inset shows obedience to Beer's law.

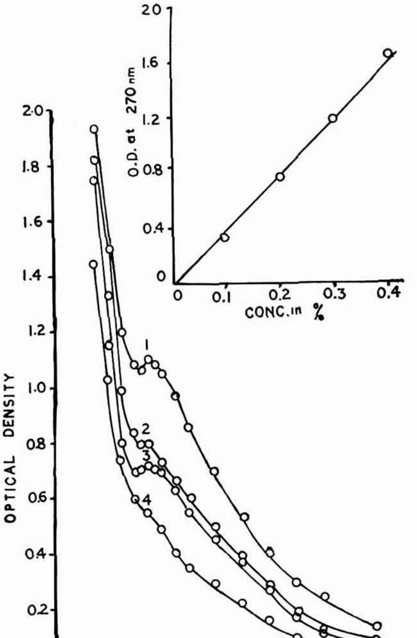


Fig. 3. Spectra of gur solutions (Beckman DU spectrophotometer). Curve 1—0·3% concentration, curves 2, 3, 4—0·2% concentration. Inset shows obedience to Beer's law.

270 to 280 nm could only be due to the presence of aldehydic or ketonic carbonyl groups which are present in these commercial products.

Fig. 4 gives the results obtained on heating a mixture of raw sugars made from samples of about 10 factories in an ordinary oven maintained at 105 $\pm$ 2°C for about four hours. The original UV spectrum showed hardly any peak. However after heating the sugar

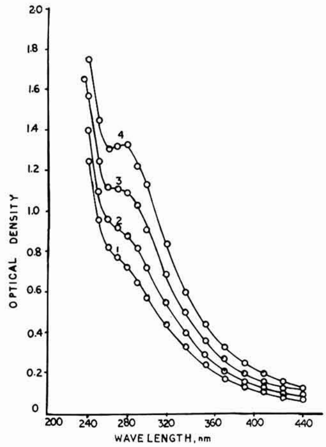


Fig. 4. Spectra of solutions of raw sugar after heating at 105 $\pm$ 2°C in solid state. Curve 1—initial raw sugar, 2—1 hour heating, 3—2 hours heating, 4—4 hours heating.

the peak became apparent and is very well marked in curves 2 to 4. In order to show quantitative increase in colour the raw sugar was weighed and kept in 4 Petri dishes and the total sugar was dissolved to the same concentration. A progressive increase in colour was visible with the naked eye as well, as indicated by the spectra. The actual studies were conducted because of the noticeable increase in colour in raw sugars kept for moisture determination. This has led the authors to believe that the presence of a peak at or near 275 nm is due to the presence of caramel produced by the heating during processing and/or drying and the colour measurements could safely be made at this wavelength.

Molasses is very dark coloured and all the colour formed during processing is concentrated in this product, so that 0·05% solution is sufficient for the colour measurement. A well-defined peak is invariably found at 270 nm (see Fig. 5) and no other absorption peak may be located anywhere else in the spectrum in the entire UV range. This was not only the case in the molasses samples illustrated but also in more than a dozen other samples examined. This indicated that melanoidins, even if present in the molasses, were either not well absorbed or were in low concentration since the peak was feeble at low concentrations and the caramel spectrum dominated over it.

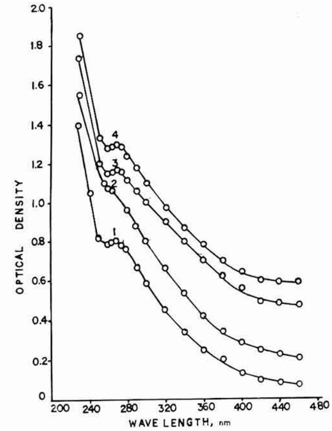


Fig. 5. Spectra of different molasses samples. Curves 2, 3 and 4 have shifted by 0·1, 0·4 and 0·5 O.D., respectively.

Similar observations were shown by the colour inherent in the juices (see Fig. 6). Ordinary mixed juice which was just heated to boiling and filtered through Whatman No. 1 paper without any other clarification treatment, as well as clarified juices from the defecation and sulphitation processes, showed well-defined absorption peaks at or near 275 nm. The colour from the clarified juice, isolated by elution from ion-exchange resins, also showed only one characteristic absorption peak at the same wavelength while it was anticipated that this spectrum would be least influenced by the presence of other interfering substances.

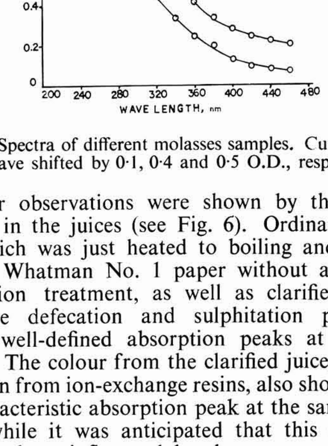


Fig. 6. Characteristic UV spectra of juices and their colour on elution from ion exchange resin. Curve 1—defecated, 2—sulphited, 3—heated, 4—eluted.

(To be continued)

A review of some recent work on chemical ripening of sugar cane

By R. A. YATES

(Tate & Lyle Research Centre, Keston, Kent, England)

Paper presented to the 14th Congress I.S.S.C.T., 1971 (here expanded)

Introduction

THE quality of cane harvested in some countries is much worse than the practicable levels, especially at the extremes of the harvest season. The average quality of about 7 tons cane/ton sugar obtained in Queensland is a practical indication of the margin of improvement possible elsewhere (Fig. 1). The superior quality obtained in Queensland can be largely ascribed to a change from normal, rapid growth of sugar cane to a prolonged period of slow growth induced by low temperatures which override any effects of moisture availability as indicated by YATES[1] (Fig. 2). INNES & COWAN[2], CLEMENTS[3] and GLASZIOU *et al.*[4] have noted the importance of low temperatures in inducing ripening. In the absence of suitably low temperatures, the classical method for inducing ripening is to suppress growth by imposing drought stress[3].

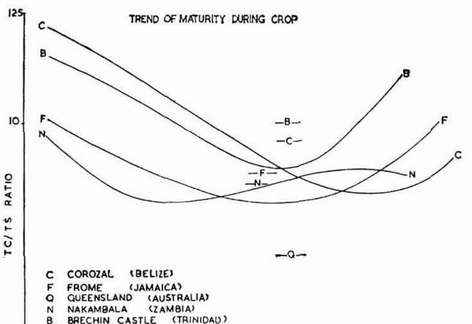


Fig. 1. Trends of cane quality (——) throughout the harvesting season in four cane growing areas, and the crop-average qualities (— —) of those areas compared with that of Queensland (1968 data).

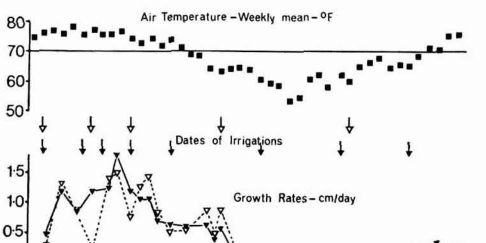


Fig. 2. Changes in growth rate of sugar cane in S. Queensland from summer to winter as affected by moisture availability and average mean-day temperature. Irrigation intervals controlled through evapotranspiration measurements.

Where weather conditions are unsuitable for ripening, it may be possible to reduce respiration of the cane by the application of suitable growth regulating chemicals. This should result in increased sugar storage so long as these chemicals do not significantly, or permanently, depress photosynthesis, translocation, or sucrose storage. Also, the period of respiration inhibition must be long enough to allow a measurable increase in accumulation of sugars. It has been reported[5] that the rate of respiration in the upper part of cane stalks was equivalent to 9 g hexose per kg dry weight per day, which suggests a maximum ripening effect of only 1 lb sugar per day per ton of cane, or about a 1% increase in available sugar in three weeks. Chemicals of different physiological activity could cause ripening if treatment resulted in an increased photosynthetic rate, or in diversion of carbohydrate from lignification or root formation into stored sugars.

Many physiologically active compounds appear worthy of consideration as chemical ripeners. These include gibberellins, antigibberellins, auxins, antiauxins, inhibitors of auxin transport, protein antimetabolites, and enzyme antagonists. However, much of the work on these compounds has been done on tissue isolates, rather than on intact higher plants, whilst commercial application of a ripening agent would normally call for aerial spray application to the leaves. The literature, therefore, often does not show whether leaf application would be effective, and gives little guidance on the rate of application required.

The number of possible combinations of the wide range of concentrations of the many compounds worthy of test are virtually infinite. As NICKELL & MARETZKI[6] have demonstrated, there is no chemical, biochemical, or biological property—other than the

[1] *Aust. J. Agric. Res.*, 1967, **18**, 903–920.
[2] *Proc.* 1960 *Meeting B.W.I. Sugar Tech.*, 99–103.
[3] *Sugar y Azúcar*, 1962, **57**, (3), 29–33.
[4] *Aust. J. Biol. Sci.*, 1965, **18**, 53–66.
[5] BURR *et al.*: *Ann. Rev. Pl. Physiol.*, 1957, **8**, 275–308.
[6] *Hawaiian Planters' Record*, 1970, **58**, (5), 71–79.

ability to ripen cane—which can simply characterize a cane ripener. Thus it is essential to have some initial screening programme to select the compounds, or combinations, most worthy of test under field conditions. Such screening programmes have been undertaken at the Experiment Station of the Hawaiian Sugar Planters' Association, at the David North Plant Research Centre in Australia, and at the Tate & Lyle Research Centre in England. This paper reviews some of the work of the Tate & Lyle Research Centre from 1967 to 1970.

Experimental Methods

Screening tests were conducted under partially-controlled greenhouse conditions or completely controlled environmental conditions of the C.N.R.S. phytotron in France. Chemicals were applied as aqueous solutions or emulsions with the addition of 0·5% "Tween 20" as a wetting agent. Solutions were applied as aerosol sprays in sufficient volume to wet both sides of each green leaf; this volume is considered equivalent to a field application of approximately 200 gallons per acre. Initial tests had indicated that responses exhibited by fully grown cane were qualitatively reflected by much smaller cane, so long as it had at least one or two visible mature internodes. Therefore, fairly young plants, of from 3 to 6 months of age, were used for screening tests.

Full leaf coverage was used so that toxicity symptoms would be obvious, and so that adverse effects on photosynthesis would be automatically measured. The volume of application was selected to ensure reproducibility, but was much greater than that which would be used in commercial applications. Few complications as a consequence of this are anticipated, since a prime requirement of most potential ripeners is that they should be readily absorbed and translocated.

Preliminary selection of candidate ripeners was normally based on their effect on growth rate, and on the absence of excessive phytotoxicity. In suitable cases, stems were harvested for analysis. These stems were scalded and macerated in warm water after sub-samples had been taken to determine dry weights. Extracts were analysed for sucrose and reducing sugars, and the residue dried to measure the "fibre" contents.

The chemicals showing the most suitable response patterns were tested in small plot field trials.

Results and Discussion

(a) Patterns of growth response

It is logical to test growth inhibitors for cane ripening activity. At non-toxic dosage rates, however, several growth inhibitors caused only temporary growth inhibition, followed by abnormally rapid "compensatory" regrowth. In the examples illustrated in Fig. 3, the compensatory regrowth occurred too early for any significant accumulation of stored sugars to be expected. The regrowth could be postponed by a second application at the critical time, as illustrated for "Ethrel" (formulation ACP 66-329 of 2-chloroethyl phosphonic acid).

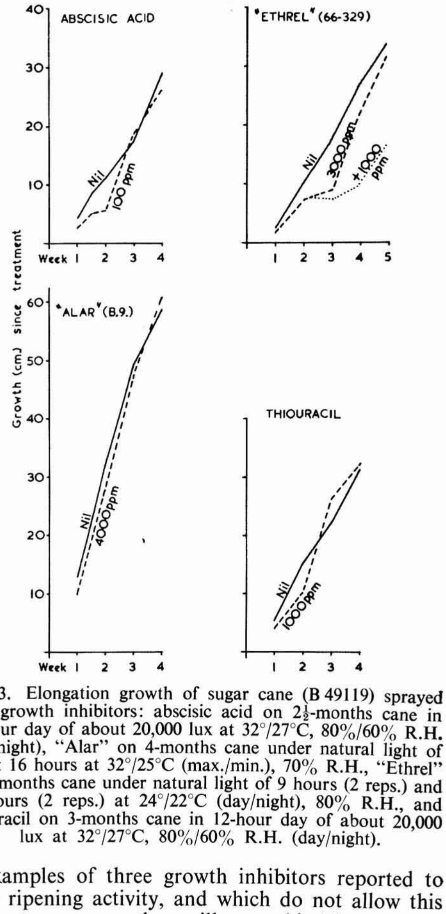


Fig. 3. Elongation growth of sugar cane (B 49119) sprayed with growth inhibitors: abscisic acid on 2½-months cane in 12-hour day of about 20,000 lux at 32°/27°C, 80%/60% R.H. (day/night), "Alar" on 4-months cane under natural light of about 16 hours at 32°/25°C (max./min.), 70% R.H., "Ethrel" on 3-months cane under natural light of 9 hours (2 reps.) and 16 hours (2 reps.) at 24°/22°C (day/night), 80% R.H., and thiouracil on 3-months cane in 12-hour day of about 20,000 lux at 32°/27°C, 80%/60% R.H. (day/night).

Examples of three growth inhibitors reported to have ripening activity, and which do not allow this early recovery growth, are illustrated in Fig. 4. These are "Azauracil"[7], CP.41845[8], [N, N—bis (phosphonomethyl) glycine] and "Dalapon" (2,2-dichloropropionic acid)[9,10]. A later formulation of "Ethrel" (ACP 68-250) differed from the earlier formulation in preventing rapid elongation during the recovery phase, though it did not prevent the emergence of new leaves.

The "stop-go" pattern of growth response illustrated in Fig. 3 was reminiscent of, but opposite to, the responses obtained with gibberellic acid (GA) in Australia and Puerto Rico[11]. GA stimulated growth

[7] ALEXANDER: *J. Agric.* (Univ. Puerto Rico), 1969, **53**, 81–92.
[8] BIESKE: *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 117–124.
[9] YATES: *Trop. Agric.* (Trinidad), 1965, **41**, 225–230.
[10] YANG *et al.*: *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–69, 48.
[11] YATES: *Agron. J.*, 1972, **64**, 31–35

for a period of 3 to 7 weeks (the longer periods, of lesser amplitude, associated with lower temperatures), after which there was a prolonged period of growth suppression (Fig. 5). As with "Ethrel" (Fig. 3) a second application at the critical time postponed the reversal of growth response. The growth suppression phase was sufficiently prolonged to suggest that any depression of the stored sugar levels caused by the initial growth stimulation may be corrected, or even reversed, without excessive loss in weight of cane. BULL[12] and ALEXANDER[13] have reported that GA can increase the sucrose content and/or yield of cane. Further greenhouse tests with GA showed that the growth inhibitory phase was not sufficiently dependable (e.g. Fig. 6) and the admixture of some material which would reinforce this latter phase seemed essential. The delayed-action growth retardant effect of "Dalapon" (Fig. 4) appeared to be particularly suitable.

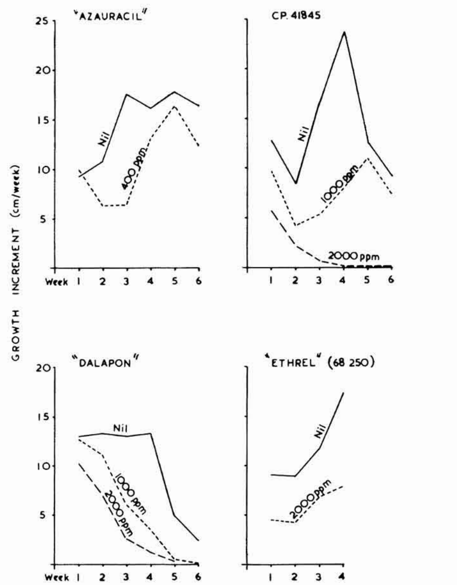


Fig. 4. Elongation growth of sugar cane (B 49119) sprayed with growth inhibitors. All trials at 32°/25°C (max./min.) and 70% R.H. "Azauracil" on 5-months cane under natural light of about 16 hours, CP.41845 on 3½-months cane under natural light of about 14 hours, "Dalapon" on 3-months cane under natural light of about 8 hours supplemented artificially to 12 hours, and "Ethrel" on 3-months cane under natural light of about 16 hours.

Applications of the auxin-herbicide MCPA (2-methyl, 4-chlorophenoxyacetic acid) induce a growth response similar to that caused by GA, but the growth stimulation is transitory, and the subsequent growth suppression of rather shorter duration (Fig. 6). The transient growth stimulation caused by MCPA cannot be detected in internode lengths, whilst GA has obviously increased the length of at least two internodes.

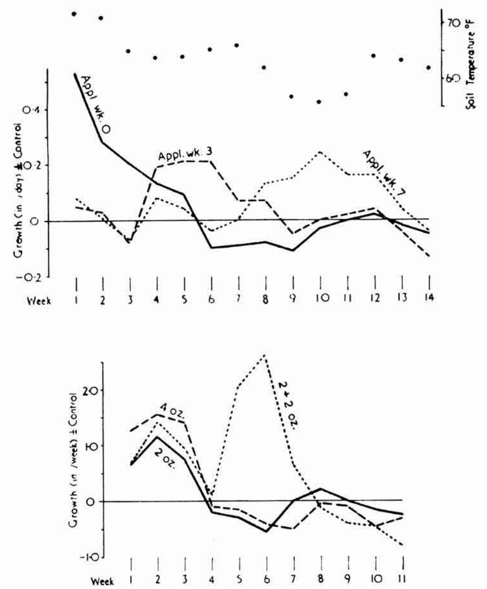


Fig. 5. Elongation growth responses of field-grown sugar cane to applications of gibberellic acid. Upper graph: experiment in Queensland on Q 70, 5 months old at start, in early winter (May to August); all applications at 2 oz/acre applied on 16 replicates at each of weeks 0, 3 and 7; soil temperatures recorded at 3 in depth. Lower graph: experiment in Puerto Rico on PR 1059, 4 months old at start in mid-February; applications of 2 oz and 4 oz made at week 0, and 2 + 2 oz/acre applied at weeks 0 and 4; four replicates (with three similar trials applied at different times giving similar results).

Many compounds have failed to affect growth rate when applied to the leaves of intact plants. These include a range of phenolic compounds and also a number of mineral oils which were reputed to have ripening activity. Similarly, most of the anti-metabolites of proteins tested have proved unsuitable either owing to excessive phytotoxicity or to complete lack of activity.

(b) Ripening trials

Responses to a few compounds proved sufficiently consistent in screening trials to warrant the extension of testing to small-plot field trials. Twenty-two such trials were conducted in the Caribbean area in 1970; detailed descriptions of these trials are being published elsewhere.

Most of the responses obtained in these field trials were reasonably similar to those which had been obtained in greenhouse screening trials. The major exception occurred in the testing of "Ethrel". As noted above, the later formulation, ACP 68-250, did not allow the rapid regrowth found with the earlier formulation. Neither formulation exhibited serious phytotoxic effects at the rates tested. The results

[12] *Aust. J. Agric. Res.*, 1964, **15**, 77–84.
[13] *Proc. 13th Congr. I.S.S.C.T.*, 1968, 523–530.

of one screening trial on 6-months old cane are illustrated in Fig. 7; at four weeks, terminal internode elongation had been completely inhibited and ripening had been induced throughout the stem. Comparative data from one field trial are also illustrated in the same figure. In this field trial, growth suppression was of short duration whilst in four other field trials, no growth suppression occurred. Leaf damage was severe, involving the death of about three leaves per stem, compared with variable toxicity in the other trials. In all field trials, quality of the cane was reduced. Subsequent greenhouse tests have indicated that neither the higher spray concentrations (due to reduced spray volume) nor the pH of the diluent could explain these very different responses. A possible explanation is differential varietal susceptibility: greenhouse trials utilized the variety B 49119, whilst field trials utilized HJ.5741, UCW.54/65 and PR.980. HAWORTH[14] has obtained responses in Trinidad on B 41227 which more closely approximate to those obtained in the greenhouse.

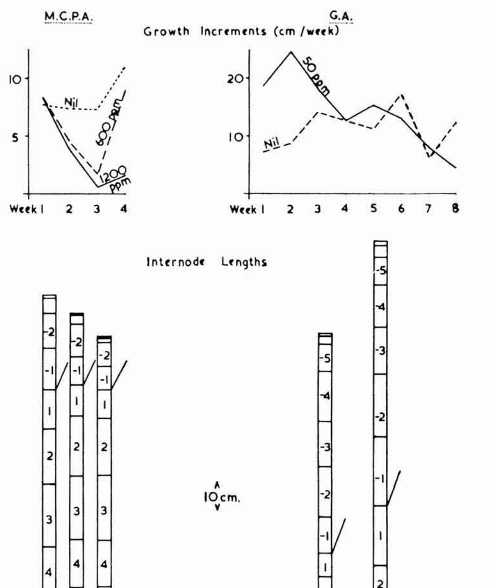


Fig. 6. Elongation growth and internode lengths of sugar cane (B 49119) treated with MCPA and GA. Both experiments under natural light at 32°/25°C (max./min.), 70% R.H. Internode lengths of the MCPA trial taken from the 28-days harvest of 10 replicates; of the GA trial, averaged over six replicates harvested at 42, 49 and 56 days. Internodes numbered from the point of attachment of the sheath of the T.V.D. leaf at the time of treatment.

In contrast, CP.41845 behaved in exactly the same way in both screening and field trials (Fig. 8). Rendement was increased by about 1% in all three field trials, this response continuing for 2 to 4 weeks. Growth data suggest that ripening would be more prolonged at higher application rates. All the field trials were conducted under wet conditions which allowed fairly rapid growth of about 5 cm per week. The marked reduction in growth rate caused by CP.41845 implies that cane yields would be reduced, as reported by BIESKE[8]. However, the trials reported here relied on weights of 20-cane samples to estimate changes in cane yield, and this has been shown to be unreliable in Puerto Rico[15]; this unreliability was confirmed by the standard errors obtained.

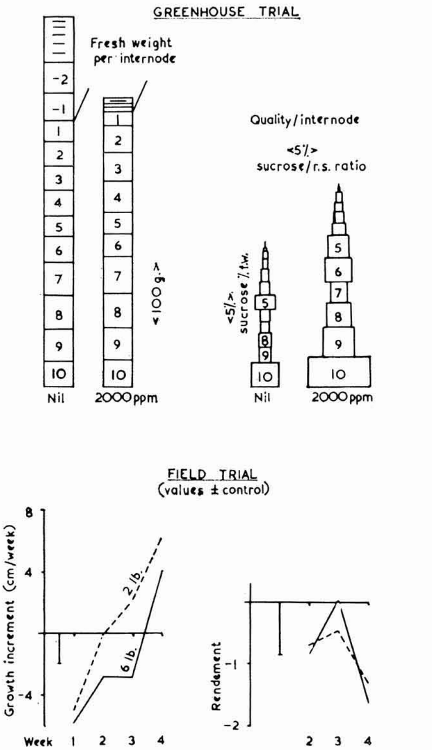


Fig. 7. Responses of sugar cane to "Ethrel" (formulation ACP 68-250). Greenhouse trial on 6-months B 49119 under natural light of about 12 hours at 32°/25° (max./min.), 70% R.H.; data from 4 replicates harvested on day 28. Field trial on 8½-months PR 980 in Puerto Rico, six replicates; vertical bars are L.S.D.'s (5%) of differences between means.

"Pesco 1815" (150 g/litre MCPA plus 48 g/litre 2,3,6-trichlorobenzoic acid) induced good ripening responses in both Jamaican trials which were conducted under relatively dry conditions (Fig. 9). In these trials, the growth responses were of the pattern illustrated for MCPA in Fig. 6. Under wetter conditions in Puerto Rico, growth responses fitted a different pattern, and ripening effects were much less

[14] Private communication.
[15] YATES: *Agron. J.*, 1969, **61**, 113–115.

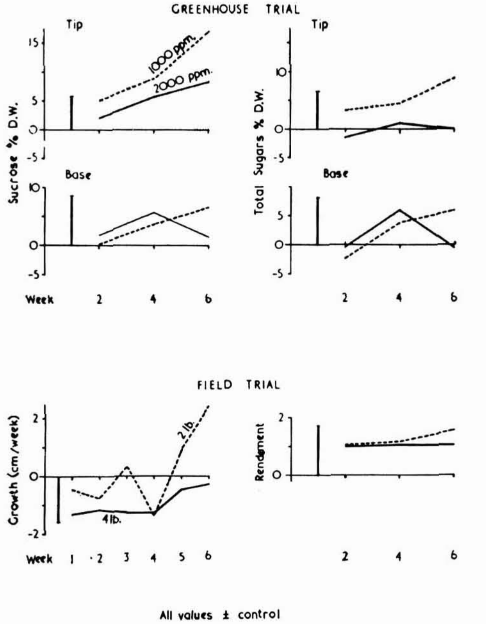


Fig. 8. Responses of sugar cane to CP. 41845. Greenhouse trial on B 49119, 4 months old, under natural light of about 8 hours supplemented artificially to 12 hours, at 25°C; at harvest, stems divided into "Tip" and "Base" at the point of attachment of the TVD + 1 leaf at the time of spraying. Field trial in Puerto Rico on 9-months PR 980, six replicates. Vertical bars are L.S.D.'s (5%) of differences between means.

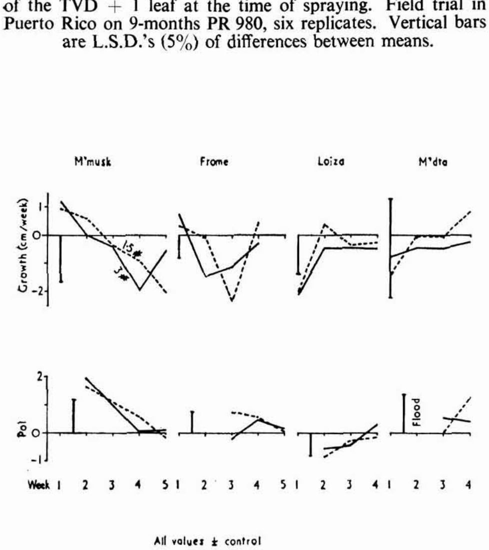


Fig. 9. Responses of field-grown sugar cane to "Pesco 1815": Monymusk, Jamaica, on 9¾-months HJ 5741, four replicates; Frome, Jamaica, on 9-months B 51410, six replicates; Loiza, Puerto Rico, on 8½-months PR 980, six replicates; and Mercedita, Puerto Rico, on 9-months CP 5243, four replicates. Vertical bars are L.S.D.'s (5%) of differences between means.

convincing, though the trends suggested increasing responses beyond the termination of these trials. Earlier reports of field responses to "Pesco 1815" in Trinidad[16] could not be confirmed in Jamaica[17], but the rates tested were mainly much higher than those tested here. Screening trials have shown that the pattern of response is very dependent on environmental conditions. For example, under completely controlled environmental conditions, in phytotron chambers, growth rate and photosynthetic rate responses were considerably modified by day-length, and by size and/or initial growth rate of the plant (Fig. 10).

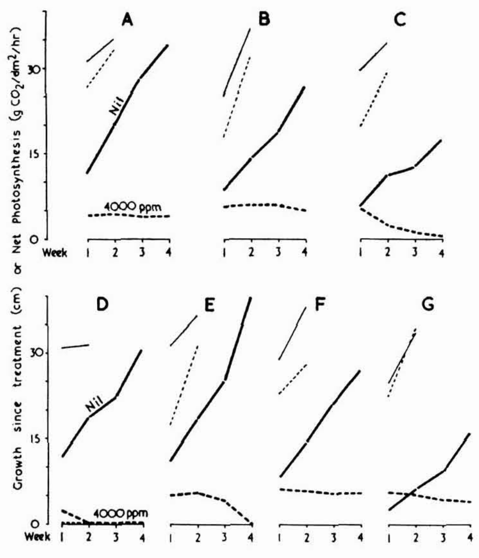


Fig. 10. Responses of sugar cane (B 49119) to "Pesco 1815". Cane grown at 32°/27°C, 80%/60% R.H. (day/night) at a light intensity of about 20,000 lux for:— A: 16-hour day; B: 12-hour day; C: 9-hour day. Size and growth rate (week prior to application) were:

	D	E	F	G
Height (cm) to TVD	78	60	43	28
Growth rate (cm/day)	2·3	2·0	1·1	0·5

Mid-15 cm portions of TVD leaves detached at end of dark period, and CO_2 exchange rates measured at 15,000 lux for 2 hours.

Field trials with GA and "Dalapon" were installed as 2 × 2 factorials. The result of three field trials in Jamaica and Belize suggested that the "Dalapon" rate selected (1·6 lb a.i./acre) was too low, and the time interval to reaping (6 weeks) was too short.

[16] VLITOS and LAWRIE: *Proc. 12th Congr. I.S.S.C.T.*, 1965, 429–445.

[17] *Ann. Rpt. Research Dept. Sugar Manuf. Assoc.* (Jamaica), 1963, 5.

These factors were modified in two later trials in Puerto Rico. Again, the GA + "Dalapon" combination failed to induce ripening in spite of the promising indications given by the Maturity Index measurements (Fig. 11). It is apparent that the general pattern of field responses as regards growth rates agrees very closely with that obtained in the greenhouse, where ripening was induced (Fig. 11). Further field trials appear to be justified, to include a wider range of rates of application and times of harvest.

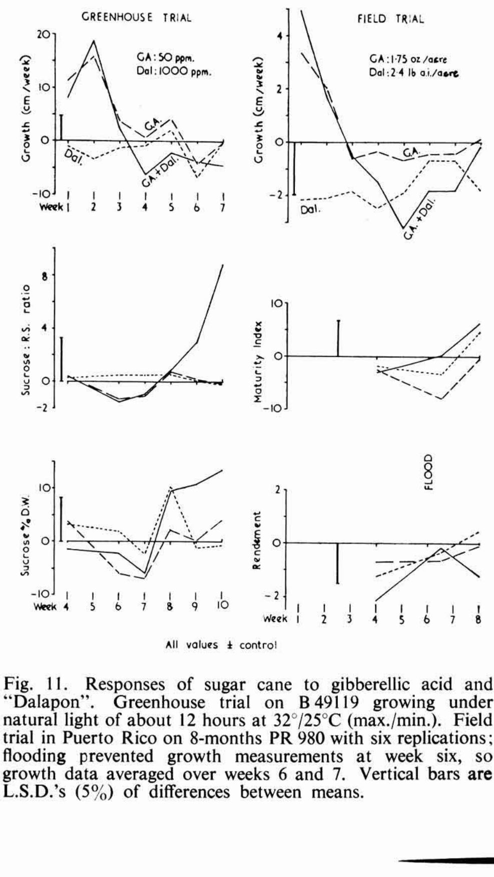


Fig. 11. Responses of sugar cane to gibberellic acid and "Dalapon". Greenhouse trial on B 49119 growing under natural light of about 12 hours at 32°/25°C (max./min.). Field trial in Puerto Rico on 8-months PR 980 with six replications; flooding prevented growth measurements at week six, so growth data averaged over weeks 6 and 7. Vertical bars are L.S.D.'s (5%) of differences between means.

Conclusions

The screening techniques employed appear to be reasonably successful in selecting compounds which have suitable activity in the field, and in defining the approximate application rate required. They also show the interaction of environment and treatment, such as the effects illustrated in Fig. 10. In this way, conditions under which certain compounds can be expected to work may be anticipated.

Acknowledgements

The assistance of members of the staffs of the following organizations is gratefully acknowledged: the Tate & Lyle Research Centre; Le Phytotron, C.N.R.S., France; Monymusk and Frome Estates in Jamaica; Tower Hill Estate in Belize; Central Aguirre, Central Mercedita, the Autoridad de Tierras, and the Agricultural Experiment Station in Puerto Rico.

Summary

Physiologically active chemicals were screened under controlled conditions for cane ripening activity. The techniques used were designed to simulate the major aspects of field application methods. Various active compounds were selected, and their ripening effects checked in greenhouse and field trials. CP 41845 at 2–4 lb actual/acre proved most reliable as a ripener under wet conditions. "Pesco 1815" at 1·5–2·0 lb a.i./acre was effective under fairly dry conditions, but responses require checking over a wider range of conditions. A mixture of GA plus "Dalapon" has given positive results in screening tests, but requires further testing in the field. "Ethrel" was the only compound which gave completely contrary responses in field trials (these being adverse) to those obtained in screening trials.

Assessing boiling house efficiency

By B. L. MITTAL, B.Sc., A.I.I.S.T.

(Sugar Technologist, Sugar Industry Consultants, Moradabad, India)

THE importance of making a comparison of the boiling house efficiency, not only of different factories but also of the same factory from time to time, cannot be over-emphasized. Various formulae have been proposed for this purpose by eminent sugar technologists at various times. The International Society of Sugar Cane Technologists had, however, given recognition to NOËL DEERR's formula for Reduced Boiling House Recovery, ESG, as the best figure for comparing and assessing boiling house efficiency. But the NOËL DEERR formula has been under constant pressure from GUNDU RAO's formula for quite some time and it has now been reported that the International Society of Sugar Cane Technologists has accepted the claim that the GUNDU RAO formula is an improvement over that of NOËL DEERR and have recognized it for international use.

The present author has conceived another formula[1] based on the concept of sucrose lost % non-sucrose in mixed juice which is analogous to sucrose lost % fibre in cane, i.e. the milling loss.

The purpose of boiling house work, besides producing the desired quality of sugar, is to separate sucrose from the non-sucrose entering the house together in the mixed juice. In the process of separation and elimination of the non-sucrose some sucrose is invariably lost and carried away along with the by-products. A part of the sucrose remains unaccounted for and forms the undetermined loss. The whole boiling house process, both clarification and crystallization, is aimed at elimination of the non-sucrose while incurring the smallest loss of sucrose in the process. It is basically the efficiency of the elimination of the non-sucrose in all the operations of the boiling house put together which can be considered as the efficiency of the boiling house work.

The quantity of sucrose lost % non-sucrose in mixed juice, which can be termed as "Boiling House Loss", is a good indicator of the efficiency of the boiling house work. The boiling house loss (BHL) can also be expressed in terms of reduced boiling house recovery ESG, reduced to a standard juice purity of 85 as

$$R_{85} = 100 - 3 \times \mathrm{BHL}/17$$

where R_{85} = reduced boiling house recovery ESG, BHL = boiling house loss = $(S_l/N_m) \times 100$, S_l = sucrose lost in boiling house % cane, N_m = non-sucrose in mixed juice % cane.

OOMMEN and GURUMURTHY[2] propounded the concept of total purity loss and arrived at the conclusion that NOËL DEERR's "virtual purity" of molasses is the same as the total purity loss, i.e. the mean purity of the losses taking place in the boiling house including the losses in final molasses and filter cake and the undetermined loss. The concept of the total purity loss is shown by GURUMURTHY[3] and OOMMEN and GURUMURTHY[4], with the help of many numerical examples, to be free from the objections which have usually been advanced against the concept of the virtual purity although the values of the total purity loss and the virtual purity are the same.

According to GUNDU RAO[5], the virtual purity of molasses has been defined as "the purity of molasses which would give the recorded boiling house recovery by the formula (s-j-m formula), i.e. on the assumption that all the losses take place in the molasses only". GUNDU RAO argues that, by definition, the virtual purity of molasses will always be higher than the actual purity owing to inclusion of other sugar losses and the difference in purity will depend on the magnitude of these losses and on the quantity of molasses itself.

The above interpretation of the concept of virtual purity is evidently erroneous and it is not the sugar losses which are being added to the loss of sugar in molasses but the purity loss. It is the reason why the virtual purity is considerably lower than the actual purity of molasses in the case of factories recording high clarification efficiencies. OOMMEN's concept of total purity loss simply explains this fact and redefines the virtual purity.

In the light of the new concept of total purity loss it is unnecessary to go into the merits and demerits of the concept of the virtual purity. MEADE[6] has already considered the virtual purity of molasses as an unnecessary complication and recommended the following formula for reduced boiling house recovery, ESG, without using virtual molasses purity:

$$R_{85} = 100 - \frac{J \times (100 - R)}{5{\cdot}667 \times (100 - J)}$$

where J = gravity purity of mixed juice, R = recorded boiling house recovery, ESG, and the term 5·667 in the divisor is 85/15.

The MEADE expression is the same as $R_{85} = 100 - 3 \times \mathrm{BHL}/17$, i.e. the expression derived by the present author.

Since the results obtained by the formulae of NOËL DEERR, OOMMEN and MITTAL (the present author) coincide, it would be useful to compare the formulae of GUNDU RAO and MITTAL.

The GUNDU RAO formula is:

$$R_{85} = R + K \times \frac{m}{100 - m} \times \frac{(1700 - 20\,J)}{17\,J}$$

where K = non-sucrose in clear juice % non-sucrose in mixed juice, m = gravity purity of final molasses, and R_{85}, J, and R have the same significance as given earlier.

In the derivation of the above formula, it has been assumed that loss in filter cake and undetermined loss are independent of the purity of the mixed juice under identical processing conditions. Keeping them, therefore, as such, the molasses loss is reduced to what it would have been if mixed juice of 85 purity were processed under the same manufacturing conditions.

Evidently the assumption that filter cake and undetermined losses are independent of the purity of juice is not true and, in extreme cases, substantial error is likely to be introduced in the values of the reduced boiling house recovery, ESG. A few numerical examples are cited below to demonstrate the point.

Example 1. It is assumed that the loss of sugar takes place in final molasses only and the pol % filter cake is zero although clarification efficiency, i.e. elimination of non-sucrose % non-sucrose in mixed juice, is 10·00.

1 MITTAL: *Proc. Sugar Tech. Assoc. India*, 1963, **31**, 61–69.
2 *ibid.*, 1970, **37**, 393–399.
3 *Proc. 4th Joint Conv. All-India Sugar Tech.*, 1971, M-12–M-19.
4 OOMMEN and GURUMURTHY: *ibid.*, M-21–M-27.
5 *Proc. 7th Congr. I.S.S.C.T.*, 1950, 665.
6 "Cane Sugar Handbook", 9th edition (Wiley, New York), 1963, p. 638.

Basis of the calculations is per 100 solids in mixed juice.

	Case I	*Case II*	*Case III*
Purity of mixed juice, J	70·00	85·00	90·00
Clarification efficiency........	10·00	10·00	10·00
Sucrose lost in filter cake	0·00	0·00	0·00
Non-sucrose removed in clarification	3·00	1·50	1·00
Brix in clear juice	97·00	98·50	99·00
Purity of clear juice	72·165	86·294	90·909
Non-sucrose in clear juice	27·00	13·50	9·00
Purity of final molasses	30·00	30·00	30·00
Loss of sucrose in molasses ..	11·571	5·786	3·857
Recovery of sucrose	58·429	79·214	86·144
Boiling house recovery ESG, R	83·470	93·194	95·715
Non-sucrose in clear juice, % non-sucrose in mixed juice, K	90·00	90·00	90·00
Reduced Boiling House Recovery, ESG, R_{85}:			
GUNDU RAO	93·194	93·194	93·194
MITTAL	93·194	93·194	93·194

Since the loss of sugar has taken place in only the molasses, the figures of reduced boiling house recovery, ESG, from both of the formulae becomes the same.

Example 2. It is assumed that sucrose % filter cake is 3% in all three cases and that the loss of sugar in filter cake takes place as clear juice; other conditions of example 1 remain the same:

	Case I	*Case II*	*Case III*
Pol (sucrose) % filter cake ..	3·00	3·00	3·00
Filter cake % solids mixed juice	30·00	20·00	15·00
Sucrose lost in filter cake	0·90	0·60	0·45
Sucrose in clear juice	69·10	84·40	89·55
Purity of clear juice	72·165	86·294	90·909
Brix in clear juice	95·753	97·805	98·505
Non-sucrose in clear juice	26·653	13·405	8·955
Clarification efficiency........	11·157	10·633	10·450
Loss of sucrose in molasses ..	11·423	5·745	3·838
Total loss of sucrose	12·323	6·345	4·288
Recovery of sucrose	57·677	78·655	85·712
Non-sucrose in clear juice % non-sucrose in mixed juice	88·84	89·37	89·55
Boiling house recovery ESG..	82·396	92·535	95·236
Reduced Boiling House Recovery, ESG, R_{85}:			
GUNDU RAO	91·995	92·535	92·727
MITTAL	92·751	92·535	92·433

In the above example, the factory in Case I has recorded the same sucrose % filter cake as the other two in spite of the fact that it has to deal with much more cake and obtained higher clarification efficiency. Hence this factory cannot be said to be less efficient than the other two but on the contrary, seems to be more efficient. Looking into the values of reduced boiling house recovery, ESG, obtained above, it appears that MITTAL's figures evaluate the working of the factories above more correctly.

Example 3. It is assumed that sucrose % filter cake is unequal in the three cases above and the rest of the conditions of the preceding examples remain the same:

	Case I	*Case II*	*Case III*
Pol (sucrose) % filter cake ..	2·00	3·00	4·00
Filter cake % solids mixed juice	30·00	20·00	15·00
Loss of sucrose in filter cake..	0·60	0·60	0·60
Sucrose in clear juice	69·40	84·40	89·40
Purity of clear juice	72·165	86·294	90·909
Brix in clear juice	96·169	97·805	98·340
Non-sucrose in clear juice	26·769	13·405	8·940
Clarification efficiency........	10·770	10·633	10·600
Sucrose lost in molasses	11·472	5·745	3·831
Total loss of sucrose	12·072	6·345	4·431
Non-sucrose in clear juice % non-sucrose in mixed juice..	89·230	89·367	89·400
Recovery of sucrose	57·928	78·655	85·569
Boiling house recovery, ESG..	82·754	92·535	95·077
Reduced Boiling House Recovery, ESG, R_{85}:			
GUNDU RAO	92·395	92·535	92·573
MITTAL	92·899	92·535	92·181

Although the total loss of sucrose in filter cake in all three cases above is the same, the factory in Case I has recorded lower sucrose % filter cake which is definitely creditable to it. The working of this factory is definitely more efficient than the other two but the GUNDU RAO formula fails to show this and depicts this factory as the least efficient of all the three. MITTAL's figures show the factories in the true order of their working efficiency.

Example 4. All the conditions of the previous examples remain the same except for minor changes in the values of sucrose % filter cake and the filter cake % solids in juice:

	Case I	*Case II*	*Case III*
Sucrose % filter cake	2·50	3·00	3·00
Cake % solids in mixed juice	20·00	20·00	20·00
Sucrose lost in filter cake	0·50	0·60	0·60
Sucrose in clear juice	69·50	84·40	89·40
Purity of clear juice	72·165	86·294	90·909
Brix in clear juice	96·307	97·805	98·340
Non-sucrose in clear juice	26·807	13·405	8·940
Clarification efficiency........	10·643	10·633	10·600
Sucrose lost in final molasses	11·489	5·745	3·831
Total loss of sucrose	11·989	6·345	4·431
Non-sucrose in clear juice % non-sucrose in mixed juice	89·357	89·367	89·400
Recovery of sucrose	58·011	78·655	85·569
Boiling house recovery, ESG..	82·873	92·535	95·077
Reduced Boiling House Recovery, ESG, R_{85}:			
GUNDU RAO	92·527	92·535	92·573
MITTAL	92·948	92·535	92·181

The data in example 4 show without doubt and very clearly that the factory in Case I is considerably more efficient than the other two but still the GUNDU RAO formula does not indicate it as such.

Similar results can be shown for different values of undetermined losses.

It must, therefore, be concluded that the GUNDU RAO formula favours the factories processing higher purity juices.

Also, the above explanation proves beyond doubt that NOËL DEERR's concept of "virtual molasses", MEADE's simplification of the DEERR formula, OOMMEN's concept of "total purity loss" and the MITTAL concept of "Boiling House Loss" which lead to the same result, do correctly reduce the boiling house recovery, ESG, to the standard purity of juice and indicate the efficiency of the boiling house work reliably.

The MITTAL formula is an improvement over the others in so far as it is simplest, avoids unnecessary complications and calculations and its values can be determined in a short time.

Sugar cane agriculture

Progress in soil test calibration trials. L. S. CHAPMAN. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 101–107.—For many years the Bureau of Experiment Stations has relied on soil analyses for forecasting the fertilizer requirements of cane, soil tests at 5-year intervals being desirable. The work reported was undertaken to calibrate the most suitable soil analysis methods for N, P and K, with cane yield responses, for use in the fertilizer advisory service. Thirty trials are being conducted over a 3-year period and the yield results of 10 such trials are represented plus some other trials. The main yield response in these 16 trials was to N fertilizer and the N effects on c.c.s. are recorded for classes of cane, varieties and season. An economic assessment of the yield data is presented and the proposed method of processing and interpreting the data from the project is discussed.

* * *

An evaluation of liming in the Cairns-Babinda area. A. P. HURNEY. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 109–112.—There has been much controversy on the subject of liming of sugar cane in Queensland. This paper summarizes the yields of the plant crop and first ratoon crops of field experiments designed to evaluate liming in the Cairns-Babinda area, where there is high rainfall and soil leaching. It was concluded that the failure to produce yield responses in these trials suggests that, when only soil acidity and calcium nutrition is under consideration, responses to applications of limestone are unlikely to be obtained on alluvial soils in the Cairns-Babinda area.

* * *

Prediction of nitrogen requirements from mineralizable soil nitrogen levels. G. C. BIESKE. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 121–125. Results of quantitative nitrogen trials harvested over the period 1967–70 are given, 9 on plant cane and 15 on ratoons. It was concluded that although mineralizable soil nitrogen values in plant cane sites approximated those found in ratoon blocks, plant cane relative yield was unrelated to mineralizable nitrogen level. Ratoon relative yield was correlated to some extent with mineralizable nitrogen levels, particularly when the latter was extended to the subsoil layers and was not corrected for available nitrogen present in the soil prior to incubation. The prediction of ratoon nitrogen requirements from mineralizable nitrogen was subject to too large an error to be of any practical use.

The decline of leaf scald as a major disease in Northern Queensland. B. T. EGAN. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 157–161.—In Northern Queensland this cane disease may be found at all times but its severity varies from season to season. In this paper the cane variety situation over the past 20 years is discussed. The decline of the disease is related to the increased use of resistant varieties. The rôle of plant breeding and variety resistance trials is discussed with relation to past performance and future prospects.

* * *

A progress report on leaf scald investigations. G. J. PERSLEY. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 163–168.—Leaf scald is stated to be the least understood of all the major diseases of sugar cane. This paper discusses some current trends and future prospects in the Bureau leaf scald research programme, with particular reference to host range studies and the ability of the pathogen to survive in the soil. Infection was obtained in maize, sweet corn and a number of other grasses. It has been determined that the bacterium responsible for the disease (*Xanthomonas albilineans*) can survive in the soil for up to two days.

* * *

A new hot water treatment plant for Tully. P. J. VALMADRE and P. BORGNA. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 169–172.—The increase in demand for hot water treatment of cane to control ratoon stunting disease and chlorotic streak caused the Tully Cane Pest and Disease Control Board to erect a new hot-water treatment plant, with offices, on a new site. A description of the plant is given. It has performed with a high degree of efficiency.

* * *

Sugar, a time for stocktaking. ANON. *Producers' Rev.*, 1971, **61**, 3–7.—The importance of the sugar cane industry to Queensland and to Australia is discussed. Its growth has been phenomenal and today sugar is worth $200 million a year to Queensland. Seventy years ago, when the Bureau of Sugar Experiment Stations was established, Queensland produced only 92,000 tons of sugar a year. Now it produces 2·4 million tons. Many towns arose purely because of their association with the sugar mills and cane lands. Examples are Mossman, Babinda, Tully, Innisfail, Ingham, Ayr, Home Hill and Gordonvale, all "sugar towns".

Grasses—the pros and cons. ANON. *Producers' Rev.*, 1971, **61,** 19.—The pastoralist and the agriculturalist looks at grasses in entirely different ways. The former sees them as the lifeblood of his property or the food supply for his stock. On the other hand the agriculturalist—and the cane grower is no exception—observes grasses as weeds, costly to control, which grow among the cultivated plants, robbing them of plant food, moisture or light, and providing a haven for pests such as rats.

* * *

Aerial rat baiting in Proserpine. ANON. *Producers' Rev.*, 1971, **61,** 23.—As a large part of the crop was in a sprawled condition, owing to cyclonic weather, hand baiting in 1971 would have been difficult, and it was proposed to apply baits from the air to over 8000 acres or approximately one third of the area of cane to be harvested.

* * *

Cane left in field. ANON. *Producers' Rev.*, 1971, **61,** 31.—Although 550,704 tons of cane went through the mill in 1970 at Racecourse some had to be left uncut as the quota, according to the International Sugar Agreement, had been reached. The opinion is expressed that standover cane will most likely be a feature of harvests in good seasons while the International Sugar Agreement is in operation. Consequently growers are advised to have a portion of their crop of varieties that will standover.

* * *

DDT and army worm control. A. A. MATTHEWS. *Producers' Rev.*, 1971, **61,** 42.—Factors governing the advisability of DDT spraying are discussed; these include the stage of the army worm life cycle (if it has ceased feeding and is about to pupate the DDT will be wasted) and the amount of crop defoliation (even though the natural enemies may be killed, the crop will be preserved since the army worm population is destroyed).

* * *

Nitrogen and sugar cane. 1. Efficiency of organic and inorganic manures as judged by leaf nitrogen. U. S. SINGH. *Sugar News* (India), 1971, **2,** (10), 28–32, 15.—The efficiency of different nitrogen manures was tested in experiments over a two-year period at the Shahjahanpur Sugar Cane Research Station. All manures were applied on a uniform nitrogen basis. The variety of cane was Co 453. Ammonium sulphate was most efficient in nitrogen nutrition of sugar cane. Castor oil cake proved to be next best, but almost similar to groundnut cake. Press mud and municipal compost were equally effective and were next in order of efficiency. Urinated earth and farmyard manure proved the least efficient and were almost alike in their effect. The nitrogen content of the leaves remained almost at its maximum in the month of May, declined during June and registered an increase during July. It declined sharply during the succeeding months of the growth period up to harvest in December.

Hot water tank for treating sugar cane setts. P. APPALANARASIAH and Y. SATYANARAYANA. *Indian Sugar*, 1971, **20,** 777–778.—A description is given of a new hot water tank erected at the Sugar Cane Research Station, Anakapalle, for treating sugar cane setts. It is a masonry structure with internal dimensions of 185 × 122 × 76 cm and a capacity of 1600 litres. About 30 cm above the floor 1·25 cm iron rods are fixed across the width of the tank, 20 cm apart, to support the cane containers. Between the floor of the tank and the rods an iron shaft with blades rotates to maintain an even water temperature during operation.

* * *

Result of the half field demonstrations on the IISR 8626 planting technique. Y. N. BALI. *Indian Sugar*, 1971, **20,** 779–787.—A few years ago a new method of sugar cane planting developed at the Indian Institute of Sugar Cane Research became known as the IISR 8626 method. This paper records the results obtained in testing the method by small-scale cultivators under their own conditions, 31 trial plots being involved. In general it was found that costs were higher in using the new technique than with the existing flat system but because of a higher yield of sugar cane the net gain was Rs. 2166 per hectare.

* * *

Response of sugar cane to green manuring under North Indian conditions. G. N. MISRA. *Indian Sugar*, 1971, **20,** 789–793.—It is pointed out that there has been much controversy on the subject of green manuring of sugar cane and that it is likely to prove more beneficial with light soils than with heavy soils. Historical aspects of the subject are discussed. The experiments here described were designed to test the value of green manuring under conditions prevailing in North India, using several different green manure crops. Sunn hemp and lobia improved the fertility status of soil and thereby the yield of the following sugar cane crop better than dhaincha or guar. Dhaincha, however, being tolerant to stagnation of water, may be used under such conditions with advantage. On average sunn hemp gave appreciably increased yields but involved losing a cash crop for the grower.

* * *

Sugar cane development in the Punjab, retrospect and prospect. N. L. BHATIA, A. S. BAINS, P. S. DHILLON and C. N. BABU. *Indian Sugar*, 1971, **20,** 795–797. The nature of the sugar cane industry of the Punjab and the way it is organized are discussed under the following headings: Funds, Cane Development Work, Cultural Practices, Seed and Soil Treatment, Better Varieties, Irrigation and Fertilizers, Plant Protection, Demonstrations and Training.

* * *

Giru irrigation scheme details. ANON. *Australian Sugar J.*, 1971, **63,** 61.—Further details are given of this irrigation scheme which has now been approved. It involves the construction of a weir 300 yards downstream of the railway bridge at a cost of

$A537,000. This weir will cut off 1·3 miles of salt water penetration up the Haughton River, thus reducing salt water intrusion into the aquifer. It will also store some 2000 acre feet as surface and underground reserves. The weir will have a fixed crest 1100 feet long with a height of 12 feet, which will back water up to the base of the second weir. Construction of a second weir 1 mile upsteam of the Bruce Highway will cost $A900,000.

* * *

The effects of fertilizers on Phil. 53-33 grown on Binalbagan sandy loam soil. S. S. GARRUCHO. *Sugar News* (Philippines), 1971, **47,** 110–111, 121–124.—Experiments were carried out to ascertain the best economic returns for fertilizer used. The addition of nitrogen alone gave highly significant increases in tons of cane per hectare, % sugar in cane and yield of sugar per hectare. No response was obtained from the addition of potash or phosphorus. The combination of nitrogen, potash and phosphorus did not significantly affect yield of sugar per ton of cane.

* * *

Aspects of control of *Diatraea centrella* **in Guyana.** M. J. WILEN. *Proc.* 1969 *Meeting W.I. Sugar Tech.,* 180–192.—This moth borer is the major sugar cane pest of Guyana. Tables show average infestation levels over the last five years. New methods of controlling the yellow headed borer are continually being sought, but the only control used at present is on heavy infestations in cane up to 4 months of age using "Endrin" (2% granules). The routine use of insecticides is precluded by the absence of phased reproduction of the moth borers and by the risk of upsetting the continued establishment of the Amazon Fly and other parasites. Current approaches for the control of this pest are dealt with briefly, notably use of the parasite *Palpozenilla* sp. of Bolivian origin.

* * *

Fluctuations in the population of *Diatraea saccharalis* **in Barbados. Results of light trapping.** M. M. ALAM and J. C. HUDSON. *Proc.* 1969 *Meeting W.I. Sugar Tech.,* 193–198.—It was found that conventional light traps are not very useful for a study of the population dynamics of moth borers. However, there do appear to be circumstances when appreciable numbers of moths are attracted to lights. Where counts were made under attractive circumstances the results closely followed the annual cycle of larval activity and there was a definite indication of short term periodicity in the counts, apparently linked to the moon's phases. Both males and females were found to be attracted. Studies are to be continued.

* * *

Loss of sugar in *Castnia***-infested cane.** S. B. KHAN. *Proc.* 1969 *Meeting W.I. Sugar Tech.,* 199–201.—The giant moth borer (*Castnia*) was considered to be a secondary cane pest in Guyana in the earlier days of the sugar industry but today it is regarded as a major pest. In this paper the author draws attention to loss from *Castnia* infestations in the hope that this will stimulate further investigations which may lead to improved methods of control.

* * *

Post-harvest treatments in burnt fields in Barbados with special reference to the control of jumping borer (*Elasmopalpus lignosellus*). J. C. HUDSON and C. JOHNSON. *Proc.* 1969 *Meeting W.I. Sugar Tech.,* 202–205.—In Barbados in recent years this pest has increased, probably as a result of the increasing number of cane fires. An account is given of experiments involving different cultural treatments in attempts to control the pest. It was suppressed only by moulding the stools after cutting. However the treatments for achieving the best stand of cane at the beginning of the wet season were the early application of manure and any form of mulching. Moulding, if believed necessary, would probably be best left until the field has an adequate stand of tillers.

* * *

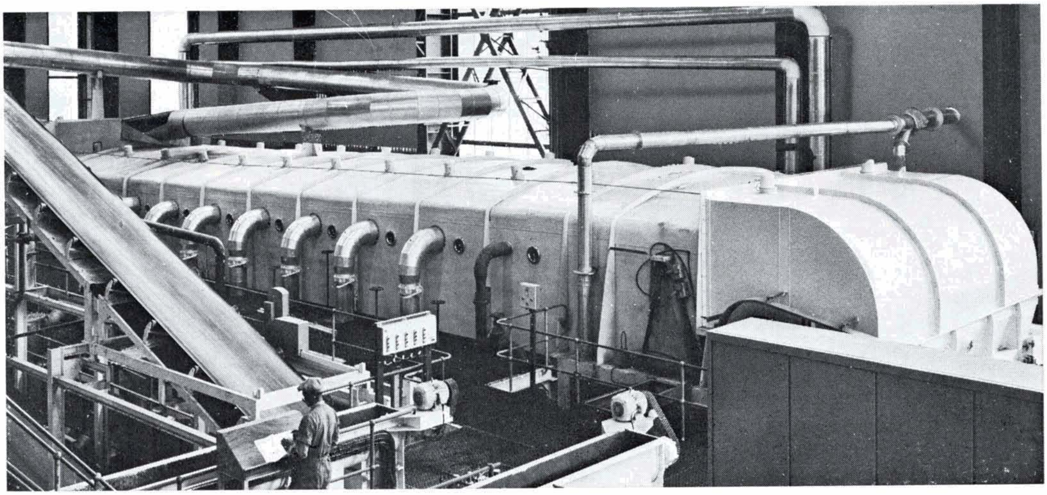
Practical considerations of sugar cane diseases in Guyana. J. F. BATES. *Proc.* 1969 *Meeting W.I. Sugar Tech.,* 206–209.—Sugar cane has been cultivated in Guyana for over 400 years and a number of different diseases have had to be dealt with. Some two dozen pathological conditions of sugar cane have been recorded for the country. Some have caused much anxiety and necessitated extensive control measures. In this paper much attention is devoted to leaf scald (*Xanthomonas albilineans*), at present the major cane disease of Guyana, having first appeared about 20 years ago. It has been noted that field reactions of certain commercial varieties are at variance with the ratings given in disease resistance trials. Susceptible/tolerant varieties account for up to 25% of the acreage of certain estates. The existence of different strains of leaf scald is noted and the frequent occurrence of typical foliar symptoms is a cause for concern.

* * *

Exploratory survey of Negros sugar haciendas. F. B. MENDOZA. *Sugar News* (Philippines), 1971, **47,** 115–117.—The survey, headed by a Jesuit monk, was of the social conditions affecting sugar cane workers in the Philippines. t was found that, largely as a result of too many local workers, farms were overstaffed and the pay was spread among these workers, many of whom were thus paid at rates below the legal minimum. The survey leader advised sugar planters to pay the minimum wage and give other benefits, arrange for in-service training, create alternative employment, retrain cane workers for other jobs, de-congest the farms, and adopt a system of profit-sharing.

* * *

Pests, diseases and their control. J. R. RIVERA, L. G. REYES, I. B. CANO and A. CHU. *Sugarland* (Philippines), 1971, **8,** (1), 10–16, 67–69, 81.—The very great damage caused by sugar cane pests and diseases to the sugar industry of the Philippines is discussed. Loss due to borers alone may equal a fifth of the crop. The present article was prepared to assist growers



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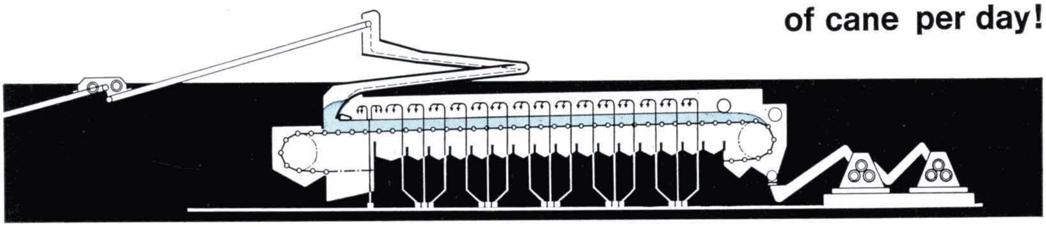

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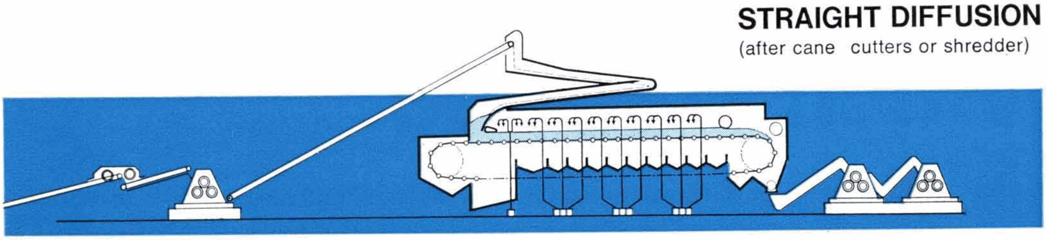

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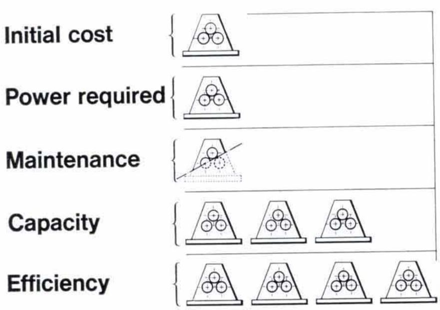

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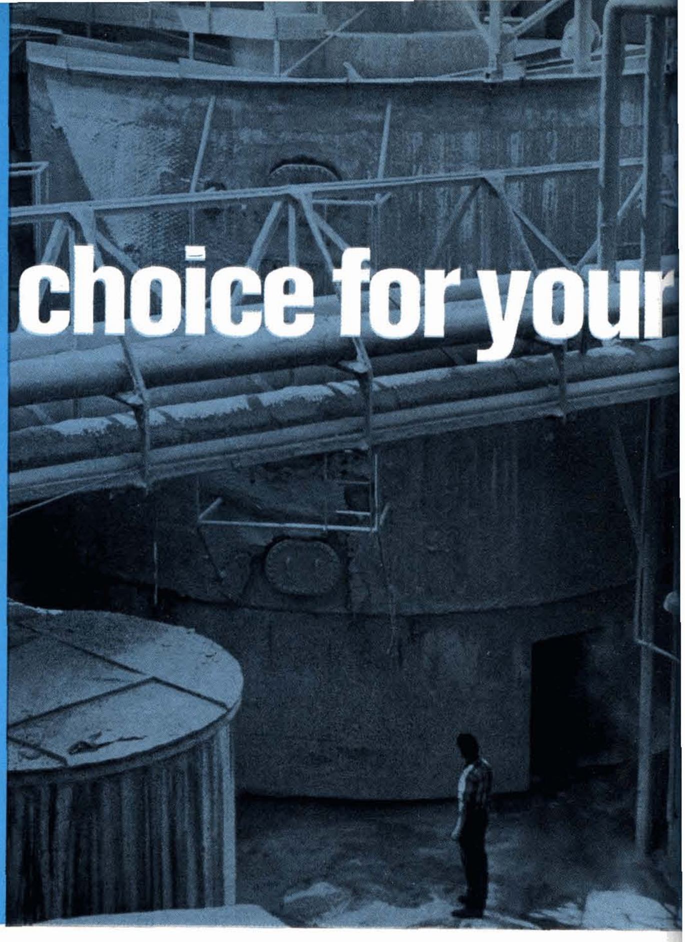

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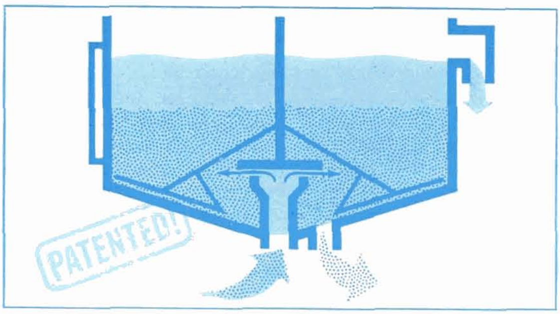

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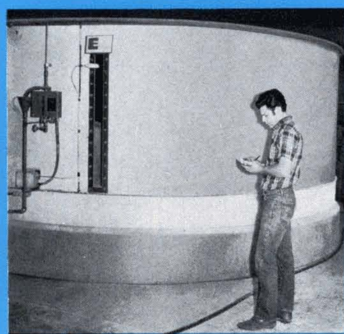

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in recognizing and in combating the major diseases. Each is briefly described in turn with the aid of line drawings, the diseases concerned being mosaic, Fiji disease, ratoon stunting disease, leaf scorch, smut, yellow spot, pokkah boeng, and downy mildew.

* * *

Negros and its sugar barons. A study of misinformation. E. L. CLAPAROLS. *Sugarland* (Philippines), 1971, **8**, (1), 18–19, 40, 46, 50–59, 64.—In this article the writer, who has resided over 50 years in Negros, disputes the criticism that has so often been made about the "sugar barons" or large estates treating their workers in a bad manner. A photograph shows a school class of labourers' children with teacher, all facilities provided by the hacienda or estate.

* * *

A challenge to the sugar industry of Negros Occidental. E. R. MONDOÑEDO. *Sugarland* (Philippines), 1971, **8**, (1), 28–30, 63–64.—The many difficulties that face the industry of Negros Occidental are discussed. Among these the problem of labour figures very prominently. With present day labour costs it is difficult for the industry to compete on world markets. Methods whereby the industry might be improved are discussed.

* * *

Trials and tribulations of growing sugar cane. C. TERRY. *Sugar Bull.*, 1971, **49**, 224–227.—A US cane grower recalls that 20 years ago he could divide his crop into five parts—land rent 20%, labour 20%, equipment 20%, supplies 20% and gross profit 20%. Since that time land rental percentage has stayed the same, but everything else has gone up. Productivity has increased also, but now operating expenses take up 70% of the production so that gross profit is now only 10%.

* * *

Developments in surface irrigation systems in Hawaii. R. M. GILL, A. F. WINSLEY, O. R. MOE and J. W. HOXIE. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 1–10.—Pioneer Mill Co. irrigates 7000 acres by concrete monocast pipeline. Pipelines are often extremely long and the irrigator spends much time walking. To simplify this a remote timer control panel, as developed at Lihue Plantation Co., was installed as an experiment which allows all gates to be operated from the field edge. The diversion gates are opened and closed by hydraulically operated cylinders mounted on each transfer box. Other methods of automating the irrigation system have been tried and are described. These centred round using aluminium flumes for a conveyance system.

* * *

Cane harvesting and transporting considerations. L. W. WISHARD and J. BOUVET. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 26–41.—Legal limitations on cane harvesting and transportation in Hawaii are listed as are objectives for an integrated system for Laupahoehoe Sugar Co. The present scheme is described and information provided on two new systems, one a modification of the present system and the other a new departure, involving an integrated high-production harvester. A detailed account is given of a proposed system for a hydraulic cane transport system with tabulated details of costs.

* * *

Challenges of the seventies—research. L. G. NICKELL. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 42–46. Fields of research worthy of concentrated effort in the 1970's are discussed; these include cane breeding and selection with the aid of mathematics and data processing by computers, increasing genetic variability in cane, increasing basic knowledge on cane: water relations, the approval and registration of agricultural chemicals, cane borer control, flat culture, factory research, and environmental quality.

* * *

Harvester development in Puerto Rico. H. W. WILLETT. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 56–69. Owing to labour shortage or inability to obtain cane cutters, sugar estates in Puerto Rico have been forced to turn to mechanical harvesting. Many difficulties were encountered owing largely to the unusual conditions prevailing in different parts of Puerto Rico. This paper gives an account of these and of the progress that has been made in the last few years as a result of new or redesigned harvesters. Photographs of many of these are shown.

* * *

Herbicide and fertilizer movement in Hawaiian sugar cane soils in relation to subsurface water quality. R. E. GREEN and R. H. F. YOUNG. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 88–96.—This paper is yet another indication of the world-wide interest in pollution and the fact that sugar cane technologists are not oblivious to the possibilities of cane growing being a source of pollution. A table shows the total quantity of herbicides used in Hawaii during a year. The discussion is concerned with fertilizers, soil mineralogy, soil structure and water movement, fertilizer movement, herbicide movement and management implications. It is concluded that the sugar industry of Hawaii has played a key rôle in the development of ground water in Hawaii and can, with positive management, assist in maintaining the high quality of this unique and valuable resource.

* * *

Comparisons of burning *vs.* non-burning of cane. I. Field. L. G. NICKELL. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 101–110.—The air pollution, especially by sulphur dioxide, caused by volcanic eruptions in Hawaii causes any pollution from cane burning to be quite insignificant. An account is given of air pollution studies as a result of trash burning with sugar cane and of the costs involved from using burned or unburned cane.

* * *

Use of various rolls for removing trash from bulk sugar cane. H. D. WHITTEMORE and J. E. CLAYTON. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 122–125. Tests are reported in which various types and shapes of rolls were incorporated in small cane cleaners. The two basic groups consisted of polygonal and spiral rolls, while rolls designed for purposes other than cane cleaning, e.g. corn husking and potato cleaning, were also tested. A tractor-mounted field system comprising two 6-ft cleaners using husking rolls with augers for moving the cane reduced the cane trash content from 14–15% to 4–5% at a cleaning rate of 35–40 tons/hr. Better results were achieved when the cane was cut into short pieces as opposed to long pieces.

* * *

A new approach to our phosphorus problem. T. M. LAI and E. OKAZAKI. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 130–137.—Many Hawaiian soils have high phosphorus (P) capacities with the result that both P availability and efficiency of P are low. Many areas require high amounts of P fertilizer for satisfactory cane yields. P supply is often a limiting factor for good cane growth. It is felt that much more knowledge is needed in regard to the P problem in Hawaii. The present paper is intended as a contribution. It is concluded that the P problem in Hawaiian soils is highly complex and that there are interactions between several different factors, which may vary with different soils. It is hoped further studies may throw more light on the problem.

* * *

Australia strides towards complete mechanization of harvesting. J. E. CLAYTON and C. B. TOFT. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 138–141.—Tables emphasize the amazing advance of mechanical harvesting in Australian cane fields during the decade 1959-69, the percentage of the crop harvested mechanically having increased from 1·6 to 84·9, and since 1969 there have been marked further advances. A list of names of men is given who have played a notable part in the development of Australian mechanical harvesters. Sugar cane varieties and cultural practices are fortunately keeping pace with mechanical harvesting.

* * *

Advances in sugar cane harvesting and cleaning systems. J. E. CLAYTON and H. D. WHITTEMORE. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 142–147.—Events in Puerto Rico have demonstrated the crucial need for mechanical harvesting. Harvester manufacturers have been working there and new developments are under way. Experimentation has continued in Florida with primary emphasis on removal of immature trash. The Louisiana industry has continued upgrading the transportation, storage and handling systems. In Hawaii emphasis has been on dry cleaning, some harvester refinements and seed cane carvesting and handling. Many labour surplus areas such as the West Indies are also short on manual cane cutters and are trying harvesters. All areas are receiving criticism about preharvest burning owing to recent concern about pollution. Those areas that clean cane by washing are also receiving water pollution complaints. Some areas are already under strict controls and others are studying what the industry can do to improve the processes affecting the environment. The following areas are dealt with in turn: Puerto Rico, Florida, Louisiana, Hawaii and the West Indies.

* * *

The current varieties picture—59-3775 looks like a winner. D. J. HEINZ, R. URATA and B. K. NISHIMOTO. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 4.—The variety 59-3775 is a fast-growing, high-sucrose, high-tonnage variety with generally excellent condition when harvested after 24 months. It is widely cultivated in Hawaii. It is resistant to eye spot, leaf scald and red rot disease, highly resistant to herbicides and tolerant to borers but susceptible to drought.

* * *

Vermiculite may replace soil in greenhouse. H. K. MEYER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 9.—Reasons why fertilized vermiculite could be used to replace compost to fill the many thousand "flats" for hybrid seedling propagation, are given. Compost takes two years to prepare and is not always reliable.

* * *

Fuzz harvest and planting list computerized. H. K. MEYER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 9–10.—The advantages obtained by computerizing much of the book work associated with the crossing season are explained.

* * *

Hybrid fuzz from India and Fiji. R. URATA and D. J. HEINZ. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 11.—Details are given of the successful raising of hybrid cane (crosses with *Saccharum spontaneum*) from fuzz obtained from India and Fiji.

* * *

Gamma irradiation of seedpieces. R. URATA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 12.—A large number of morphological mutations were produced and possibly physiological mutations as well. A mutant of 53–263, not easily damaged by "Diuron", was produced.

* * *

Isoenzymes as a tool in clone identification. D. J. HEINZ and B. AKK. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 12–13.—Enzymes are the biological agents that control most biochemical reactions. They sometimes exist in several active forms known as isoenzymes. The possibility of using isoenzymes for distinguishing clones is discussed.

* * *

Studies of sugar cane isoenzymes. E. HAMMIL and D. J. HEINZ, *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 13–14.—Horizontal cyanogum electrophoresis has been found to be an effective method of studying cane isoenzymes on the basis of band deletions, additions or position changes. Reactions of a number of enzymes are tabulated.

Variation in plants derived from cell suspensions treated with colchicine. D. J. HEINZ. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 14–15.—The use of colchicine gave clones with greatly increased resistance to eye spot disease. Other changes, some perhaps deleterious, may also have been induced.

* * *

Doubling the chromosome number of sugar cane through use of colchicine. D. J. HEINZ and G. W. P. MEE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 16.—Highly polyploid canes might have increased yield potential, and results are reported on the induction of mutations with doubled chromosome numbers by tissue cultures in solutions containing colchicine.

* * *

Modification of microclimate in the cane canopy under sprinkler irrigation. P. HARAGUCHI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 23–24.—There was no appreciable change in temperature and relative humidity under sprinkler irrigation, as compared with that with furrow or no irrigation, before the sixth month of cane growth. After this stage, with the canopy closed-in, temperature and relative humidity regimes were modified under sprinkler irrigation.

* * *

Spindle extension—an indicator of short-term growth. J. C. MONGELARD and L. MIMURA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 24–25. It was found that the rate of spindle growth was highly correlated with water consumption and with increase in dry matter production.

* * *

Air and root temperatures—their effects on four sugar cane clones. J. C. MONGELARD and L. MIMURA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 25–27.—There was a high correlation between mean increase in dry weight and mean water consumption. Lowering of air and root temperatures reduced dry matter production. With cool root temperatures there was a decrease in water consumption despite an increase in leaf area, and they thus impede water absorption.

* * *

Importance of root temperature to cane growth. L. C. MONGELARD and L. MIMURA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 27.—An experiment was set up with 8 root temperatures (55–90°F) and one air temperature (86°F day and 75°F night). The amount of dry weight accumulated during a 28-day period was almost double for each 5°F increase in root temperature in the range 60°F to 75°F. At higher temperatures the increase was slightly less. Tiller production was also inhibited by low root temperature, and dry matter accumulation in the tillers was negligible at and below 75°F.

* * *

Interactions of gibberellic acid and root temperature. J. C. MONGELARD and L. MIMURA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 27–28.—Results of experiments indicated maximum response at two different root temperatures. The response in terms of economic returns was better at 65°F than at 85°F.

* * *

Soil types and furrow irrigation data. C. M. VAZIRI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 33–34.—Work has continued in this sphere on five major soil types, but has not been completed.

* * *

Testing sprinklers. W. M. REDDITT. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 34–35.—Sprinkler pattern tests at several centres are reported. They showed that the HSPA-design nozzles with a 16° convergence angle produce the greatest range of throw of the water stream under conditions of wide spacing and high winds—the usual conditions in Hawaii. Increases of 40 feet over results with standard nozzles were common.

* * *

Test plot installed for study of subsurface irrigation. C. M. VAZIRI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 35–36.—The establishment of subsurface irrigation test plots is described. Subsurface irrigation may have a number of advantages. Water storage efficiency is increased and there is no run-off and little evaporation. Flat culture minimizes costs for field preparation and harvesting. Nutrient can be supplied through the system. Soil can be kept at filled capacity so that maximum water at least resistance is available to the plant. There is less soil compaction and weed growth because the surface of the ground is fairly dry. Increased yields may be possible as shown by initial growth patterns.

* * *

Using spindle extension growth to measure water availability. J. C. MONGELARD and L. MIMURA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 37–38.—Experiments utilizing a kymograph are described.

* * *

Cane varieties and nitrogen. ANON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 41.—It is pointed out that the variety H 37-1933 needs large amounts of nitrogen for good yields and it can tolerate large and late applications of nitrogen without adverse effects on cane and juice quality. On the other hand H 50-7209 needs plenty of nitrogen early in the crop, but if it has too much too late the effect on cane and juice quality is very bad. The variety H 59-3775 is more like H 37-1933 than H 50-7209.

* * *

Field trials with gibberellic acid. M. ISOBE and L. G. NICKELL. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 42.—Trials are reported with two proprietory formulations of gibberellic acid ("Pro-Gibb Plus" and "Gib-isol") applied from the air and from the ground. There was a gain in sugar yields in the strip tests and a loss in the blocks, but both were too small to be statistically significant.

Variety nitrogen interactions. D. T. TAKAHASHI and L. G. NICKELL. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 43–44.—Further trials showed striking differences among different varieties in their response to nitrogen: 14 varieties showed larger yields at 200 lb than at 400 lb/acre while 15 varieties derived benefit from 400 lb added nitrogen. That of variety 50-7209 is discussed in some detail.

* * *

Movement of broadcast potassium nitrate and urea in soils. H. MONTAGNE and M. ISOBE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 45–46.—Experiments showed that a substantial amount of water is required to move nitrogen fertilizer, applied to the soil surface, to a depth of 12 inches. In broadcast applications a portion of the fertilizer falls between the furrows, above the zone wetted by irrigation. On very young cane this portion will have to be moved down in some instances as much as 12 inches before it reaches the plant root zone. Thus it would seem that broadcasting urea on very young cane is most effective when there is enough rainfall to move nitrogen downward into the rooting zone.

* * *

Laboratory study on controlled release fertilizers. H. H. HAGIHARA and M. DOI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 46–47.—Experiments are reported with two controlled release fertilizers, i.e. "Osmocote", a granulated potassium nitrate fertilizer coated with a plastic material, and *iso*butylidene diurea (IBDU), a derivative of urea having low solubility. The release characteristics of controlled release fertilizers appear to vary with different forms. The low release rate of "Osmocote" in the first few weeks would tend to reduce any leaching losses of nutrients, particularly during the early growth period of sugar cane when the root system is restricted. Subsequent rapid release of nutrients would benefit the crop at the time when demand for these nutrients would be greater.

* * *

Controlled release nitrogen experiment harvested. M. ISOBE and Y. YAMASAKI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 48.—An overall comparison between the slow-release nitrogen and the ordinary urea indicated more cane was produced by the coated material than by the ordinary urea. The sugar yield per acre was higher for the sulphur-coated urea, but the increase was not significant at the 5% level.

* * *

Behaviour of applied potassium. B. G. CAGAUAN. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 49.—Preliminary results indicated that muriate of potash applied broadcast at the rate of 100 lb elemental K per acre moves down only by two inches with five inches of irrigation water; on a simulated furrow application (the same application rate but concentrated on a 12-inch band in the furrow) the finding showed movement down to twelve inches. In both cases, however, over 70% of the applied potassium was found to be concentrated in the upper two inches.

* * *

Phosphorus availability influenced by anions, micro-organisms and organic matter. T. M. LAI and E. OKAZAKI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 50–52.—The soils of Hawaii are known to have a high capacity to fix phosphorus, thus reducing its availability to growing plants. A reliable measure of fixation capacity would make it possible to predict phosphorus availability more accurately and thereby provide a better guide to phosphorus fertilizer practices. It is first considered necessary to know more about the mechanism of the reaction in which phosphorus is adsorbed on soil particles. The preliminary investigations here described are concerned with this.

* * *

Response of ratoons to supplemental calcium silicate. H. H. HAGIHARA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 52–53.—Field experiments at three plantations showed a marked increase in yields from the application of calcium silicate to the plant crop in silicon-deficient soils. In subsequent experiments to investigate the residual effect of calcium silicate on ratoon crops the residual silicon was measured by soil analysis and related to yields of the ratoon crop. Yield (tons pol per acre) increased with increasing levels of residual silicon, suggesting that applications of supplementary calcium silicate may be required at the lower residual levels.

* * *

Influence of iron and manganese on zinc uptake and cane growth. J. C. JUANG and M. ISOBE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 53–55.—Zinc deficiency diseases with sugar cane are known to occur in Hawaii. The experiments reported have shown that the Fe:Mn ratio plays an important part in zinc uptake and plant growth. The results suggest that a low Fe:Mn ratio in the growing medium enhances zinc deficiency.

* * *

Chemical ripeners. L. G. NICKELL and D. T. TAKAHASHI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 58–59.—During the year 390 additional compounds and combinations of compounds were screened to determine activity as ripening agents. Nine compounds demonstrated sufficient activity to be worthy of additional testing. These are listed. Increases in yield occurred with DA-5 treatment in field tests but not consistently, and differences in cane tonnages from untreated fields masked the gain.

* * *

Photodelay of early flowering clones for the breeding programme. P. H. MOORE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 59–60.—The success achieved in Hawaii in causing postponement of flowering of early-flowering clones or varieties (including wild types) by light treatment is discussed.

Ontogeny of inflorescence development. P. H. MOORE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 60–61.—Morphological, anatomical and histochemical studies on the developing sugar cane inflorescence have been continued. The potential practical importance of this work is discussed, especially in indicating the correct time to apply post-inductive treatments.

* * *

Do changes in cultural practices play any rôle in the decline in yield of a given variety ? D. T. TAKAHASHI. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 62.—Factors that could be responsible for the decline of some varieties are considered to be: increased rate of fertilizer application, compaction of soil (in the case of ratoons) from increased mechanization, accumulation of large amounts of cane roots releasing phytotoxins, and biological factors (nematodes, fungi, bacteria, soil insects, viruses). Any may play a part in the overall decline in yields of a variety.

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Rates of photosynthesis. H. P. KORTSCHAK. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 62–63.—The rate of photosynthesis and number of green leaves present were both higher in plants grown at 50% of full sunlight than at 100% or at 25%. This finding—that very low light intensities reduce the photosynthesis rate—removes the discrepancy between results obtained showing high rates for 50% shade and results of others who find lower rates on shading. A leaf-fed radioactive carbon dioxide can lose as much as 50% of the initially fixed radioactive carbon by respiration during a subsequent dark period. This complicates the interpretation of translocation tests which include the night.

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Auxin effect in cell suspensions. A. MARETZKI and M. THOM. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 63.—Sugar cane cells have no clear-cut requirement for two types of plant hormones—the gibberellins or the kinins. In media used under laboratory culture conditions they can presumably meet their requirements for these hormones by synthesis. The cells must, however, have a hormone supplement of the auxin type for cell proliferation. Without the auxin the cells undergo structural differentiation. An account is given of all culture work which it is thought represents the initial steps that cells undergo as they begin to differentiate.

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Arginine and sugar cane growth. A. MARETZKI and M. THOM. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 64.—Investigations on the impact of exogenous arginine on sugar cane growth are reported. The effects may be indirect. There is now additional evidence that cells rely largely on biosynthesized lysine rather than on externally supplied lysine when lysine is supplied in the medium. It was found that exogenously added amino-acid can enter the protein-forming pool without passing through a compartmentalized pool of free amino-acids in the cells.

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Studying nucleic acids in sugar cane cell cultures. A. HIGA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 65–66.—DNA (deoxyribonucleic acid) and ribonucleic acid (RNA) have been successfully isolated and purified from a sugar cane cell culture. These substances are discussed.

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Studying nucleic acids in sugar cane plants. G. M. RICHARDS. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 66–67.—A thorough study of the nucleic acids as they occur in sugar cane can be expected to lead to practical results in measuring and altering many aspects of sugar cane behaviour. Two initial steps in such a study have been completed. Workers have reviewed various means of breaking up the extremely tough and fibrous sugar cane tissues and have developed new procedures for specific ends—e.g. to permit efficient recovery of the very large but fragile DNA molecules in undamaged form from sugar cane leaves. Such DNA will be used in experiments designed to introduce new characteristics into cane cells grown in suspension. Another goal is to allow the total removal of both DNA and RNA from either fresh or dried tissue in order to measure the amounts present. In this case a certain amount of mechanical and chemical damage can be tolerated.

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Starch utilization by cell suspension cultures. A. MARETZKI and A. DE LA CRUZ. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 67–68.—Sugar cane cells can utilize starch as a source of energy for growth; in fact, when cells have become adapted to it, this polysaccharide brings about a higher growth rate than does sucrose. Because the enzymes involved in this phenomenon are concerned chiefly with carbohydrate utilization, an understanding of their function will of necessity have a bearing on increased production and/or better quality.

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Membrane transport in sugar cane cells. A. MARETZKI and M. THOM. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 69–71.—The usefulness of cell suspensions was exploited for measurements of membrane transport to provide answers to a number of problems such as nitrogen metabolism and carbohydrate transport and storage. Recent reports indicate that several substances that destroy the integrity of plant cell membrane may be potential ripening agents for sugar cane.

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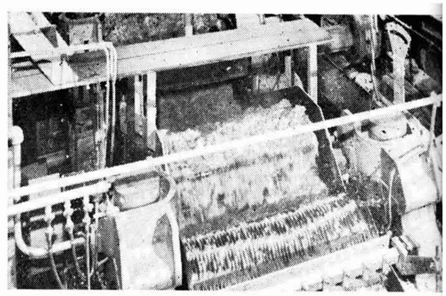
Diseases and their control. ANON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 72.—It is claimed that in Hawaii clones or varieties of sugar cane have been developed that show some resistance to red spot, eye spot, leaf scald, ratoon stunting disease and brown spot.

Cane sugar manufacture



Technical diffusion: steam generators. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1971, (255), 3–11.—Aspects of boilers for sugar factories which are discussed include inspection, operation (water and fuel feeding) and cleaning. The author discusses steam pressure, absolute pressure, manometric pressure, heat of vaporization and the point of ebullition and presents a steam distribution chart for a 3000 t.c.d. factory. He also describes and illustrates cylindrical storage tanks for use under atmospheric pressure, with notes on their specifications, capacities and costs of erection.

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Important losses of sugar can be avoided by control of inversion by means of a powerful bactericide. ANON. *La Ind. Azuc.*, 1971, **76**, (920), 63–64.—Tabulated data are presented showing the action of "Purexan H-21-A" against *Aerobacter aerogenes*, *Alcaligenes* sp., *Bacillus mycoides* and *Leuconostoc mesenteroides*. It is non-toxic, non-corrosive and completely inoffensive, and is considered suitable for use in mill tandem disinfection, as a 30 ppm solution, since even at high treatment rates no traces remain in the sugar or molasses produced. The maker is not named in the article but an advertisement nearby for "Purexan" products gives the address: Laboratorios Pen S.A.A.C.I.F.I.A., Calle 433, No. 1725, S. Lugares, Argentina.

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Quinquennial production plan for the Mexican sugar industry. A. GONZÁLEZ G. *Sugar y Azúcar*, 1971, **66**, (7), 24–25, 41.—Details are given of the provisions in the plan for 1972–76, under which Mexican sugar production is to be increased to 3,169,000 metric tons by 1976 compared with an estimated 2,224,927 metric tons produced in 1971. The plan provides for construction of a further 11 sugar factories and an increase in cane area of some 150,000 ha.

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Prevention of deterioration of harvested sugar cane on storage. ANON. *N.S.I. News* (India), 1971, **6**, (6), 5–6.—Spraying cut cane with formalin reduced the purity fall after 72 hours' storage to 2–4 units compared with 24 units in untreated cane, and to 8–17 units after 144 hr compared with 26–30 units. The reducing sugar content and acidity in the untreated cane also increased to a greater extent than in the treated cane.

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Trial of the Bauer "Centri-cleaner". ANON. *N.S.I. News* (India), 1971, **6**, (6), 7.—While the Bauer "Centri-cleaner"[1] has proved successful in removing suspended solids from mixed juice, resulting in improved sulphitation juice settling rates, there was little difference in juice purity rise or clarity compared with normal juice. The underflow can be used for imbibition after dilution to about 4°Bx. The "Centri-cleaner" gave unsatisfactory results in thickening thin mud from a continuous clarifier and in treatment of Oliver muddy filtrate.

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Milling *vs.* diffusion. U. C. UPADHIAYA. *Indian Sugar*, 1971, **20**, 833–837, **21**, 11–18.—Assuming a hypothetical case where cane of a given analysis is passed through a diffuser of the Silver ring type, the author sets out to show that diffusion will yield more bagged sugar (a gain of about 0·39 tons sugar/hr) than will milling 100 t.c.h. in a 15-roller tandem. Other advantages of diffusion are discussed, including the cost factor.

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The importance of recording field yield during the season. H. RODRÍGUEZ A. *Bol. Azuc. Mex.*, 1971, (256), 8–11.—The variation of cane sucrose content and of cane yield per hectare during the season are discussed and theoretical expressions derived for their individual and combined effects whereby optimal starting and closing dates for the season can be calculated. It is pointed out, however, that the factors involved (and hence the dates, etc.) vary with many factors, including soil, cane variety, cycle of ratooning, etc., and it is considered better to prepare actual graphs of sugar yield per hectare for each of these factors so that the start and finish of the season can be worked out for each, instead of using an overall "average" curve which will not provide optimum data for other than a single set of the factors.

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Maximum pressure for maximum extraction. F. MORALES V. *Bol. Azuc. Mex.*, 1971, (256), 18–22. The change in the ratio of feed opening-discharge opening as the top roller lifts in a conventional three-roller mill is discussed and illustrated by a diagram and the basis of the Fives Lille-Cail self-setting mill[2] described.

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Physico-mechanical method. G. VILLAGRA. *Bol. Azuc. Mex.*, 1971, (256), 23.—The author discusses the crystallization of final massecuite in raw sugar factories and refineries and postulates the reaching

[1] *I.S.J.*, 1971, **73**, 310.
[2] *ibid.*, 1970, **72**, 267–269.

of a moment when the colloidal impurities are irreversibly precipitated onto the surface of the growing crystals. He has patented a physico-mechanical process, details of which are not specified, whereby the crystal surfaces are maintained in a clean form.

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Technical diffusion—mechanical analysis and lost time. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1971, (256), 24–25.—The use of detection of increased and excessive vibration as a means of forecasting and taking preventive measures against mechanical failure and breakage, and so reducing downtime, is discussed.

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The San Cristóbal bagasse press. L. C. ROJAS. *Bol. Azuc. Mex.*, 1971, (256), 28.—Improvements to a French bagasse press, installed originally in 1967, are described. They allow the press to handle 85–95% of the bagasse from the San Cristóbal tandem as compared with 50% formerly, dealing with up to 40 tons of fibre per hour with a 100 hp motor. Milling losses have been reduced by 40% and the press allows recovery of an extra 25 tons of sugar per day.

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The vibrating screen in the weigher. J. FUMERA M. *Bol. Ofic. A.T.A.C.*, 1971, 20–23.—Vibrating screens are employed at Centrals Orlando Nodarse and Habana Libre and cane passed over these to the mills. Elimination of extraneous material amounted to 0·40% and 0·72% on cane, respectively, and since the original content is some 2·10% (the cane is cut manually but mechanically loaded), this represents up to one-third elimination. The separated matter has to be removed manually and arrangements need to be made to attend to this mechanically.

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The Saranin phosphatation process and multi-cell flotation melt clarifier. J. G. DAVIES. *Sugar y Azúcar*, 1971, **66**, (8), 11–14.—See SARANIN: *I.S.J.*, 1966, **68**, 37–39; 1969, **71**, 99–103; 1971, **73**, 247.

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A centenary in sugar milling for Colonial Sugar Refining Company. ANON. *Sugar y Azúcar*, 1971, **66**, (8), 18–21.—A survey is presented of the activities of the Colonial Sugar Refining Co. Ltd. in Australia and Fiji over the last 100 years. (See also *I.S.J.*, 1970, **72**, 312.)

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The future of sugar in Vietnam. ANON. *Sugar J.*, 1971, **34**, (3), 14–15.—See *I.S.J.*, 1972, **74**, 21.

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Cutting entrainment loss in vacuum pans. N. L. LUCAS. *Sugar J.*, 1971, **34**, (3), 20–21.—An entrainment separator is described which consists of vertical baffles arranged cylindrically in a vessel in which vapour flows outwardly from the inlet plenum to the annular space between the baffles and the vessel wall, while the sugar droplets drain down the baffles and pass via a down-pipe to a melter or other type of tank whence they return to process. The separator (manufactured by C F & I Engineers Inc.) is located between the vacuum pan and condenser. At two sugar factories equipped with the device the condenser water BOD has been reduced to an average of 12 ppm, corresponding to more than 500,000 lb of sugar returned to process in a campaign. This compares with losses in condenser water ranging from 100 to 500 ppm where various other types of separator are used.

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A vacuum pan for low-grade massecuites. B. B. PAUL. *Sugar J.*, 1971, **34**, (3), 25–28.—See *I.S.J.*, 1971, **73**, 149, 277.

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Clarification problems. *Seminar held by S. Indian Sugarcane & Sugar Tech. Assoc.*, 1971, 38 pp.—Because of clarification difficulties experienced by South Indian sugar factories, a special committee was formed to investigate the problems, and a questionnaire sent to all 52 sugar factories in the region. The data obtained from the 19 factories which answered the questionnaire are reproduced and provide detailed information on the processing methods used and results obtained. An attempt is made to identify the general causes of the clarification difficulties and suggestions on how to overcome the problems are made in broad terms.

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Sugar economy in Cameroun. H. J. DELAVIER and H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1971, **96**, 429–431.—A brief survey is presented of the small sugar industry of Cameroun which involves a cane sugar factory at Mbandjok erected by Soc. Fives Lille-Cail and first operated in 1967/68. It has a crushing capacity of 1200 t.c.d. expandable to 2000 t.c.d. and produces some 9000 tons of sugar per year from cane grown on an area of 3000 ha. Its refining section handles some 3000 tons/year of imported raws as well as its own cane raws. Most of the sugar is sold in cube form. The factory is expected eventually to be able to produce enough sugar to cover all the country's requirements of 15,000 tons of sugar annually.

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A device for applying forced draft in a step-grate furnace. G. K. CHETTY. *Sugar News* (India), 1971, **3**, (1), 23–25.—See *I.S.J.*, 1971, **73**, 180.

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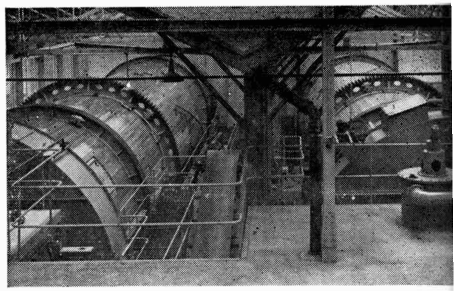
Production of bold grain sugar. A. C. CHATTERJEE. *Sugar News* (India), 1971, **3**, (1), 32–35.—Factors to be considered in the production of No. 30 colour sugar of larger grain size (A, B and C) under Indian conditions are discussed and the quantities of massecuite, boiling house capacities and extra steam required are calculated as well as the extra costs involved. The conclusion is that it is economically more practical to produce more sugar in the form of fine grains.

Beet sugar manufacture



Filter-thickeners. Z. Somora. *Listy Cukr.*, 1971, **87,** 132–133.—A preliminary report is presented on experimental operation of Kalisky-design filter-thickeners at Rimavská Sobota sugar factory in Czechoslovakia during the 1970/71 campaign. Results for 1st carbonatation juice cover a wide range of values under unfavourable conditions associated with the end of the campaign and further tests are to be undertaken.

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Measurements of electrical power consumption in sugar factories. J. Browkin and S. Romański. *Gaz. Cukr.*, 1971, **79,** 89–95, 116–118.—Measurements of electricity consumption by beet pumps, slicers and washers, centrifugals and vacuum pan mechanical stirrers were made over a number of campaigns at three Polish sugar factories with an average daily beet slice of 2000 tons. Some comparisons were also made with measurements for individual stations and items at other factories and with the ranges of values in British, Soviet, German and Hungarian sugar factories. The findings showed a total consumption of 20–28·4 kWh/ton of beet and 172–270 kWh/ton of sugar.

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Forerunners of the Braunschweig carbonatation system with reference to the avoidance of filtration difficulties in the processing of frost- or heat-damaged beet. A. Dolínek. *Zucker*, 1971, **24,** 396–398.—The Braunschweig carbonatation process is compared with three carbonatation schemes devised some 50 years ago by Czechoslovakian technologists, viz. Staněk, Pšenička and Hruda, with the aim of improving muddy juice filtration, particularly in the case of deteriorated beet. The point is made that some elements of the earlier schemes are still in use today.

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Study tour of West Germany. O. Krieger. *Cukoripar*, 1971, **24,** 90–96.—Information is given on some aspects of the West German sugar industry as observed by the author during a 3-months' study tour.

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Sugar dryers and coolers. S. Vermes. *Cukoripar*, 1971, **24,** 58–63, 96–98.—A survey is presented of dryers and coolers for sugar and sugar factory by-products.

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Critical study on the diffusion process. III. G. D'Orazi. *Ind. Sacc. Ital.*, 1971, **64,** 31–35.—The author discusses the mathematical relationships of diffusion of sugar from beet slices in a counter-current continuous process. He ends with a logarithmic relation $x_n = 100.e^{-Kt}$, where x_n is the sugar remaining in the slice after time t and K is a constant, the nature and significance of which are discussed.

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"Reggiane 3D" process for the simultaneous deliming, decolorization and partial demineralization of beet sugar juices. II. Comparison with the H-OH process. P. Baldassari. *Ind. Sacc. Ital.*, 1971, **64,** 36–39.—A techno-economical analysis of the "Reggiane 3D" process[1] has been made for comparison with the classic process of ion exchange treatment applied to 50% of a beet juice supply in order to achieve the same amount of non-sugar elimination. The former process is favoured in respect of all the parameters studied since it does not require cooling of the juice nor its previous decalcification, the capacity of the resin containers is lower by a third and stocks of resin required are similarly reduced. Waste treatment is minimized or obviated, and the initial quantity of resin required is about 8·7% less. Regeneration chemicals are reduced by 32·5%. In addition, the partially demineralized juice is also decolorized to the extent of 85% in the "Reggiane 3D" process and yields very good quality sugar, while the process is simple and direct and, operating at a buffered pH, avoids the risk of sucrose inversion.

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Automatic control of batch vacuum pans in the sugar factory and refinery. J. de Crémoux. *Sucr. Franç.*, 1971, **112,** 341–344.—The automatic control of discontinuous pan boiling is described in the form of the parameters involved in boiling, physical factors representing the two major parameters requiring control (supersaturation and crystal content), and a comparison between manual and automatic operation. The aim is to provide information for the supplier of automatic control equipment who has no knowledge of what is required for boiling control.

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Modern juice purification methods. S. Zagrodzki and S. M. Zagrodzki. *Zeitsch. Zuckerind.*, 1971, **96,** 329–332.—A beet sugar factory scheme is outlined, whereby optimum utilization of intermediate products would permit maximum molasses exhaustion and sugar yield. Details are given of a carbonatation scheme which would, it is claimed, give a thick juice

[1] Baldassari: *I.S.J.*, 1971, **73,** 279.

of more than 94 purity and having a low colour content. Thickened 3rd carbonatation mud (4% on beet) is added to raw juice which is then limed to pH 11 with juice/lime suspension (10% on beet) from 2nd main liming. After heating to 87°C, the juice is adjusted to pH 9 in 1st carbonatation and subsequently limed with 0·4% CaO to pH 11 (1st main liming) in the 1st carbonatation juice holding tank to coagulate the non-sucrose matter. From this tank some 700% juice is recycled to 1st carbonatation. At 85°C the juice is limed with 1·1% CaO to pH 12 (2nd main liming) to decompose invert sugar and amides, followed by 2nd carbonatation, where the pH is brought to 11·0–11·1 (0·09–0·10% CaO alkalinity) to effect maximum precipitation of all harmless non-sucrose matter. The juice plus filtrate from 2nd carbonatation suspension rotary filters is heated to 95°C and fed to a continuous vibratory pressure filter, the mud from which (20% on beet) is returned to the rotary filters. The filtrate is limed with 0·1% CaO and subjected to 3rd carbonatation followed by filtration in vibratory filters. The suspension is recycled to the raw juice, as stated above, while the juice is decolorized with active carbon. Because of a low lime salts content (20 mg/100 g dry solids), the evaporator heating surface could be reduced by 40% and there would be no foaming. The scheme is the outcome of several years of research at Łódź Technical University in Poland.

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C F & I Engineers-Fives Lille-Cail continuous vacuum pan system. B. SILVER. *Rpts.* 1970 *Meeting Hawaiian Sugar Tech.*, 53–55.—Details and advantages are presented of the Five-Lille Cail continuous vacuum pan, made under licence by C F & I Engineers.

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High-temperature concentration of heat-stable carbonatation juices. V. A. KOLESNIKOV and V. A. MAKSYUTOV. *Sakhar. Prom.*, 1971, **45**, (7), 21–26. The advantages of raising the temperature of beet juice evaporation are discussed and the possibility of doing so demonstrated by results of tests in which juice subjected to prolonged cold-hot liming[1] was concentrated at 130°C compared with 126°C used for juice limed by the conventional method. The juice evaporated at the higher temperature had lower reducing matter and colour, although the lime salts content was somewhat greater. Even lower reducing matter and colour were obtained when cold-hot limed juice was evaporated at 126°C. In all cases, results were poorer when sulphitation was carried out to a pH some 0·20–0·30 units lower than normal, e.g. 6·60 *vs.* 6·83 and 7·30 *vs* 7·56. Total sucrose losses in evaporation were higher in September–November and less so in December–January with cold-hot limed juice evaporated at 130°C after sulphitation to a lower pH than with conventional juice evaporated at the lower temperature, but the overall sucrose losses in evaporation plus boiling were very much lower with the higher temperature juice; again, the same juice evaporated at the lower temperature gave best results of all three juices.

New forms of containers for sugar packaging. S. A. BRENMAN, R. M. YASHCHUK and N. S. IVOL'GA. *Sakhar. Prom.*, 1971, **45**, (7), 28–31.—While polyethylene sacks proved excellent for white sugar storage for 8 months at +20°C, —5°C and —10°C without any deterioration in the free-flowing properties of the sugar, the reducing matter content in which also remained unchanged, the adverse effects of atmospheric conditions, particularly photo-chemical oxidation, on polyethylene must be considered. Further tests with sacks made from a combination of linen, jute and hemp lined with polyethylene showed that these had the same excellent storage properties as polyethylene sacks, while their anti-burst properties were as good as those of sacks made from conventional fibres. Technical requirements for the plastic-lined sacks have been worked out and are listed.

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Improvement in purification of carbonatation gas. N. S. LUKANIN and V. G. ZHELTYAKOV. *Sakhar. Prom.*, 1971, **45**, (7), 41–42.—A description is given of a gas scrubber and cyclone unit for solids separation from CO_2 gas at Ryzhavskii sugar factory. At a water usage of 12–14% on weight of beet and a pressure of 3–4 atm, 80–95% solids removal is achieved.

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Beet stability during storage. M. Z. KHELEMSKII, M. L. PEL'TS and I. R. SAPOZHNIKOVA. *Sakhar. Prom.*, 1971, **45**, (7), 46–48.—The biochemical and physiological processes which take place in damaged beet are described and reference made to chromatographic studies of necrotic tissue. Varieties of beet have been found to differ in the intensity of their necrotic reactions. For damaged beet to "heal" themselves, it is recommended to use forced ventilation at an air velocity of 0·08–0·25 m/sec to keep the pile temperature at about 10°C at a relative humidity which should not fall below 95%.

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Development of the sugar industry in Morocco. ANON. *Sucr. Belge*, 1971, **90**, 349–355.—A survey is presented of the Moroccan beet sugar industry, with details of individual factories, which in 1969 produced sufficient sugar (107,640 metric tons, white value) to cover one-third of the country's requirements, compared with only 19,700 in 1964. The aim is to produce 600,000 metric tons by 1985 and thereby achieve the theoretical self-sufficiency level.

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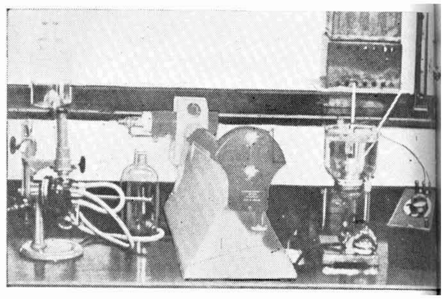
Progress of sugar losses during beet storage. J. C. CHARTIER, P. DEVILLERS, M. LOILIER, R. CHABLAY, J. Y. GUYOT, G. MESNARD and C. DE WILDE. *Sucr. Franç.*, 1971, **112**, 381–392.—See *I.S.J.*, 1972, **74**, 85.

[1] *I.S.J.*, 1970, **72**, 86.

Laboratory methods & Chemical reports



Factors affecting enzymatic starch hydrolysis in sugar solutions. I. A. Smith. *Proc. 44th Congr. S. African Sugar Tech. Assoc.*, 1970, 88–93.—Laboratory tests were made on the hydrolysis of starch using a mill syrup, a synthetic mixture of refined sugar and starch (0·2% on sucrose), and a solution of starch alone, subjected to the action of two commercial α-amylase preparations. The effects of various factors were studied and are indicated graphically. Enzyme activity fell with increasing temperature at up to 45°Bx but rose at 60° and 70°Bx. Hydrolysis at these densities is, however, less than at lower Brix. Optimum temperature was 71·1°C. The extent of hydrolysis with time is greater at lower Brix, being virtually complete after 15 min at 7·5°Bx but about 70% at 45°Bx. Logarithmic addition of enzyme is necessary to increase hydrolysis, i.e. doubling the amount to raise hydrolysis from 50 to 60%. With different amounts of starch in solution, the same amount of enzyme hydrolysed a roughly constant percentage of the total. Changes in viscosity are recorded.

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Decomposition products of enzymatic starch hydrolysis. J. Bruijn. *Proc. 44th Congr. S. African Sugar Tech. Assoc.*, 1970, 94–97.—Potato starch was hydrolysed by an α-amylase preparation and the oligosaccharides G_1–G_7 separated by paper chromatography; fractions comprising compounds of molecular weight greater than G_7 were separated by gel chromatography on "Sephadex G 50". The major group of products (70%) was a mixture of oligosaccharides in which G_3, G_6 and G_7 were predominant; the second group (30%) are polysaccharides with an average M.W. $< 10{,}000$.

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Estimation of potash content in clarified juices. Anon. *N.S.I. News* (Kanpur, India), 1971, 6, (4), 7.—Laboratory experiments showed that the cane juice potassium content fell during clarification and that carbonatation juice contained much less potassium (40–45%) than did sulphitation juice (70–80%), while defecation juice contained 85–90% compared with the original raw juice content.

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A method for the determination of organic acids in sugar beets and factory juices by gas liquid chromatography. R. M. Sequeira. *J. Amer. Soc. Sugar Beet Tech.*, 1970, **16**, 136–141.—A convenient analytical method for the simultaneous quantitative determination of a number of organic acids commonly present in beet and factory juices has been developed. The method is based on the prior isolation of the acids by ion exchange procedures with subsequent determination of their methyl esters by gas chromatography. Overall recovery of acids is greater than 92% except for lactic acid, which can sometimes be inadvertently lost through evaporation.

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"Polamat A" and "Polamat S"—two new versions of automatic routine polarimeters. W. Menzel, H. Riegler and O. Schiek. *Jena Review*, 1971, **16**, 88–92.—The two new VEB Carl Zeiss instruments[1] are described and illustrated.

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Effect of raffinose on sucrose crystallization. P. Devillers and C. Cornet. *Sucr. Franç.*, 1971, **112**, 295–300.—See *I.S.J.*, 1972, **74**, 58.

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Determination of beet molasses exhaustion. F. Schneider, A. Emmerich and V. Kiatsrichart. *Zucker*, 1971, **24**, 345–351.—See *I.S.J.*, 1972, **74**, 120.

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Study by chromatography and spectrophotometry of the colouring substances in sugars and syrups at two Belgian sugar factories. J. Houssiau, R. Waegeneers and J. Gurny. *Sucr. Belge*, 1971, **90**, 301–311.—See *I.S.J.*, 1972, **74**, 87.

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Estimation of the microbial population of cane juices by means of the use of resazurine. M. T. Hernández N. *CubaAzúcar*, 1970, (Jan./March), 27–30, 54–58. See *I.S.J.*, 1971, **73**, 186.

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Microbiology of sugars. III. Study of the microorganisms of "black sugar"—inversion of sucrose. S. Joly and A. J. de Oliveira. *Brasil Açuc.*, 1971, **77**, 191–203.—From samples of "black sugar" were isolated nine fungi, the inversion activity of which was examined using 2·433 mg/cm³ sucrose solutions. This activity varied with the fungus, but two—*Penicillium steckii* and *P. diversum*—produced complete inversion in 48 hours, one—*Mycelia sterilia*—in 72 hours and another—*P. humili*—in 96 hours.

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Effect of reducing sugars on sucrose decomposition kinetics. Kh. Kh. Fai and S. Z. Ivanov. *Sakhar. Prom.*, 1971, **45**, (6), 12–15.—In tests on the effects

[1] *See I.S.J.*, 1971, **73**, 221.

of invert sugar, glucose and fructose on sucrose decomposition in aqueous solutions of varying temperature and pH, the sugars all caused the sucrose decomposition induction period to fall, the effects being greater with increase in the monosaccharide concentration and temperature and with reduction in pH. Reasons for the effects are suggested.

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Thermostatically-controlled laboratory crystallizer. I. A. PRIKHOD'KO. *Sakhar. Prom.*, 1971, **45**, (6), 29–30.—Details are given of a device for crystallizing small quantities of sample, e.g. for determining saturation coefficients and sucrose crystallization rates, which comprises a thermostatically-controlled, electrically-heated water bath in which is immersed an electrically-driven horizontal shaft. This carries frames for four vertical cells, each holding 150 cm^3 of sample, placed symmetrically across the shaft axis and rotating with it. After a set time under controlled conditions each cell is removed, its bottom section removed and the cell inserted in the top of a vacuum chamber for removal of mother-liquor from the crystal mass. The run-off is collected in a vessel which is removed after a tight-fitting cap has been screwed on.

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Side reactions in juice purification. V. PREY and H. ANDRES. *Zeitsch. Zuckerind.*, 1971, **96**, 267–271. See *I.S.J.*, 1972, **74**, 88.

* * *

Nucleation and the sugar industry. H. E. C. POWERS. *Zeitsch. Zuckerind.*, 1971, **96**, 272–277.—After discussing various aspects of crystal nucleation and growth, including the state of molecules in gaseous, liquid and solid phases and transition from the liquid to the solid phase, the induction period and the dynamics and mechanism of nucleation, the author considers the importance of nuclear structure and endeavours to explain the effects of "foreign" molecules on crystal habit, at the same time emphasizing "individuality" in crystal growth. The theoretical concepts of crystallization are then applied to practical crystallization in the sugar industry, including natural *vs.* mechanical circulation in boiling, the advantages and disadvantages of commercially available vacuum pans, and means of improving seeding techniques.

* * *

Direct quantitative determination of sucrose by means of ***Bacillus stearothermophilus.*** G. POLLACH and H. KLAUSHOFER. *Zeitsch. Zuckerind.*, 1971, **96**, 277–280. The method is based on the fact that *B. stearothermophilus* causes sucrose to decompose to acid faster than it does other sugars. By adding two standard sucrose solutions at intervals to a *B. stearothermophilus* culture followed by the test sample and comparing the pH fall with time, it has proved possible to determine the sucrose content in a solution containing up to 50-fold invert sugar excess with a reproducibility of about 5%. Accuracy has still to be checked, since it depends considerably on glucose and fructose excess, sucrose concentration and analysis time, and the excesses of certain sugars and alcohols at which the result may be affected have also to be found. The sucrose decomposition rate is practically uniform and independent of concentration at concentrations in the range 0·003–10%. At least 0·05% sucrose should be present in the sample to avoid prolonging the analysis.

* * *

Beet molasses formation and composition. XII. Recent experiments with molasses after cation exchange treatment. G. VAVRINECZ, C. A. ACCORSI and G. MANTOVANI. *Cukoripar*, 1971, **24**, 77–84.—In experiments with beet molasses from a North Italian sugar factory, the cations were replaced with potassium ions and these in turn replaced with magnesium or calcium ions. The saturation functions of the resultant fractions were then determined and compared with values obtained for Belgian beet molasses treated in the same way[1]. While some agreements were found, there were also several significant differences, mostly of a quantitative nature and apparently mostly a result of the effect of temperature. Hence, it is concluded that the effect of cations on the saturation functions of molasses will be specific for a given molasses composition.

* * *

Nils Weibull AB semi-automatic beet laboratory. M. KOVÁCS. *Cukoripar*, 1971, **24**, 70–76, 99–101. Details are given of the equipment included in the Weibull semi-automatic tarehouse at Sárvár sugar factory in Hungary. The polarimeter used is a Bendix-NPL 143 automatic instrument. Some results are also given.

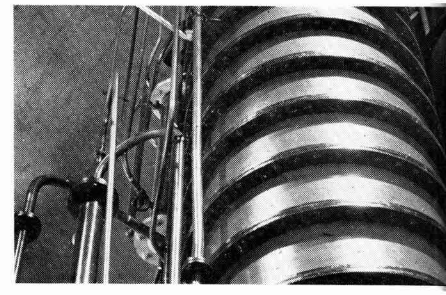
* * *

The measurement of crystal shape. E. T. WHITE and R. J. BATSTONE. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 69–82.—After an examination of various measures used to express crystal shape, details are given of a technique applied to measurement of crystal shape distribution in terms of the B:C ratio, i.e. between a given longitudinal and latitudinal dimension. The samples of crystal masses were dispersed in castor oil or syrup and allowed to settle, whereby more than half of the particles were suitably aligned for counting. Photomicrographs of the crystals obtained with a projection microscope by replacing the ground glass screen, on which the field of view was magnified, with photographic paper were then analysed by a modified Zeiss-Endter analyser. The results were then expressed in terms of average size and CV, average B and C dimensions and the so-called "shape coefficient of variation" (SCV), for which the definition is given as follows:

$$\frac{\text{shape at } 84\% - \text{shape at } 16\%}{2 \times \text{shape at } 50\%}$$, where "shape at 84%", for instance, refers to the shape ratio for which 84% of the particles have smaller ratios. Graphs and 3-dimensional shape-size distribution diagrams were prepared from the data.

[1] PIECK *et al.*: *I.S.J.*, 1968, **70**, 120.

By-products



Properties of fibreboard from sugar cane bagasse manufactured by the conventional Asplund processes. M. SALAHUDDIN, R. SAMANIEGO, P. BAWAGAN and L. YNALVEZ. *Sugar News* (Philippines), 1970, **46,** 516–522.—Bagasse was depithed and treated in an Asplund digester and in a rotary digester, following which the pulp was ground and refined and moulded into mats which were hydraulically pressed. The boards produced were tested by standard methods for bending, water absorption, hardness, specific gravity and moisture. The yields from the digesters were 82·95% and 80·34% on depithed bagasse, respectively, and the physical characteristics showed that good quality hardboard was produced by both methods.

* * *

Production of corrugating medium from sugar cane bagasse. F. J. CONSOLACION, R. SAMANIEGO, L. YNALVEZ and P. BAWAGAN. *Sugar News* (Philippines), 1970, **46,** 561–564, 572–575.—Corrugating paper was produced by blending various proportions of bagasse pulp, produced by the cold soda process, with waste paper pulp and it was found that a 50:50 mixture gave a product with physical properties exceeding those of commercial products from Australia, Japan and Sweden. Pulping of depithed and un-depithed bagasse showed that the latter consumed more NaOH and reduced the physical properties of the corrugated paper.

* * *

Increased production of biogas from cowdung by adding other agricultural waste materials. R. D. LAURA and M. A. IDNANI. *J. Sci. Food Agric.*, 1971, **22,** 164–167. By addition of urea or $CaCO_3$, which maintains a pH > 7 during fermentation, decomposition of cowdung in the presence of dry leaves and cane sugar yielded high proportions of methane in the gas mixtures produced and these additions also increased the rate of gas production by promoting anaerobic conditions in the medium.

* * *

Effect of copper on the citric acid fermentation of molasses solutions. V. F. FEDOSEEV *et al. Khlebopekar. Konditer. Prom.*, 1970, **14,** (1), 33–35; through *S.I.A.*, 1971, **33,** Abs. 71–477.—Citric acid was produced by surface culture of *Aspergillus niger* strain EU-119 on beet molasses media initially containing 15% of sugar. Addition of $CuSO_4$ to the fermentation media increased daily citric acid yields by 4–23% depending on the composition of the molasses. Yields and % sugar utilization are tabulated for 5-, 6- and 7-day cultures with and without $CuSO_4$. Pre-treatment of the molasses with $K_4Fe(CN)_6$ precipitated the Fe ions and other trace elements including Cu; Cu added subsequently as a 1% solution remained in solution.

* * *

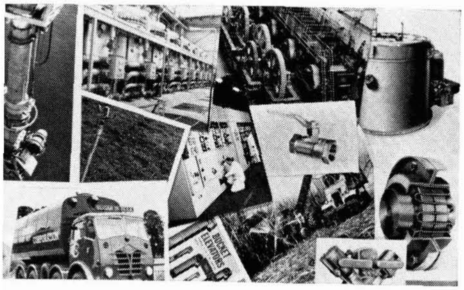
Citric acid preparation from Chilean molasses by submerged fermentation with *Aspergillus niger*. S. FIGUEROA VARGAS. *An. Fac. Quim. Farm.* (Univ. Chile), 1968, **20,** 57–61; through *S.I.A.*, 1971, **33,** Abs. 71–478.—*Aspergillus niger* NRC A-1-233 gave higher citric acid yields than the strain *A. niger* van Tieghem. Of the various additives tested, the best was potassium ferrocyanide trihydrate. Molasses from Ñuble factory, which contained only low concentrations of colloids and heavy metals, was more suitable for citric acid fermentation than other Chilean molasses. On the basis of these laboratory results, a pilot-scale plant was established.

* * *

Investigation of beet molasses for activators or inhibitors of citric acid fermentation. L. JANOTA-BASSALIK, C. OLCZYK and M. CHODOROWSKA. *Acta Microbiol. Polon.*, 1970, **2(19)**, (2), 137–140; through *S.I.A.*, 1971, **33,** Abs. 71–479.—*Aspergillus niger* was cultured in 2 molasses media and a synthetic medium for up to 16 days. Citric acid yields were good in one molasses medium and poor in the other; removal of ether-extractable substances increased the yield in both bases. The yield in the synthetic medium was increased considerably by adding the dried ether extract from either of the molasses. It appears that certain substances in molasses act as inhibitors only in combination, and that some of them are removed by ether extraction.

* * *

Pilot plant-scale trials on the treatment of distillery effluents. ANON. *N.S.I. News* (India), 1971, **6,** (5), 5.—Spent wash cooled to 45–50°C and diluted to 3·2–3·5°Bx with water was treated in two 6000-gal fermenters with an acclimatized 48-hr old ammonifying culture in a 1:2 ratio after enrichment with urea and superphosphate. The medium was later transferred to a 9000-gal fermenter for continuous fermentation based on 72-hr ammonification, some of the medium being recirculated. A COD reduction of 70–80% from an original 28,000–30,000 ppm was obtained at a daily treatment of 600–1000 gal, and a pH rise from 3 to 3·25 also occurred. Dilution of the distillery effluent with sugar factory waste before treatment also gave satisfactory results.



Trade notices

Descaling equipment. Flexible Drives (Gilmans) Ltd., Millers Rd., Warwick, England.

"Skatoskalo" descaling equipment is already well known in the sugar industry. Now a series of Mark 2 "Skatoskalo" units especially designed for the sugar industry are being produced to give a higher efficiency. They incorporate totally-enclosed fan-cooled motors of greater horsepower than before, and the high-speed units have re-designed gearboxes which ensure a much longer life coupled with considerably quieter operation. The range includes the general-purpose SK111 (2 hp) and SK112 (3 hp) units with a direct-drive single output spindle rotating at 2800 rpm designed for treatment of tubes of $\frac{1}{2}$–4 inches (12·7–101·6 mm) i.d. in boilers, vacuum pans, economizers, superheaters and condensers; the SK121 4500-rpm model with a single output spindle driven from a 2- or 3-hp motor through a gearbox and intended for evaporator and juice heater tubes where speed of cleaning is of prime importance (it is also suitable for all tubes of $\frac{1}{2}$–2 inches i.d.); the SK122, SK123 and SK124 models with twin output spindles driven through a gearbox from a 4-hp motor and rotating at 2800, 4500 or 2800/4500 rpm to treat tubes capable of being cleaned with the appropriate single-spindle units described above; and the 5·5-hp unit with three output spindles driven through a gearbox at speeds in the range 1400–4500 rpm. For tubes of i.d. greater than 4 inches (101·6 mm) lower speeds should be used and Flexible Drives invite enquiries.

* * *

Dryers and dust filters. Newell Dunford Engineering Ltd., 143 Maple Rd., Surbiton, Surrey, England.

Newell Dunford, manufacturers of the well-known "Rotary Louvre" dryer of wide application in numerous industries including the sugar industry, have produced a number of brochures describing their various products. Apart from the "Rotary Louvre" dryer, which combines the advantages of counter-current and parallel-flow rotary cascading dryers and provides for hot air circulation through the sugar to achieve a high heat transfer rate at relatively low temperatures of the drying medium without risk of damage to the sugar crystals, there is the "Dunelt" rotary cascading dryer, in which the material, e.g. beet pulp, is lifted by internal flights and "showered" through a stream of hot gas. A 24-page booklet describes the activities of Newell Dunford Engineering in English, German and Spanish.

Among the dust separation equipment manufactured by Newell Dunford and described in various brochures are the "Airmix" wet dust collector of medium pressure drop which is available for capacities ranging from 1350 ft^3/min (2300 m^3/hr) to 47,000 ft^3/min (80,000 m^3/hr); the "Thermix" centrifugal dust collectors, which are highly efficient in dealing with particles of relatively large mass; the "Thermix" tubular cloth-filter dust arrestors which efficiently handle very small particles (down to 0·1 μ); and various types of dust discharge valves. Reprints of articles by K. THOMPSON entitled "Cloth filtration corners new markets" and "Dry centrifugal dust separators" are also available from Newell Dunford.

* * *

Thyristor variable-speed drives. Renold Ltd., Renold House, Wythenshawe, Manchester M22 5WL, England.

A new range of Crofts SCR (thyristor) variable-speed units are now available. Each comprises an electronic controller as a chassis or mounted in a convection-cooled casing, which operates with a matched D.C. motor of 0·5–5·50 h.p. Supply is 200/250 V, 50/60 Hz, single-phase current. Motor base speed is 2000 rpm in all cases and a speed ratio of 20:1 is standard under continuous rating, although an intermittent rating of 100:1 is permissible under certain circumstances. Typical applications include use as conveyor drives, pump drives, mixer and feed drives. Brochure L-CEL 711 describes the salient features of the drives.

* * *

Cane weed control. May & Baker Ltd., Dagenham, Essex RM10 7XS, England.

Specifically developed for the cane industry under field conditions in the Caribbean and South America, "Actril D" and "Asulox 40" can be used safely as pre- and post-emergence weedkillers without risk of damage to the cane. "Actril D", which contains the octanoyl ester of 4-hydroxy-3,5-diiodobenzonitrile and the *iso*-octyl ester of 2,4-D, is effective against broad-leaved weeds, including some species resistant to 2,4-D, while "Asulox 40", an aqueous solution containing methyl 4-aminobenzenesulphonylcarbamate, is of use in combating grass weeds. A mixture of the two may be used where required. The susceptibilities of named weeds to the weedkillers are listed in a brochure obtainable from the manufacturers.

Silo weighing system. Portasilo Research Ltd., Grovely Rd., Christchurch, Hants., England.

Details are announced of a new weighing system which consists of an electronic detector clamped to the support structure of a container plus a remotely located meter which responds to deflection of the loaded member. The detector senses the slightest movement under the changing weight of the load down to well below one-thousandth of an inch. A transducer feeds an amplified signal via a 10-volt cable to the meter which provides a continuous reading in terms of tons or other specified calibrations with a typical accuracy of $\pm$ 3% and even down to 0·1% in certain circumstances. Successful testing has been carried out in the temperature range 15–55°C and up to 100% relative humidity. The system can be run off mains supply or batteries and consumes only 20 μamp of current. The system is ideal for a wide range of materials including sugar.

* * *

Fabcon "I-14" anti-scale agent. Fabcon Inc., 33 Public Square, Cleveland, Ohio, USA.

Issues of the Fabcon newsletter "Globetrotter" carry information on the new "I-14" scale inhibitor which is an improvement on the "I-12". Evaporation tests at Sevens cane sugar factory in Jamaica, where "I-12" has been used for some years, showed that application of 7 ppm "I-14" for 5 days followed by 8·7 ppm for 8 days permitted a syrup Brix of 60° to be maintained for the 13 days before stoppage for cleaning. The intervals between stoppages was finally increased to 20 days while the Brix was still maintained at 60°. Costs of "I-14" are lower per 1000 tons of cane than those of "I-12". In a US beet sugar factory operation time between evaporator cleaning has been raised to 30 days using 3 ppm "I-14" on weight of beet, compared with only 6–7 days using an unnamed scale inhibitor at the rate of 7·5 ppm on weight of beet.

PUBLICATIONS RECEIVED

CHAINS AND CHAIN SLINGS. Parsons Chain Co. Ltd., Stourport-on-Severn, Worcs., England.

"Kuplex" chain slings, made from an alloy steel of exceptionally high tensile strength, are featured in a 7-page brochure produced by Parsons Chain. Because of the steel's strength, a lighter sling may be used for any given load than was previously needed and safe working loads can be recommended which are considerably higher than applied to any type of sling available before. Details of Parsons chains are to be found in another brochure describing various applications, including use as conveyor and elevator chains.

* * *

CANE MECHANIZATION. Massey-Ferguson (Export) Ltd., Banner Lane, Coventry, CV4 9GF England.

Issue No. 1 of "Cane News" is a 4-page newspaper published by Massey-Ferguson concerning the use of MF equipment in cane mechanization. Apart from items describing results obtained in various parts of the cane world using the MF 201 "Cane Commander" chopper harvester, information is given on the MF 102 self-propelled chopper harvester designed to handle up to 15,000 tons of cane in a season (hence, a medium-sized harvester smaller than the MF 201) and on the MF 20 cane planter. Other articles describe the MF 4-wheel-drive tractors, the pros and cons of mechanical harvesting (particularly the use of chopper harvesters), and what needs to be done in the cane field in preparation for mechanical harvesting.

* * *

INDUSTRIAL WEIGHERS AND DRUM DRYERS. Richard Simon & Sons Ltd., Vernon Rd., Basford, Nottingham, NG6 0AU England.

Four leaflets describing Richard Simon weighing equipment are available: No. 538 gives details of the complete range of equipment, No. 545 describes the type EPG automatic gravity high-speed nett weigher, No. 537 describes the EMC in-line check weigher, and No. 543 gives information on the HSP automatic high-speed belt-fed nett weigher such as is used by the British Sugar Corporation Ltd. for beet pulp (followed by a check weigher).

Another publication, No. 534, provides details of dryers, flakers and coolers manufactured by Richard Simon for a number of industries. Among the items is a rotary cascade-type dryer/cooler which is applicable to sugar and which is designed to eliminate crystal damage while allowing comparatively high throughputs.

* * *

CONTINUOUS HANDLING. Soc. Stephanoise de Constructions Mécaniques, 2 rue Achille, 42 St. Etienne, Boîte postale 81, France.

This is the title of a 4-page pamphlet describing various types of conveyors (fixed, movable and apron conveyors, extractors and chain feeders) manufactured by Soc. Stephanoise for continuous bulk handling.

* * *

Kenya sugar factory expansion.—An order for expansion of Muhoroni cane sugar factory has been placed with Stork-Werkspoor Sugar N.V., of Hengelo, Holland. The factory, situated near Kisumu on the shore of Lake Victoria in Kenya and owned by East African Sugar Industries Ltd., is to be enlarged from a capacity of 1200 t.c.d. to 2000 t.c.d. The order, worth about 7·5 million guilders (approximately £900,000) includes a cane-unloading crane of 32-m span, a 30 × 60-in 3-roller mill driven by a 400-hp turbine, a 45 tons/hr boiler of 26 atm pressure complete with water treatment plant, a 1500-kWh turbo-generator, pumps, filters, centrifugals and sulphur burners. A vacuum pan, crystallizer, juice heater and various tanks are to be manufactured locally from SWS drawings and specifications.

* * *

Cane milling plant for Iran.—It has been announced that a 18-roller tandem to handle 6000 t.c.d. has been completed by Skoda Works of Czechoslovakia, for supply to Teheran sugar factory, Iran. Together with knife sets, the tandem will have an overall length of 85 m.

* * *

Oil-fired lime kiln.—An oil-fired lime kiln delivered by West's (Manchester) Ltd., of Albion Works, Miles Platting, Manchester, England, to Mosul beet sugar factory in Iraq is believed to be the first commercial application for an oil-fired vertical kiln to beet sugar manufacture outside the USA. The kiln was supplied on the basis of a nominal production of 80 metric tons of lime per day (ranging from 66 to 95 tons/day) at a carbonatation gas CO_2 content of not less than 28%, and since its installation for the 1971/72 campaign it has come well up to expectation as regards reliability, ease of control and high thermal efficiency.

Cuban sugar exports, 1971[1]

	1971	1970	1969
	—— (*metric tons, raw value*) ——		
Albania	23,278	10,807	0
Algeria	24,619	37,691	41,832
Belgium-Luxembourg	1,092	1,027	516
Bulgaria	210,655	231,170	205,308
Canada	73,367	65,411	79,900
Ceylon	23,134	0	46,098
Chile	191,424	0	0
China	463,947	530,430	444,554
Czechoslovakia	189,638	226,605	224,356
Denmark	0	0	2,065
Egypt	42,590	31,689	68,720
Finland	11,936	0	0
France	7,721	0	0
Germany, East	338,096	352,666	252,508
Germany, West	2,622	1,027	0
Holland	787	2,074	0
Hong Kong	10,292	10,405	0
Hungary	59,396	16,304	16,663
Iran	25,458	0	0
Iraq	52,117	21,286	21,795
Japan	912,234	1,220,941	1,017,689
Kenya	46,095	0	0
Korea, North	196,704	149,110	154,851
Lebanon	44,878	9,915	0
Libya	0	10,832	0
Malaysia	140,551	214,536	104,938
Malta	2,283	0	0
Morocco	165,312	106,035	175,760
Poland	30,313	24,177	28,134
Rumania	109,312	99,178	69,143
Senegal	6,518	0	0
Singapore	37,560	47,467	36,679
Spain	81,881	143,401	181,577
Sudan	36,535	14,229	0
Sweden	47,307	60,323	10,177
Switzerland	2,607	1,334	516
Syria	115,995	97,959	87,217
UK	50,603	0	42,912
USSR	1,580,988	3,105,030	1,352,329
Vietnam, North	76,106	56,512	60,129
Yugoslavia	72,300	0	67,360
Other countries	2,609	4,432	5,091
Total*	5,510,860	6,906,286	4,798,817

* Includes donations of 5091 tons in 1969, 4432 tons in 1970 and 2609 tons in 1971 as well as 1087 tons for animal fodder in 1970 and 1971.

The EEC and the International Sugar Agreement[2].—The British Minister of State for Foreign and Commonwealth Affairs, addressing the General Assembly of UNCTAD III in Santiago, Chile, in May stated that the UK intends to remain a member of the International Sugar Agreement after entry into the EEC. She went on to say that Britain hoped that at the renegotiation of the ISA next year it would be possible for the enlarged EEC as a whole to become a party to the Agreement. She reiterated that the UK has made a firm assurance of a secure and continuing market in the enlarged EEC for sugar originating in those developing countries which are members of the Commonwealth Sugar Agreement.

* * *

Lebanon sugar factory plan[3].—The Lebanese Government has been asked by beet farmers in the Bekaa area to set up a technical commission to evaluate tenders submitted for the construction of a second sugar factory in the Bekaa Valley where the existing sugar factory is also situated. The present beet crop in the Lebanon is about 100,000 tons, of which a maximum of 85,000 tons is processed by the existing factory which has a daily slicing capacity of only 700 tons of beet. The second factory is to have a slicing capacity of 1500 tons of beet per day, since the beet area can be considerably extended. Sugar consumption in the country stands at about 60,000 tons a year but this is expected to rise to about 100,000 tons by 1985. The deficit is made up by importation of raws which are refined in the Lebanon.

Brevities

New Philippines sugar publication.—The *Philsuccap Crystal* is a new addition to the sugar literature under the editorship of CARLOS M. MADRAZO, Boiling House Superintendent of San Carlos Milling Co. Inc., San Carlos City, Negros Occ., Philippines. It is the organ of the Philippine Society of Sugar Central Chemists and Processors, which was founded in 1971. Officers of the Society include V. A. CUSTODIO, President, and B. M. BALASICO, Secretary.

* * *

Irrigation research in Hawaii[4].—An advisory committee, comprising ten sugar company representatives under the chairmanship of WARREN GIBSON, head of the engineering department of the HSPA Experiment Station, has been formed to coordinate research by the companies and Station personnel into "trickle" and "subsurface" irrigation of cane. Adoption or either or both methods could lead to furrow-less or flat culture on Hawaii's irrigated plantations which, although 50% of the cane lands, produce about 60% of the state's sugar. Both methods of irrigation could lead to better use of water resources, and provide savings in labour and materials at every step in field production. At present most fields are furrow-irrigated.

* * *

New sugar factory for Malaysia[5].—A sugar factory is to be built at Ayer Hitam in Malaysia for the production of 150 tons of sugar per day from cane (later to be expanded to 450 tons/day). The factory is part of a project involving some 35,000 hectares, and is planned to start operations in 1974.

* * *

Guatemala Sugar Technologists Association.—The Asociación de Técnicos Azucareros de Guatemala was recently formed at a meeting held at the El Salto estate. The President elected is Ing. SENÉN VIEGO DELGADO, a former President of the Cuban Sugar Technologists Association, and well known as a technical author; at the present time he is General Superintendent of the Ingenios La Unión and Los Tarros. The Secretary-Treasurer of the Association is Sr. J. A. FUENTES, of Ingenio El Salto, while Ing. MIGUEL ANDUX, elected a member of the Executive Committee, was commissioned to contact technologists in neighbouring countries in order to explore the possibility of establishing a Central American Sugar Technologists Association.

* * *

Cyprus sugar imports, 1971[6].—Imports of sugar into Cyprus during 1971 totalled 17,087 tons, compared with 16,177 tons in 1970. The principal suppliers were the UK (6735 tons) and the USSR (5840 tons).

* * *

Turkey sugar industry expansion[7].—Current sugar production in Turkey is about 800,000 tons per year and this is to be increased to 1,000,000 tons by extension of the existing sugar factories at Adapazar, Burdur, Eskisehir and Turhal. In the period 1978–1982 a further five new sugar factories are to be built, and the annual production raised thereby to 1,400,000 tons.

[1] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (15), 2–3.
[2] C. Czarnikow Ltd., *Sugar Review*, 1972, (1074), 82.
[3] *Zucker*, 1972, **25**, 280.
[4] *Willett & Gray*, 1972, **96**, 182.
[5] *Zucker*, 1972, **25**, 280.
[6] C. Czarnikow Ltd., *Sugar Review*, 1972, (1066), 49.
[7] *Zucker*, 1972, **25**, 324.

Dutch sugar statistics[1]

	1971	1970
	(*metric tons, tel quel*)	
Imports		
Belgium/Luxembourg	*	31,570
Cuba	1,619	1,401
Czechoslovakia	—	358
Finland	—	215
France	5,918	96,911
Germany, East	1,047	2,931
Germany, West	526	25,221
Poland	7	—
Surinam	1,034	2,353
UK	3,749	4,772
Other countries	—	38
	13,900	165,770
Exports		
Bahrein	—	1,000
Belgium/Luxembourg	*	460
Denmark	1,838	—
France	44	621
Germany, West	579	2,208
Ghana	20	1,600
Greece	15,096	3,094
Iceland	523	435
Indonesia	3,032	714
Israel	22,150	—
Italy	1,213	1,432
Malta	6,294	1,300
Muscat	1,000	—
Nigeria	11,250	778
Norway	585	4,222
Peru	—	1,000
Sierra Leone	950	—
Surinam	500	2,000
Switzerland	21,890	30,013
UK	29,994	40,599
Vietnam, South	—	5,250
Other countries	1,441	2,239
	118,399	98,965

* The figures for 1971 do not include trade between Holland and Belgium/Luxembourg.

Kenya sugar production 1971[2].—Production of cane sugar from the four sugar factories amounted to 137,724 metric tons in 1971, an increase of 9·3% compared with the 125,902 tons produced in 1970. Imports in 1972 will nevertheless be higher than the 70,000 tons of 1971 because of growing consumption[3].

* * *

Brazil sugar target, 1972/73[4].—A production target of 5,832,000 metric tons, raw value, has been set for the compaign year 1972/73 commencing on the 1st June. Of this quantity 1,476,000 tons will be made available for export with a further 190,000 tons should market conditions warrant expansion of exports. Production in 1971/72 is anticipated to amount to just over 5·5 million tons but, even with the expansion of production, sugar available for export in 1972/73 will fall short of the figure for 1971/72 which was inflated by substantial stocks held at the start of the campaign.

* * *

Antigua sugar problems[5].—As a result of the difficulties encountered by the sugar industry, a Commission of Enquiry has been formed to look into the future prospects of the industry as a whole. It is understood that there is little likelihood of a crop being reaped this year.

* * *

Portugal sugar imports, 1971[6].—Sugar imports into Portugal in 1971 totalled 188,251 metric tons, compared with 232,496 tons in 1970. As earlier, most of the sugar came from Mozambique (155,140 tons), the next greatest amount (4482 tons) coming from Poland.

Hong Kong sugar statistics[7]

	1971	1970
	(*long tons, tel quel*)	
Imports		
Australia	11,967	10
Belgium/Luxembourg	1,476	5,421
China	45,638	37,494
Colombia	12,373	15,322
Cuba	19,622	—
Czechoslovakia	9,496	14,372
France	1,093	295
Germany, East	5,906	6,016
Germany, West	326	1,127
Holland	—	10,309
Japan	2,460	—
Korea, North	—	2,017
Poland	—	787
Singapore	5,016	1,886
South Africa	2,479	—
Taiwan	1,224	832
USSR	—	394
Vietnam, North	5,400	—
Other countries	10	1
	124,486	96,283
Exports and re-exports		
Cambodia	4,040	—
Indonesia	2,013	36
Kenya	948	769
Macao	1,173	1,035
Malaysia & Brunei	18,359	14,749
Papua & New Guinea	1,391	1,167
Saudi Arabia	307	447
Singapore	1,167	1,067
US Oceania	6,890	4,910
Other countries	1,110	900
	37,398	25,080

Morocco sugar factory.—The eighth sugar factory in Morocco was due to start operations in April at Zaio in North-East Morocco[8]. It is equipped to process both beet and cane[9] and has been in part financed by a $2,500,000 loan from the Kuwait Development Fund.

* * *

U.S. cane area 1972[10].—In April the US Department of Agriculture announced a further increase in the permitted cane areas for 1972. The areas for Louisiana and Florida set in October 1971 (375,916 and 240,306 acres, respectively) have been raised to 394,712 and 252,320 acres. Despite good carry-over stocks at the beginning of 1972, sugar production from the 1971/72 crops fell short of 1·2 million tons against the Mainland Cane quota for 1972 of 1,677,667 tons. The increases in area will contribute to higher Mainland Cane supplies towards the end of this year and early in 1973.

* * *

US beet sugar factory closure[11].—The Amalgamated Sugar Company has announced the closure of its factory at Lewiston, Utah. The factory was built in 1905 and, with a capacity of 1750 tons/day, was the smallest operated by the company.

[1] C. Czarnikow Ltd., *Sugar Review*, 1972, (1066), 49.
[2] *Barclays International Review*, April 1972, 12.
[3] *Reuter's Sugar Rpt.*, 4th April 1972.
[4] C. Czarnikow Ltd., *Sugar Review*, 1972, (1071), 69.
[5] *Barclays International Review*, April 1972, 50.
[6] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (9), v.
[7] C. Czarnikow Ltd., *Sugar Review*, 1972, (1066), 47.
[8] *Reuter's Sugar Rpt.*, 20th March 1972.
[9] See also *I.S.J.*, 1971, **73**, 64.
[10] C. Czarnikow Ltd., *Sugar Review*, 1972, (1070), 65–66.
[11] *Zeitsch. Zuckerind.*, 1972, **97**, 292.

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FOR THE BUYERS' GUIDE SEE THIS ISSUE pp. xxvi-xlii

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see Steam Accumulators.

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see Sack.

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see Conveyor belting.

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Atlas Chemical Industries, Canada, Ltd
Atlas Chemical Interamerica Inc.
Atlas Chemicals Division, ICI America Inc.
BMA Braunschweigische Maschinenbauanstalt.
Chemviron S.A.
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Rohm and Haas Company.

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

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

Diatomaceous earth
see Filter-aids.

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

Distillery plant
see Alcohol plant.

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

Drives, Hydraulic
Edwards Engineering Corporation.

Drives, Variable speed
Renold Limited.
Thorn Automation Ltd.

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

Dryers
A.P.V.-Mitchell (Dryers) Ltd.
Henry Balfour & Co. Ltd.
BMA Braunschweigische Maschinenbauanstalt.
W. van den Broek's Machinefabriek N.V.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
Escher Wyss Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Jenkins of Retford Ltd.
Newell Dunford Engineering Ltd.
Rosin Engincering Co. Ltd.
Salzgitter Maschinen A.G.
S.E.U.M.
Richard Simon & Sons Ltd.
A. & W. Smith & Co. Ltd.
Stansteel Corporation.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division.

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

Dust control equipment
Buell Ltd.
Dust Control Equipment Ltd.
Newell Dunford Engineering Ltd.
Stansteel Corporation.
Takuma Co. Ltd.
The Tills Engineering Co. Ltd.

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

Economizers
E.Green & Son Ltd.

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

Electric heaters for pipes
Stabilag Engineering Ltd.

Electric heaters for vessels
Stabilag Engineering Ltd.

Electric motors
ACEC.
Weir Pumps Ltd.

Electric motors, Fractional horsepower
The Thames Packaging Equipment Co.

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

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

Electronic control systems for process plant
Bailey Meters & Controls Ltd.
Tate & Lyle Enterprises Ltd.
Taylor Instrument Companies (Europe) Ltd.

Electronic equipment
ACEC.
Bailey Meters & Controls Ltd.

Engineering design and contracting services
Applied Research and Engineering Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Buell Ltd.
C F & I Engineers Inc.
Dorr-Oliver Inc., Cane Sugar Division.
Fletcher and Stewart Ltd

Engineering design and contracting services—*continued*
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
John Laing Construction Ltd.
Lucks & Co. G.m.b.H.
Polimex-Cekop.
Sucatlan Engineering.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
The Tills Engineering Co. Ltd.

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

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

Entrainment separators
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
A. & W. Smith & Co. Ltd.
Techserve (Pty) Ltd.
York Export Corporation.

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

Evaporator additives
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Hodag Chemical Corporation.

Evaporator tube cleaners
see Tube cleaners.

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

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

Expanders, Tube
see Tube expanders.

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

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

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

Filter cloths
Associated Perforators & Weavers Ltd.
John R. Carmichael Ltd.
Cotton Bros. (Longton) Ltd.
N. Greening (Warrington) Ltd.
JK Industrial Fabrics.
P. & S. Textiles Ltd.
Sankey Green Wire Weaving Co. Ltd.
A. & W. Smith & Co. Ltd.
United Silk Mills Ltd. G.m.b.H.

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

Filter papers
Evans, Adlard & Co. Ltd.
A. H. Korthof N.V.
Schenk Filterbau G.m.b.H.
The Sugar Manufacturers' Supply Co. Ltd.

Filter screens
Associated Perforators & Weavers Ltd.
Cotton Bros. (Longton) Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Haver & Boecker.
JK Industrial Fabrics.
Krieg & Zivy Industries.
Paxman Process Plant Division.
J. & F. Pool Ltd.
Sankey Green Wire Weaving Co. Ltd.
Stockdale Engineering Ltd.
United Silk Mills Ltd. G.m.b.H.

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

Automatically controlled filters
Chemap A.G.
Paxman Process Plant Division.
Schenk Filterbau G.m.b.H.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stella Meta Filters.
Stockdale Engineering Ltd.
U.S. Filter Systems.

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

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

Diatomite filters
Chemap A.G.
Paxman Process Plant Division.
Schenk Filterbau G.m.b.H.
Schumacher'sche Fabrik.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.
U.S. Filter Systems.

Filter presses
BMA Braunschweigische Maschinenbauanstalt.
A. F. Craig & Co. Ltd.
Fletcher and Stewart Ltd.
Schenk Filterbau G.m.b.H.
A. & W. Smith & Co. Ltd.

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

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

Iron removal filters
The Permutit Co. Ltd.
Rapid Magnetic Ltd.
Stockdale Engineering Ltd.

Laboratory filters
see Laboratory filters.

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

Plate and frame filters
Fletcher and Stewart Ltd.
Schenk Filterbau G.m.b.H.
Stork-Werkspoor Sugar N.V.

Pressure filters
BMA Braunschweigische Maschinenbauanstalt.
Chemap A.G.
Dorr-Oliver Inc., Cane Sugar Division.
The Permutit Co. Ltd.
Schenk Filterbau G.m.b.H.
Schumacher'sche Fabrik.
A. & W. Smith & Co. Ltd.
Sparkler Manufacturing Company.
Stockdale Engineering Ltd.
Suchar.
U.S. Filter Systems.

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

Flanges, Non-Ferrous
Blundell & Crompton Ltd.

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

Flexible shaft couplings
David Brown Gear Industries Ltd.
Renold Limited.

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

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

Flowmeters
Bailey Meters & Controls Ltd.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.

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

Gear couplings
David Brown Gear Industries Ltd
Renold Limited.

Gearing
see Reduction gears.

Gearmotors
David Brown Gear Industries Ltd.
Renold Limited.

Granulators
see Dryers.

Harvesters
see Beet harvesters *and* Cane harvesters.

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

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

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

Heat exchangers, Spiral-type
Alfa-Laval AB.

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

Heat sealers
The Thames Packaging Equipment Co.

Instruments, Process control
Anacon (Instruments) Ltd.
Bailey Meters & Controls Ltd.
Bellingham & Stanley Ltd.
Chemap A.G.
A/S De Danske Sukkerfabrikker.
Negretti & Zambra Ltd.
Polimex-Cekop.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
Ronald Trist Controls Ltd.
Ulrich Walter Maschinenbau.
Westinghouse Brake and Signal Co. Ltd.
G. H. Zeal Ltd.

Insulation, Thermal
Lafarge Aluminous Cement Co. Ltd.

Ion exchange plants
Akzo Chemie nv—Imacti.
BMA Braunschweigische Maschinenbauanstalt.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Tate & Lyle Enterprises Ltd.
Werkspoor Water N.V.

Ion exchange resins
Akzo Chemie nv—Imacti.
Diamond Shamrock Chemical Co., Nopco Chemical Division.
The Permutit Co. Ltd.
Robert Reichling & Co. K.G.
Resindion Divn. of Sybron Italia S.p.A.
Rohm and Haas Company.

Irrigation equipment
Evenproducts Ltd.
Farrow Irrigation Ltd.
SPP Agricultural Services.
Wright Rain Ltd.
Wright Rain Africa (Pvt.) Ltd.
Wright Rain Irrigation (Pty.) Ltd.

Juice heaters
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.

Juice heaters—*continued*
A. F. Craig & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Kingston Industrial Works Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.

Juice scales
Fletcher and Stewart Ltd.
N.V. Servo-Balans.
see also Weighing Machines.

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

Juice and syrup mixers
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
The Sugar Manufacturers' Supply Co. Ltd.

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

Knives, Milling
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Honiron.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

Knives, Milling—Drives
Farrel Company.
Fletcher and Stewart Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Thorn Automation Ltd.

Laboratory apparatus and equipment
Bellingham & Stanley Ltd.
Chemap A.G.
A. H. Korthof N.V.
The Permutit Co. Ltd.
The Sugar Manufacturers' Supply Co. Ltd.
Tate & Lyle Enterprises Ltd.
Carl Zeiss.
see also Laboratory instruments, *etc.*

Laboratory cane grinders
Jeffress Bros. Ltd.

Laboratory filters
Paxman Process Plant Division.
Stockdale Engineering Ltd.

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

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

Level indicators and controllers
Bailey Meters & Controls Ltd.
Haver & Boecker.
Negretti & Zambra Ltd.
Siemens A.G.
Ronald Trist Controls Ltd

Lime kilns
C F & I Engineers Inc.
Cocksedge & Co. Ltd.
International Combustion Ltd.
Koppers-Wistra-Ofenbau G.m.b.H.
Newell Dunford Engineering Ltd.
Polimex-Cekop.
West's (Manchester) Ltd.

Lime slaking equipment
Cocksedge & Co. Ltd.
Dorr-Oliver Inc., Cane Sugar Division.
Polimex-Cekop.
Stork-Werkspoor Sugar N.V.

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

Locomotives, Battery-electric
Hunslet Engine Co. Ltd.

Locomotives, Diesel
Hunslet Engine Co. Ltd.

Locomotives, Diesel-electric
Hunslet Engine Co. Ltd.

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

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

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

Massecuite heat treating equipment
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
Fletcher and Stewart Ltd.
E. Green & Son Ltd.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.
The Western States Machine Co.

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

Mill roll movement indicators and recorders
Edwards Engineering Corporation.

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

Milling plant
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
A. F. Craig & Co. Ltd.
Farrel Company.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Honiron.
Kawasaki Heavy Industries Ltd.
Kingston Industrial Works Ltd.
Salzgitter Maschinen A.G.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

Mixing machines
Babcock & Wilcox Ltd.

Moisture expellers
Richard Simon & Sons Ltd.
Sucatlan Engineering.

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

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

Molasses tanks
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Kingston Industrial Works Ltd.
Polimex-Cekop.
Salzgitter Maschinen A.G.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.

Packeting machinery
Thomas C. Keay Ltd.

Pan boiling aids
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Techserve (Pty) Ltd.

Pan boiling automatic control
Siemens A.G.

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

Pans, Vacuum
A.P.V.-Mitchell (Dryers) Ltd.
Blundell & Crompton Ltd.
BMA Braunschweigische Maschin enbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
A/S De Danske Sukkerfabrikker.
John Dore & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
T. Giusti & Son Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Honiron.
Kingston Industrial Works Ltd.
Salzgitter Maschinen A.G.
S.E.U.M.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.
Ingeniörsfirman Nils Weibull A.B.
Wellman Incandescent Furnace Co. Ltd., Swenson Equipment Division

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

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

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

Pipe fittings
see Tube fittings.

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

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

Polythene bag sealers
The Thames Packaging Equipment Co.

Power plants
W. H. Allen, Sons & Co. Ltd.
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.
Renold Limited.

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

Pressure feeders
Walkers Ltd.

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

Pressure vessels
A.P.V. Co. Ltd.
Babcock & Wilcox Ltd.
Buckau-Wolf Maschinenfabrik A.G.
John Dore & Co. Ltd.
Fletcher and Stewart Ltd.
Foster Wheeler John Brown Boilers Ltd.
T. Giusti & Son Ltd.
Robey of Lincoln Ltd.
S.E.U.M.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Thibodaux Boiler Works Inc.

Printing machinery for sugar cartons, etc.
Chambon Ltd.

Pulp screens
Associated Perforators & Weavers Ltd.
N. Greening (Warrington) Ltd.

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

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

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

Boiler feed pumps
Ateliers de Construction d'Ensival S.A.
Howard Pneumatic Engineering Co. Ltd.
Polimex-Cekop.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski. Weise Soehne G.m.b.H.

Centrifugal pumps
ACEC.
Allen Gwynnes Pumps Ltd.
A.P.V. Co. Ltd.
Ateliers de Construction d'Ensival S.A.
Henry Balfour & Co. Ltd.
BMA Braunschweigische Maschin enbauanstalt.
Polimex-Cekop.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne. G.m.b.H.

Corrosion-proof pumps
The Albany Engineering Co. Ltd.
Allen Gwynnes Pumps Ltd.
A.P.V.-Mitchell Craig Ltd.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Drum Engineering Co. Ltd.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
Saunders Valve Co. Ltd.
Sigmund Pulsometer Pumps Ltd.

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

Filtrate pumps
August Ahrendts K.G.
Ateliers de Construction d'Ensival S.A.
BMA Braunschweigische Maschinenbauanstalt.
Houttuin-Pompen N.V.
Howard Pneumatic Engineering Co. Ltd.
Mono Pumps Ltd.
Sigmund Pulsometer Pumps Ltd.
Weise & Monski, Weise Soehne G.m.b.H.
Peter Zeilfelder K.G.

Gas pumps
George Waller & Son Ltd.

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

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

Sedimentation accelerators
Allied Colloids Manufacturing Co. Ltd.
Fabcon Inc.
Hodag Chemical Corporation.
Tate & Lyle Enterprises Ltd.

Sedimentation tanks and clarifiers
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Maschinenfabrik A.G.
Enviro-Clear Company Inc.
Fletcher and Stewart Ltd.
Polimex-Cekop.
Werkspoor Water N.V.

Settling basins for flume water treatment
Lucks & Co. G.m.b.H.

Sewing threads, Heavy grade
Thames Packaging Equipment Co.

Ship loading installations
Babcock & Wilcox Ltd.
British Ropeway Engineering Co. Ltd.
Crone & Taylor (Engineering) Ltd.
Stothert & Pitt Ltd.
Tate & Lyle Enterprises Ltd.

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

Shredders
BMA Braunschweigische Maschinenbauanstalt.
C F & I Engineers Inc.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Gruendler Crusher & Pulverizer Company.
Stedman Foundry & Machine Co. Inc.
Stork-Werkspoor Sugar N.V.
Techserve (Pty.) Ltd.
Walkers Ltd.

Silos
Lucks & Co. G.m.b.H.
The Tills Engineering Co. Ltd.
Ingeniörsfirman Nils Weibull AB.

Slats for slat conveyors
Ewart Chainbelt Co. Ltd.

Spectrophotometers
Perkin-Elmer Ltd.
Tate & Lyle Enterprises Ltd.

Spectropolarimeters
Bellingham & Stanley Ltd.
Perkin-Elmer Ltd.
Rudolph Research Inc.
Schmidt + Haensch.

Spraying and dusting machinery
Cooper Pegler & Co. Ltd.

Sprockets
Ewart Chainbelt Co. Ltd.
Renold Ltd.

Stainless steel pipelines, Large diameter
Welding Technical Services Ltd.

Starch removal enzymes for cane juice
A.B.M. Industrial Products Ltd.
Tate & Lyle Enterprises Ltd.

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

Steam storage equipment
see Steam accumulators.

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

Steam turbines for mill drives, etc.
W. H. Allen, Sons & Co. Ltd.
Peter Brotherhood Ltd.
A. F. Craig & Co. Ltd.
Elliott Division of Carlyle Air Conditioning Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A. G. Kühnle, Kopp & Kausch.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Terry Steam Turbine Co.

Steam turbo-alternator sets
ACEC.
W. H. Allen, Sons & Co. Ltd.
Peter Brotherhood Ltd.
Elliott Division of Carlyle Air Conditioning Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hiro Zoki Co. Ltd.
A.G. Kühnle, Kopp & Kausch.
Polimex-Cekop.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Terry Steam Turbine Co.

Steel framed buildings
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.

Storage vessels, Stainless steel
John Dore & Co. Ltd.
T. Giusti & Son Ltd.
S.E.U.M.
Stork-Werkspoor Sugar N.V
The Tills Engineering Co. Ltd.

Strainers
Elliott Division of Carlyle Air Conditioning Co. Ltd.

Sugar agronomy consultancy services
Basico G.m.b.H.
Bookers Agricultural & Technical Services Ltd.
Hawaiian Agronomics Company (International).
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.

Sugar detectors
Anacon (Instruments) Ltd.

Sugar factory consultancy services
Basico G.m.b.H.
Bookers Agricultural & Technical Services Ltd.
C F & I Engineers Inc.
Hawaiian Agronomics Company (International).
Hitachi Shipbuilding & Engineering Co. Ltd.
Industrieprojekt A.G.
Polimex-Cekop.

Sugar factory consultancy services— *continued*
F. C. Schaffer & Associates Inc.
Soc. Sucrière d'Etudes et de Conseils S.A.
Tate & Lyle Technical Services Ltd.
Techserve (Pty.) Ltd.
Walkers Ltd.

Sugar factory design and erection (Cane and Beet)
ABR Engineering.
Applied Research and Engineering Ltd.
BMA Braunschweigische Maschinenbauanstalt.
Buckau-Wolf Waschinenfabrik A.G.
C F & I Engineers Inc.
A. F. Craig & Co. Ltd.
Fives Lille-Cail.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Honiron.
John Laing Construction Ltd.
Lucks & Co. G.m.b.H.
Polimex-Cekop.
Reggiane O.M.I. S.p.A.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

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

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

Sugar refinery design and erection
Buckau-Wolf Maschinenfabrik A.G.
Fletcher and Stewart Ltd.
Hitachi Shipbuilding & Engineering Co. Ltd.
Lucks & Co. G.m.b.H.
Polimex-Cekop.
F. C. Schaffer & Associates Inc.
A. & W. Smith & Co. Ltd.
Stork-Werkspoor Sugar N.V.
Tate & Lyle Enterprises Ltd.
Techserve (Pty.) Ltd.

Sugar silos
A/S De Danske Sukkerfabrikker.
Fives Lille-Cail.
John Laing Construction Ltd.
Lucks & Co. G.m.b.H.
The Tills Engineering Co. Ltd.
Ingeniörsfirman Nils Weibull A.B.

Sugar tabletting machinery
Chambon Ltd.
Ingeniörsfirman Nils Weibull A.B.

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

Sulphur furnaces, Continuous
Buckau-Wolf Maschinenfabrik A.G.
Cocksedge & Co. Ltd.
Stork-Werkspoor Sugar N.V.

Switchgear
ACEC.

Temperature recorders and controllers
Bailey Meters and Controls Ltd.
The British Rototherm Co. Ltd.
Chemap A.G.
A. H. Korthof N.V.
Negretti & Zambra Ltd.
Siemens A.G.
The Sugar Manufacturers' Supply Co. Ltd.
Taylor Instrument Companies (Europe) Ltd.
G. H. Zeal Ltd.

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

Test sieve shakers
Haver & Boecker.

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

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

Tissues, Lens cleaning
see Lens cleaning tissues.

Trailers
Lufkin Industries Inc.
Martin-Markham (Stamford) Ltd.
Ransomes Sims & Jefferies Ltd.
Salopian-Kenneth Hudson Ltd.
Tate & Lyle Enterprises Ltd.

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

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

Tube expanders
Rotatools (U.K.) Ltd.

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

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

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

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

Urea addition plant for molasses fodder mixtures
Ulrich Walter Maschinenbau.

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

Vacuum pans
see Pans.

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

Vacuum pumps, Oil-free
Drum Engineering Co. Ltd.
Nash International Company.
Siemens A.G.
George Waller & Son Ltd.

Valve actuators, Hydraulic
Edwards Engineering Corporation.

Valves
Bells Asbestos & Engineering Ltd.
Chemap A.G.
George Waller & Son Ltd.

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

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

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

Relief valves
Blundell & Crompton Ltd.

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

Stainless steel valves
A.P.V. Co. Ltd.
Saunders Valve Co. Ltd.
Serseg (Seguin-Sergot).
TI Stainless Tubes Ltd.

Vibrating feeders
Electromagnets Ltd.
Haver & Boecker.

Vibrators
Electromagnets Ltd.

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

Water screens
Associated Perforators & Weavers Ltd.

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

Weed control chemicals
May & Baker Ltd.

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

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

Wire cloth
Associated Perforators & Weavers Ltd.
Ferguson Perforating & Wire Co.
Fontaine & Co. G.m.b.H.
N. Greening (Warrington) Ltd.
Haver & Boecker.
Sankey Green Wire Weaving Co. Ltd.
Wire Weaving Co. Ltd.

Wire gauze strainers
Associated Perforators & Weavers Ltd.
N. Greening (Warrington) Ltd.

Wire tying sack tool
Thames Packaging Equipment Co.

Woven wire
Associated Perforators & Weavers Ltd.
N. Greening (Warrington) Ltd.
Sankey Green Wire Weaving Co. Ltd.

Wrapping machines
SAPAL.

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

BUYERS' GUIDE—ADDRESS LIST

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

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

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

August Ahrendts K.G.,
D2000 Hamburg 52, P.O. Box 520310, Germany.
Tel.: 89 26 18/89 64 88. *Cable:* Antillas, Hamburg.
Telex: 02-13703.

Akzo Chemie nv-Imacti,
Postbus 240-C, Amsterdam, Holland.
Tel.: (20) 60821. *Cable:* Activit, Amsterdam.
Telex: 11652 Imac NL.

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

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

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, Yorkshire, BD12 0JZ England.
Tel.: Bradford 671267. *Cable:* Colloidall, Bradford.
Telex: 51646.

Anacon (Instruments) Ltd.,
Rose Industrial Estate, Cores End Road, Bourne End, Bucks., England.
Tel.: 06285–25456/25874.
Telex: 847283.

Applied Research and Engineering Ltd.,
Parsons Estate, Washington, Co. Durham, England.
Tel.: (0632) 461411.
Telex: 53596.

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

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

ASEA-Weibull,
P.O. Box 4015, S-28104 Hässelholm 4, Sweden.
Tel.: (0451) 14115. *Cable:* Nilswei, Hässelholm.
Telex: 48086.

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: 41358.

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

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

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

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

Babcock & Wilcox Ltd.,
165 Gt. Dover St., London, SE1 4YB England.
Tel.: 01–407 8383. *Cable:* Babcock, London S.E.1.
Telex: 884151/2/3.

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

Balco-Filtertechnik G.m.b.H.,
3300 Braunschweig, Am Alten Bahnhof 5, Germany.
Tel.: 830 71–2. *Cable:* Balco, Braunschweig.
Telex: 952509.

Henry Balfour & Co. Ltd.,
Leven, Fife, Scotland.
Tel.: Leven 3020.
Telex: 72304.

Basico Gesellschaft für internationale Projekte der Landwirtschaft, Forstwirtschaft und Agrarindustrie m.b.H ,
D-6370 Oberursel, Postbox 547, Germany.
Tel.: (06171) 51054. *Cable:* Basico, Oberursel.
Telex: 4–10 730.

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

Bells Asbestos & Engineering Ltd.,
Farnham Road, Slough, Bucks., England.
Tel.: Slough 23921. *Cable:* Bestobell, Slough.
Telex: 84107.

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

Blundell & Crompton Ltd.,
West India Dock Road, London, E14 8HA, England.
Tel.: 01–987 6001. *Cable:* Blundell, London, E14 8HA.

BMA Braunschweigische Maschinenbauanstalt,
33 Braunschweig, Am Alten Bahnhof 5, Postfach 295, Germany.
Tel.: (0531) 804-1. *Cable:* Bema, Braunschweig.
Telex: 952 456.

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

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

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

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

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

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

Thomas Broadbent & Sons Ltd.,
Queen Street South, Huddersfield, Yorkshire, HD1 3EA England.
Tel.: 0484–22111. *Cable:* Broadbent, Huddersfield.
Telex: 51515.

W. van den Broek's Machinefabriek N.V.,
Driebergen-R., 9–11 Stationsweg, Holland.
Tel.: 03438-5114. *Cable:* Vdbro, Driebergen.
Telex: Vdbro NL 47337.

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

David Brown Gear Industries Ltd.,
Park Gear Works, Huddersfield, Yorkshire, HD4 5DD England.
Tel.: 0484–22180. *Cable:* Gearing, Huddersfield.
Telex: 51562/3.

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

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

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

C.E.C.A.,
11 Avenue Morane-Saulnier, B.P.66, 78 Velizy-Villacoublay, France.
Tel.: 946 96.35. *Cable:* Carbacti, Velizy.
Telex: 60-584.

Cellier S.A.,
B.P.58, 73 Aix-les-Bains, France.
Tel.: (79) 35.05.65.
Telex: 32.053 Inoxel Aixbs.

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

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

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

Cooper, Pegler & Co. Ltd.,
P.O. Box 9-98, Burgess Hill, Sussex, RH15 9LA England.
Tel.: Burgess Hill 2525. *Cable:* Stomata, Burgess Hill.

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

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

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

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

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

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

Dicalite/GREFCO Inc., International Division,
630 Shatto Place, Los Angeles, Calif., 90005 U.S.A.
Tel.: (213) 381–5081. *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. *Cable:* Slicing, Dereham.
Telex: 97357.

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

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

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

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

Elliott Division of Carlyle Air Conditioning Co. Ltd.,
15 Portland Place, London, W1N 3AA England.
Tel.: 01–637 1591. *Cable:* Carell, London.
Telex: 25969.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Foster Wheeler John Brown Boilers Ltd.,
P.O. Box 160, Greater London House, Hampstead Rd., London, NW1 79N1 England.
Tel.: 01–388 1212. *Cable:* Rewopsteam, London.
Telex: 263984.

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

T. Giusti & Son Ltd.,
202–224 York Way, Kings Cross, London N.7, England.
Tel.: 01–607 5021. *Cable:* Giustison, London N.7.
Telex: 22592.

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

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

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

Greif-Werk Maschinenfabrik,
24 Lübeck, Postfach 1183, Germany.
Tel.: 5303-1. *Cable:* Greifwerk, Lübeck.
Telex: 026895.

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

Haver & Boecker,
4740 Oelde/Westfalen, Postfach 163, Germany.
Tel.: (02522) 301. *Cable:* Haboe, Oelde 1.
Telex: 89521 haver.

Hawaiian Agronomics Company (International),
P.O. Box 3470, Honolulu, Hawaii, 96801 U.S.A.
Tel.: (808) 536-4461. *Cable:* Agronomics, Honolulu.
Telex: (RCA) 723326; (ITT) 7430173; (WUI) 634130.

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

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

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

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

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

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

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

Honiron,
P.O. Box 3140, Honolulu, Hawaii, 96802 U.S.A.
Tel.: (808) 531-2011. *Cable:* Honiron, Honolulu.
Telex: 7430081.

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

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

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

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

Industrieprojekt A.G.,
Sihlstr. 61, CH-8001 Zürich, Switzerland.
Tel.: (01) 27-22-38/39. *Cable:* Indarchag, Zürich.
Telex: 54803.

Ingeniörsfirman Nils Weibull A.B.,
see Weibull.

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

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.

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

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

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

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

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

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

Dr. Wolfgang Kernchen Optik-Elektronik-Automation,
D-3011 Laatzen/Hannover, Postf. 1123, Germany.
Tel.: Hannover 86 37 11. *Cable:* Optronic, Hannover.

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

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

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

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

A. H. Korthof N.V.,
Hertshooiweg 18, Bergen, N.H., Holland.
Tel.: 02208-5526. *Cable:* Sugarlab, Bergen.

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

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

Lafarge Aluminous Cement Co. Ltd.,
Fondu Works, London Road, West Thurrock, Essex., England.
Tel.: Purfleet 3333. *Cable:* Cimenfondu, Graysuk.
Telex: 897515 Lafarge Grays.

John Laing Construction Ltd.,
Park House, 207/211 The Vale, Acton, London W.3, England.
Tel.: 01–743 1230. *Cable:* Laing 01–743 1230.

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

Lucks & Co. G.m.b.H.,
D-33 Braunschweig, Celler Str. 66-67, P.O. Box 782, Germany.
Tel.: 0531/5971. *Cable:* Baulucks, Braunschweig
Telex: 09–52713 luco d.

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

Lurgi Apparate-Technik G.m.b.H. — Bereich Chemotechnik,
6 Frankfurt (Main), Lurgihaus, Gervinusstr. 17-19, Germany.
Tel.: (0611) 157. *Cable:* Lurgitechnik, Frankfurt.
Telex: 04 12 36.

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

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

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

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

Mennesson & Cie.,
Route de Nimes, 30200 Bagnols-sur-Cèze, France.
Tel.: 16-66-89.50.75.
Telex: 48146 Telexer Nimes Code 25.

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

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

Nash International Company,
Norwalk, Conn., 06856 U.S.A.
Tel.: (212) 421-4200. *Cable:* Hytor, Norwalk, Conn.
Telex: 96-5971.

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

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

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

Nordon & Cie.,
9 Avenue du XXème Corps, B.P. 441, 54 Nancy, France.
Tel.: 28–52 2060. *Cable:* Frernordon, Nancy.
Telex: 85040.

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

Paxman Process Plant Division, G.E.C. Diesels Ltd.,
P.O. Box 8, Colchester, Essex, CO1 2HW England.
Tel.: (0206) 5151.
Telex: 98151.

Perkin-Elmer Limited,
Beaconsfield, Bucks., England.
Tel.: 5151/2571. *Cable:* Peco, Beaconsfield.
Telex: 83257.

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

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

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

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

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

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

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

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

Rapid Magnetic Ltd.,
Lombard St., Birmingham, B12 0QW England.
Tel.: 021–773 1361. *Cable:* Magnetism, Birmingham.
Telex: Chamcom Bham 338024 Magnetism.

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

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

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

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

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

Resindion Division of Sybron Italia S.p.A.,
Via Santa Valeria 3, 20123 Milano, Italy.
Tel.: 865979. *Cable:* Sybronit, Milano.
Telex: 31403.

Robey of Lincoln Ltd.,
P.O. Box 23, Lincoln, England.
Tel.: (0522) 21381. *Cable:* Robey, Lincoln.
Telex: 56109.

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

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

Rotatools (U.K.) Ltd.,
43/45 Pembroke Place, Liverpool L3 5PH, England.
Tel.: 051–709 6117/2682. *Cable:* Scalewell, Liverpool 3

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

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

Salopian-Kenneth Hudson Ltd.,
Prees, Whitchurch, Salop., England.
Tel.: Whitchurch 3411. *Cable:* Implements, Prees.
Telex: 35218.

Salzgitter Maschinen A.G.,
Postfach 51 1640, D–332 Salzgitter 51, Federal Republic of Germany.
Tel.: (053 41) 302–1. *Cable:* Samag, Salzgitter-Bad.
Telex: 95445 smg d.

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

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

Saunders Valve Co. Ltd.,
Grange Rd., Cwmbran, Monmouthshire, England.
Tel.: 063 332044. *Cable:* Saunval, Newportmon.
Telex: 49241.

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

Schenk Filterbau G.m.b.H.,
Postfach 95, 7070 Schwäbisch Gmünd, Germany.
Tel.: (07171) 82091. *Cable:* Filterbau, Schwäbisch Gmünd.
Telex: 7-248818.

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

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

Serck Tubes,
Warwick Road, Birmingham, B11 2QY England.
Tel.: 021-772 4595. *Cable:* Nerleak, Birmingham.
Telex: 33141.

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

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

S.E.U.M.,
62 Corbehem, France.
Tel.: (20) 88-70-40. *Cable:* SEUM, Corbehem
Telex: Seum 11.500F.

Siemens A.G., Power Engineering Group,
D-8520 Erlangen, Postfach 325, Germany.
Tel.: (09131) 71.
Telex: 629871.

Sigmund Pulsometer Pumps Ltd.,
Oxford Road, Reading, RG3 1JD England.
Tel.: (0734) 25555. *Cable:* Sigmeter, Reading.
Telex: 84189.

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

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

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

Richard Sizer Ltd.,
Cuber Works, Cornwall Street, Hull, England.
Tel.: (0482) 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 5346. *Cable:* Sugrengine, Bromley, Kent.
Telex: 2-2404.

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

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

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

SPEICHIM,
106 rue d'Amsterdam, Paris 9e, France.
Tel.: 744-73-79. *Cable:* Rectifpast, Paris.
Telex: 65688.

SPP Agricultural Services,
Oxford Road, Reading, RG3 1JD England.
Tel.: (0734) 25555. *Cable:* Sigmeter, Reading.
Telex: 84189.

Stabilag Engineering Ltd.,
34 Mark Rd., Hemel Hempstead, Herts., England.
Tel.: Hemel Hempstead 4481/2.
Cable: Stabilag, Hemel Hempstead.

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

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

Stein Atkinson Stordy Ltd.,
Deepdene House, Deepdene Ave., Dorking, Surrey, England.
Tel.: Dorking 5981. *Cable:* Metasteina, Dorking.
Telex: 85677.

Stella Meta Filters,
Division of The Permutit Co. Ltd.,
632-652 London Road, Isleworth, Middx., England.

Stockdale Engineering Ltd.,
Rock Bank, Bollington, Macclesfield, Cheshire, SK10 5LB England.
Tel.: Bollington 2521. *Cable:* Mechanical, Bollington.
Telex: 668885.

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

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

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

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

Suchar,
Division of De Sola Bros. Inc.,
120 Wall Street, New York, N.Y., 10005 U.S.A.
Tel.: (212) 344-2124. *Cable:* Sucharing, New York.
Telex: 22637 Desola.

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

Takuma Co. Ltd.,
Eitaro Bldg., 4-Tori-1 Nihonbashi, Chuo-ku, Tokyo, Japan.
Tel.: 271-2117. *Cable:* Takuma, Tokyo.
Telex: 0222-2878 Takuma Tok.

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

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

Taylor Instrument Companies (Europe) Ltd.,
Gunnels Wood Rd., Stevenage, Herts, SG1 2EL England.
Tel.: (0438) 2366. *Cable:* Taylortrol, Stevenage.
Telex: 82281.

Techserve (Pty.) Ltd.,
P.O. Box 113, Jacobs, Natal, South Africa.
Tel.: 87 6951. *Cable:* Sucrotech, Jacobs.
Telex: 6-7462.

Terry Steam Turbine Co.,
P.O. Box 1200, Hartford, Conn., 06101 U.S.A.
Tel.: (203) 688–6211.
Telex: 099324.

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

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

Thomson International Company,
P.O. Box 71, Thibodaux, La., U.S.A.
Tel.: (504) 447-3773. *Cable:* Thomson, Thibodaux.

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

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

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

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

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

United Silk Mills Ltd. G.m.b.H.,
4152 Kempen 4, Speefeld 7, Postfach 80, Germany.
Tel.: 02152/7001/2. *Cable:* Verseidag, Kempen.
Telex: 0853/464.

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

The Vaughan Crane Co. Ltd.,
West Gorton, Manchester 12, England.
Tel.: 061–223 2771. *Cable:* Vaunting, Manchester 12.
Telex: Chamcom Mchr 668701.

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

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

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

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

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

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

Weir Pumps Ltd.,
Albany House, Petty France, London, S.W.1, England.
Tel.: 01–799 4861. *Cable:* Weirgroup, London S.W.1., Telex.
Telex: 22556.

Weise & Monski, Weise Soehne G.m.b.H.,
752 Bruchsal, Industriestr. 29, Germany.
Tel.: 07251/2721. *Cable:* Weisens, Bruchsal.
Telex: 07 822 207.

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

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

Werkspoor Water N.V.,
de Boelelaan 14, P.O. Box 7811, Amsterdam, Holland.
Tel.: 020–44 19 66. *Cable:* Werkwater, Amsterdam.
Telex: 14004.

The Western States Machine Company,
Hamilton, Ohio, U.S.A.
Tel.: (513) 863-4758. *Cable:* Wesmaco, Hamilton, Ohio.
Telex: 214 577.

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

West's (Manchester) Ltd.,
Drewett Street, Miles Platting, Manchester, M10 8AB England.
Tel.: 061–205 2351. *Cable:* Westman, Manchester.
Telex: 668991.

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.: 1841. *Cable:* Draadweverij, Dinxperlo.
Telex: 45211 mddpl nl.

Wright Rain Ltd.,
Ringwood, Hants., BH24 1PA 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.

York Export Corporation,
42 Intervale Road, Parsippany, N.J., 07054 U.S.A.
Tel.: (201) 263-2200. *Cable:* Ottoyork, Parsippany.
Telex: 136404.

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

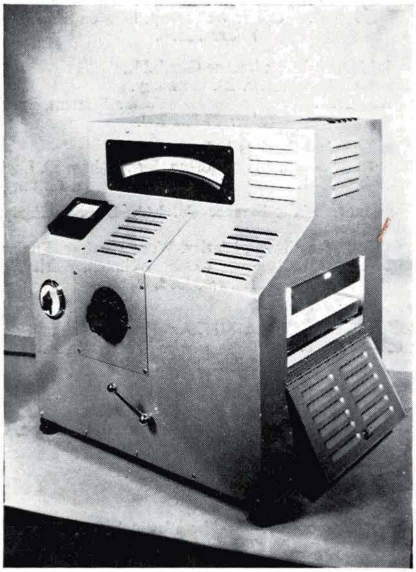
G. H. Zeal Ltd.,
Lombard Rd., Merton, London SW19 3UU, England.
Tel.: 01–542 2283/6. *Cable:* Zealdom, London, Telex.
Telex: 929519.

Peter Zeilfelder K.G.,
D333 Helmstedt, Schulstr. 3–6, Germany.
Tel.: 3669. *Cable:* Zeilfelder, Helmstedt.

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

DRYING EQUIPMENT



MOISTURE BALANCE—TYPE D

The moisture balance type D illustrated is essentially the same as the type CB excepting that it can take samples from 100 to 1000 grm depending on the density of the product. In the case of bagasse the weight of sample possible is 100 grm contained in a dish 250 mm long × 200 mm wide × 22 mm deep.

The scale range is graduated 0/100% moisture and the maximum temperature of determination is 200°C controllable by a resistance knob.

The accuracy of the scale for 100 grm is ±0.5% or 0.05% on 1000 grm samples of material. The power required for operation is 1 kW. A timer 0/60 minutes is fitted as standard.

Additional extras which can be fitted if required are:

1. Pyrometer. 2. Voltage stabiliser.

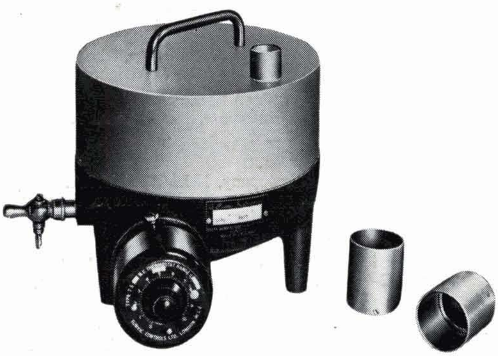
Please state single phase voltage and frequency when ordering.

MOISTURE TELLER ▶

Work carried out in South Africa using this type of dryer gave excellent results in drying bagasse. Experiments revealed that 100 g of bagasse could be dried in 20 minutes at a temperature of 266°F, which agreed very closely with laboratory oven determinations at 225°F for 20 hours. Such rapidity of determination is a great benefit to the engineer.

The equipment consists essentially of a fan which draws in air, passes it over heating elements and then through the bagasse. A time switch and thermostat are provided so that any temperature between 90° and 150°C can be maintained with a time of operation between 0 and 60 minutes.

Please state single phase voltage and frequency when ordering.



LABORATORY SUGAR DRYER

For the rapid estimation of moisture in sugars, a comparatively large volume of heated air should be passed over and through the sample. Care should be taken in these estimations, however, as it is essential to know the conditions of temperature and time of drying during which period no decomposition takes place. Once these conditions have been established for a particular type of sugar estimations become routine thereafter and results can be obtained in about 10 to 15 min.

This oven is fitted with a thermostat type TS.2, which gives temperature control of ±0.25°C over a range of ±60° from a central adjusted temperature.

Four sample containers are provided to fit into recesses in the body of the oven, and two additional containers are provided as spares.

This type of oven must be used in conjunction with a vacuum pump or the factory vacuum line, if available, for drawing the air over the heating element, through the sample and into the vacuum line or pump trap. A time device can also be supplied as an extra with a re-set push-button so that, simply by pushing the button for making contact, a whole series of rapid determinations can be made under the predetermined conditions of time, temperature and air volume, the whole process being automatic once the cycle is set in operation.

The Sugar Manufacturers' Supply Co. Ltd.

196-204 BERMONDSEY STREET, LONDON, SE1 3TP, ENGLAND

Telephone: 01 - 407 5422 *Cables:* "Sumasuco, London S.E.1"

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