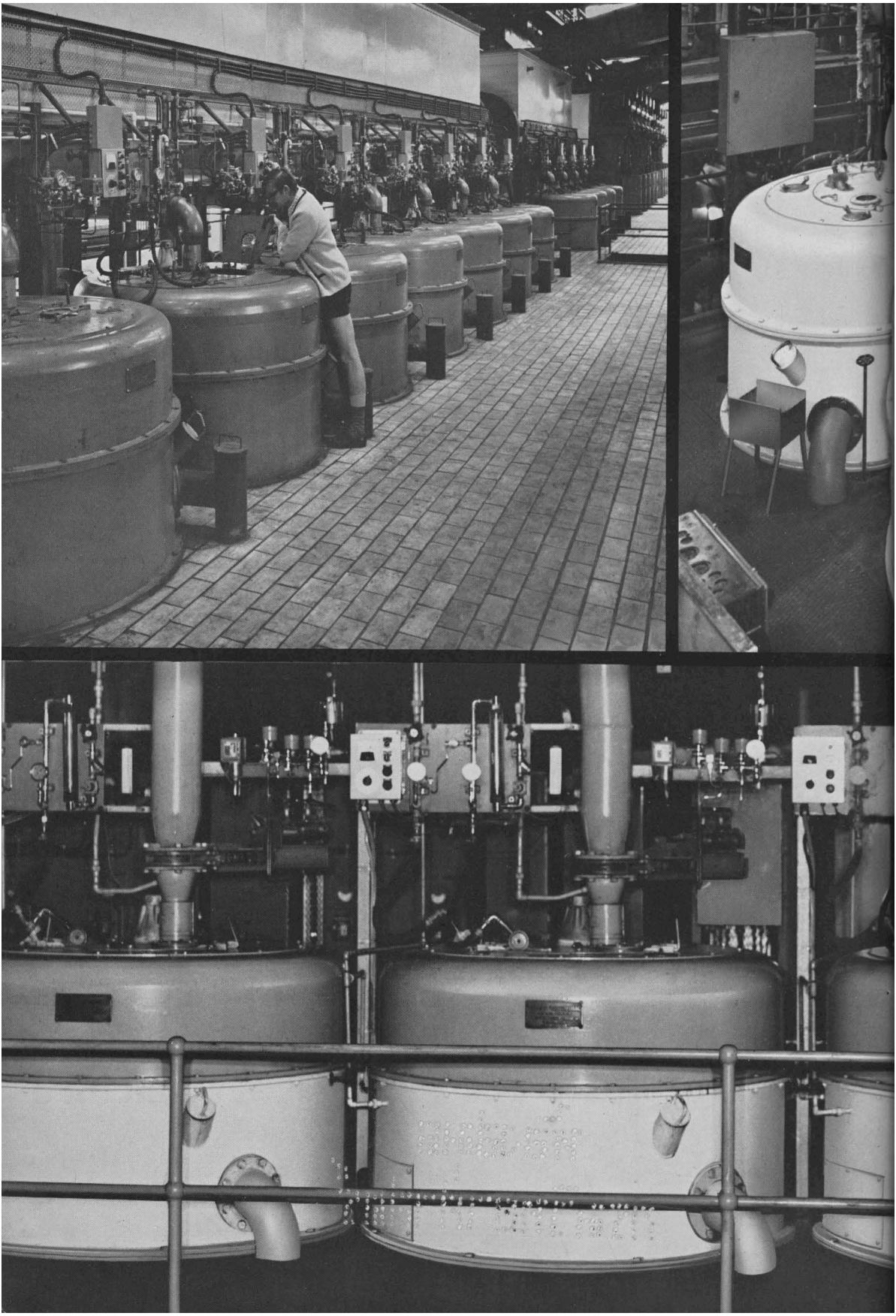
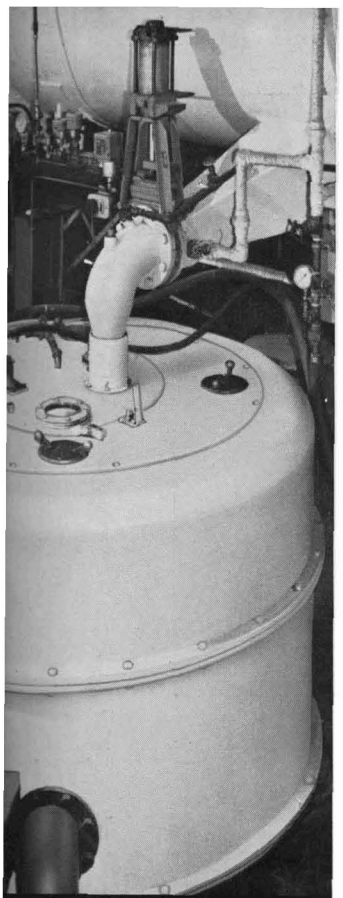
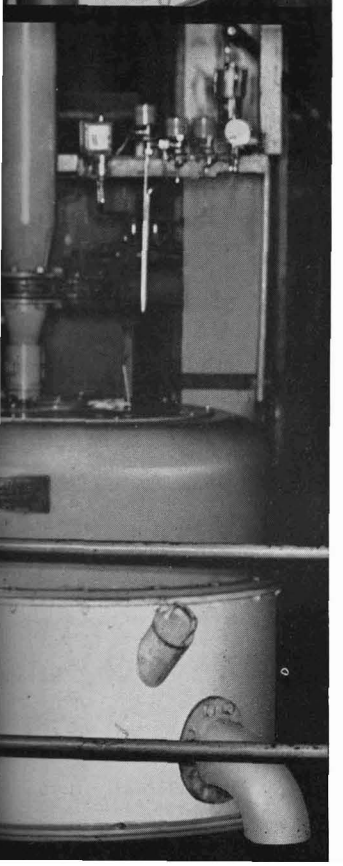
THE International Sugar Journal

APRIL 1970







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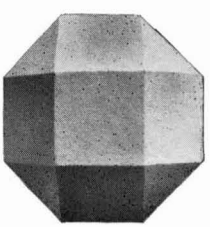

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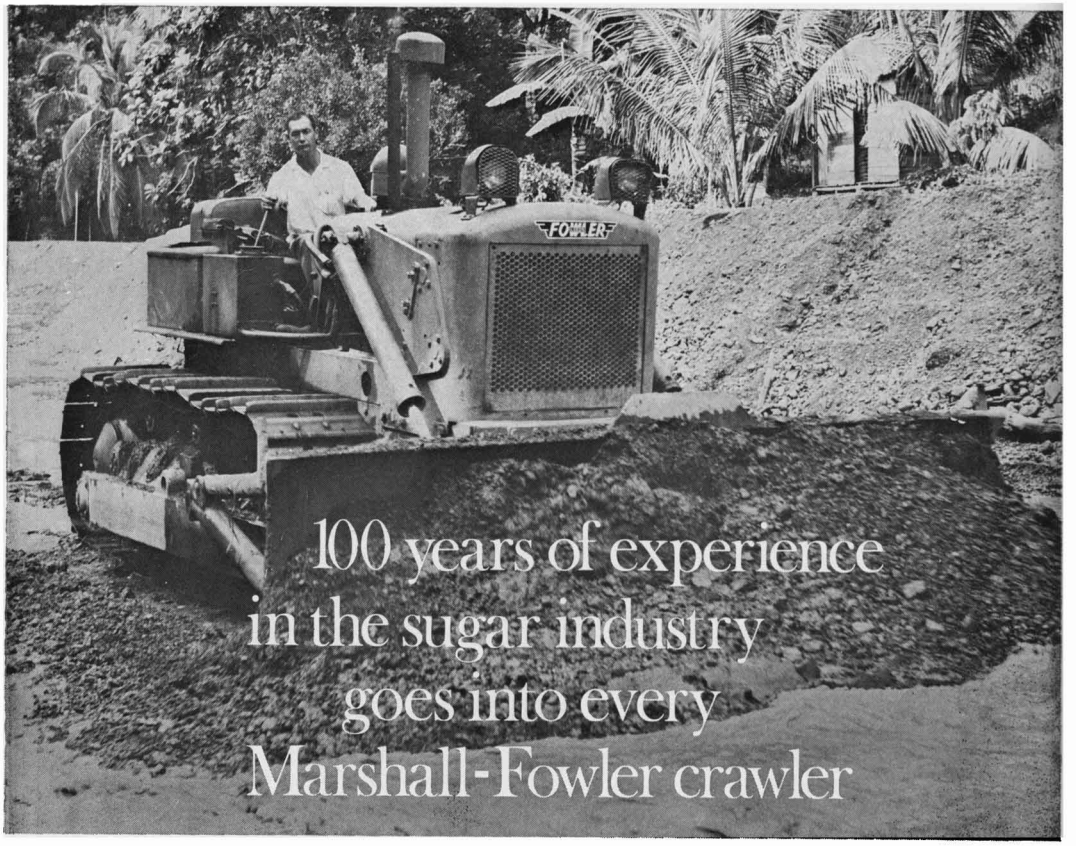

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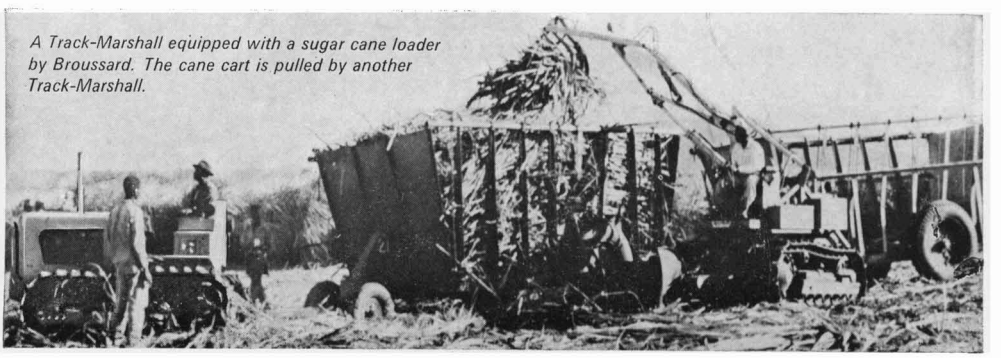

A Track-Marshall equipped with a sugar cane loader by Broussard. The cane cart is pulled by another Track-Marshall.

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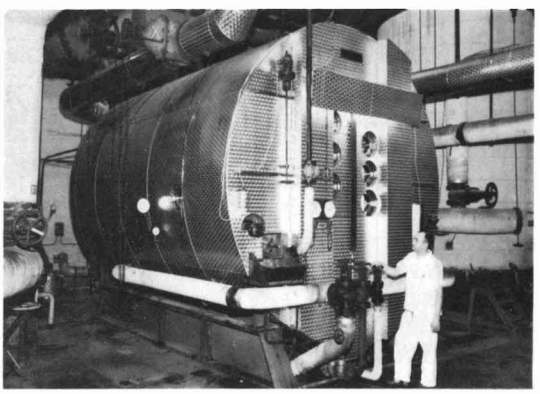
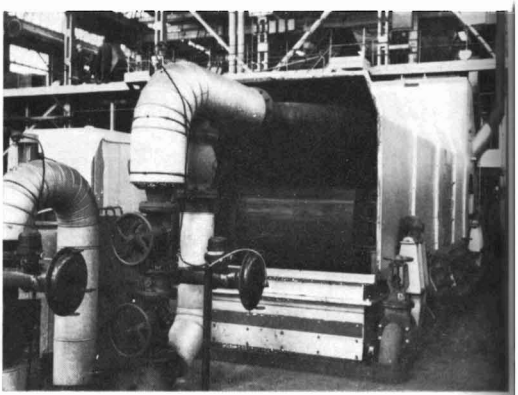
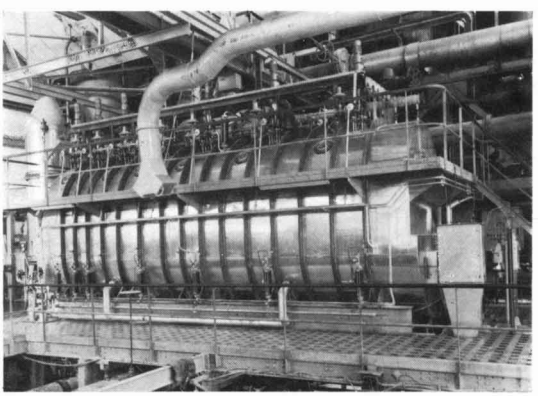


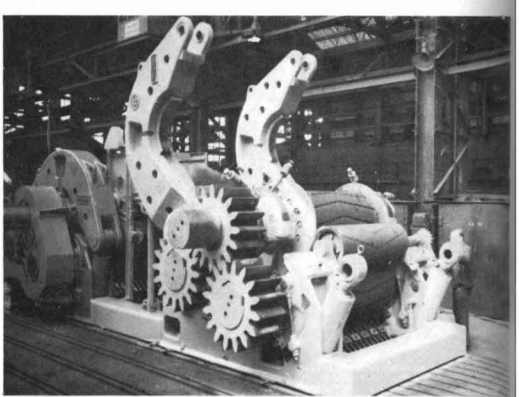
Horizontal vacuum pan with plate type heating element



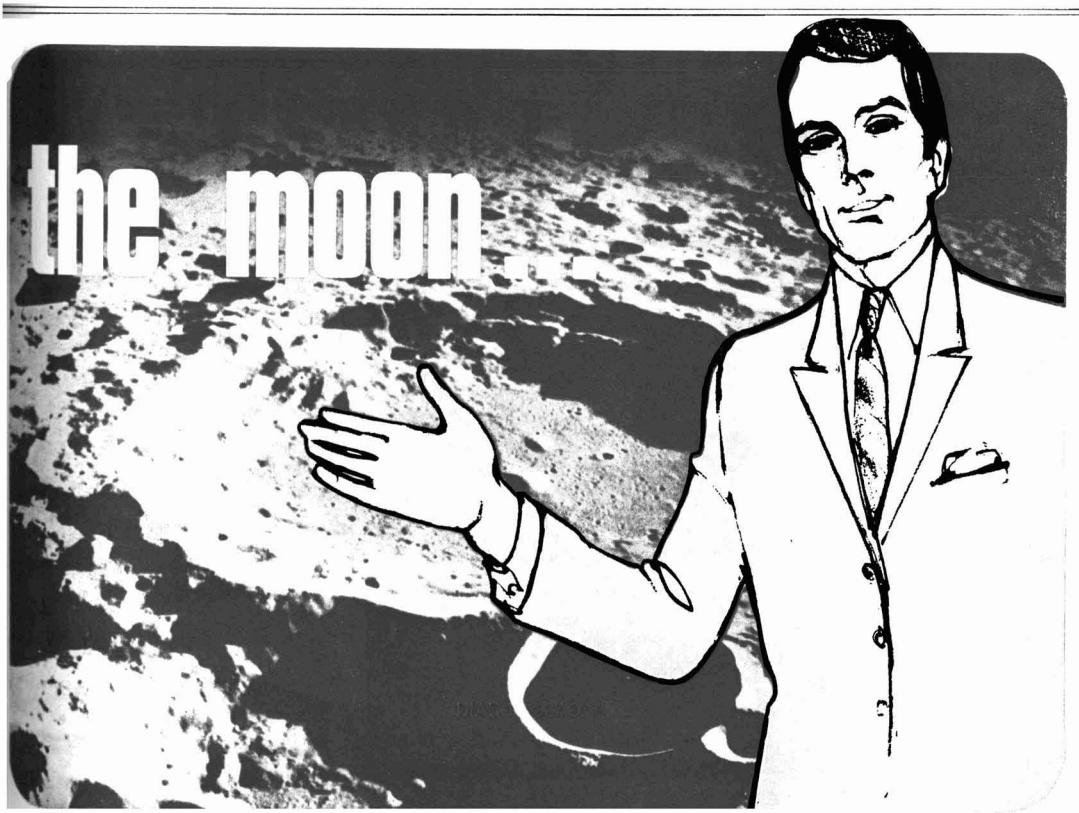
Prescalder



Continuous vacuum pan



Self-setting cane mills (top housing members raised)



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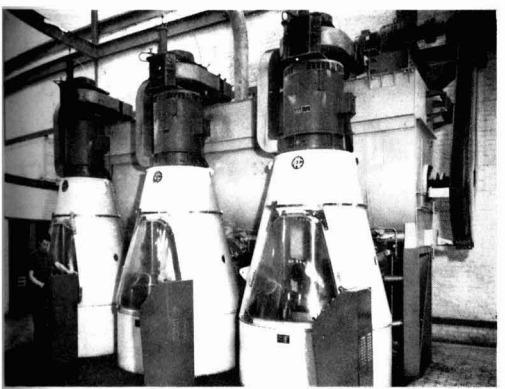

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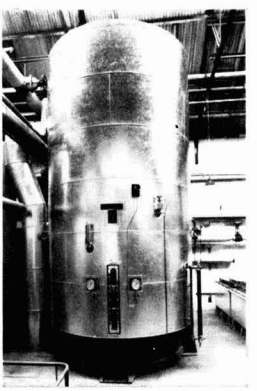
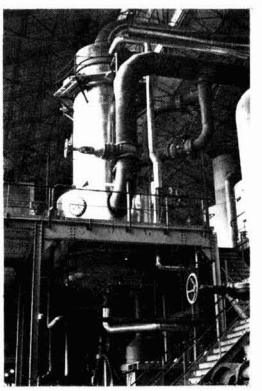
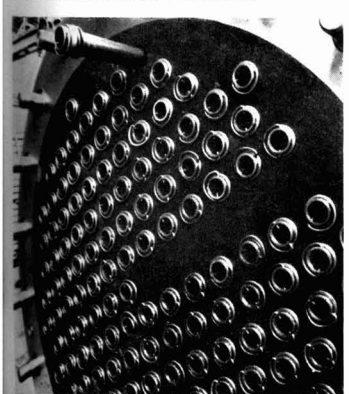


Annular space overflow evaporator



Falling film evaporator



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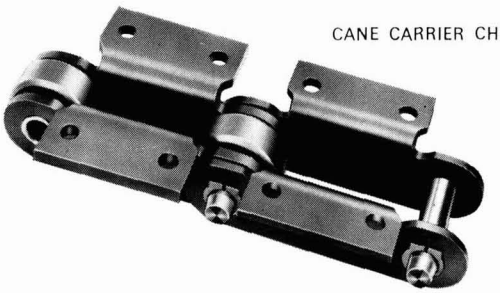

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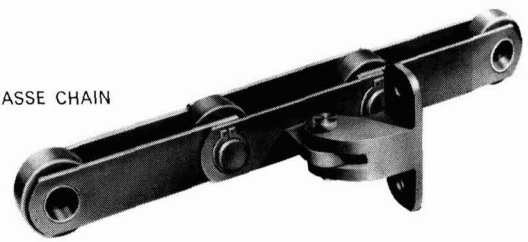

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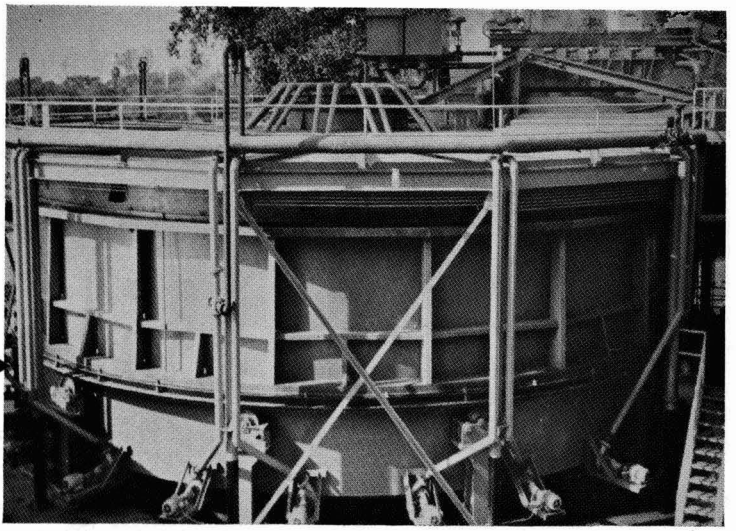

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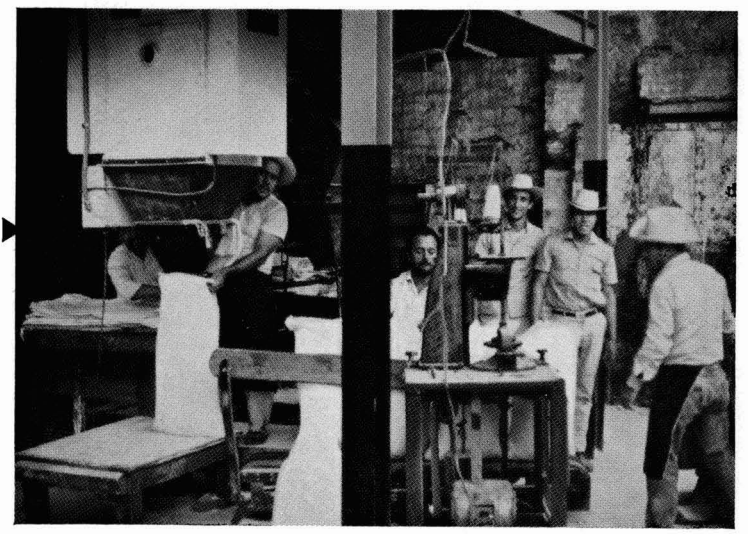

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April 1970

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Quelques observations sur la diffusion de canne par des techniques de percolation et d'immersion. IIe Partie. E. J. BUCHANAN et L. M. S. A. JULLIENNE. p. 99–103

Au cours de tests de diffusion par immersion, on a constaté que des températures supérieures a 70°C causaient une augmentation rapides de la vitesse d'extraction. Une préparation fine de la canne augmentait l'extraction ainsi que les vitesses d'extraction. Une préparation fine semblerait permettre l'emploi de températures plus basses sans affecter de façon néfaste l'extraction, réduisant en même temps le taux de polysaccharides dans le jus de diffusion. A part les polysaccharides, aucune autre impureté ne fut affectée de façon significative par les variables du processus soumises à l'étude. Sauf peut-être dans le cas d'une préparation extrêmement fine qui n'est guère utilisée en pratique dans les diffuseurs commerciaux, la diffusion est bien le mécanisme déterminant dans l'extraction de sucre.

* * *

Raffinage du sucre—Notes sur les processus unitaires. VIe Partie. Considérations sur la cuisson du sucre. F. M. CHAPMAN. p. 103–106

Dans la seconde partie de cet article, l'auteur considère les avantages de la cuisson continue et présente des données montrant la relation existant entre la dimension des cristaux et le poids pour des temps de cuissons donnés. On donne également les détails sur une unité de cuisson semi-continue, dans laquelle un appareil à cuire équipé d'un agitateur mécanique est entouré d'appareils "satellites" démunis d'agitateur. Une combinaison d'appareils à cuire destinés à la cuisson continue de refonte est également décrite brièvement.

* * *

L'emploi dans les cultures de canne à sucre à Taïwan du "Paraquat" destiné à son application contrôlée aux mauvaises herbes après leur croissance. SHENG Y. PENG. p. 106–108

On discute l'emploi du "Paraquat" en combinaison avec le "Dalapon" ou le "Diuron" plus 2,4-D en vue du désherbage en *postémergence pour la culture de canne. On se réfère à des expériences menées à Taïwan.*

Einige Beobachtungen über die im Perkolationsverfahren und die submers durchgeführte Zuckerrohr-Diffusion. Teil II. E. J. BUCHANAN und L. M. S. A. JULLIENNE. *S.* 99–103

Bei Untersuchungen über die submers durchgeführte Diffusion wurde festgestellt, dass Temperaturen oberhalb 70°C einen schnellen Anstieg der Extraktionsgeschwindigkeit hervorrufen. Ferner wurde gefunden, dass eine feinere Aufbereitung des Rohrs eine bessere Extraktion und höhere Extraktionsgeschwindigkeiten bewirkt. Die feinere Aufbereitung dürfte die Anwendung niedrigerer Temperaturen erlauben, bei denen die Extraktion night nachteilig beeinflusst und der Polysaccharidanteil im Diffusionssaft verringert wird. Andere Verunreinigungen als die Polysaccharide unterliegen keinem wesentlichen Einfluss durch die untersuchten Versuchsparameter. Abgesehen wahrscheinlich von einer extrem feinen Aufbereitung, die aber bei den in der Praxis üblichen Diffusieuren nicht zur Anwendung kommt, ist nach den Untersuchungen die Diffusion der die Saccharoseextraktion beherrschende Vorgang.

* * *

Zuckerraffination—Bemerkungen über Grundoperationen. Teil VI. Gedanken über den Kochprozess. F. M. CHAPMAN. *S.* 103–106

Im zweiten Abschnitt dieses Artikels behandelt der Autor die Vorteile des kontinuierlichen Kochens und veröffentlicht Werte, aus denen der Zussammenhang zwischen Kristallgrösse und Kristallgewicht für gegebene Kochzeiten hervorgeht. Ferner werden Einzelheiten über eine halbkontinuierliche Kochanlage mitgeteilt, bei der ein mit einem mechanischen Rührer ausgestatteter Kochapparat von weiteren Kochapparaten umgeben ist, die keine Rührer besitzen. Ferner wird kurz eine einfache Anordnung von Kochapparaten beschrieben, die für das kontinuierliche Verkochen von Kläre geeignet ist.

* * *

Die Verwendung von "Paraquat" im Nachauflaufverfahren für die gezielten Unkraut-bekämpfung bei Zuckerrohr in Taiwan. SHENG Y. PENG. *S.* 106–108

Die Verwendung von "Paraquat" in Verbindung mit "Dalapon" oder "Diuron" plus 2,4-D zur Unkrautbekämpfung bei Zuckerrohr im Nachauflaufverfahren wird unter Bezugnahme auf in Taiwan durchgeführte Versuche diskutiert.

Algunas observaciones sobre difusión de caña por técnicas de percolación y sumersión. E. J. BUCHANAN y L. M. S. A. JULLIENNE. *Pág.* 99–103

En ensayos de difusión por sumersión, los autores hallaron que temperaturas más alta que 70°C causa un rápido crecimiento en la velocidad de extracción, y que extracción más completa y velocidades más altas de extracción resultan de fina preparación de la caña. Preparación fina parece permitir el uso de temperaturas más bajas sin afectar desfavorablemente la extracción mientras que el nivel de polisacáridos en el jugo de difusión se reduzca. Aparte de polisacáridos, ningún otra impureza estaba afectado significantemente por las otras variables que se han investigado. Excepto posiblemente con preparación sumamente fina, no usada en la práctica con difusores comerciales, se halló que difusión es el mecanismo decisivo en extracción de sacarosa.

* * *

Refinación de azúcar—Notas sobre procesos unitarios. Parte VI. Pensamientos sobre cocción de azúcar. F. M. CHAPMAN. *Pág.* 103–106

En la segunda sección de este artículo, el autor considera las ventajas de cocción contínua y presenta dados que demuestran la relación entre tamaño del cristal y su peso para tiempos dados de cocción. También da detalles de una sistema semi-contínua de tachos de que uno, equipado con un agitador mecánico, se rodea de tachos no-agitados "satélitos". Una sistema elemental de tachos se describe brevemente, conveniente para cocción contínua de "refundo".

* * *

El use de "Paraquat" en la post-aparición aplicación para tratamiento de malas hierbas en caña de azucar en Taiwan. SHENG Y. PENG. *Pág.* 103–108

El uso de "Paraquat", combinado con "Dalapon" o "Diuron" y 2,4-D para tratamiento post-aparición de malas hierbas en caña se discute con referencia a ensayos realizado en Taiwan.

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXXII APRIL 1970 No. 856

Notes & Comments

British Sugar Corporation Ltd., 1968/69 Report.

Favourable weather during the spring of 1968 enabled the crop to be sown earlier than in any previous season but emergence was slow and early growth retarded by the subsequent cold conditions. Heavy rainfall during the summer depressed sugar content although minimizing the effects of pests and diseases, and continuance of rain hindered harvesting, although supplies to factories were maintained and the tonnage of beets delivered, at 7,006,108,was second only to the record crop of 1960.

The number of growers has decreased by 50% to 23,400 during the past twenty years although the acreage sown to beet has increased ; the larger and more efficient units, combined with the use of precision drills, chemical weed control, increase in the use of monogerm seed (now 25% of the total) and other labour-saving techniques has contributed to increased yields, which reached an average of 15·75 tons per acre. The beet yield from the 1969 crop is below average, at almost six million tons, but sugar contents are higher, averaging just under 17% compared with 15·3% in 1969.

The Corporation's policy is to increase throughput at most factories and to reduce the length of the campaign; as a result the total slicing capacity reached a new record of 60,349 tons/day in 1968/69, an increase of 2080 tons/day on 1967/68. Capacity increase over the past five years has been from 52,127 tons/day, i.e. equivalent to a new factory of over 8000 tons/day capacity.

Output reached 883,439 tons of white sugar, with 586,525 tons of dried pulp and 322,824 tons of molasses; of the latter, 93,001 tons was sold as such, the remainder being added to pulp. Reconstruction of Wissington factory continued while installations for automatic beet sampling and improvements of beet reception facilities were made at other factories. A new boiler and a new pulp dryer have been erected at Spalding and a new plant for pulp in paper sacks has been provided at York. Ion exchange plants have been put in at Allscott and Peterborough, while installations to reduce river and air pollution have been completed at a number of factories.

Cuban sugar production 1969/70.

A production timetable announced by the Cuban Prime Minister, Dr. CASTRO, is as folllows: 2 million tons by the 18th January, 3 million tons by the 9th February, 4 million tons by the 28th February, 5 million tons by the 17th March, 6 million tons by the 3rd April, 7 million tons by the 20th April, 8 million tons by the 7th May, and 10 million tons by the 15th July[1]. Various difficulties have been reported, however, including bad weather, low sugar contents, insufficient labour, and mill breakdowns; in spite of these, the 2 million tons target was reached only one day late and the 3 million tons by the 11th February. Subsequently, the target date for the 4 million tons was postponed to the 3rd March and it was, in fact, reached on the 5th March.

C. Czarnikow Ltd. comment[2]: "Although there are few who expect the target of ten million tons to be achieved, a very large crop seems assured. As Cuban exports to the world market are limited under the terms of the International Sugar Agreement, it will be necessary, if substantial stocks are not to be carried forward, to raise the level of deliveries to the socialist group of countries. From the Cuban point of view this poses no problem as existing trade agreements allow for shipments far in excess of the tonnages which have been effected in recent years. Indeed, an increase in deliveries to the USSR may well be needed, in view of the poor 1969/70 crop in that country.

"Exports from the Soviet Union to other socialist countries are not limited under the ISA and it has been suggested that heavy shipments from Cuba might lead to increased exports from the USSR to other socialist countries which are not members of the Agreement. The latter would then be free to re-export the sugar to the world market. Although this would seem to be theoretically possible, the provision of the Agreement under Article 34 (4) must be borne in mind. This specifies that when special arrangements —and this term applies to both Cuban exports to

[1] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (1), 6.
[2] *Sugar Review*, 1970, (955), 17.

socialist countries and to exports by the USSR—involve re-exports of sugar to the free market, the members concerned must take appropriate measures to ensure that any increase in trade above the level prevailing before the Agreement came into operation does not result in an increase in re-exports to the free market. Under these circumstances it would appear to be the responsibility of both Cuba and the Soviet Union to make certain that their trade arrangements do not result in increased sales to the world market by other socialist countries."

* * *

UK sugar imports and exports.

Statistics for imports and exports of sugar by the UK during 1969 have been published[1] and are reproduced elsewhere in this issue with corresponding data for the three previous years. The importance of the Commonwealth Sugar Agreement is emphasized by the latest figures which show that of total imports of 2,111,355 long tons, tel quel, no less than 1,897,872 tons came from Commonwealth origins. Australia was the major supplier with 500,000 tons, almost a quarter of UK imports, followed by Mauritius with 400,000 tons.

Of the non-Commonwealth suppliers the USSR was the largest, with 51,257 tons in 1969 and it is interesting that this is a new development, only a small quantity of Soviet sugar having been supplied previously, while 100,000 tons has already been acquired for supply in 1970.

Exports of refined sugar have continued to fall, although the 1969 total is very little less than that of 1968. As former customers develop their own industries, demand for British sugar falls and it is creditable that the UK refiners have been able to retain their markets in Norway and Switzerland and to increase sales to South Vietnam and Tunisia. Jamaica took over 15,000 tons in 1969 but this was the result of unusual conditions on the island and is not likely to be repeated. A disappointment is the fall in supplies to the Netherlands which were down to 2000 tons, compared with 17,000 tons in 1968 and 45,000 tons the year before, while raw sugar imports from that source had increased from 26,000 tons to 42,500 tons between 1967 and 1968, falling to 15,870 tons in 1969.

* * *

Swiss sugar economy.

The Frauenfeld sugar factory finished its last operations with a deficit of 12,240,000 Swiss francs and, while the Government has covered most of this deficit, providing 12,170,000 francs to the factory, the remaining 70,000 francs are added to the deficits for previous years, to make a total of 1,560,000 Swiss francs[2].

On the 1st February a referendum was held among the Swiss electorate and decided that the deficit for both factories is to be balanced by the State[3].

The losses suffered by the two Swiss factories—the Frauenfeld sugar factory and the Aarberg factory-refinery—result from the paradoxical situation in that the higher the production at the two factories, the more they lose money. The agricultural price support policy of the Swiss Government requires payment for beet to Swiss farmers at a level considered exorbitant by the sugar manufacturers. The latter must sell their output of sugar, which has reached 25% of the country's consumption, at the price of the imported product, that is to say at the world price plus the very high customs duty. Thus, as a result of the low world price, the sugar factories' deficit has become considerable.

Furthermore, while the beet area has only been slightly increased, higher productivity has led as a consequence to an increase in production of 50% between 1965 and 1968. This situation is only one aspect of Swiss agricultural policy which maintains the highest prices in Western Europe. This protection of agriculture by the Swiss authorities is justified by the requirements of neutrality and by the necessity of maintaining human activity in the high Alpine valleys.

* * *

British Sugar Corporation Ltd. factory rationalization.

It was announced last July that the Cupar factory, the only Scottish factory operated by the Corporation, was to be closed after the 1970/71 campaign as part of a rationalization plan. The second stage of the plan has been decided and involves the closure, after the 1973/74 campaign, of the factory at Selby, Yorkshire, the smallest of the British factories, with a corresponding increase in capacity of the neighbouring factory at York. No beet grower will be deprived of a contract as a result of the closure and the rationalization does not involve any change in the overall beet area, which is set annually by the Minister of Agriculture, Fisheries and Food. Factory employees will be offered employment at other factories and departments or will be given early retirement pensions where appropriate.

Brevities

UK sugar production, 1969/70[4].—Sugar production in the UK in 1969/70 amounted to 846,000 long tons, white value, compared with 883,000 tons in 1968/69. The total beet slice was only 5,900,000 tons against 7,000,000 tons the previous campaign, but sugar content was higher at 16·89% compared with 15·31%.

* * *

Israel sugar situation[5].—Sugar consumption in Israel now amounts to some 140,000 tons per year, including 20,000 tons for industrial use and a similar quantity in the administered areas. Local sugar output reached a peak of 37,000 tons in 1965 when it accounted for almost one-half of aggregate consumption, but declined to 26,000 tons in 1968.

[1] C. Czarnikow Ltd., *Sugar Review*, 1970, (956), 26.
[2] *Agence France-Presse*, 13th December 1969.
[3] *Zeitsch. Zuckerind.*, 1969, **94**, 694; 1970, **95**, 100.
[4] C. Czarnikow Ltd., *Sugar Review*, 1970, (959), 41.
[5] *Barclays Overseas Review*, December 1969, 39.

Some observations on diffusion of cane by percolation and submerged techniques

By E. J. BUCHANAN and L. M. S. A. JULLIENNE
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PART II

Effect of Temperature and Particle Size on Extraction

During a series of submerged diffusion runs on first mill bagasse, it was found that higher *initial* rates of extraction were achieved at higher temperatures. Fig. 8 shows the Brix *versus* time relationship

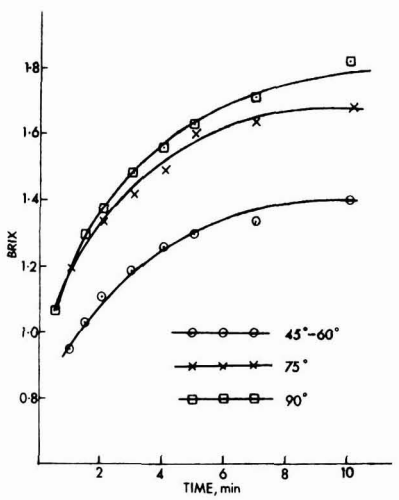

Fig. 8. Effect of temperature on extract concentration during initial stages of submerged diffusion of first mill bagasse

in the first ten minutes at several temperatures. These results indicate that temperatures above 70°C are desirable for rapid stagewise approach to equilibrium. A second series of tests was conducted on coarsely shredded cane using screened particles greater than ½ inch. Under submerged diffusion at 75°C a relatively rapid rate of extraction was found during the whole period of 80 min. However, a cold disintegrator analysis showed that only about 70% extraction had been achieved after this period. This extraction curve is compared against extraction at 20°C in Fig. 9. At this latter temperature the approach to equilibrium was very slow after an initial rapid washing to about 43% extraction in the first 60 min. After 160 min, extraction increased to only about 47%. At this stage the temperature was increased to 75°C resulting in a rapid increase in extraction rate similar to that experienced in the initial run at this higher temperature.

These results indicate that higher temperatures are advantageous not only in rendering the closed cells permeable but also in promoting higher mass transfer rates in the initial stages of extraction. At individual stages in a multistage diffuser with retention times of about 5 min these high rates of mass transfer are desirable. There seems little doubt that rapid extraction rates obtained on coarse cane particles at 75°C after initial washing at 20°C for 160 min occurred by molecular diffusion. The reason for this conclusion is that heating could only render the cell walls permeable but the cellular structure would still preclude eddy diffusion or washing.

The effect of particle size is shown graphically in Fig. 10. In this series of tests cane was prepared by shredding to three degrees of fineness as characterized by Table I. Each batch of prepared cane was diffused separately in the submerged diffuser at 70°C for an extended period to reach equilibrium. For the fine, medium and coarse preparations respectively, the percentage extractions were 99, 94 and 81, after a period of 50 min. The graph shows that finer preparation favours higher extractions and higher extraction rates.

Extraction of Impurities

General

Recent papers by Bjerager and Brüniche-Olsen[2] and also by Loft[3] have reported an increase in polysaccharides/total solids ratio with diffusion time, temperature and pH increases. However, a critical examination of the results indicates that the increases reported were by no means consistent (some decreases were recorded with certain canes) and in order to achieve these increases it was necessary to exaggerate operating conditions far beyond the normal range of commercial diffusers. The effect of diffusion temperature on starch extraction was noted by Graham *et al.*[5] At temperatures below 70°C a marked reduction of starch in diffusion juice was noted.

In the present investigation the effect of retention times from 25 to 50 min, temperatures from 68 to 78°C, pH from natural to 8·0 adjusted by milk-of-lime and cane preparation from fine to coarse as shown in Table I on the quality of juice extracted in the percolation diffuser was determined. The investigation was planned on a factorial basis with two levels of each variable. The analyses conducted included refractometer Brix, pol, reducing sugar, sulphated ash, polysaccharides, starch, gums, pectin and colour. Methods of analysis are briefly outlined in Table II. All impurities were expressed as p.p.m. on dry solids and a factorial matrix was drawn up for each impurity. In addition to the diffusion juices the press-water recovered by hydraulic pressing of the spent bagasse was also subjected to the above analyses and the results

were entered in the factorial matrix. The cane used was freshly cut N:Co 310.

The effect of the various variables on pol extraction is shown in Table III. The coarse and fine preparations

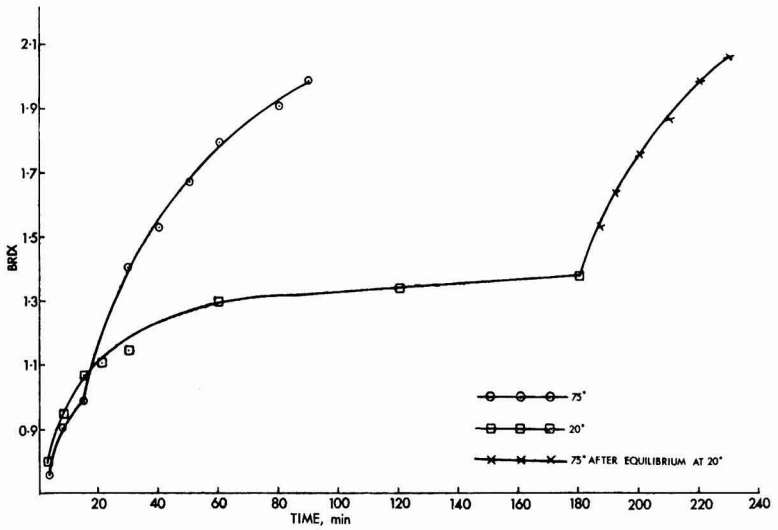

Fig. 9. Effect of temperature increase after diffusing to equilibrium at low temperature using coarse cane particles in a submerged diffuser

are characterized in Table I. The general conclusions regarding the effect of particle size and temperature are again illustrated with the effect of retention time.

Table I. Characteristics of cane prepared in Waddell shredder

Screen size, cm	*Cumulative % less than stated size*		
	Fine	*Medium*	*Coarse*
2·54	100·0	96·5	84·4
1·27	100·0	69·1	45·2
0·63	84·5	44·5	20·5
0·32	59·1	29·4	11·4
Sieve weight median, cm	0·26	0·60	1·15
Geometric standard deviation of cumulative weight distribution	0·25	0·25	0·25
True mean particle diameter, cm*	0·038	0·088	0·168

* converted to numerical distribution basis

Table II. Analyses conducted on diffusion juices

Analysis	*Method*
Brix	Refractometer after filtration of juice
Dry Solids	Drying on sand in vacuum oven
Pol	Standard lead acetate method
Reducing Sugars	Lane and Eynon method
Sulphated Ash	Standard ICUMSA method
Polysaccharides	Precipitated with acid alcohol, redissolved by boiling, determined colorimetrically[8]
Starch	Starch—iodine colorimetric method
Colour	ICUMSA method II
Pectin	Verhaart and de Visser method[9]

In keeping with the conclusions reached by the authors[2,3] mentioned above, no significant correlations were found between the above operating variables and the true or apparent purities of diffuser juice or press-water, nor were there any consistent or significant differences in purities of the two juice fractions. No significant correlations were found between the operating variables and reducing sugars or sulphated ash both as a ratio on dry solids. There was no significant relationship with colour. The effect of the various variables on polysaccharide extraction was found to be similar to that reported by the above authors. The results of polysaccharide

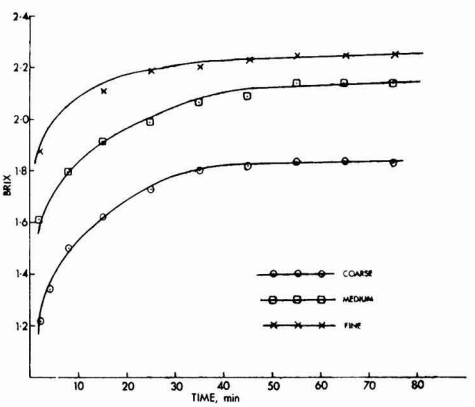

Fig. 10. Effect of cane preparation on diffusion juice concentration in submerged diffuser

[8] DUBOIS *et al.*: *Analytical Chem.*, 1956, **28**, 350.
[9] *Zeitsch. Zuckerind.*, 1962, **87**, 657.

extraction are summarized below using average results from factorial replicates.

Table III. Effect of preparation, temperature and time on percolation extraction

Conditions	*Percentage pol extraction*			
Temperature:	68°C		78°C	
Preparation:	*Coarse*	*Fine*	*Coarse*	*Fine*
25 min	71·0	96·1	71·5	97·7
50 min	78·2	99·0	79·7	99·0

Total Polysaccharide Extraction

The polysaccharide extraction, in p.p.m. on dry solids, was not significantly related to the pH level from natural to 8·0 nor was there any significant difference between diffusion juice and press-water. At the lower temperature level of 68°C, polysaccharides, expressed as p.p.m. on solids, increased from 2200 to 3400 for the coarse and fine preparations of cane, respectively. At the higher temperature level of 78°C the polysaccharide level was consistently about 5300 p.p.m. for both coarse and fine preparations. These levels of polysaccharides are considerably lower than those reported by the above-mentioned authors using canes from India and Uganda[2,3]. It appears from the above results that only at the lower temperatures would it be possible to inhibit the extraction of polysaccharides by applying a coarse preparation.

Extraction of Starch

At the lower temperature level it was found that the starch extraction decreased slightly with retention time from 25 to 50 min. This was attributed to degradation by enzymes. At the higher temperature level the starch level remained practically the same for both retention times. There was no significant correlation with pH nor was there a significant difference between diffusion juice and press-water. At 68°C the starch extraction increased from 500 p.p.m. on solids for coarse to 800 p.p.m. for fine preparation while at 78°C the starch was consistently 1200 p.p.m. As with total polysaccharides, it appears that a coarse preparation would reduce the starch extraction only at the lower temperature level.

Extraction of Gums

The "gum" content was recorded as starch-free polysaccharide and expressed in p.p.m. on solids. Again there was no significant increase with time, pH or in the press-water for the same two levels of the variables. At 68°C the gums increased from 2000 to 2500 p.p.m. for coarse and fine preparations, respectively. At 78°C the gums increased to 3800 p.p.m. for both coarse and fine preparations. These results also indicate that coarse preparation would be of benefit only at the lower temperature.

Extraction of Pectins

Initially the higher pH level was adjusted by addition of a sodium hydroxide solution for convenience. Large increases in pectin extraction were recorded and it was subsequently realized that this was due to the increased solubility of sodium pectinate. Subsequent runs were conducted using milk-of-lime.

The method of analysis was accurate to a minimum of 40 p.p.m. on solids equivalent and for convenience this is referred to as 0 p.p.m. Although increases in pectin extraction were found at the higher pH level the magnitude was considerably lower than previously found using sodium hydroxide. Small increases in pectin extraction were recorded from diffuser juice to press-water at the higher levels of pH, temperature and preparation. These variables were all significantly related to pectin in diffuser juice. In the discussion following, the first figures refer to pectin extraction after 25 min diffusion and the second in brackets to the pectin level after 50 min diffusion. At 68°C the pectins were 0 p.p.m. on solids (0 p.p.m.) for coarse and 0 p.p.m. (0 p.p.m.) for fine preparations at natural pH but increased slightly to 0 p.p.m. (60 p.p.m.) and 0 p.p.m. (60 p.p.m.) respectively at a pH of 8·0. At the higher temperature level of 78°C the pectins were 0 p.p.m. (0 p.p.m.) for coarse and 0 p.p.m. (100 p.p.m.) for fine preparations at the natural pH, increasing at 8·0 pH to 0 p.p.m. (70 p.p.m.) and 170 p.p.m. (480 p.p.m.) respectively.

The above results indicate that while all the process variables have a significant effect on pectin extraction the pectins constitute only a small faction of the total polysaccharides in diffuser juice. Hence in spite of the apparent serious effect of increased pH on pectin extraction, operation at the lower pH level on this account only would not appear to be warranted.

Discussion

Mechanism of Extraction

The rapid initial extraction of the greater portion of solute has indicated that most of the mass transfer during "diffusion" occurs by washing. This is confirmed by the higher initial rates of extraction found to occur in percolation diffusion, as compared with initial rates in submerged diffusion, as a result of the direct displacement of juice in the percolation column. Only in the event of serious plugging of the percolation bed could diffusion-controlled transfer be approached in the initial stages of extraction. With coarse preparations it was shown that cold washing achieved only low extractions. Extraction and extraction rate increased markedly on subsequent increase of temperature. It is logical to conclude that later extraction from larger particles is under the control of molecular diffusion since this occurs through intact cell walls which have been rendered permeable by heating. It has also been pointed out that, owing to incomplete wetting of aerated percolation beds because of channelling, the equilibrium extraction is lower than in the case of submerged agitated diffusers. This suggests that hindered molecular diffusion would control extraction from the stagnant areas of the bed. Since the diffusion path length is greater than the particle diameter in the latter case such diffusion rates are likely to be considerably reduced and therefore rather ineffectual during normal diffusion times. In both submerged and percolation diffusion it was found that towards the end of the extraction a change occurred in the nature of the mass transfer suggesting

a transition from washing-controlled to diffusion-controlled extraction. This point was reached earlier in the extraction cycle in the case of percolation than for submerged extraction.

The above observations all suggest that during the whole extraction cycle a minor portion of the mass transfer occurs by molecular diffusion. However in a countercurrent multistage diffuser, with a normal interstage residence time of only 5 min, the mass transfer to the imbibition juices by direct displacement and by eddy diffusion would be of more significance than molecular diffusion. Ultimately, however, in each particle of cane as it progresses through the diffuser, a stage (depending on the size of the particle) must be reached when further mass transfer occurs under the control of molecular diffusion. Therefore it is concluded that unless the preparation is so fine that complete extraction is rapidly achieved by washing, the ultimate extraction is determined by the diffusion coefficient, the particle size and the diffusion time. In commercial diffusers it is considered that a diffusion *controlled* extraction occurs and that design criteria may be based on this principle as previously reported[4].

Extraction of Impurities

With the information available so far it appears that only the extraction of polysaccharides increases with higher levels of process variables required to promote higher extraction. These include the higher temperature level and fine preparation. The effect of retention time and pH was significant only on the pectin level which constitutes only a small fraction of the total polysaccharide content of the juice. The effect of increasing the preparation from coarse to fine at 68°C was almost equivalent to increasing the temperature from 68°C to 78°C while maintaining a coarse preparation. Table III indicates that it would be uneconomical to operate with both coarse preparation and low temperature. It also indicates that with very fine preparation (the finest in Table I) the higher level of temperature achieved no greater pol extraction than the lower temperature, provided that the higher level of diffusion time was applied. This suggests that with very fine preparation the temperature may be maintained just below 70°C without reducing the level of extraction but with a significant reduction in the polysaccharide to solids ratio in diffuser juice. It is interesting to note that the level of polysaccharides in the diffusion juice was well within the range normally found in mill mixed juice and this would suggest that the quality of cane is of greater importance in this respect than the change from milling to diffusion.

CONCLUSIONS

(i) Considerable evidence has been presented to indicate that unless preparation is extremely fine the magnitude of extraction of sucrose from cane is dependent on diffusion. It is concluded that commercial diffusers are diffusion *controlled* and that design may be based on this principle.

(ii) Since initial extraction rates are higher in percolation diffusion than in submerged diffusion (probably owing to the direct displacement of juice of imbibition in the former) the stagewise mass transfer rates should be greater for percolation diffusers. However, incomplete wetting due to channelling can reduce the final extraction attained in a percolation diffuser. In order to prevent this it is essential to apply a fine, even preparation of the type that would create a high and even bed permeability. Commercial submerged diffusers normally incorporate some type of pulsing or squeezing action and this would tend to compensate for the absence of displacement action.

(iii) The wetted area and permeability of percolation diffusers may be increased appreciably by initial upward washing and subsequent operation in a flooded condition. Owing to the generally high permeabilities in the small-scale diffuser the effect of increased permeabilities on extraction was small but would probably be more significant in commercial diffusers in which lower permeabilities are found. The most serious retardation of permeabilities was found to occur when the surface of the bed was plugged by segregated bagacillo particles.

(iv) The investigation was not intended to provide quantitative results for scaled application to commercial diffusers. The object was to provide a basis for principles of operation. The results clearly indicated that preparation is the most important single variable in determining extraction and that with fine preparation temperatures of 68°C were adequate, producing the same extraction as at 78°C for 50 min retention. Whether or not advantage of the lower temperature could be taken in practice is dependent on the practical limit of preparation fineness.

(v) Polysaccharides were the only impurities found to be significantly affected by increased temperature and fineness. At lower temperatures coarse preparation gave lower polysaccharides. Pectins, which constituted only a small fraction of the total polysaccharides, were also increased in diffusion juice by the addition of milk-of-lime to pH 8·0 and by increasing the diffusion time from 25 to 50 min. However, the latter two effects were insignificant unless in conjunction with fine preparation and particularly the higher temperature level. There was no significant difference between the impurity-to-solids ratio in diffusion juice and press-water. Starting at 68°C, increasing the fineness of preparation and then raising the temperature to 78°C gave approximately equal increments in polysaccharide:solids ratio.

(vi) The latter two conclusions suggested that the finest practical preparation should be applied to cane so that lower temperatures may be used in the diffuser without reducing extraction. This would reduce the polysaccharide level in the diffusion juice. Polysaccharide levels were generally very much lower than those reported by other authors and were well within the range found locally in mill juices, both expressed as polysaccharides ratio on total solids.

SUMMARY

Using small-scale co-current batch diffusers of the percolation and submerged type, an attempt has been made to illustrate some of the principles of diffusion, including the effect of process variables on extraction and juice purity and the mechanism of extraction. Fine preparation appears to be the most advantageous method of promoting increased extraction but the preparation should be of the type to promote high permeabilities. Aeration and channelling reduce extraction in percolation diffusion but owing to direct displacement the rate of extraction is initially greater than in submerged diffusion. Aeration could be eliminated by upward washing which increases permeabilities. Fine preparation would appear to promote the use of reduced temperature operation without detracting from extraction and with considerable benefit to the polysaccharide level in diffusion juice. At higher temperatures there was no (apparent) advantage in having a coarser preparation as far as polysaccharide level was concerned. Apart from polysaccharides no other impurities were affected significantly by the process variables within the scope of the investigation. It has been shown that except possibly with extremely fine preparation not found in commercial diffusers, diffusion is the controlling mechanism in extraction of sucrose from cane.

Sugar refining - Notes on unit processes

Part VI. Thoughts on sugar boiling

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

(*continued from page* 78)

Continuous boiling

Continuous boiling has some obvious advantages:

(a) By being able to operate in steady state with a dense population the productivity of a white sugar pan should be more than doubled. The way is open also to higher feed densities, which, coupled with absence of downtime, should compound the increase in output.

(b) Controls would be simplified, the pan need cycle less frequently, and could boil at constant temperature. The flow of steam, and of condensing water, would be regular, and vacuum pump capacity could be much reduced.

(c) A dense crystal population implies a short diffusion path, a smaller gradient in crystallization pressure, and consequently, a reduction in the problems of conglomeration.

There are also some disadvantages:—

(d) Any continuous process is an inflexible process.

(e) If exhaustion of syrup is to be progressive, boiling *must* proceed in successive compartments.

(f) If S.D. is to be small, the proportion of "oversize" crystals also must be small, which requires that successive compartments be *emptied* at intervals.

(g) Other things being equal, the productivity of a vacuum pan is directly proportional to the surface of the crystal population. In a batch operation, if crystal size is switched from 300 microns to 1000 microns, there will be a reduction in output, during one strike, of 70%

Any size of crystal can be produced, there being only one variable—cycle time. As will be shown later, a versatile continuous pan *must* be extravagant in heating surface.

Continuous boiling is fundamentally a problem of time, surface and weight, but the volumetric relationships are most awkward, as indicated in Table II.

Table II. Basic data involved in crystallizing 100 lb white sugar the yield from the massecuite being 65% on solids

Solids in liquor feed 100/0·65	153	pounds
Liquor at 75°Brix	204	pounds
Vol. liquor at 75°Brix	2·37	cu.ft.
Pounds massecuite at 91·6°Brix	167	
Volume of massecuite	1·80	cu.ft.
Volume of crystals 100/62·5 × 1·57	1·02	cu.ft.
Water evaporated	37	pounds
Volume of vapour at 25 in Hg	5400	cu.ft.
Volume of vapour/volume of crystal	5300	

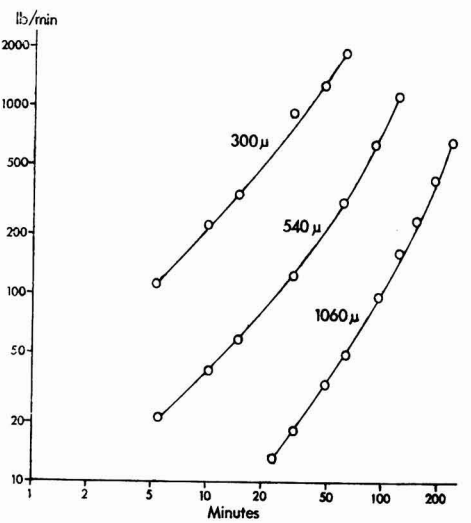

Fig. 3. Relationship between output and M.A.

Table III

Stage	Crystal length (microns) Charge	Strike	Time (minutes) Elapsed	Cumulative	Relationship Length	Weight Charge	Strike	Maximum length (microns)
1		60 Seed	0	0	1·0		1·0	
2	60	80	5	5	1·32	1	2·35	
3	80	100	5	10	1·67	2·35	4·6	
4	100	120	5	15	2	4·6	8·0	
5	120	150	7·5	22·5	2·5	8·0	15·6	
6	150	180	7·5	30	3	15·6	27	
7	180	240	15	45	4	27	64	
8	240	300	15	*60*	5	64	125	*300*
9	300	420	30	90	7	125	343	
10	420	540	30	*120*	9	343	729	*540*
11	540	660	30	150	11	729	1331	
12	660	840	45	195	14	1331	2744	
13	840	1020	45	*240*	17	2744	4913	*1020*

The enormous volume of vapour generated means that at every stage mixing is intensive, which is exactly what is *not* required for rod-like flow.

Time/geometry relationships in crystals

Let us consider the design of a system to produce massecuites of various M.A., all having a low S.D. Let us assume a rate of growth of 4 microns/minute, and say also that when using calandria heating surface the strike:charge ratio should not exceed 2·5. The elementary progression is given in Table III.

Now let us suppose that we wish to produce sugars of varying M.A. at a rate of 1000 lb/min. or 30 tons/hr, then, using liquor of 75°Brix, feed is 40 tons/hr, evaporation is 10 tons/hr, and at 15 lb/sq.ft./hour we need 1330 sq.ft. heating surface.

The crystal size and weight for varying final M.A. are recorded in Table IV.

Obviously, no one could afford this excess capacity, so that we *have* to design for constant *weight* of strike, as indicated in Table V.

The relationship between final M.A. and output in lb/minute is recorded in Table VI and illustrated in Fig. 3.

Fig. 3 indicates how large is the problem of designing a continuous system capable of producing a wide range of M.A. Table VI shows that the only easy solution is to juggle with the size of the seed, e.g.

Final M.A. (microns)	300	540	1060
Appropriate seed (microns)	60	180	540

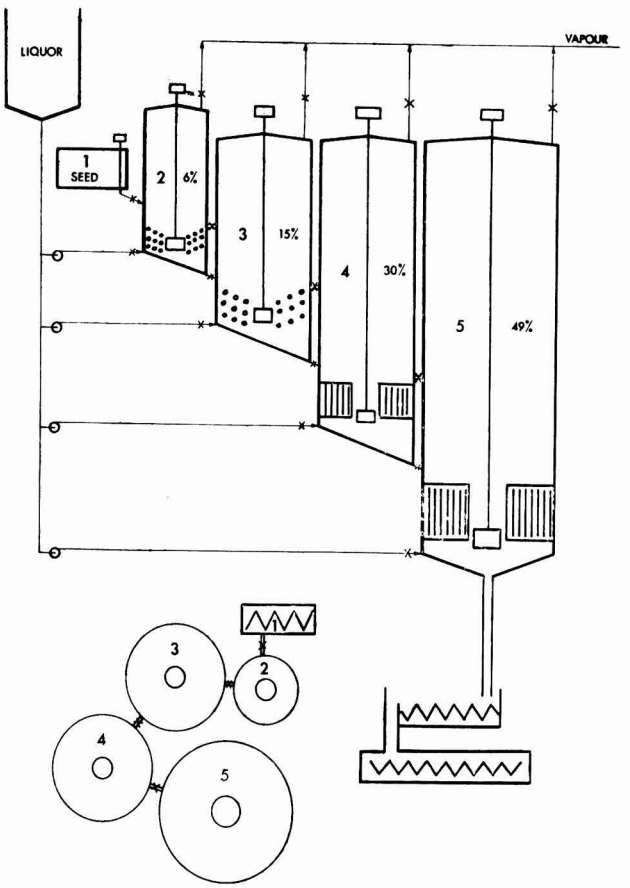

Fig. 4. Semi-continuous boiling in a pan with satellites

Arrangement of plant for continuous boiling

One possibility is to surround an existing pan with stirred satellites (see Fig. 4). If these are unstirred they could be inside the main shell.

These vessels will normally overflow one to another, but for close regulation of S.D. they must empty successively (5) to centrifugals, (4) to (5), (3) to (4), and so on.

Semi-continuous boiling in one vessel

If we establish a normal massecuite having a dense population of crystals boiling at constant temperature, and inject continuously into this the appropriate

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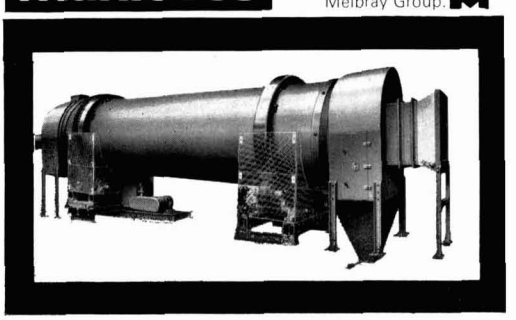

number of seed crystals, and enough liquor to keep the heating surface employed, we have the stage set for steady state working. However, the laws of chance ensure that some of the seed crystals will short-circuit to the outlet, and some growing crystals will circulate indefinitely, becoming ever larger. The longer the cycle the worse will be the S.D., and because of the preponderant effect of "oversize", the larger also will be the M.A. As shown, with 75°Brix feed, the volume of vapour generated is about 5400 times the volume of the sugar crystallized. The only way entirely to avoid oversize is to empty the pan periodically, but the frequency of emptying can be varied to suit the requirements of the particular process.

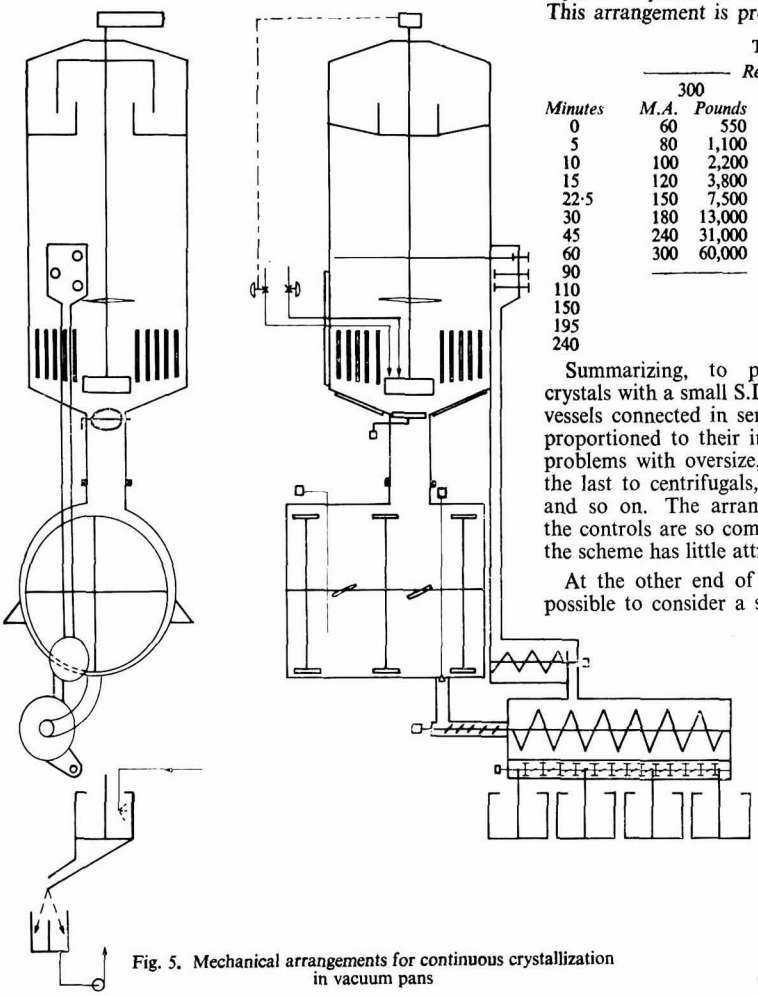

Fig. 5. Mechanical arrangements for continuous crystallization in vacuum pans

Fig. 5 shows an elementary arrangement suitable for remelt boiling, or for any operation where a proportion of oversize can be sold, or milled, or dissolved. This arrangement permits a high yield, because in the massecuite, as a whole, can be less mother syrup than is required to fill the voids, i.e. the massecuite escaping down the overflow can be partly "dried out" (as in a heavy boiling batch massecuite). When the "spread" of crystal size becomes objectionably large the pan can be dropped, and a fresh cycle initiated. On the shaft of the pan stirrer is shown a disc, designed to choke the suction of the impeller, and so promote the formation of a dense layer of crystals on the surface of the massecuite. This arrangement is protected.

Table IV

	Required M.A. (microns)					
	300		540		1060	
Minutes	*M.A.*	*Pounds*	*M.A.*	*Pounds*	*M.A.*	*Pounds*
0	60	550	60	160	60	46
5	80	1,100	80	370	80	110
10	100	2,200	100	740	100	220
15	120	3,800	120	1,300	120	380
22·5	150	7,500	150	2,600	150	750
30	180	13,000	180	4,500	180	1,300
45	240	31,000	240	10,600	240	3,100
60	300	60,000	300	20,000	300	6,100
90			420	56,000	420	16,800
110			540	120,000	540	35,500
150					660	65,000
195					840	136,000
240					1,020	240,000

Summarizing, to produce continuously sugar crystals with a small S.D. requires a number of batch vessels connected in series. These vessels should be proportioned to their individual duty, and to avoid problems with oversize, should *empty* progressively, the last to centrifugals, the penultimate to the last, and so on. The arrangement is cumbersome, and the controls are so complicated and numerous, that the scheme has little attraction.

At the other end of the scale of simplicity, it is possible to consider a single pot from which an inglorious mixture will overflow to the centrifugals. the pot will be emptied once a shift, once a day, or conceivably once a week.

Between these extremes are some half-way houses. Satellite vessels can overflow one to another, and finally, via an existing pan, to the centrifugals. A third possibility, promoted by Soc. Fives Lille-Cail, employs a horizontal pan divided into compartments of increasing length, designed to give the crystals equal residence time. The author is doubtful about this, since the proportionate gain in weight in the early stages is so large as to create problems. Feed liquor is proportioned to steam flow. The arrangement seems to resemble a 20 compartment continuous pan built 30 years ago by Werkspoor, for use at Dinteloord in Holland.

Table V. Relationship between final M.A. and output (lb)

	Required M.A. (microns)					
	300		540		1060	
Minutes	*M.A.*	*Pounds*	*M.A.*	*Pounds*	*M.A.*	*Pounds*
0	60	550	60	80	60	12
5	80	1100	80	185	80	27
10	100	2,200	100	370	100	55
15	120	3,800	120	650	120	95
22·5	150	7,500	150	1,300	150	190
30	180	13,000	180	2,250	180	325
45	240	31,000	240	5,300	240	800
60	300	60,000	300	10,000	300	1,500
90			420	28,000	420	4,200
120			540	60,000	540	9,000
150					660	16,000
195					840	34,000
240					1,020	60,000

Data on performance of this Fives Lille unit are fragmentary, but it is evident that because the compartments do not empty, each will contain a mixture. But the seed is injected into one compartment (of seven) and successive compartments feed each other. The amount of backflow should be negligible, and the end result will be a mixture, the spread of which *may* be acceptable.

Table VI

	Required M.A. (microns)					
	300		540		1060	
Minutes	*M.A.*	*lb/min.*	*M.A.*	*lb/min.*	*M.A.*	*lb/min.*
0	60		60		60	
5	80	110	80	21	80	3
10	100	220	100	37	100	6
15	120	320	120	56	120	8
22·5	150	495	150	87	150	13
30	180	870	180	127	180	18
45	240	1,200	240	200	240	32
60	300	1,930	300	310	300	47
90			420	600	420	90
120			540	1,070	540	160
150					660	230
195					840	400

The use of "Paraquat" in directed post-emergence application for weed control in sugar cane in Taiwan

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THE local climatic conditions under which the sugar cane is cultivated in Taiwan have been for years a chance hindrance to extension of chemical weed control programmes for this crop. Generally all the crops are harvested in the cold season (from November to March) of each year but planted in two periods of distinctly different climates. One crop is planted during the rainy season from late July to early September and has an 18-month growth period before harvest (autumn-planted cane), while a second crop is planted in the dry months of January or February (spring-planted cane) and has a growth period of about 12 months. The subsequent ratoon crops are cultivated also for about 12 months. Weed infestation and its control by using herbicides is a problem only in the 18 month-old plant cane which, however, usually makes up the largest proportion of the yearly acreages. Since the planting time of this crop is only during the hot and rainy months of the year, herbicides ("Diuron" or "Atrazine" in mixture with 2,4-D sodium salt at 1·6 kg active ingredient/ha for each component) sprayed before emergence are very often lost by washing, as a result of monsoon rains that may fall unexpectedly within a few hours of application. Frequently, therefore, not only must pre-emergence applications of herbicides be cancelled owing to continuous torrential rain but sometimes the planting of cane must be delayed until the rains have stopped and the fields have drained, by which time the weeds have already emerged in abundance. After emergence of both cane and weeds, some careless growers may use the same herbicides mentioned above to give the usual blanket sprays as they do under a pre-emergence condition. The chances are that not only is poor weed control obtained but also severe phytotoxicity of the sensitive varieties is reported. Obviously, in order to meet various situations the versatility of chemical weed control should therefore be improved by looking for new herbicides and different methods of applications.

In recent years, "Paraquat" (1,1′-dimethyl-4,4′-dipyridylium dichloride, produced by Plant Protection Ltd. under the trade name of "Gramoxone") has been utilized in many experiments to find a practical method in which this herbicide, in combination with other residual compounds, could be used in foliar sprays to kill the emerged weeds in cane fields and check the regrowths for a few months. As "Paraquat" was particularly effective in killing aerial parts of plants but would be inactivated by contact on soils, the mixing with other compounds was necessary to give the desired residual effect in

soils. It was found in the long run that, when combined with such chemicals as "Dalapon" or "Diuron" and 2,4-D sodium salt, "Paraquat" can be used in directed post-emergence application (DPA) to get a complete kill of the emerged weeds among the cane seedlings while giving satisfactory residual effect to control weed regrowths. When the ordinary pre-emergence application with "Diuron" or "Atrazine" in combination with 2,4-D for an autumn-planted crop fails owing to a prolonged rain, this method can suitably be employed as a remedy in early September when the monsoon is over. Further, being absorbed mainly through leaves, the herbicides in this type of application appear not only less subject to loss through soils but provide an effective tool in controlling some perennial species such as *Cynodon dactylon* Pers. in sugar cane where the pre-emergence "Diuron" and 2,4-D usually fail to show results. While the use of "Paraquat" has been extensively tested for weed control in other plantation crops but scarcely reported in sugar cane when combined with some other residual herbicides[1], this article should be of interest to other workers on chemical weed control.

Since 1965 "Paraquat" in a mixture with "Dalapon' and 2,4-D sodium salt (at product rates of 2 litres + 5 kg + 2 kg per hectare) in DPA sprayed toward the end of the monsoon as one treatment had manifested its merits for weed control in experiments with either sugar cane alone or interplanted with soybeans and peanuts[2,3]. Although the spray was directional, fume drifts that would cause some chlorosis on basal cane leaves were unavoidable. Yet such symptoms were short-lived and the cane seedlings would grow normally through the season. Only the interplanted soybeans or peanuts would suffer some degree of phytotoxicity and slight reduction of seed yield would result. Encouraged by such results this new method was put into more extensive trials with the 1967–68 cane crops. The experiments were carried out in 3 locations with different weed populations and soil types, planted (in either spring or autumn) with different cane varieties. The dosage rates of the component herbicides in such mixture were further classified into 2, 4, and 5 l/ha for "Paraquat", 2·5, 5, and 10 kg/ha for "Dalapon". The 2,4-D sodium salt was invariably at 2 kg/ha. Other compounds compared also in DPA were "Diuron", "Linuron" ("Lorox") and "Isocil" ("Hyvar X") which were tested either singly or in combination with "Dalapon" also at 3 levels of application rate. To each of these a constant dose of 2 kg/ha of 2,4-D sodium salt was also added. The ordinary pre-emergence "Diuron" and "Atrazine" with 2,4-D and the hand-weeding were entered as check plots. From the assessments of herbicidal effects on weeds and cane and the final analysis of cane and sugar yields the following conclusions were reached:

In those areas where the weed population consists mostly of seed-germinated annuals of both broad-leaved and graminaceous species, the formula of "Paraquat" + "Dalapon" + 2,4-D sodium salt (2 litres + 2·5 kg + 2 kg per hectare, respectively) in DPA can be used to control such weeds in the autumn-planting cane. The practice is to make a broadcast pre-emergence spray with 2 kg/ha of 2,4-D alone or just make pre-emergence band-sprays on cane rows with "Diuron" + 2,4-D (2 + 2 kg/ha) and follow with the above preparation in DPA to treat the emerged weeds after the monsoon (about one month later). The broadcast pre-emergence 2,4-D alone serves to subdue the germination of weeds during the intervening time before the follow-up DPA is carried out and makes this practice much more easy to handle. However, pre-emergence band-spraying on cane rows with "Diuron" and 2,4-D is preferred because it will eliminate weeds around and between the cane plants in furrows and thus limits the following DPA treatment on interrow weeds alone without contaminating the cane seedlings. If, however, a chance monsoon rain makes the partial pre-emergence treatments ineffective, the loss will be much smaller by comparison with the ordinary blanket pre-emergence operation. This DPA treatment has been found to be superior to other treatments in that it not only results in satisfactory weed control (77·0% observed 4 months after application) but produces the highest cane yield (12·3% higher than the 141,322 kg/ha achieved with common hand-weeding) perhaps because of the minimal effects it has on cane plants. All the plots treated by other herbicides in DPA showed cane yields below the standard, owing to either lower efficacy of weed control, when the cane growth was reduced by weed competition, or to cane damage by the herbicide. Broadcast pre-emergence treatment with "Diuron" and 2,4-D also did not achieve a higher-than-standard cane yield because the "Diuron" was more easily subject to soil inactivation when smaller dosages were used and caused some yield reduction through cane damage when higher dosages were used.

In some sugar estates where the soil (composed mostly of gravels) is especially suitable for infestation by the *Cynodon dactylon* Pers. (Bermuda grass), the mixture of "Paraquat" + "Dalapon" + 2,4-D in DPA at higher dosage rates (6 litres + 10 kg + 2 kg per hectare) was found especially effective for controlling such perennial species (81·0% weed control observed 2 months after application) while it caused the least effect on cane and gave a satisfactory yield of 114,366 kg/ha, only 7·6% lower than the 123,832 kg/ha obtained by hand-weeding. By contrast, the ordinary blanket pre-emergence spray with "Diuron" and 2,4-D at 3 + 2 kg/ha showed much poorer weed control of less than 33·0% and caused slightly lower cane yield of 112,232 kg/ha or 9·4% lower than that with hand-weeding. The results from other DPA treatments were even poorer.

[1] DARTER: *Outlook on Agriculture* (Jealotts Hill Research Station, Bracknell, Berks., England.), 1967, 5, (5).
[2] PENG: *Proc. First Asian-Pacific Weed Control Interchange* (East-West Center, Honolulu, Hawaii), 1967, 85-87.
[3] *idem*: *Tropical Agriculture* (in press).

	Dosage rate (kg a.i./ha)	*Weight of regrown plants kg/sq.m. (70 days after treatment)*	*% weight of control*
"Diuron"	10	0·084	0·88
"Paraquat"	10	2·840	29·90
2,4-D amine	10	6·756	71·20
"Diuron" + "Paraquat"	6 + 4	0·078	0·82
"Diuron" + "Paraquat" + 2,4-D amine	6 + 2 + 2	0·017	0·18
Control (unsprayed)		9·492	100·00

However, the DPA with such mixture of herbicides was not as good as the above instances when used in a spring-planted cane grown on clay soils. Owing to the low temperature and the scarcity of rainfall during this time, the weeds germinated and grew much slower than when it was summer. The herbicides used in such application were therefore actually sprayed on to the soil surface rather than on the weeds. Much poorer weed control resulted, therefore, because a great part of the herbicides were soon inactivated by the clay soils and there was virtually no residual effect on weed regermination. The ordinary blanket pre-emergence application with the residual "Diuron" or "Atrazine" and 2,4-D sodium salt should be used therefore under such conditions.

In another experiment with spring-planted cane on sandy soils, the dominant weed species being the perennial *Panicum repens* (Torpedo grass), treatment with the combination of "Paraquat" and "Dalapon" at 6 litres + 4 kg/ha in DPA reduced the weed infestation by about 50% during the early 70 days of cane growth and gave a cane yield 23–26% higher than non-weeded plots. The standard pre-emergence "Diuron" and 2,4-D showed only slight efficacy in checking this species and resulted in a cane yield only 19% higher than non-weeded cane. "Paraquat" in other combinations with substituted ureas ("Diuron", "Linuron") or uracils ("Isocil") showed much more potency to kill this weed but at the same time brought about also much lower cane yields.

The striking synergical activity expressed by "Paraquat", "Diuron" and 2,4-D in mixture was demonstrated with *Panicum repens* in another experiment. The stems and underground rhizomes of this weed were collected and planted in flat beds measuring 0·25 sq.m. at an equal density of 2 kg/sq.m. and the aerial parts of weed were sprayed with these herbicides at the 3-node stage. The regrowths of treated plants were dug out and weighed about 70 days thereafter and the following results were obtained:

When "Dalapon" was substituted for "Diuron" in making the mixtures, the synergical activity after spraying was found mostly in killing of the aerial parts, and there was only a short residual effect to check regrowths from underground rhizomes of the weed. This illustrates the fact that when the mixture of "Paraquat", "Dalapon" and 2,4-D was used for killing emerged annual species among cane plants after the monsoon, the short residual effect of the herbicides would not influence much the subsequent growth of the cane plants. However, once the top growths of weeds were killed by such a mixture, regermination from seeds or storage roots of the annual species would be easily controlled by some residual effect in cooperation with the prevailing dry condition. Successful weed control during the early growing of cane plants, as in the case of the autumn-planted crops, could be secured without possibly any growth and reduction of cane yield.

Perhaps some cane growers may suspect that before the DPA treatment destroys the emerged weeds among the cane plants, the month-long weed competition may cause some detrimental effect on the cane seedlings. This can be refuted by quoting some evidence from another experiment also with an autumn-planted crop. When compared with the clean hand-weeded plots which produced an average of 6 stalks per stool and 123·5 cm stalk length after 10 months of growth, the plots on which weeds were left intact for 3 and 6 weeks after planting (after which hand-weeding was then used to keep the plots weed-free through the season) even produced a slightly higher figure for stalks per stool with only insignificant reduction of stalk length. While for those plots on which only the cane rows were clean hand-weeded, the inter-spaces being left open for weed infestation for nearly 3 months since planting, the tillering of cane plots was also not influenced, only the lengthwise growth being somehow slightly affected. This fact should further justify the safe use of the DPA treatment for weed control in an autumn-planting crop since in the interval the competition produced by the early growing weeds will not influence the growth of cane seedlings which presumably still depends on nutrition from the planted cane cuttings.

Jamaican Government measures to preserve the sugar industry. Depression of the Jamaican sugar industry has been attributed partly to world conditions during the past few years and also to difficulties of high costs and low returns on the home market. The Government has been chided for not implementing the recommendations of the Mordecai Commission but, following meetings of the Prime Minister, Mr. Hugh Shearer, with representatives of the Sugar Manufacturers' and Cane Farmers' Associations in October, new measures have been proposed by the Government to improve the industry's economy. Among these, the price of sugar is to be raised, increases are to be made in the fertilizer subsidy to farmers and in the investment allowance to sugar manufacturers and cane farmers, and the Government's taxation policy towards the sugar industry is to be revised.

Sugar cane agriculture

Typhoons and the Philippine sugar industry. P. ESLEYER. *Sugarland*, 1969, **6,** (1), 32–36.—Since 1966 there have been some 14 typhoons or an average of 5 typhoons per year. A number of these did not hit the Visayas where about 80% of the sugar cane plantations are located. The damage that can be done to cane and cane fields is described and graphically illustrated by means of photographs.

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Performance and characteristics of four outstanding Philsugin varieties. F. T. AALA. *Sugarland*, 1969, **6,** (1), 38–40, 48.—From 1953 to 1966 the Philippine Sugar Institute produced over 3 million sugar cane seedlings from its breeding work. Twelve of these varieties have been released for commercial planting, four being high yielders in the Visayas, with yields much higher than the standard variety (POJ 3016). These four varieties, (Phil. 5333, Phil. 5460, Phil. 56226 and Phil. 58260), their yield, performance and characteristics, are fully described.

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Fate of ammonium and nitrate fertilizers in lysimeter studies with ^{15}N. D. T. TAKAHASHI. *Hawaiian Planters' Record*, 1968, **58,** (1), 1–11.—The experiments with sugar cane here discussed were carried out at the Experiment Station in Honolulu using sixteen 2 × 2 × 2 ft concrete lysimeters planted with the variety H 50-7209 and fertilized with ammonium sulphate and potassium nitrate. The experiments were designed to determine (a) the relative uptake of ammonium and nitrate, (b) any differences between the two forms in losses through leaching and (c) the fate of the applied N in planted and unplanted pots. Recoveries of N in the above-ground parts of ammonium treated plants for 50 lb and 150 lb treatments were 26·42% and 26·22% respectively, as against 37·60% and 30·30% for the corresponding nitrate treatments. The nitrate affected both recovery and yield more than did the ammonium. Much of the fertilizer N not recovered in the plants remained in the soil. Analyses of leachates showed that there was no marked loss of fertilizer N due to leaching in any treatment despite heavy rainfall. Leaching losses were greater in the unplanted pots than in the planted.

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A new fertilizer for cane farmers. ANON. *Australian Sugar J.*, 1969, **61,** 39.—A new nitrogenous fertilizer that could have a widespread appeal to cane farmers is now being manufactured in Australia at the giant new factory on Kooragang Island, N.S.W. It is "Nitram", an ammonium nitrate preparation which has the form of small pellets or prills.

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An investigation of the growth of long-term sugar cane of Chintapu brown sugar mill in Taiwan. P. Y. HO. *Taiwan Sugar*, 1969, **14,** (2), 6–10.—Reasons why short-term cultivation has been practised in Taiwan under the prevailing climatic conditions are discussed. Details are given of a 24-month trial crop and the problems and difficulties that arose with it.

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Mechanical preparation of compost at Tsing-Pu cane plantation. ANON. *Taiwan Sugar*, 1969, **14,** (2), 28. A description is given of the preparation of "compost", a mixture of bagasse with manure from some 4000 pigs kept on the estate, making full use of mechanization. The plant has an output of 80 tons of fresh "compost" daily at about half the cost of employing hand labour. (See *I.S.J.*, 1968, **70,** 169.)

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Manage cane farm like city business. ANON. *Producers' Rev.*, 1969, **59,** (4), 3–5.—Reference is made to the benefit that can accrue to the cane farmer from keeping proper records and running his farm on business-like lines. Details are given of the recommendations of the Steering Committee for the establishment of a farm management advisory service, to be phased into the Queensland sugar industry and to be under the direct control of the Bureau of Sugar Experiment Stations.

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Don Mizzi DMH6 cane harvester demonstrated over a wide area. ANON. *Producers' Rev.*, 1969, **59,** (4), 14–15.—Details are given of this new self-propelled cane harvester in Queensland and its performance. It has two engines, one for propulsion and the other for work, low mounted for stability. The very high output was demonstrated when the machine was timed to fill a four-ton bin in just 61 seconds. It is claimed to be capable of continually harvesting over 2000 tons a week. Compactness, manoeuvrability and capacity to cut the worst cane are other features.

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Leaf scald disease. ANON. *Producers' Rev.*, 1969, **59,** (4), 17.—The writer regards this disease as potentially the most dangerous cane disease in Queensland. It cannot be controlled by the measures adopted for ratoon stunting disease (e.g. hot air or hot water treatment) and some plants may be carriers of the

disease without showing symptoms. The popular variety Q 63 is unfortunately highly susceptible. Measures taken to restrict the disease are discussed.

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Louisiana 1969 recommendations for sugar cane insect control. ANON. *Sugar Bull.*, 1969, **47,** (15), 6–7.—It is emphasized that the worst pest in Louisiana is the sugar cane borer. Less important are wire-worms and army worms. Minor pests are sugar cane aphid, sugar cane beetle, sugar cane mealy bug, root-stock weavils and springtails. Recommendations are made for dealing with the first three mentioned of these pests. How cultural practices can assist in borer control is explained. The need for regular field inspection to determine the best time to use insecticides against borers is explained. Current dosages and application of "Guthion" and "Sevin" for borer control and of "Diazinon" for wire-worms and "Toxaphine" for army worms are indicated.

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Quantitative relationship between fleas and rodents in a Hawaiian cane field. G. E. HAAS. *Pacific Sci.*, 1969, **23,** (1), 70–82.—Fleas (*Xenopsylla vexabilis*) were counted on trapped rodents (rats and mice) and in their nests in a cane field on the Hamakua coast, an enzootic plague area. The mean numbers of fleas in active rat nests were closely correlated with the mean numbers of fleas infecting rats when they were cage-trapped in the previous month. The same applied to mice nests and mice.

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Estimating rat damage to sugar cane. G. A. HOOD. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 40–44.—Three different methods of estimating rat damage are described, designated as the "area method", "cut and pull method" and "V-cut method". The coefficient of variation in relation to the mean of each method was similar. Each method had some advantages and disadvantages, the "cut and pull" method being probably the most reliable but requiring the most man-power.

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Engineering research on recumbent sugar cane harvesting and cleaning. J. E. CLAYTON and H. D. WHITTEMORE. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 45–49.—The USDA engineering harvester research was reorientated in 1965 with special emphasis on harvesting of recumbent cane. Much of the mill cane of Hawaii, Florida and Puerto Rico is of this nature while Louisiana has been plagued by very tangled cane owing to hurricane damage in high yielding fields. The various avenues of research in progress are described, including a study of base cutters, the development of an auger pick-up device and the development of cleaners.

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Harvester developments in Florida, Puerto Rico, Louisiana and Australia. J. E. CLAYTON. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 50–57.—This paper covers the recent developments (since 1964) in the areas mentioned. Harvesting conditions vary enormously in the four areas so that a harvester suited to one area may be totally unsuited to another. A popular Australian harvester (designed for the heavier canes of Queensland) was found in Florida to be unable to pick up recumbent canes without breaking or uprooting them. The market for harvesters in these areas is discussed and the opinion expressed that suitable harvesters will, in time, be built when the need is great enough.

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Consumptive use of water by sugar cane. P. C. EKERN. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 58–60.—An account is given of a joint venture between the HSPA Experiment Station and the Water Resources Centre of the University of Hawaii to establish more precisely the water use of sugar cane at the HSPA Kunia substation.

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Status of the 1967-68 experiments on the New Guinea sugar cane weevil on Hawaiian sugar cane plantations. W. C. MITCHELL, M. TAMASHIRO, T. NISHIDA and M. SHERMAN. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 66–72.—The damage caused by the New Guinea sugar cane weevil (*Rhabdoscelus obscurus*), commonly called the "sugar cane beetle borer" in Hawaii, and its life history are described. Current investigations on the possibility of biological and insecticidal control are dealt with. Preliminary results showed little or no weevil control from applications of insecticide to cane foliage. Hot water treatment of planting material is recommended and, if possible, cane debris should not be left in the field.

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Varietal tolerance of sugar cane to herbicides. R. V. OSGOOD, R. P. ROMANOWSKI and H. W. HILTON. *Rpt. 27th Ann. Conf. Hawaiian Sugar Tech.*, 1968, 73–76.—Sugar cane varieties in Hawaii are known to differ widely in their response to both pre- and post-emergence insecticides. Data is given showing the effects of "Diuron" and "Ametryne" on the growth of three varieties of sugar cane. The uptake and metabolism of radioactive "Diuron" in susceptible and resistant varieties were studied. Results showed that Hawaiian varieties of cane are differentially tolerant to "Diuron", both in the field and under controlled conditions. Metabolism of "Diuron" was more complete in a resistant variety which may explain its resistance.

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Studies on the utility of mature and immature seed of sugar cane in eastern Uttar Pradesh. B. C. MATHUR and A. SINGH. *Indian Sugar*, 1969, **18,** 893–897. Results are given of planting trials with mature (millable) and immature seed cane carried out over a period of 3 years. Quicker and better germination was obtained with the immature seed cane. Tiller production and yield were also better. Recommendations to growers are to use the tops of the stalks for seed cane while the lower portions go to the mill.

Biological control of stalk moth borers in the Old World. II. V. P. RAO. *Indian Sugar*, 1969, **18,** 899-920.—The use of *Trichogramma* for the control of stalk moth-borers in China, India, Malagasy, Mauritius, the Philippines and Taiwan is reviewed. The trial of other parasites in cane growing countries of the Old World is also dealt with. A list of cane borers is included and a lengthy bibliography given.

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Round table conference on the cultivation of sugar cane (in Mexico). A. GONZÁLEZ GALLARDO. *Bol. Azuc. Mex.*, 1969, (229), 12-20.—Introductory matter includes a brief historical summary of the cultivation and production of sugar cane in Mexico. This is followed by a discussion of the variety position, the most important aspect of cane cultivation in Mexico. The more important introduced varieties are listed with the percentage of the total cane area planted to each. Mexican varieties and the hybridization work that is in progress are discussed.

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The fertilization of sugar cane (in Mexico). B. ORTIZ VILLANUEVA. *Bol. Azuc. Mex.*, 1969, (229), 22-33. The quantities of fertilizer used for cane in Mexico in terms of N-P-K are discussed and the advantages of fertilizing the sugar cane crop emphasized.

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Combating weeds by means of cultivation during the dry season and herbicides in the wet season. S. LUJÁN CÓRDOVA. *Bol. Azuc. Mex.*, 1969, (229), 34-38.—The value of harrowing or discing during the early stages of growth of cane, to destroy weeds still in the small seedling stage, is emphasized, an additional advantage on some soils being the aeration of the soil which proves beneficial to the young cane. The use of various herbicides is discussed including 2,4-D, 2,4,5-T, "Dalapon", "Trifen", "Gesaprim", "Gesapax", P-R 30-2-2, "Karmex", "Gramapol", "Gramoxone" and "Fenac".

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Mechanical harvesting of sugar cane. D. SILLER Y SILLER. *Bol. Azuc. Mex.*, 1969, (229), 40-42.—The advantages and disadvantages (high initial cost) of mechanical harvesting under Mexican conditions are discussed.

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Pests and diseases of sugar cane (in Mexico). S. FLORES CACERES. *Bol. Azuc. Mex.*, 1969, (229), 43-45. Pests and diseases are considered to affect about 100,000 ha of sugar cane annually in Mexico or about 25% of the total area under cane. The rat and the sugar cane borer are two of the worst pests, sugar cane mosaic and ratoon stunting disease two of the worst diseases.

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Effect of fertilizers on yield of sugar cane. R. RICAUD. *Sugar J.*, 1969, **32,** (1), 12-15.—Results are given of six fertilizer experiments carried out in 1968 in co-operation with growers involving N, P and K. Four were concerned with fertilizer quantities and proportions, one was designed to test fertilizer treatment with and without irrigation, and the sixth tested the effects of autumn applications with and without treatment the following spring. Response to N at 160 lb/acre was significant, which was not always the case with P and K. Response to treatment with irrigation was greater than without. The advantages of autumn treatment were not significant.

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Varietal reaction of sugar cane to red rot in the eastern tract of Uttar Pradesh. G. P. SINGH and N. SINGH. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (I), 5 pp.—It is pointed out that varietal resistance to this disease (*Glomerella tucumanensis*) may vary with location and strain of pathogen and that resistance tests at regional levels are needed. Tests carried out at the Sugar Cane Research Station, Gorakhpur, from 1963 to 1968, are reported and results shown in tabular form. The varieties regarded as resistant (to available or existing strains) were: Co 1148, Co 6402, CoS.611, CoS.561, B.O.34 and B.O.43.

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Deterioration of sugar cane after harvest. A. P. GUPTA, I. S. JUNEJA and S. P. SHUKLA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (II), 13 pp.—Changes in sugar cane during storage were studied, apart from moisture loss and inversion of sucrose. These included the behaviour of non-sugar constituents such as starch and gum, which may be concerned in the well-known manufacturing difficulties that arise with stale cane. It was found that the variety of cane was important in determining the amount of deterioration of harvested cane and that the significance of starches and gums depended upon length of storage.

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Studies on the effects of varying levels of irrigation and nitrogen on sugar cane over a shallow water table. M. B. TIPPANNAVAR and M. GOPAL REDDY. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (III), 7 pp.—Experiments carried out at the Sugarcane Research Station, Mandya, during the 3 seasons (adsali) from 1960/61 are reported. Average depth of water table varied from 10 to 90 cm during the crop season. It was found that with a shallow water table cane did not respond to higher levels of water from irrigation or to nitrogen. About 90% of the roots were in the top layers of soil, which explains the tendency of the cane to lodge. The practice of over-irrigation was considered to be very prevalent among farmers.

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The variety situation in Jamaica. M. D. S. RICHARDS. *J.A.S.T.J.*, 1967, **28,** 34-40.—A variety survey showed that B 4362 continued to be the dominant variety for the 1966 crop in spite of its tendency to lodge and rot when bearing heavily, as in rich soil. The variety B 49119 continues to increase in popularity in most areas; B 51410 and B 51415 are slowly gaining favour. The detailed distribution of varieties is set out in a table.

Sugar beet agriculture

Breeding for *Rhizoctonia* resistance in sugar beet. J. O. GASKILL. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **15**, 107–119.—It is pointed out that root and crown rot of sugar beet of about middle age, caused by *Rhizoctonia solani*, is a serious problem in all the major sugar beet areas of the United States. The difficulties that exist in breeding for resistance against the disease are explained. The application of dry, ground, barley-grain inoculum in the centre of the rosette 3 to 5 weeks after thinning is considered to be the most dependable of the various inoculation techniques studied. Progress made so far in breeding is indicated.

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Selection for resistance and chemical control of *Rhizoctonia* root rot disease of sugar beets. M. M. AFANASIEV and D. E. BALDRIDGE. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **15**, 151–158.—Some varieties of sugar beet showed a degree of resistance to the disease but none showed an outstanding degree of resistance. Resistant strains may have to be sought by concentrating resistant genes by recurrent mass selection or by searching for resistance among wild species of *Beta*. In attempts at chemical control of the disease "Vitavex" proved far too toxic to the sugar beet plants. Field tests with "Tetrachlor" showed a distinct beneficial effect.

* * *

Uptake of phosphorus by sugar beets. O. C. SOINE. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **15**, 159–166. In some sugar beet areas in Minnesota and North Dakota the soils are inherently low in phosphorus and the application of this element is essential for maximum yields. A description is given of an experiment initiated in 1964 to ascertain whether sugar beet takes up more phosphorus from a mixture of ammonium nitrate and phosphate or from phosphate fertilizer, and what effects the two treatments might have on yield, sucrose content, purity, total nitrogen and phosphorus content of tops and roots. There were no significant differences.

* * *

Sugar beet variety trials, 1964-7. L. A. WILLEY and S. F. H. MCCULLAGH. *J. Nat. Inst. Agric. Bot.* (Cambridge), 1968, **11**, 302–306.—Results are given of field trials of 6 sugar beet varieties, Sharpe's Klein E being used as control. Varietal assessment included percentage of bolting, yields of roots and sugar, sugar content and purity of juice, and incidence of powdery mildew. None of the new varieties in these trials gave a performance of sufficient merit to justify recommendation for commercial use in Britain.

* * *

Recommended varieties of sugar beet. ANON. *Farmers' Leaflet, Nat. Inst. Agric. Bot.* (Cambridge), 1968, (5); through *Plant Breeding Abs.*, 1969, **39**, (1), 144. Data are presented on yield, quality, bolting, resistance to *Peronospora farinosa*, and sugar content for eleven multigerm and three monogerm varieties.

* * *

Herbicide improvement is the key to successful beet mechanization. O. S. ROSE. *Farmer and Stockbreeder*, 1968, **82**, (4116), 25; through *Weed Abs.*, 1969, **18**, 173.—The opinion is expressed that an improvement is required in herbicide effectiveness (including greater persistency) and skill of application before the national sugar beet crop can become more fully mechanized.

* * *

Experiments on the field performance of "Phenmedipham". C. J. EDWARDS. *Proc. 9th Br. Weed Control Conf.*, 1968, 575–579; through *Weed Abs.*, 1969, **18**, 173.—Results of 42 development trials with sugar beet, mangels and red beet are given. With sugar beet a formulation containing 20% "Phenmedipham" at 2 lb/acre gave good control of most annual broad-leaved weeds in the very young stages, while rates of 3 and 4 lb/acre gave only slightly better control. There was an excellent margin of safety in the sugar beet even when 2 treatments were applied at an interval of about 2 weeks.

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"Phenmedipham"—activity and selectivity under UK conditions. H. M. HOLMES. *Proc. 9th Br. Weed Control Conf.*, 1968, 580–585; through *Weed Abs.*, 1969, **18**, 173.—In experiments carried out in 1966–68 "Phenmedipham" gave good post-emergence control of most of the important annual weeds of sugar beet in Britain, except *Polygonum aviculare* (knotgrass). Formulations and rates used are discussed. The recommended rates did not damage the beet or affect crop stand, yield of roots or sugar content.

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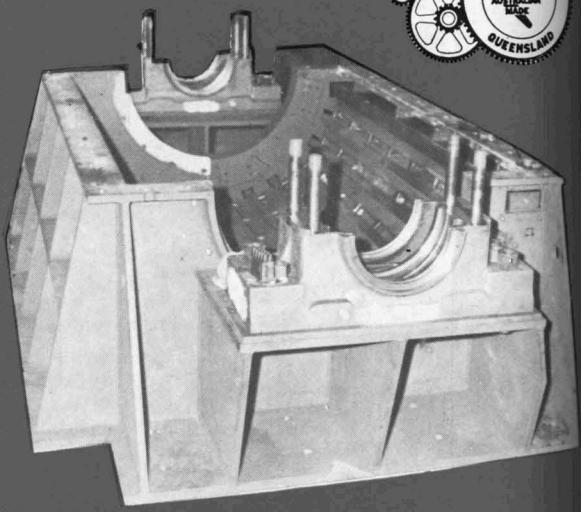
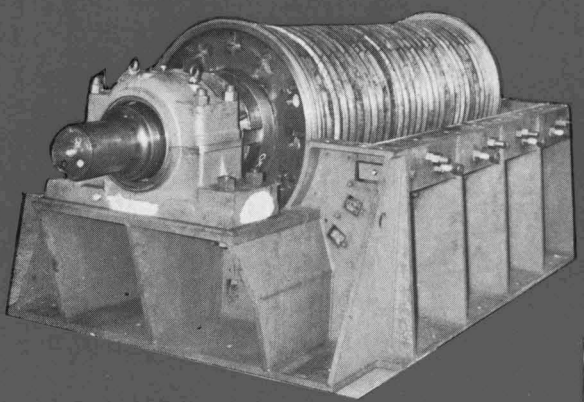
The use of "Trifluralin" for persistent weed control in sugar beet after crop emergence. D. H. BARTLETT *et al. Proc. 9th Br. Weed Control Conf.*, 1968, 596–601; through *Weed Abs.*, 1969, **18**, 174.—Following successful use of "Trifluralin" in the United States to control weeds in sugar beet up to the time of harvest, trials were carried out in Britain in 1967 and

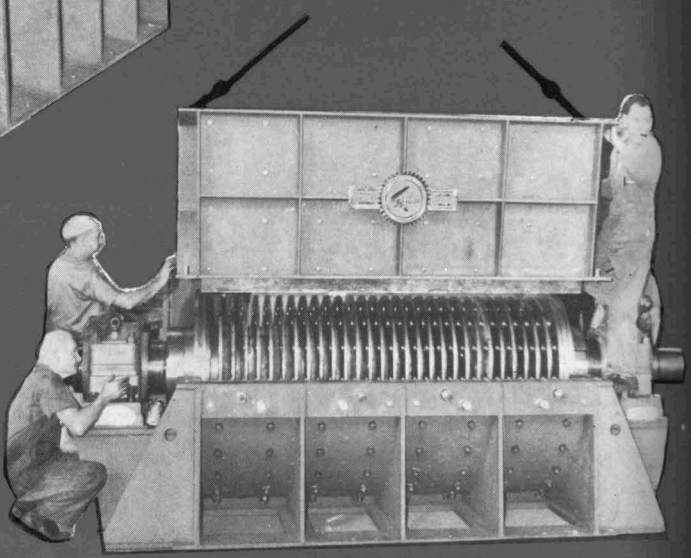
CANE PREPARATION BY SHREDDING

HIGH EXTRACTION AT HIGH RATES IN MILLS OR DIFFUSERS REQUIRES THE ULTIMATE IN CANE PREPARATION. PRELIMINARY KNIFE PREPARATION FOLLOWED BY SHREDDING PROVIDES THE SOLUTION.
TECHNICAL KNOW-HOW AND THE UNSURPASSED SKILL OF THEIR TRADESMEN GIVE **WALKERS LTD.** AN INTERNATIONAL LEAD AS DESIGNERS AND MANUFACTURERS OF SWING-HAMMER SHREDDERS.





STAGES IN THE SHOP ASSEMBLY OF AN 84" HEAVY DUTY CANE SHREDDER



84" CANE SHREDDER

45 METRIC TONS FIBRE PER HOUR.
750 H.P., 1000 R.P.M., 40 LB. HAMMERS.
DOUBLE END DRIVE OPTIONAL.
FLYWHEELS IF DESIRED.
FULLY AND EASILY ADJUSTABLE BREAKER SECTOR OPTIONAL.
SPHERICAL ROLLER BEARINGS.
ALL STEEL CONSTRUCTION.

WALKERS LIMITED

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1968. These were successful and are discussed. A rate of 1 lb/acre gave effective control of most weeds until harvest, including knotgrass (*Polygonum aviculare*).

* * *

EPTC for the control of perennial grasses and other weeds in sugar beet. D. H. BARTLETT and R. A. JONES. *Proc. 9th Br. Weed Control Conf.*, 1968, 602–607; through *Weed Abs.*, 1969, **18,** 174.—Results of trials conducted at 9 sites, with ½-acre plots, during 1968, are given. Provided 13 or more days had elapsed between EPTC application to the soil and sowing, it was found that germination and growth of beet were unaffected. Average control of perennial grasses was 92% or 84% at the late season assessment. Satisfactory control of annual weeds was also found at sites where no additional pre-emergence herbicide had been band-sprayed on top of the EPTC.

* * *

An evaluation of "Pyrazon"/"Propham" mixtures for pre-emergence weed control in sugar beet. M. G. ALLEN, T. THOMAS and D. F. REID. *Proc. 9th Br. Weed Control Conf.*, 1968, 615–620; through *Weed Abs.*, 1969, **18,** 174.—Results of trials in England and Scotland comparing "Pyrazon" and "Propham" used alone and mixed are given. Results obtained in England and Scotland varied. These are discussed. Under English conditions no mixture was sufficiently superior to the recommended rates of "Pyrazon" to justify commercial use.

* * *

The synthesis and movement of carbohydrates in sugar beet grown under different moisture conditions. V. D. SAKALO and I. G. VIJVAL'KO. *Ukr. Bot. Zh.*, 1968, **25,** (4), 79–86; through *Soils and Fertilizers*, 1969, **32,** 313. In experiments using carbon-14, more hexose and less sucrose were formed and the movement of sugars in the plant was lower in sugar beet grown in soil with water at 40% of field capacity than at 60%.

* * *

Observations on the field germination of pelletted sugar beet seed in Upper Austria. H. BRONNER. *Bodenkultur*, 1968, **19,** (1), 46–54; through *Field Crop Abs.*, 1969, **22,** 57.—Percentage germination on 100 farms varied between 25 and 75% and on 87 farms between 35 and 64%, compared with 78% in the laboratory. It is concluded that in order to obtain the recommended minimum plant population of 100,000 plants/ha, most farmers in this survey could have sown seed 9 cm apart in the row.

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Sugar beet yield variation with soil type in Solano County. A. K. SWENERTON. *Calif. Agric.*, 1968, **22,** (7), 5; through *Field Crop Abs.*, 1969, **22,** 163.—In trials over 2 years sugar beet gave average root yield of 24·1–24·4 tons/acre on clay loam soil, 21 tons/acre on silty clay loam, 17·9 tons/acre on clay soil and 14·5 tons/acre on fine sandy loam soil. Sucrose content in roots tended to increase with decrease in yield.

"Betanal"—a review of the first year's performance. ANON. *Fisons' Agric. Tech. Inf.*, 1968, 7–14; through *Weed Abs.*, 1969, **18,** 174.—"Betanal" post-emergence herbicide[1] at 5 parts per acre in general proved safe on sugar beet and gave excellent weed control in 1968. The effect on different individual weeds is discussed.

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Effect of preceding crops on yields of sugar beet following winter wheat. R. LITVINYUK. *Sakhar. Svekla*, 1968, (8), 26–27; through *Field Crop Abs.*, 1969, **22,** 163.—Results are given of rotation trials in E. Ukraine in which sugar beet followed winter wheat, this having been preceded by various crops such as pea, oat/vetch, soya bean and maize. The crop preceding the winter wheat had an effect on the sugar beet yield.

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Regional variety testing of sugar beet in 1967. S. P. SEVOST'YANOV. *Sakhar. Svekla*, 1968, (8), 33–34; through *Plant Breeding Abs.*, 1969, **39,** 141.—Ten new cultivars and hybrids were recommended for further testing in the Soviet Union and are described.

* * *

Approval of sugar beet cultivars. N. S. YAKIMENKO. *Sakhar. Svekla*, 1968, (8), 35–36; through *Plant Breeding Abs.*, 1969, **39,** 141.—Trials of 95 Soviet cultivars and hybrids and 15 from abroad in 1967 led to certain changes in the list of those approved. Some of these are discussed, cold and disease resistance being considered.

* * *

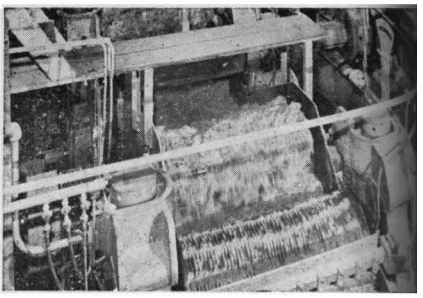
Nitrogen studies on sugar beets in 1968. E. C. VARSA. *Sugar Beet J.*, 1969, **32,** (3), 4–5.—The well-known drawbacks of applying excessive nitrogen to sugar beet are enumerated. A table, based on 11 locations, shows the influence of applied nitrogen on yield and quality of sugar beet. The major increase in beet tonnage occurred when nitrogen was increased from 20 to 50 lb per acre. Declining sugar recoveries have been associated with excessive nitrogen fertilization. Optimum rates for nitrogen were found to vary from farm to farm.

* * *

The spray warning scheme for control of virus yellows. R. HULL. *British Sugar Beet Rev.*, 1969, **37,** 169–172, 179.—The manner in which this scheme operates in the UK is explained. In the 1950's it was found that spraying sugar beet with systemic persistent insecticides decreases the incidence of virus yellows disease and increases the yield. To be effective spraying must be done when the green aphis (*Myzus persicae*) first begins to infest sugar beet. The sugar factories send out spray warnings to growers at the appropriate time. These are based on the reports of fieldmen who examine crops for aphids each day from the beginning of May. To spray when plants are free of aphids and few are expected is a waste of money on insecticide and labour.

[1] *I.S.J.*, 1968, **70,** 190.

Cane sugar manufacture



Efficiency of the sugar cane dry cleaning stations (cane conditioning centres). A. F. BETANCOURT. *CubaAzucar*, 1968, (Jan./Feb.), 2–18, 42–55.—Cane dry cleaning stations were introduced on an experimental basis in Cuba in 1964 and by 1967 numbered 67, of which two were double stations. The standard station handles 60–70 t.c.h. and the double units 110–140 t.c.h. The station includes a chute with a carrier feeding a conveyor belt which delivers the cane (hand-cut and topped) to a pair of rollers moving in opposite directions and fitted with knives which cut the cane into 40 cm billets. These fall through an air blast, which removes trash and soil, to a conveyor belt which carries the cane to the rail car in which it is taken to the mill. Comparison of the cane quality for various systems showed that the stations reduced the trash content to 5·62% (cumulative over 1964–67) compared with 3·02% for hand-cutting and loading, 4·08% for hand-cutting and mechanical loading, and 12·70% for mechanical cutting and loading. Analysis of a truck-load showed a reduction of trash from 11·83% in unprocessed cane to 5·13% after processing. With untopped cane a similar reduction was only from 19·68% to 11·98% trash. Further, it was found that the air blast also removed clean millable cane to the extent of 2·47% on the original weight. The treatment halves the time needed for trash removal compared with hand-trashing and further time savings result when the cane is cut into lengths of no more than 1·5 metres.

* * *

Influence of the process of cane juice purification with active magnesium oxide on the technology of raw and refined sugar production. O. ARGUDÍN. *CubaAzucar*, 1968, (Jan./Feb.), 27–32, 60–62.—Use of MgO for clarification of cane juice permits whole-juice filtration; this allows elimination of clarifiers (and sucrose losses therein during retention and shutdowns), turbid filtrates, bagacillo filter-aid and its separation and handling, and of scale formation in evaporators (with consequent improved evaporating capacity and thermal efficiency, reduction in cleaning chemicals and their attack on the evaporator metal surfaces). A transparent syrup of low viscosity and high Brix is obtained which results in higher rates of crystallization, increased pan capacity and lower steam consumption, higher Brix massecuites, better exhaustion of molasses, greater centrifugal throughput and better quality sugar. An extended trial of the process was to have been made at Central Camilo Cienfuegos (formerly Hershey) in 1968.

Compressed air drying. W. F. MCGRATH. *Rpts.* 1968 *Meeting Hawaiian Sugar Tech.*, 34–39.—The three types of dryers available for drying of compressed air (refrigeration, dual-tower desiccant and chemical) are described and their applicabilities and costs discussed.

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The Honiron "Hi-Extractor". J. W. BERSCH. *Rpts.* 1968 *Meeting Hawaiian Sugar Tech.*, 61–65.—Operation of the "Hi-Extractor" at Honokaa Sugar Co.[1] and modifications carried out are described and the annual gain possible, based on data from the final days of its operation, is calculated.

* * *

Lihue Plantation grit separator. G. SLAJCHERT. *Rpts.* 1968 *Meeting Hawaiian Sugar Tech.*, 90–93. Details are given of an Eimco grit separator for removal of solids from water used to wash cane at the Lihue Plantation Co. The separator includes three main sections: deflector plates to minimize turbulence, a rake mechanism to move the settled particles to a central point for discharge, and a discharge screw. The separator removes about 4 cu.ft. of grit per min from water flowing at a rate of up to 12 million gal/day.

* * *

Operation of the 72-inch Silver cone press at C.V.F. Central Cumanacoa, Cumanacoa, Venezuela. H. B. MOSER. *Rpts.* 1968 *Meeting Hawaiian Sugar Tech.*, 94–100.—Details are given of the operation of the Silver cone press during the 1968 season[2] with information on major difficulties encountered and improvements being made. The press reduced the bagasse moisture content from 51,546 tons of cane to an average of 47·16% up to the point where the press became choked and operation was stopped. The press was damaged during the course of clearing, but nevertheless operated for a further 2 months to the end of the crop.

* * *

Control systems for sugar vacuum pans. J. G. ZIEGLER. *Rpts.* 1968 *Meeting Hawaiian Sugar Tech.*, 108–113. Results of experiments with boiling control systems are discussed and some generally accepted principles with regard to boiling shown to be false or of doubtful significance, while others have been found to be valid. Factors covered include absolute pressure, syrup level, supersaturation, seeding and consistency.

[1] *See also I.S.J.*, **1969, 71,** 116.
[2] *ibid.*, 116.

Helical gears and the advantage of their use in sugar mills. A. K. DE. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (VI), 11 pp.—The advantages and selection of helical gear drives in the sugar industry are discussed and calculation of various important factors demonstrated by means of worked examples. Comparison is made with wormgears.

* * *

Simple and cheap washing and steaming device for sugar centrifugals. S. P. MISRA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (VII), 9 pp.—A washing and steaming system for centrifugals is described. Designed by the author, it incorporates a water metering device to serve two centrifugals connected by isolating valves, and individual atomizers attached to each centrifugal.

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Bearing pressures in three-roller cane mills at various hydraulic loads and journal specifications. P. P. SETH. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (VIII), 5 pp.—Various factors have been calculated for working out the bearing pressure for a mill at a given journal apex angle under given conditions. The requisite formulae and a worked example are also given.

* * *

Process of protective coatings in the sugar industry. S. K. CHATTOPADHYAY. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (IX), 7 pp.—The surface treatment of metal component parts, scale removal methods, and types of paint most suitable for application to various pieces of sugar factory equipment are discussed.

* * *

Application of stoppages recorder. M. G. GODBOLE, R. P. MITTAL and M. SINGH. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (X), 7 pp.—A device is described which has been designed to record the movement and stoppages of a cane carrier on a circular 24-hr chart. The sensing element is a flat strip which is in contact with the shaft of the idler pulley of the return-type carrier, movement of which actuates a cam and lever arrangement linked to the pen arm.

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Removal of non-condensable gases from heaters and vessels with minimum heat losses. B. B. PAUL. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XI), 8 pp. Means of removing incondensable gases from sugar factory heat exchange plant suggested by various authors are discussed.

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Use of phosphates and phosphoric acid in reducing losses in waste molasses. T. T. OOMMEN and B. S. GURUMURTHY. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XII), 9 pp.—Addition of 0·005% orthophosphoric acid on cane to clarified juice in tests at Shimoga sugar factory[1] resulted in improved molasses exhaustion in *B* and *C* strikes. The acid is preferred to 0·05% single superphosphate (on cane). Results of the tests are tabulated.

* * *

Drop in pH of clear juice in a Dorr clarifier. T. K. MUKERJEE. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XIII), 6 pp.—Trials at the author's sugar factory indicated that partial preliming of the mixed juice immediately on discharge from the mills reduced the drop in pH from sulphited juice to clarified juice to 0·2 units compared with a drop of 0·4 units when the juice was prelimed in the preliming tank. Optimum mixed juice temperature was found to be 70°C and sulphited juice optimum pH 7·2. However, simultaneous liming and sulphitation in the continuous sulphitation vessel gave better clarity, flocculation and mud volume.

* * *

The mud trouble in sulphitation sugar factories. B. L. MITTAL. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XIV), 17 pp.—Problems encountered in clarification with high mud levels are discussed and possible means of avoiding them when using a "Rapi-Dorr" clarifier are described.

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Some observations on low-grade boiling and curing. R. N. AGARWAL. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XV), 11 pp.—*C*-massecuite boiling and curing are discussed on the basis of the author's own experiences. Particular attention is paid to the concept of apparent crystal volume (A.C.V.)[2] as an indication of molasses exhaustion. (This is the volume of massecuite remaining after the lubricating portion of the molasses is expelled in a specially-devised apparatus, so that the remaining volume still contains that molasses which is needed to fill the void between the crystals.) Values of A.C.V. at dropping of the massecuite and after cooling are tabulated. Optimum was found to be 57–58%, at which the massecuite could be handled satisfactorily and a reasonably low molasses purity obtained.

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Heating of second carbonatated juice depends on the optimum pH also. B. B. PAUL and I. S. SAXENA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XVI), 7 pp. At a pH of 8·7–8·8 corresponding to minimum CaO content, heating of 2nd carbonatation juice to 75-76°C (recommended for prevention of microbial infection) was found to give filtered juice which was darker than 1st filtered juice. The optimum temperature to which to heat the juice at this pH with regard to coloration was 68–70°C.

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Absorption efficiency in first carbonatation: a controlling factor for limestone consumption. B. B. PAUL. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XVII), 9 pp.—Modifications to the 1st carbonatation tank

[1] *See I.S.J.*, 1968, **70**, 371.

[2] GILLETT: "Low grade sugar crystallization" (California and Hawaiian Sugar Refining Corp. Ltd., Crockett, California, USA). 1948, pp. 25–27.

for simultaneous gassing and liming at an Indian sugar factory reduced the average gassing time from 20 min to 13 min, cut limestone, coke and filter-cloth consumption, helped improve juice clarity and resulted in a drop in molasses production. Details are given of the modifications and of the process used.

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Clarification and filtration trouble with Co 1148 variety cane juice during the season 1967-68. D. P. SANJANA, H. H. N. SAXENA, P. N. MALIK and K. R. SAKHUJA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XVIII), 5 pp.—See *I.S.J.*, 1970, **72**, 20.

* * *

Processing of beet mixed with sugar cane with a DDS diffuser. K. H. PAREKH and C. J. MAHTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XIX), 5 pp. Results are given of experiments in which 1 part of beet was processed together with 9 parts of cane at the authors' factory. No pol extraction of the beet occurred in the two mills through which it passed with the cane, and the bagasse moisture and pol content after the 2nd mill were higher with the combined processing than with cane alone. The cane did not have any qualitative effect on diffusion of the beet. No difficulties were encountered after diffusion.

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A case study of difficult settling. S. N. G. RAO and S. C. SHARMA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XX), 12 pp.—Difficulties with mud in clarification which occurred in a number of factories in eastern Uttar Pradesh (reasons are given) were overcome by cold preliming with 0·6–1·6% 10–12°Bé milk-of-lime by volume, raising the raw juice temperature to 80–85°C and adding 1·5–2·0% 10–12°Bé milk-of-lime in the juice receiving tank after weighing.

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Effect of Co 1148 variety of sugar cane on the process of plantation white sugar manufacture. M. MOHAN and K. K. SHARMA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXI), 11 pp.—Clarification difficulties with juice from Co 1148, which is now the predominant cane variety in western Uttar Pradesh, have led to experimental modifications of the process. Of the systems tried, the best proved to be preliming to pH 7·4–7·6 followed by 4–5 min retention before carbonatation, juice alkalinity being maintained in the range 200–600 mg CaO/litre.

* * *

Effect of high versus low vacuum on the boiling of low grade massecuites. R. SINGH, N. C. VARMA and S. C. GUPTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXII), 7 pp.—The effect of vacuum level on *C*-massecuite boiling was tested. Definite advantages of a higher vacuum (represented by 27 in Hg) over a lower vacuum (25 in Hg) were found and are listed, including a shorter boiling and cooling time and better molasses exhaustion.

Evaluation of "Flocal TN 40" as a settling aid in cane juice clarification. S. C. GUPTA, N. C. VARMA, K. K. GUPTA and R. K. DIXIT. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXIII), 27 pp.—Laboratory and factory tests with "Flocal TN 40", a flocculant of Indian manufacture, are reported in detail. Although the tendency was for 25 p.p.m. as a 0·5% solution, added to limed and sulphited juice before heating, to reduce the mud volume compared with the control, the test results are considered to need confirmation and further experiments are to be made.

* * *

Observations on processing problems of Co 1148 variety of sugar cane. S. C. GUPTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXIV), 9 pp.—Difficulties in the processing of juice from Co 1148 cane are discussed and possible means of avoiding these are described.

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Effect of various constituents of sugar cane juice on settling. S. N. G. RAO, S. C. SHARMA and N. S. GUPTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXV), 17 pp.—The effects of addition of phosphate, starch, *Leuconostoc*, gums, silica, nitrogen and tannins, respectively, on clarification efficiency were studied and the results recorded in graph form. The most suitable clarification procedure to follow in each case so as to avoid difficulties is described.

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Use of ion exchange resins for decolorization of syrups during manufacture of white sugar. S. C. GUPTA, N. A. RAMAIAH and S. K. SRIVASTAVA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXVI), 17 pp. Details are given of laboratory tests on syrup decolorization with three unnamed resins, the physical characteristics of which are tabulated.

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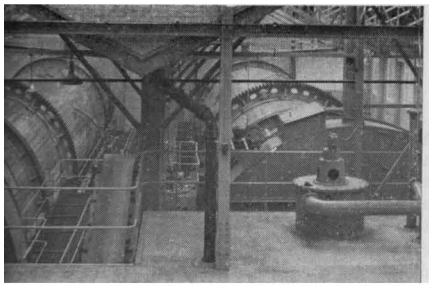
Successful working of a DDS diffuser in India. K. H. PAREKH and D. J. MEHTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXVII), 11 pp.—The performance of the DDS diffuser at The Belapur Co. Ltd. cane sugar factory in India is discussed in the form of answers to questions of the type put by technologists visiting the factory[1].

* * *

Optimization of sulphitation temperature for a continuous juice sulphiter with recirculation. B. B. PAUL, B. S. RAO and J. S. AHUJA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXIX), 9 pp.—Tests indicated that the optimum temperature (as regards juice colour) for sulphitation in the continuous sulphiter[2] lies between 165° and 171°F, depending on the lime doses, although it is pointed out by S. C. SHARMA in a discussion that maintenance of a constant pH in such tests is of great importance.

[1] *See I.S.J.*, 1969, **71**, 140–141.
[2] PAUL: *ibid.*, 1968, **70**, 372.



Beet sugar manufacture

Solution concentration and electrical power consumption in molasses purification by electrodialysis. R. Ts. MISHCHUK, L. D. BOBROVNIK and K. D. ZHURA. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (2), 64–66.—Tests showed that the optimum solution Brix is 28–32°, that the ratio between the electrolyte content in the concentrate and that in the dialysate should not exceed 1:5 (otherwise there is a sharp rise in power consumption), and that the optimum initial electrolyte concentration in the concentrate is 4% (at which 65–70% demineralization is achieved). The power consumption also rises sharply with increase in demineralization above 70%.

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Diaphragm gate valve for massecuite. M. I. IL'IN and V. I. PUGACHEV. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (2), 111–113.—Details are given of a diaphragm gate valve for feeding of massecuite into the basket of a centrifugal.

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The heat economy of a beet sugar factory. I. Effect of the beet sugar content and raw juice purity on the heat economy. P. FREUND. *Zucker*, 1969, **22**, 347–351. Although investigations have shown that the two factors named in the title have a considerable effect on the various parameters involved in a factory's heat economy (pan and evaporator vapour requirements, overall steam consumption of the factory, quantity and Brix of thin juice, etc.), the findings are of universal validity only on a qualitative basis, since quantitatively they are valid only for a particular factory scheme.

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New filter media in the sugar industry. L. BERGMANN. *Zucker*, 1969, **22**, 351–353.—Tests are reported from the 1968/69 campaign in which candle filter elements were covered with synthetic felt sleeves. Specific filter capacity was 2–3 times greater in liquor filtration than with ceramic candles, while the kieselguhr requirements were considerably lower. The costs of the sleeves are greater than those of conventional fabric sleeves, although they should be balanced against the economies effected by using the new sleeves.

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"Rupro" mechanical (beet) sampler: validity of the samples extracted. P. DEVILLERS and S. TOURLIÈRE. *Sucr. Franç.*, 1969, **110**, 323–327.—Tests during the 1968 campaign have shown that samples withdrawn by a "Rupro" sampler from beets loaded on a road truck were highly representative of the load at the sampling point. Rather high scatter occurring in the values when samples were taken from several points was attributed to the load characteristics rather than to the sampling method. For loads exceeding 10 tons (the most usual case) three samples were taken per load, the location in the pile from which the samples were taken being determined from a table of permutations. This permutation method increased the accuracy of tare determination. Uniformity in loading of vehicles is called for as one means of increasing sampling precision.

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Some aspects of the 1968/69 campaign (in West Germany). F. SCHNEIDER. *Zucker*, 1969, **22**, 365–377. Amongst the work described is a large section devoted to the subject of micro-organisms in waters and juices and isolated from frost-damaged beet. The processing of such beet is discussed. Carbonatation studies are also reported, and details are given of the Gaudfrin filter for mud treatment. Other aspects of beet sugar factory work are dealt with to a varying extent.

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Manufacture of beet sugar in India. S. C. GUPTA, N. C. VARMA and J. S. MEHTA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXII), 9 pp.—In addition to details of beet sugar manufacturing tests at Sri Ganganagar[1], the use of beet pulp and molasses as animal fodder, etc. is discussed. Comparison of the costs of sugar production favours combined cane and beet sugar production, which is cheaper than cane sugar manufacture alone.

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Berlin's Institute for Sugar Technology. N. MANYAS. *Sugar y Azúcar*, 1969, **64**, (6), 13–17.—Details are given of the facilities and course of study followed at the Institut für Zuckerindustrie in Berlin. The institute's sugar museum is also mentioned.

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Diffusion microbiology. A. SIMONART. *Sucr. Belge*, 1969, **88**, 355–357.—To reduce sugar losses caused by excessive cossette retention in diffusers, any new diffuser design should allow for minimum retention. For diffuser disinfection the juice should be kept at 74°C under constant acid conditions, formalin being added at a point about two-thirds along the diffuser from the head in an amount sufficient to inhibit infection. Should infection occur, then the dose should be increased.

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[1] *I.S.J.*, 1969, **71**, 170–172.

The history of beet sugar in Chile. B. KRETSCHMER. *Zeitsch. Zuckerind.*, 1969, **94**, 375–376.—A survey is presented of the Chilean sugar industry, the idea of which was first conceived by DUCAUD in 1854. Up to 1964, with the start-up of Los Angeles sugar factory, the industry was troubled by various problems. Four factories now operate and a fifth is to start operations this year. A sixth is planned at Curicó.

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Application of sensitive adiabatic calorimetry to beet sugar industry problems. W. O. BERNHARDT and R. A. MCGINNIS. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **15**, 235–245.—Equipment and procedures for determination of spontaneous heating rates in dried beet pulp are reported. Adiabatic tests carried out by Spreckels Sugar Co. since 1956 have indicated that the rates are governed not only by the type and level of additives, moisture content and storage temperature, with which they increase exponentially, but also by seasonal factors, the rate for pulp in one year differing considerably from that for pulp in another year at identical molasses addition, moisture and storage temperature. Hence, periodic determination of the heating rate is thought necessary in order to be able to adjust pulp composition or storage factors and hence prevent spontaneous combustion.

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Re-utilization of pulp press water in an Olier diffuser. H. GELEN. *Seker*, 1969, **18**, (72), 1–11.—The method used to discover the causes of faulty operation of the Olier diffuser at Kayseri beet sugar factory in Turkey is reported and measures to reduce losses and improve performance are described. Investigations into the recycling of pulp press water to diffusion at the factory are discussed and the monetary savings possible are shown to be considerable.

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Lime and lime kilns in the sugar industry. Y. AYHAN. *Seker*, 1969, **18**, (72), 29–33.—The various problems associated with lime kiln operation at a beet sugar factory are discussed.

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The Quentin process at Franken sugar factory. H. NEUMANN. *Zeitsch. Zuckerind.*, 1969, **94**, 377–380. The Quentin ion exchange process (replacing K and Na with Mg ions) and its application at the Ochsenfurt factory of Zuckerfabrik Franken GmbH are described. An extra 0·37% sugar on beet is shown to be possible on the basis of a non-sucrose balance, compared with a factory without the process. The economics of the process as worked out after the 1965/66 campaign show a credit of more than DM 250,000 based on an extra 0·4% sugar.

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Molasses sugar extraction by reverse osmosis. G. VERNOIS. *Zeitsch. Zuckerind.*, 1969, **94**, 387–389. Details are given of the Du Pont "Permasep" filter, which comprises a steel tube housing a multiplicity of hollow nylon fibres. Tests have been conducted by the manufacturers on beet molasses. At a recovery of 67% (the volume of liquid discharged from the filter as a percentage of the feed) the selectivities for sucrose and non-sugars were, respectively, 11·35% and 23·2%, indicating a sucrose: non-sugar ratio in the discard solution (that portion of the feed not passing through the fibres) 1·37 times greater than in the feed. A two-stage unit is considered more suitable for molasses treatment and is described. It is based on a recovery of 75% per stage and a total recovery of 91%.

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Fives Lille-Cail continuous crystallization. A revolutionary innovation in the history of sugar extraction. A. DOLINEK. *Zeitsch. Zuckerind.*, 1969, **94**, 393–394. The Fives Lille-Cail continuous vacuum pan and its controls are described and the advantages of the pan discussed.

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Factors which influence the phenomena of corrosion in the sugar factory. G. TRABANELLI, G. MANTOVANI and F. ZUCCHI. *Ind. Sacc. Ital.*, 1969, **62**, 127–139. An illustrated account is given of corrosion investigations at a number of sugar factories. Anti-corrosion measures available include a careful study of plant design from the point of view of corrosion, the proper choice of materials, and the use of protective coatings and corrosion inhibitors.

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The sugar industry in Sweden. S. ZAGRODZKI and H. ZAORSKA. *Gaz. Cukr.*, 1969, **76**, 129–135.—A survey is presented of the Swedish sugar industry, with particular reference to Jördberga and Ortofta sugar factories and Arlöv refinery, as well as the Swedish Sugar Corporation's research laboratory.

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The Soviet BUM U4M-2 beet unloader and results of its use. L. JUREWICZ. *Gaz. Cukr.*, 1969, **76**, 136–138. The equipment is described and its use in Poland in the 1968/69 campaign discussed. It can unload beet from a truck and pile it at the rate of up to 1000 tons/day.

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Crystal sugar fluidization. IV. Enthalpy balance of a fluidized bed dryer. J. TURCAJ and L. NEUŽIL. *Listy Cukr.*, 1969, **85**, 131–138.—Calculation of the moisture content of sugar entering a fluidized bed dryer using an equation which is given for the enthalpy balance has given more accurate values than determination of the moisture content by a gravimetric method. The enthalpy balance method can also be applied to calculation of the R.H. of the air leaving the dryer, on which depends the equilibrium moisture content of the sugar in the dryer and the drying time.

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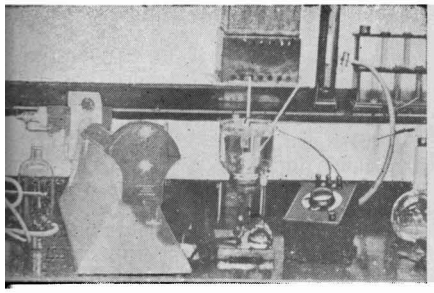
A sloping filter screen. M. STERZINGER. *Listy Cukr.* 1969, **85**, 141–144.—Tests with a Škoda sloping filter screen on beet pulp press water filtration are discussed. These have demonstrated its suitability for the task.



Laboratory methods & Chemical reports

Determination of crystal white sugar and refined sugar colour. A. YA. ZAGORUL'KO and L. A. KOROBEINIKOVA. *Sakhar. Prom.*, 1969, **43**, (6), 43–49.—Tests showed that the colour of almost colourless samples of white and refined crystal sugar can be determined by deducting the light reflection coefficient for the crystal in the deep violet or near ultra-violet regions of the spectra from the coefficient in the deep red or near infra-red regions. The difference at a given wavelength is due to colour. The method removes the effect of crystal size on colour determination. Equations derived for calculation of colour in physical units in terms of the reflection coefficients gave results reasonably close to the experimental data.

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Some derivatives of palatinose (isomaltulose) and a contribution to the question of its constitution. F. LOSS. *Zeitsch. Zuckerind.*, 1969, **94**, 323–329.—Preparation of a number of palatinose derivatives, which are described, has let to concrete evidence of the constitution of palatinose, which is finally given as α-D-glucopyranosido-(1,6)-D-fructofuranose with 1 molecule of water of crystallization.

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Colouring matter formation and colouring substances in the sugar industry. V. PREY. *Zeitsch. Zuckerind.*, 1969, **94**, 330–333.—A review is presented of work carried out at the Institut für chemische Technologie organischer Stoffe an der TH Wien in collaboration with the Zuckerforschungsinstitut in Vienna, particularly on the formation of melanoidin and determination of the nitrogenous compounds involved.

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Beet molasses formation and composition. IX. Molasses with exchanged cations; calcium chloride; phase theory. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1969, **94**, 338–341.—See *I.S.J.*, 1970, **72**, 89.

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Scintillation counting techniques in the isotope dilution analysis for sucrose. T. A. MCGAGIN and F. G. EIS. *J. Amer. Soc. Sugar Beet Tech.*, 1968, **15**, 228–234. The isotope dilution method used at the Spreckels research laboratory[1] has been modified to use a liquid scintillation counting technique instead of the gas flow proportional counting system, which proved unsuitable for analysis of a large number of samples. Details are given of the modified method, which uses a scintillation mixture composed of *p*-dioxane: naphthalene:2,5-diphenyloxazole (100:4·5:1·0 w/w/w). Comparison of the results obtained by the two methods shows no significant difference in % sucrose or analytical error between them.

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Determination of refined sugar moisture. H. MAŠKOVÁ and L. NEUŽIL. *Listy Cukr.*, 1969, **85**, 97–103.—A gravimetric method, using a drying oven, had been devised for the Czechoslovak sugar industry, but no indication was given of the number of tests required to obtain an accurate result. Subsequent tests have indicated the accuracy for moisture content in the moisture range 0·04–0·8%. Statistical analysis has produced a nomogram, which indicates the number of tests required for a given moisture content and required accuracy. This is reproduced, and means of improving the method are reported. Other methods of determining moisture are also mentioned.

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Raoult's and Babo's laws and Dühring's rule for concentrated sucrose solutions. V. I. TUZHILKIN and I. N. KAGANOV. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (2), 129–132.—Experimental data have shown that for aqueous sucrose solutions Babo's and Raoult's vapour pressure laws are identical. For approximate calculations, the activity of water in highly concentrated solutions may be assumed to be independent of temperature. In these solutions the relationship between the activity of the water and the molar concentration was found to be linear. Ramsay's and Dühring's rules are sufficiently precise for sugar factory boiling house practice. The "constants" in both rules are interrelated with solution concentration and entropy.

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Deionization of alcoholic precipitates of diffusion juices by electrodialysis with ion exchange membranes. R. BRETSCHNEIDER, I. BOHAČENKO and J. ŠTĚPÁNOVÁ. *Listy Cukr.*, 1969, **85**, 111–117.—Tests showed that for a more accurate indication of the quantity of colloidal matter in raw juice, as determined by alcoholic precipitation, it is necessary first to subject the precipitate to electrodialysis and thereby remove its ionic (ash) content.

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Problems in determination of reducing matter. B. KOPŘIVA. *Listy Cukr.*, 1969, **85**, 117–123.—Of eight methods for reducing sugar determination which

[1] SIBLEY *et al.*: *I.S.J.*, 1967, **69**, 57.

were applied to model solutions of glucose and invert sugar, six were found to be sufficiently reliable, particularly the Lane-Eynon method and the colorimetric micro-method using 2,3,5-triphenyltetrazolium chloride, both of which are suitable for routine analysis. The means used to evaluate the values obtained with the Bertrand and Potterat-Eschmann methods need revising. The Hagedorn-Jensen method is considered unacceptable, and the Luff-Schoorl method only acceptable within limits.

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Enzymatic determination of the raffinose and galactinol content in sugar factory products from the galactose produced on cleavage with galactose dehydrogenase. H. SCHIWEK and L. BÜSCHING. *Zucker*, 1969, **22**, 377–384.—A method is described for determination of the raffinose and galactinol content in products ranging from white sugar to molasses. It is based on the cleavage of raffinose into glucose, fructose and galactose by galactose dehydrogenase. The procedure is described, and results from comparison of the method with the paper chromatographic method used by Süddeutsche Zucker AG are discussed. Differences between the two were small at the campaign start but subsequently increased, the enzymatic method giving higher values in some cases and the paper chromatographic method higher values in others. The reasons for this are explained.

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Observations on the trend of final molasses purity during the season 1967-68 in the north eastern region of India. B. CHAKRAVARTY and S. SINGH. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXVI), 14 pp. The molasses purities at the factories in this region were higher than normal, and seven tables of data are presented with the aim of finding reasons for the upward trend.

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Factors affecting exhaustion of molasses. R. SINGH and N. C. VARMA. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXIX), 11 pp.—Formulae derived by various authors to calculate molasses exhaustibility are presented and their suitability determined by computer processing of analytical data to obtain regression equations. Expected true purity was found to have the highest correlation with the alkali % non-sugars in the molasses in agreement with THIEME's formula, while lowest correlation was found with calcium % non-sugars. A regression equation correlating true purity with reducing sugar % ash, alkali % non-sugars, reducing sugar % non-sugars, ash % non-sugars, Ca % non-sugars and (Ca + Mg) % non-sugars gave highly significant results at a correlation coefficient of 0·908.

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Quick estimation of sodium, potassium and calcium present in final molasses by flame photometry. R. SINGH. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXX), 6 pp.—Comparison of organic matter removal from final molasses by ashing with HCl with oxidation by nitric and perchloric acids (in that order) in preparation for flame photometric determination of Na, Ca and K showed that the two methods gave close results in the case of Na and Ca but not for K, the quantities of which were lower with ashing than with oxidation, apparently because of volatilization.

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Studies on distillers' solubles. (Examination of amino-acids.) K. A. PRABHU and R. M. MAITHANI. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXXI), 6 pp.—Spent wash from molasses fermentation was concentrated to about 90–92°Bx and the amino-acids in the resultant so-called distillers' solubles separated by ion exchange and paper chromatography. Details are given of the procedures used and of the amino-acids identified.

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Quality of palm jaggery as produced in Madras State in relation to cane gur. S. K. D. AGARWAL and P. K. AREN. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXXIV), 5 pp.—Comparison of palm gur with cane gur showed that the former had a very much lower reducing sugar content (1–1·5%) than the latter (6–10%), a higher organic matter content, was of a blackish colour and tasted and smelt like coffee, although it had a higher purity than cane gur.

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Unfermentable reducing matter in cane molasses. J. P. SHUKLA and R. M. MAITHANI. *Proc. 36th Conv. Sugar Tech. Assoc. India*, 1968, (XXXXV, given as XXXXIV), 5 pp.—The quantity of unfermentable reducing matter in distillery spent wash was found to be unaffected by the strain of yeast used for fermentation, ranging from 4·07% to 4·99% on dry matter. It is concluded that the presence of this amount of dextro-rotatory matter will significantly affect the polarization or titration of massecuites or molasses (4·67% reducing matter is given as equivalent to 3·3° pol).

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Core sampling. G. MENEZES. *J.A.S.T.J.*, 1967, **28**, 72–77.—A cane sampler installed at Monymusk, the technique used to take a sample from a cane cart and the procedure used to analyse the sample (the Hawaiian pol ratio method) are described. Comparison between the cane pol contents as determined in the samples taken from a core of the vertical cross-section of the load and as calculated in the sampled loads of cane which had passed through the factory mill showed a highly significant association, with the average core pol at 11·51% and the mill cane pol at 11·45%.

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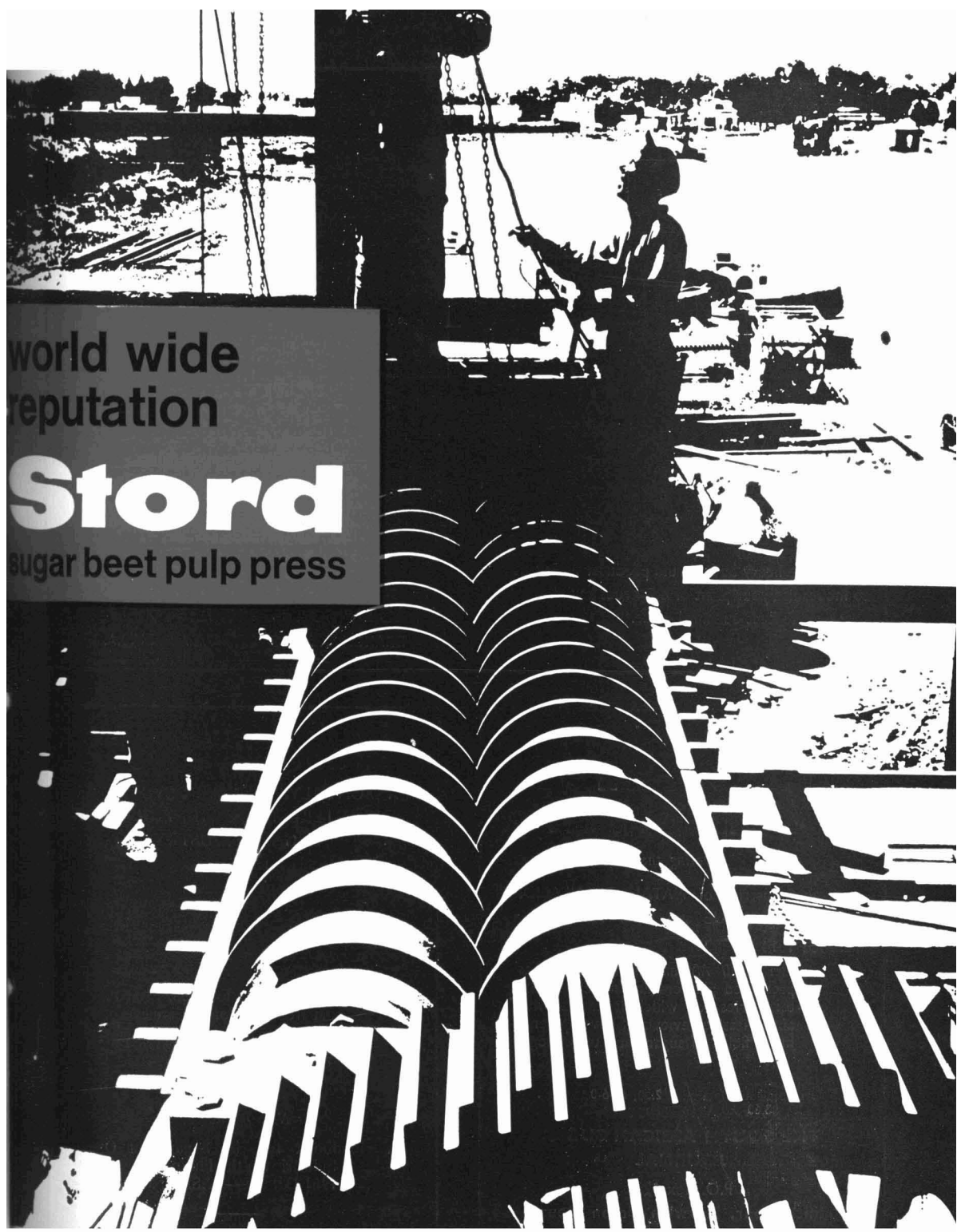
A mobile data-logging laboratory for sugar mills. ANON. *Sugar y Azúcar*, 1969, **64**, (7), 32–35.—Details are given of a mobile computerized laboratory designed by the Sugar Research Institute in collaboration with Sugar Research Ltd. to log data from sugar mills located throughout Queensland.



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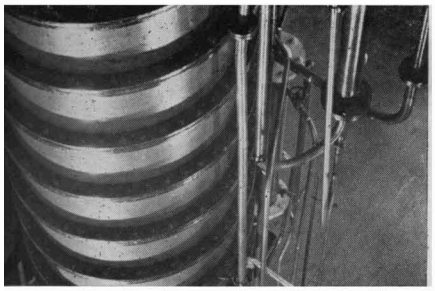

By-products

Yeast production on cane molasses. B. REVUZ. *Sucr. Belge*, 1968, **87**, 875–876.—Details are given of the Lefrançois torula yeast plant at Pina (Camagüey, Cuba) supplied by S. A. S.P.E.I.Chim to specifications furnished by S. A. Fermentation, of Paris. The plant has a daily production capacity of 30 tons of fodder yeast from cane molasses.

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The replacement of cereals by sugar or molasses for broilers raised on wire or litter. R. PEREZ, T. R. PRESTON and M. B. WILLIS. *Rev. Cubana Ciencia Agric.*, 1968, **2**, 101–108.—Tests in which sugar replaced 50% or 100% and high-test molasses 21% or 44% of cereals in broiler diets are reported. A high sugar diet was also given with 4% fat. Sorghum was used as cereal control. Growth was faster with the high molasses and sugar + fat rations, but feed conversion was best with the cereal control. Replacement of cereal by sugar + fat as energy source is governed by the economics.

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A new way of feeding urea. O. BOEGER. *Zucker*, 1969, **22**, 46–48.—References are made to results obtained with the use of "Dorma" fodder mixture. This is beet pulp to which is added a urea-phosphate-molasses solution. It is patented by Fa. Pfeifer & Langen and takes its name from the process used at Dormagen sugar factory in West Germany.

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Evaluation of sugar industry by-products used as animal fodder. V. HENRY. *Sucr. Belge*, 1969, **88**, 5–11. Among the aspects considered on the basis of experiments and computer data are the nutritional and economic value of various beet sugar factory and distillery by-products under Belgian conditions (dried pulp, molasses, vinasse, amino acid in Steffen house effluent, and denatured sugar) and the drying of various agricultural products in sugar factories during the off-season (e.g. grass and lucerne). Of the sugar by-products, dried pulp is considered nutritionally and economically the most popular.

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Dehydration of molasses. T. MIKI and T. SHIRASAKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1968, **20**, 1–7.—Refinery molasses diluted to 50°Bx was mixed with 5% (on Brix of molasses) $Ca(OH)_2$ and stirred for 1 hr at room temperature before the mixture was fed into a rotary spray dryer, where hot air of 150°C dried it to a fine particulate product of light brown colour containing 4·5–5·0% CaO and 3–4% moisture. Total sugar loss was less than 1%. Dehydration was difficult at below 5% $Ca(OH)_2$ content because of high hygroscopicity of the mixture. Heating before spray drying did not reduce hygroscopicity but only caused sucrose and reducing sugar decomposition. The dried product could be stored for a long period in polyethylene bags.

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Drying of carbonatation mud by fluidization using boiler flue gases. W. STANKIEWICZ. *Gaz. Cukr.*, 1969, **77**, 10–13.—Details are given of an experimental fluidized bed dryer used in tests to dry carbonatation mud. At a bed diameter of 340 mm and an average throughput of 93·2 kg/hr, evaporation rate averaged 341 kg H_2O/sq.m./hr, reducing the mud moisture content from 43·3% to 3·3% in the granules and 1·6% in the dust. Power consumption was 86 kWh/ton of wet mud.

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Sugar industry diversification (in Taiwan). H. S. WU. *Taiwan Sugar*, 1968, **15**, (6), 14–17.—See *I.S.J.*, 1969, **71**, 250.

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Bagasse particle board. Additional income for sugar industry. R. HESCH. *Sugar News*, 1968, **44**, 634–657. A description is given of the Bagapan particle board plant in Réunion[1] and applications of bagasse board are discussed.

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Acetic acid from sugar cane final molasses by (a) fermentation process. M. A. HUSSAIN. *Proc. 7th Conv. Pakistan Soc. Sugar Tech.*, 1968, (1), 130–133. Laboratory tests on production of acetic acid by means of *Mycoderma acetii* added to a nutrient medium containing yeast-fermented molasses and agar-agar are described.

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Boards, furniture and prefabricated houses from bagasse. R. HESCH and H. FRERS. *Zeitsch. Zuckerind.*, 1969, **94**, 125–132.—Details and illustrations are given of the plant at Crescent Sugar Mills and Distillery Ltd., Lyallpur, West Pakistan, which was planned for starting-up in 1969. It will use 80–85% of the sugar factory bagasse, producing particle and fibre board, veneers, doors and furniture. Main suppliers of the equipment are G. Siempelkamp & Co., while a Schmutz International varnishing line provided with a 3-colour printing unit will produce top quality woodgrain and other printing.

[1] *I.S.J.*, 1969, **71**, 3–6.

Patents

UNITED STATES

Producing sugar solutions. E. R. ALLEN, of Brighton, N.Y., USA. **3,428,487.** 24th May 1965; 18th February 1969.—A sugar solution is made by adding to a measured quantity of water a quantity of dry sugar measured by operating a sugar conveyor for a predetermined length of time. The quantity is such as to give a solution of somewhat higher Brix than that ultimately required and the Brix is measured by passing a sample through a bubble column, the output of which is fed, through intermediate elements, to a computing relay and thence to a pneumatically operated controller which controls the addition of water so as to lower the original Brix to that required. This is performed in a melt tank; a measuring device senses volume available in the main tank and permits the transfer of a complete batch of melt if sufficient volume is available. If not, the batch of melt is held in the melt tank until there is sufficient room in the main tank.

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Cane juice extraction apparatus and screw press. J. FARMER, of Oahu, Hawaii, *assr.* HONIRON INC. **3,432,344.** 4th November 1964; 11th March 1969.

The individual hopper-press combinations as used for the extraction system covered by US Patent 3,425,869[1] are described in detail.

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Beet harvester. E. WEICHEL, of Heiningen, Kr. Goppingen, Germany. **3,435,900.** 22nd October 1965; 1st April 1969.

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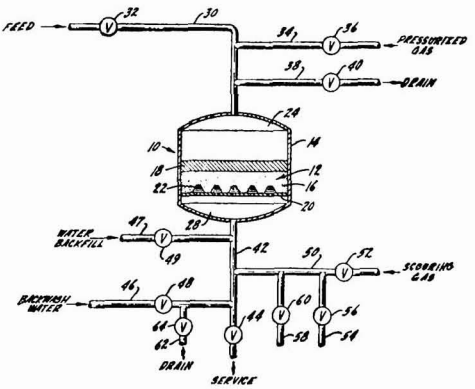
Sugar liquor filtration and filter cleaning. J. H. DUFF, of Basking Ridge, N.J., USA, *assr.* UNION TANK CAR CO. **3,436,260.** 23rd September 1964; 1st April 1969.

Sugar liquor after clarification in a refinery is filtered to remove particles of bagacillo, calcium phosphate, etc., by passage through a bed and filter media 12 (sand 16 covered by a layer of anthracite 16) in filter 10, after which it passes via pipe 42 and valve 44 to char treatment, etc. When the bed 12 is clogged the feed is stopped and the liquor in the filter discharged by means of pressurized gas (air) admitted through pipe 34, the turbid liquor being returned upstream of the filter through pipe 54. Valve 49 is then opened to admit water through pipe 47 which is used to fill the filter and dissolve any sugar liquor; after a suitable time the filter is again drained, using compressed air, the sweetwater leaving the system through pipe 58.



Backwash water is then admitted through pipe 46 and, when the bed 12 is immersed, a scouring gas (air) is admitted to the filtrate side of the strainers 22 through valve 52 and pipe 50. This action agitates the bed and dislodges the foreign particles attached to the filter media; after a suitable time the gas flow is stopped and further backwash is admitted and carries the dislodged foreign particles with it to the drain through pipe 38. When this removal is complete the backwash is stopped and the filter drained, the water leaving through pipe 62, after which the filter is ready for further use.

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Carbonization of bagasse. (I) M. F. LEONOR, of New York, N.Y., USA., *assr.* E. ROBERTSON. **3,436,312.** 29th August 1962; 1st April 1969. (II) M. F. LEONOR, of New York, N.Y., USA. **1,436,314.** 23rd July 1964; 1st April 1969.

(I) In order to prepare a carbonized product of suitable bulk density for convenience as a fuel, bagasse is (shredded to particles ½–1 inch long and) treated with (15–50% on bagasse weight of) an acid (sulphuric acid) (and 2–20% of water) to bring about

[1] *I.S.J.*, 1969, **71**, 348.

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., 20231 U.S.A. (price 50 cents each).

hydrolysis and raise the bulk density by 30–50%. The bagasse residue is separated from the liquor and heated in the substantial absence of oxygen to carbonize it.

(II) Bagasse is separated into lighter and heaver fractions by a cyclonic dust collector attached to a hopper; the lighter particles are discharged to atmosphere while the heavier particles are returned to the hopper from which they are delivered in a suspended state into a drying tube to which flue gas is supplied from a first combustion chamber at a relatively low temperature. (Moisture and flue gas leaving the drying tube are separated and the latter recycled.) The dried particles are delivered in suspension to a preheating tube supplied with flue gas from a second combusion chamber which effects partial carbonization. After this the particles pass in suspension to a carbonization tube supplied with gas from a third combustion chamber at a higher temperature to effect full carbonization. The gases and smoke from the preheating and carbonization tubes pass through cyclonic separators to recover combustible materials which are then sent to the 2nd and 3rd combustion chambers as fuels, while the non-combustible and flue gases are recycled.

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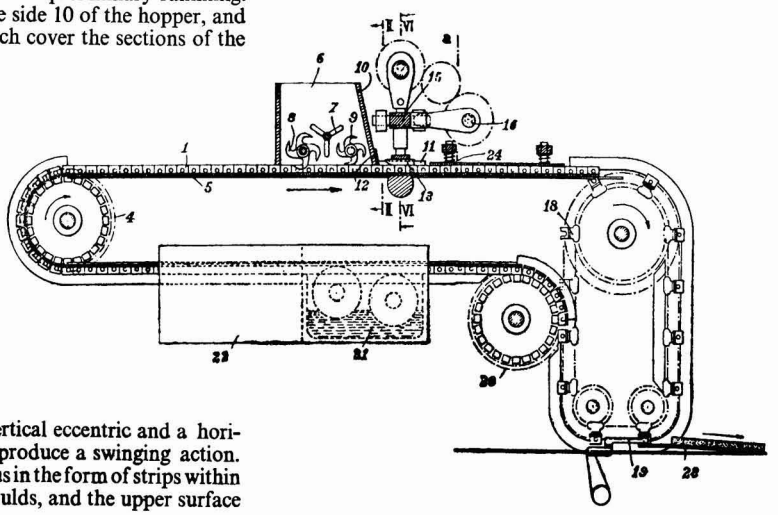
Continuous moulding of sugar cubes and tablets. L. J. CHAMBON, of Paris, France, *assr.* SOCIÉTÉ D'ETUDES DE MACHINES SPECIALES S.A. **3,436,791.** 2nd May 1966; 8th April 1969.

The moulds 1 are in the form of horizontal bars provided with lateral rectangular grooves across the upper sides and with trunnions at the outer edges. The trunnions are caught by driving wheel 4 which delivers the moulds onto the plate 5 and towards the hopper 6. Within this a fixed spider wheel 7 and spider wheels 8, 9 which are vertically adjustable keep the sugar stirred and distribute it in the grooves of the moulds, and effective a preliminary ramming. The moulds pass under the side 10 of the hopper, and under a set of bars 11 which cover the sections of the mould between the grooves. A vertically-adjustable plate 12 attached to the side 10 has a set of apertures in its lower edge corresponding to the grooves so that the height of sugar in the grooves (and between bars 11) may be set at the required level.

The thus metered mixture is compressed with a ramming head 13 actuated by the reciprocating motion of a vertical eccentric and a horizontal eccentric 16, which produce a swinging action. The compressed sugar is thus in the form of strips within the grooves of adjacent moulds, and the upper surface of these strips is closed when the moulds pass under plate 24. The trunnion on one side of each mould is long and the other is short, and the moulds are arranged so that the trunnions on both sides are alternately long and short. While under plate 24 the moulds pass between wedge-shaped side ramps which bring the ends of the long and short trunnions on the same side into alignment so that the moulds are moved horizontally with respect to each other and the strips of compressed sugar are sheared, to give individual cubes or tablets. The moulds are then returned to their original alignment by a system of blocks, and carried individually by chains 18 to the discharge point where the tablets are pushed out of the grooves by rams 19 onto slope 23 leading to a conveyor. The moulds then pass through washing chamber 21 and drying chamber 22 before being engaged again by wheel 4.



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Sucrose phosphate ester preparation. R. G. CAMPBELL, C. C. OLDENBURG, and R. A. SIMONE, *assrs.* THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,437,652.** 2nd February 1967; 8th April 1969.—A mixture of a sugar(sucrose), water and CaO, $Ca(OH)_2$ or $CaCO_3$ is maintained at 0–20°C and agitated while adding $POCl_3$ free from any protective solvents such as trichloroethylene. After allowing to react for a suitable time (at 0–20°C) the solution is clarified by centrifuging, $CaCl_2$ separated from the solution and the latter spray-dried to yield a calcium sugar phosphate-containing solid.

* * *

Manufacture of carbohydrate or polyhydric alcohol phosphoric esters. J. H. CURTIN and J. GAGOLSKI, *assrs.* THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,437,653.** 13th July 1967; 8th April 1969.—(One part of) The carbohydrate or polyhydric alcohol [a sugar (sucrose)] is mixed with

water and (2·5 parts of) CaO, $Ca(OH)_2$ or $CaCO_3$ and phosphorylated at 0–15°C (0°C) with (1 part of) $POCl_3$ dissolved in a chlorinated hydrocarbon solvent (trichloroethylene). The calcium salt of the phosphate ester is recovered and separated from $CaCl_2$ by counter-current extraction with 70–80% ethanol, by a gel-filtration process or by ion exclusion.

* * *

Beet harvester. E. C. ROLLINS, of Ogden, Utah, USA, *assr.* HESSTON MANUFACTURING CO. INC. **3,438,496.** 10th February 1966; 15th April 1969.

* * *

Beet topper. R. N. BURNS and T. E. WULF, of Boise, Idaho, USA, *assrs.* WESTERN CONVEYOR CO. **3,439,480.** 15th April 1966; 22nd April 1969.

* * *

Beet sample cleaner. N. E. CARVER and J. M. SILVER, of Ogden, Utah, USA, *assrs.* OGDEN IRON WORKS CO. **3,440,674.** 14th August 1967; 29th April 1969.

Beet samples are cleaned by washing and drying with the same housing 32 which contains a drum 12 which is in two parts 12W and 12D. The drum is formed from perforated plates to give a polygonal cross-section, is supported by trunnions 14, 15 and 16 running in bearings, and is driven by electric motor 20. Within the drum is a stationary pipe 13 the closed end of which 13a is supported by bearing 41 in the end plate 35 of the drum while the other end of the pipe is rigidly mounted on the frame 42 supporting the hopper 40.

Beet samples are placed in the drum through apertures 37 in plate 35 and are carried along the drum by the helical scroll formed by plates 43, the beets being tumbled by the action of the rotating plane surfaces forming the drum walls. A series of nozzles in pipe 13 deliver sprays of water on to the beets, so removing their dirt content and carrying it through the drum perforations into the collecting trough 27. A spray jet 44 continuously washes the upper surface of pipe 13 to prevent accumulation of dirt. The washed beet pass into the drying section 12D where water draining is collected in trough 28 while hot air is delivered through the fixed end duct and distributed within part 12D through ports 48. The dried beet samples are then delivered by the helical plates into hopper 40.

Beet harvester elevator. A. G. BAROWS, E. W. PARRISH and R. C. MINER, *assrs.* INTERNATIONAL HARVESTER CO., of Chicago, Ill., USA. **3,442,380.** 4th August 1967; 6th May 1969.

* * *

Removing starch from sorghum juices. B. A. SMITH, of Weslaco, Texas, USA, *assr.* U.S. DEPT. OF AGRICULTURE. **3,442,704.** 4th November 1966; 6th May 1969.—Starch granules are removed from raw sorghum juices by the following steps, all at a temperature not above 60°C: adjusting to 12–15°Bx, adjusting to pH 7·5–7·7 with $Mg(OH)_2$ and/or $Ca(OH)_2$ to produce a floc in the juice, adding 3–5 p.p.m. of a flocculating additive, and separating the floc.

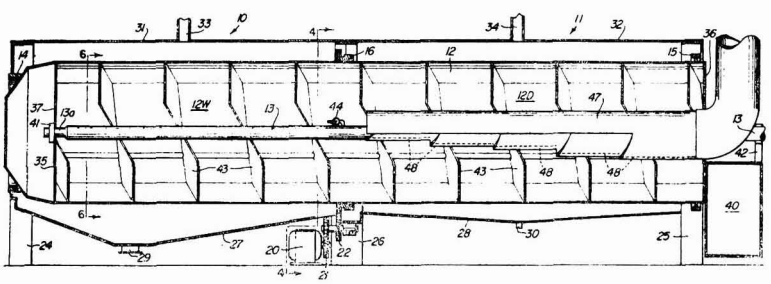
* * *

Cane diffuser. H. F. SILVER, C. R. STEELE and F. B. PRICE, of Denver, Colo., USA, *assrs.* AMERICAN FACTORS ASSOCIATES LTD. **3,443,905.** 15th May 1968; 13th May 1969.

In a ring-type cane diffuser of the type described by US Patent 3,248,263[1], the juice draining through the cane layer is collected in tanks the drainage area of which may be of increasing size towards the direction of rotation of the annular chamber; the juice is pumped through distribution outlets over the cane nearer the juice end of the diffuser, the spacing between these outlets being such that they correspond to the increased drainage areas of the tanks.

Alternatively, the tanks may be of equal drainage area while the outlets are movable to adjust their locations with respect to the tanks below the annular chamber. The exhausted cane is removed by means of a series of vertical rotating scrolls of opposite pitch and direction which carry the cane upwards and discharge it into a horizontal scroll conveyor which removes it from the diffuser.

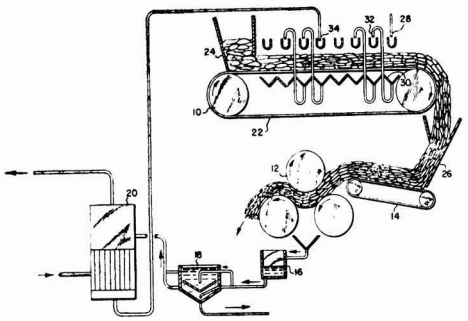
* * *



Cane juice extraction. F. DAMBRINE, of Lille (Nord), France, *assr.* SOC. FIVES LILLE-CAIL. **3,443,549.** 28th July 1966; 13th May 1969.

Suitably prepared cane is delivered from hopper 24 onto an endless belt 22, the layer thickness being adjustable by a suitable slide valve. The belt is perforated so that water supplied at pipe 28 and sprayed across the layer of cane passes through it and collects in trough 30 from which it is pumped through pipe 32 nearer the hopper 24 and so becomes richer in sucrose. The cane is carried by rotation of the drum 10 along the belt until it discharges into collector 26 which directs it to conveyor 14 feeding the three-roller press 12 where the water content of the cane is reduced before it is discharged.

[1] *I.S.J.*, 1967, **69**, 284.



The sweet-water expressed is collected and limed in vessel 16 and clarified in decanter 18, after which it is concentrated in evaporator 20 and returned to the extraction unit at the appropriate point 34 between the water and juice ends.

* * *

UNITED KINGDOM

Additives for use in sugar manufacture. FABCON INC., of Chagrin Falls, Ohio, USA. **1,157,294.** 6th March 1967; 2nd July 1969.—Reduced viscosity and surface tension in massecuite, with consequent improved boiling and purging, better crystal quality and lower molasses viscosity is achieved by addition to syrup or massecuite of a (50%) solution of at least one water-soluble salt of a sulphosuccinate ester, the ester groups of which are water-insoluble, as the sole solute(s) in a solvent comprising water and ethanol and/or propylene glycol, the organic solvents being present to the extent of about half the weight of the ester salt. The latter is a K, NH_4 or Na salt of di-octyl, di-*iso*butyl, dihexyl or ditridecyl sulphosuccinate (dioctyl sodium sulphosuccinate).

* * *

Continuous centrifugal. AMERICAN FACTORS ASSOCIATES LTD., of Honolulu, Hawaii, USA. **1,159,491.** 9th August 1966; 23rd July 1969.—Feed to the basket of a continuous centrifugal is via a valve pneumatically biased towards closure. The valve is governed by an electro-pneumatic device sensitive to the current usage of the motor driving the basket such that, if the motor load and current consumption is too high, the valve will close to stop delivery of massecuite to the basket. Delivery will also stop if the current usage is too small to drive the centrifugal. A circuit is included so that after heavy starting current consumption delivery of feed will start once current has reduced to the appropriate level, while an integrating circuit is arranged to prevent hunting in the massecuite delivery and to maintain the motor load within a given range.

* * *

Surface-active agents. RAFFINERIE TIRLEMONTOISE S.A., of Brussels, Belgium. **1,160,144.** 19th September 1966; 30th July 1969.—The surface-active agent is prepared by reacting, in a single stage, at least one organic compound having at least one labile hydrogen atom [a (mono-, di- or tri-) saccharide (sucrose, dried molasses), a (C_1-C_{10} fatty, cyclic, aromatic or terpene) alcohol or derivative, a polyol or (ether, ester or ether-ester) derivative, an alcohol acid, a phenol or polyphenol, an aromatic or aliphatic chain compound of 1–8 C atoms with a primary or secondary amino group, a C_1–C_8 amide or diamide, a C_1–C_8 amine, or a C_1–C_8 mono-, di- or tri-carboxylic acid or alcohol-acid], with at least one (natural or synthetic, C_1–C_4 alkyl) ester of a (halogen- or hydroxyl-) substituted or unsubstituted (C_8–C_{30}) fatty acid (a vegetable, animal or synthetic fat or oil) in the presence of at least one alkylene oxide (ethylene and/or propylene and/or butylene oxide) and an oxyalkylation and transesterification catalyst (which is acidic or basic, depending on the sensitivity of the labile hydrogen atom), under reduced pressure, at 70–180°C. The organic compound, ester and alkylene oxide are present in proportions by weight of 35–50: 10–35: 25–85 (12–20:8–16:60–80), (20–60:10–45:5–65), (15–35:10–25:65–80), (45–55:40–45:5–25). The reaction proceeds with distillation of the liberated alcohol, giving a product which is bleached, and the form of which may be altered by inclusion of ammonia, an amine or urea.

* * *

Increasing the sugar content of sugar-containing crops. E. I. DU PONT DE NEMOURS & CO., of Wilmington, Del., USA. **1,161,189.** 10th July 1968; 13th August 1969.—The sugar content of cane is increased by applying to it, 10–60 days before harvesting, a compound of the formula Y-O-(CHR′-)$_n$-CHR″-X, where $n = 0$ or 1, and R′, R″, X and Y are variants of wide ranges of substituents {2-aminooxypropionic acid, methyl 2-aminooxypropionate, 2-benzamidooxypropionic acid, methyl 2-[2-(2,4-dichlorophenoxy)acetamidooxy] propionic acid methyl ester, allyl 2-(benzamidooxy) propionate}.

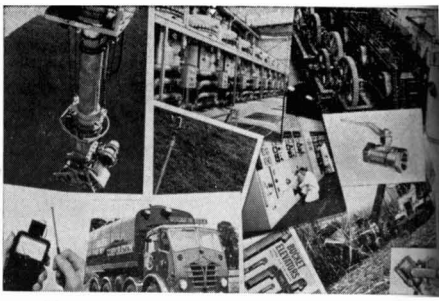
* * *

Beet thinner. DEERE & CO., of Moline, Ill., USA. **1,161,680.** 12th December 1967; 20th August 1969.

* * *

Granular, free-flowing brown sugar. AMERICAN SUGAR COMPANY, of Wilmington, Del., USA. **1,163,694.** 15th January 1968; 10th September 1969.—A sugar syrup (containing not more than 15% by weight of invert, dextrose, melassigenic components of blackstrap molasses, etc.) is concentrated at 120–130°C to 91–97% solids by weight and subjected to an impact beating in a crystallizing zone with a simultaneous forced flow of gas (air at a rate of 9 c.f.m. per lb of sugar product per min) sufficient to prevent increase in its temperature and to carry off any water vapour produced. The impact beating lasts 10–60 seconds and produces a granular sugar formed of aggregates of fondant-size (3–50 microns) sucrose crystals, the product having less than 2·5% of moisture by weight. It is then subjected to a cooling and drying process to reduce the moisture content to not more than 1%.

Trade notices



Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

New insecticide. Farm Protection Ltd., Beckwith Knowle, Harrogate, Yorks., England.

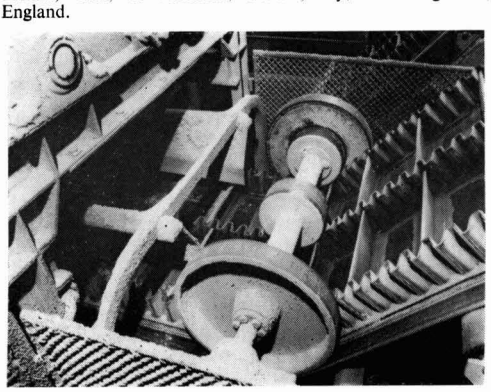
"Solvirex" is a new granular systemic insecticide containing 7·5% "Disulfoton" (a product of Sandoz Ltd., of Switzerland). Available in two formulations, the insecticide is suitable for control of aphids in a variety of crops, including sugar beet, thus restricting the spread of virus yellows disease. It is persistent and in most seasons a single application will give adequate protection during the growing period.

* * *

Sugar factory orders.—A. & W. Smith & Co. Ltd. have secured an order worth £2 million for the supply of a sugar factory and refinery to West Pakistan. The factory is designed for a capacity of 3000 t.c.d. and will be built for Rahmania Fauji Sugar Mills Ltd. An order worth £1½ million has been placed with The Mirrlees Watson Co. Ltd. for the extension of a sugar factory, built by themselves, from 3000 t.c.d. to 6000 t.c.d. The factory, owned by Central Azucarero Portuguesa S.A., is situated at Acarigua in Portuguesa State, Venezuela.

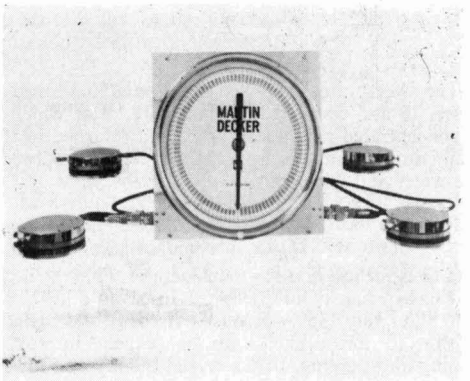
* * *

Scholtz rubber belt conveyors.—The 120 mm-high corrugated "Flexowell" side walls of the illustrated rubber conveyor belt form compartments with the lateral partitions and allow the conveyor to pass from horizontal to inclined movement as shown. The belts are manufactured by Conrad Scholtz (Gt. Britain) Ltd., of Mereside, Soham, Ely, Cambridgeshire, England.



* * *

Load cell system.—The totalizer load cell system shown in the accompanying illustration is suitable for tank and hopper weighing as well as platform scales, and consists of dial and compression (tension) hydraulic load cells of rugged construction. The system, manufactured by Martin-Decker Corp., 1928 South Grande Ave., Santa Ana, Calif., 92705 USA, is available with 2, 3 or 4 cells, the 4-cell system having a load capacity of up to 1,000,000,000 lb.



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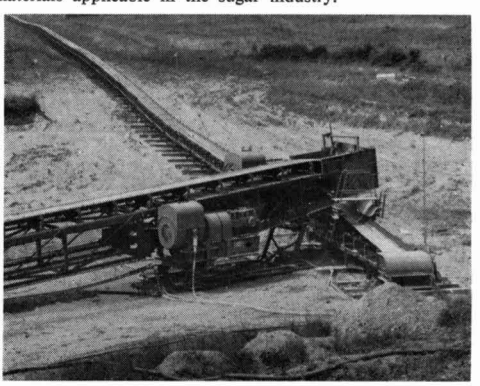
Dowty belt conveyors.—The illustration shows a 240 M 42-inch wide belt conveyor, manufactured by Dowty Meco Ltd., of Worcester, England, which is mounted on a pontoon skid base and is handling 900 tons/hr of chalk over a conveyor length of 1500 ft. The unit is rated to take up to 4 × 125 h.p. standardized transmission units, but here is using only two units. The conveyor is suitable for handling a number of materials applicable in the sugar industry.



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Thomson expansion into beet mechanization.—Thomson International Company, of Thibodaux, La., USA, manufacturers of sugar cane harvesters and cultivation machinery, have acquired Oppel Inc., of Boise, Idaho, makers of beet harvesters. In conjunction with the acquisition, Thomson have also entered into an agreement with Allis-Chalmers Mfg. Co., of Milwaukee, Wis., to distribute the Oppel equipment through its dealer organizations in Canada and eastern and central USA.

United Kingdom Sugar Imports and Exports[1]

IMPORTS	1969	1968	1967	1966
		Long tons, tel quel		
Refined and White Sugar				
Canada	3	2	163	2
W. Indies & Guyana	1,997	3,071	1,129	3,306
Other Commonw'th	40	30	11	21
Belgium	2,095	916	1,452	87
Czechoslovakia	15,406	15,849	26,528	32,022
Denmark	4,067	14,619	—	—
Finland	5,733	—	—	—
France	1,249	2,227	882	858
Germany, East	2,413	4,522	5,136	1,427
Germany, West	1,147	906	104	503
Ireland	10,118	10,127	10,725	12,530
Netherlands	4,274	12	25	—
Norway	63	—	29	52
Poland	606	2,336	2,187	3,721
Sweden	492	—	—	—
USSR	—	—	—	1,421
Other Foreign	31	32	23	39
TOTAL	49,734	54,649	48,394	55,989
Raws—Cane and Beet				
Australia	500,000	358,353	433,162	412,653
Barbados	117,622	130,310	114,088	135,549
British Honduras	13,673	22,810	15,786	17,123
Fiji	185,826	130,112	143,809	131,433
Guyana	184,906	141,718	140,666	58,971
India	24,925	24,791	76,902	96,948
Jamaica	216,833	213,653	198,541	211,198
Leeward Is.	23,089	29,660	34,416	35,739
Mauritius	400,950	484,257	370,241	436,808
Rhodesia	—	—	—	20,163
Swaziland	98,360	84,466	87,539	81,985
Trinidad & Tobago	129,648	129,587	142,914	122,943
Other Commonw'th	—	299	818	—
Commonwealth Raws	1,895,832	1,750,016	1,758,882	1,761,513
Argentina	—	—	—	500
Belgium	5,527	—	4,055	—
Bulgaria	—	—	3,995	—
Brazil	16,731	11,898	17,826	162,090
Colombia	—	9,812	11,706	30,040
Cuba	9,465	19,494	79,923	65,341
Czechoslovakia	7,809	—	—	—
Dominican Republic	—	—	9,949	—
France	—	28,372	—	824
Germany, West	11,821	5,915	—	—
Haiti	—	—	—	9,470
Malagasy	—	—	—	12,612
Mexico	—	—	—	12,605
Netherlands	15,870	42,832	26,013	—
Poland	20,115	44,314	31,792	5,882
Réunion	—	9,451	—	—
South Africa	20,899	42,548	158,539	58,360
Spain	6,293	—	—	—
USSR	51,257	—	—	—
Yugoslavia	—	—	1,008	250
Other Foreign	2	—	2	3
Foreign Raws	165,789	214,636	344,808	357,977
TOTAL RAWS	2,061,621	1,964,652	2,103,690	2,119,490

EXPORTS	1969	1968	1967	1966
		Long tons, tel quel		
Bahamas/Turks & Caicos Is.	1,001	1,242	1,101	954
Bahrein	136	1,755	102	270
Barbados	920	447	259	496
Bermuda	854	949	583	684
British Honduras	1,686	873	716	1,072
Canada	75	3,036	2,032	1,289
Ceylon	1,345	3,314	665	907
Cyprus	8,462	9,025	11,541	9,163
Gambia	130	548	775	807
Ghana	3,900	11,335	19,301	19,171
Gibraltar	1,215	1,217	1,184	994
Guyana	93	117	90	70
Hong Kong	15	8	2	303
Indian Ocean Islands	58	46	246	281
Jamaica	15,832	31	35	98
Kenya	1,894	3,183	3,580	3,237
Leeward Is.	2,218	2,235	1,367	1,000
Malaysia	562	498	523	22,691
Malta	506	551	935	857
Nigeria	14,057	8,544	24,469	24,918
Sierra Leone	2,823	4,450	8,281	10,181
Singapore	16	999	5,535	9,072
South Arabia	*	*	216	473
Trinidad & Tobago	159	91	26	1,294
Trucial States	186	589	100	816
Windward Is.	1,782	2,005	2,298	1,231
Zambia	1,797	1	2,017	—
Other Commonw'th	501	517	568	266
Total Commonwealth	62,223	57,606	88,547	112,595
Belgium	10	18	968	438
Burma	—	335	—	286
Cameroons	61	45	6	8
Chile	295	1,498	1,287	437
French Pacific	1,603	2,276	2,353	3,730
Germany, East	—	10	5,000	—
Germany, West	726	827	583	593
Greece	45	311	34,168	10,997
Iceland	2,639	2,864	3,354	3,809
Iran	1,184	1,453	1,723	1,357
Ireland	426	562	590	6,061
Israel	270	354	426	773
Italy	13	8	26	105
Kuwait	98	2,180	249	254
Lebanon	26	1,574	1,627	693
Liberia	411	523	555	735
Libya	171	203	294	446
Muscat & Oman	41	705	89	53
Netherlands	2,036	17,431	45,329	25,044
Norway	38,574	38,481	43,473	40,613
Saudi Arabia	2,190	9,043	486	514
South Yemen Rep.	—	1,968	*	*
Spain	21	104	252	1,349
Spanish Possessions Overseas	62	261	168	166
Sweden	26	89	9,859	2,382
Switzerland	43,144	45,240	56,566	55,219
Togo	50	429	246	404
Tunisia	23,657	15,781	12,817	24,782
USA	145	314	7	3,657
Vietnam, South	19,643	—	9,550	—
Other Foreign	223	171	943	276
Total Foreign	137,790	145,058	232,994	185,181
TOTAL EXPORTS	200,013	202,664	321,541	297,776

* The Federation of South Arabia left the Commonwealth on 30th November 1967 and is now the People's Republic of South Yemen.

[1] C. Czarnikow Ltd., *Sugar Review*, 1970, (956), 26.

Brevities

US beet area[1].—At the beginning of October 1969 the US Dept. of Agriculture reintroduced area restrictions for the mainland beet crop by limiting the 1970/71 season to an area of 1,450,000 acres. Since then, however, the 1969/70 harvest has suffered from rain, snow and freezing conditions during its important closing stages, which have led to lower yields. Production has closed at some 300,000 tons below earlier expectations and it compares closely with the previous season's output. In view of this decline in production and consequent lower carry-over the USDA this week raised the area limit for 1970/71 by 100,000 acres to 1,550,000 acres.

* * *

Bagasse utilization investigation in Queensland[2].—Following inspection of the by-products industry of Taiwan, an investigation into bagasse utilization in Queensland has begun. There appear to be no technical problems and the question is one of economics where the cost of the bagasse as raw material and the marketing of the product are the main factors which could block implementation of such a diversification. At present two avenues of approach are being investigated: the very large-scale production of bagasse pulp for export or for local use as a raw material of paper-making, and smaller-scale production of such items as particle board, corrugated board, containers, etc.

* * *

Cambodia sugar factory project[3].—Representatives of the Société Générale de Banque de Belgique and of the Société Nationale des Sucres in Phnom Penh have signed a credit agreement for the construction of a sugar factory in Cambodia. The factory is to be built in Kompong Kol, near Battambang. Sugar cane has already been planted on an area of 330 hectares. The total cane area is to be extended to 6000 hectares of which 1500 hectares will be state-owned plantations while the rest will be private plantations. The sugar factory will at first have a capacity of 150 tons per day but will be extended later to 400 tons per day.

* * *

New leaf scald-resistant Barbados cane variety[4].—A new cane variety, B 60267, has been introduced which, it is claimed, is free from leaf scald disease. The Director of the West Indies Central Sugar Cane Breeding Station disclosed that it had taken 8 years to breed and successfully test the new variety which, in addition to its resistance to disease, was also a straighter-growing cane. In bad attacks of leaf scald, production per acre is reduced by 5 or 6 tons.

* * *

Polish sugar industry relocations[5].—According to a report in the Polish newspaper *Slowo Powszechne*, Polish sugar experts are proposing that some of the sugar factories in the west of the country should be dismantled and removed to the main beet growing districts in the east. In this way the transport of about 1½ million tons of beets across the country would be avoided. Polish sugar consumption is expected to increase with improvement of the standard of living, but the sugar industry as at present would be unable to cover the higher requirements. The number of sugar factories has remained constant in spite of increasing beet crops, and the beet area has been reduced by more than 70,000 ha since 1965 as a result of insufficient factory capacity; nevertheless beet production has increased by a further 2 million tons.

* * *

Cyprus sugar imports[6].—Imports of white sugar into Cyprus in 1969 totalled 15,145 metric tons, of which the principal suppliers were the UK (8193 tons), Yugoslavia (2001 tons), the USSR (1396 tons), Italy (1395 tons) and Czechoslovakia (1205 tons). In 1968 imports totalled 12,750 metric tons, white value.

ISSCT 14th Congress

Mr. NORMAN J. KING, Director of Sugar Experiment Stations in Queensland, will be Chairman of the Agricultural Engineering Section for the 14th Congress of the International Society of Sugar Cane Technologists to be held in Louisiana in 1971.

He advises us that the Programme Committee for the Congress has set the deadline for receipt of all papers at 1st January 1971. All papers for that Section must be in his hands by that date.

The Agricultural Engineering Section was created initially to cover field mechanization in all aspects, but particular interest will lie in advances in mechanical harvesting and loading, and in transport of cane.

Intending contributors who do not have access to the "Rules for Preparing Papers", as set out by the I.S.S.C.T., may obtain a copy from Mr. KING by writing to him at 99 Gregory Terrace, Brisbane, Australia 4000.

Brevities

Indian beet and cane sugar factory[7].—The Rajasthan Government is reported to have decided to establish a sugar cane cum beet diffusion plant at Shri Gangapur. The plant will be set up with machinery supplied from Denmark and of indigenous manufacture, and will have a capacity of 1000–1200 tons per day.

* * *

Sugar factory effluent treatment[8].—The problem of waste water treatment has been under investigation by the Sugar Research Institute, in Queensland, and it has been found that the B.O.D. may be reduced using equipment costing only a fraction of that of previous systems. An experimental 33,000-gallon earthen pond, used initially for testing spray aeration, was provided with a 2 h.p. aerator, as a medium intensity batch type of plant, and was used to treat week-end wastes, while a factory-scale unit uses a Simcar cone aerator, driven by a 7·5 h.p. motor to treat waste waters in a 500,000-gal earth-walled tank. By operating the system close to the mill and using mill power, operating cost is considerable reduced, while there is no odour problem with the system and the treated effluent may be used for irrigation or other purposes.

* * *

Bagasse utilization in Barbados[9].—The Sugar Producers' Association has announced plans for a new process of cane utilization to go into commercial development in 1970[10]. Under the new process it will be possible to obtain several additional by-products from the cane, including raw materials for plywood construction, paper and animal feed.

* * *

Czechoslovakia beet sugar industry contraction[11].—The 1970 beet area in Czechoslovakia is to be the smallest in 35 years and the sugar industry fears that it will not be possible to cover domestic requirements as well as export commitments. The fall in beet area began five years ago when it become possible to change to more profitable crops, the main reasons for the decrease being a lack of the necessary labour, and insufficient fertilizers and harvesting machines. Seventeen sugar factories have closed during the past 12 years.

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[1] C. Czarnikow Ltd.. *Sugar Review*, 1970, (959), 40.
[2] *Australian Sugar J.*, 1969, **61**, 407.
[3] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (3), 4.
[4] *Barclays Overseas Review*, December 1969, 50.
[5] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (3), 4–5.
[6] C. Czarnikow Ltd., *Sugar Review*, 1970, (960), 45.
[7] *Indian Sugar*, 1969, **19**, 457.
[8] *Australian Sugar J.*, 1969, **61**, 298–299.
[9] *Barclays Overseas Review*, December 1969, 50.
[10] See *I.S.J.*, 1969, **71**, 351.
[11] F. O. Licht, *International Sugar Rpt.*, 1970, **102**, (7), 3.

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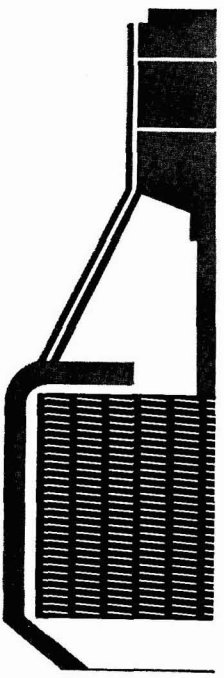

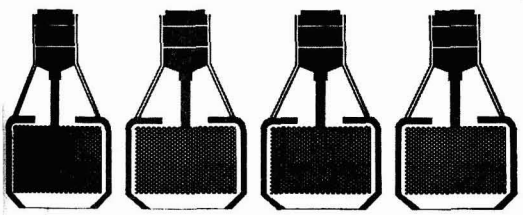

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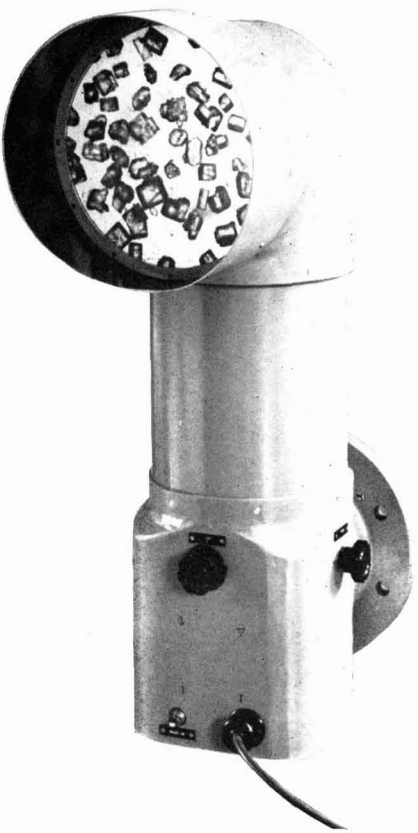

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