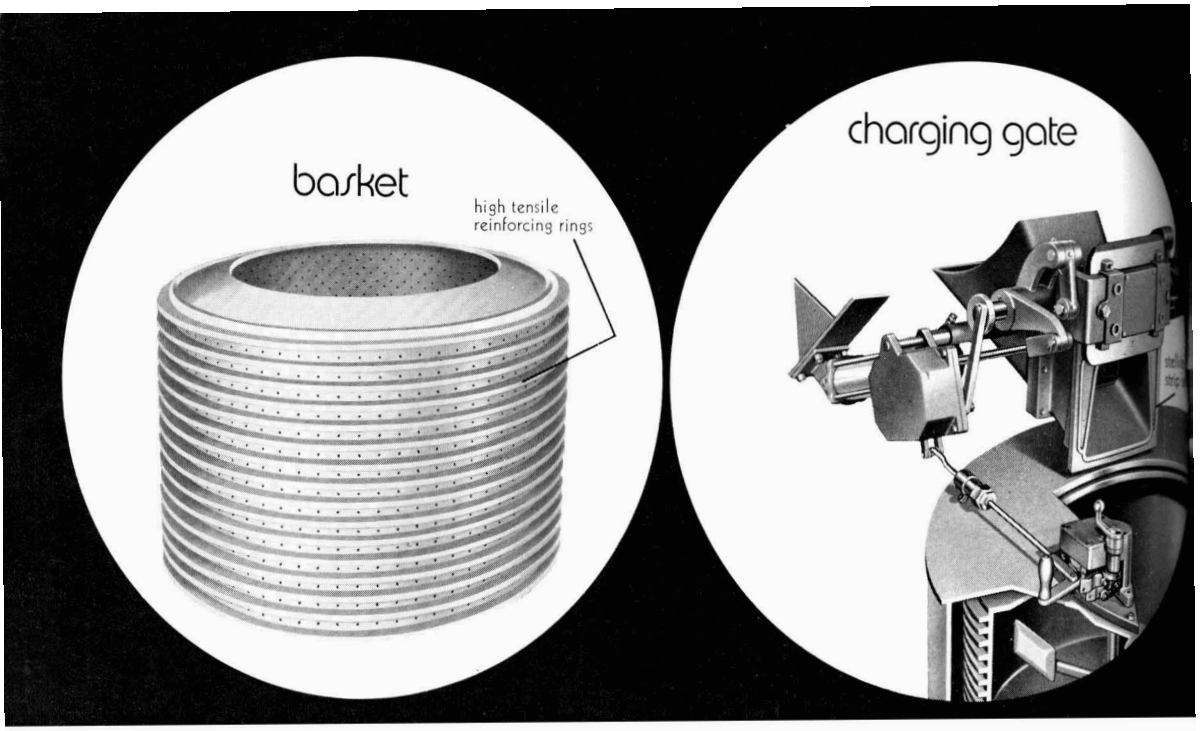
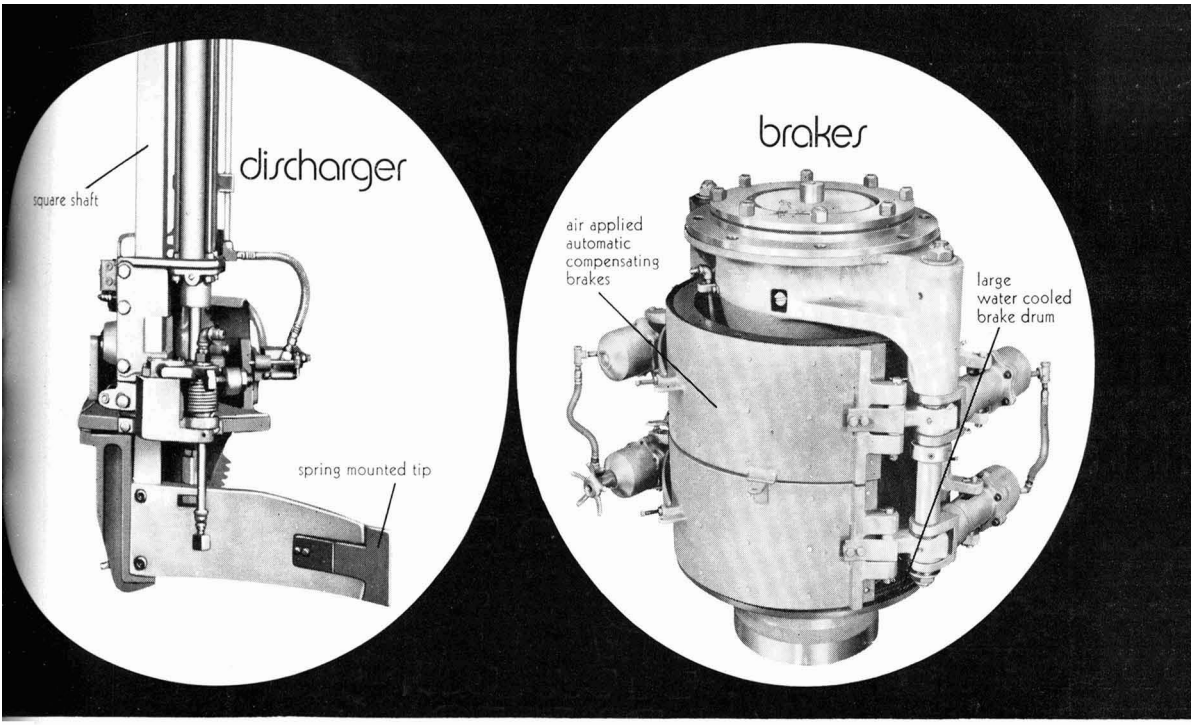
THE International Sugar Journal

SEPTEMBER 1971



western centrifugals cost more and are worth more



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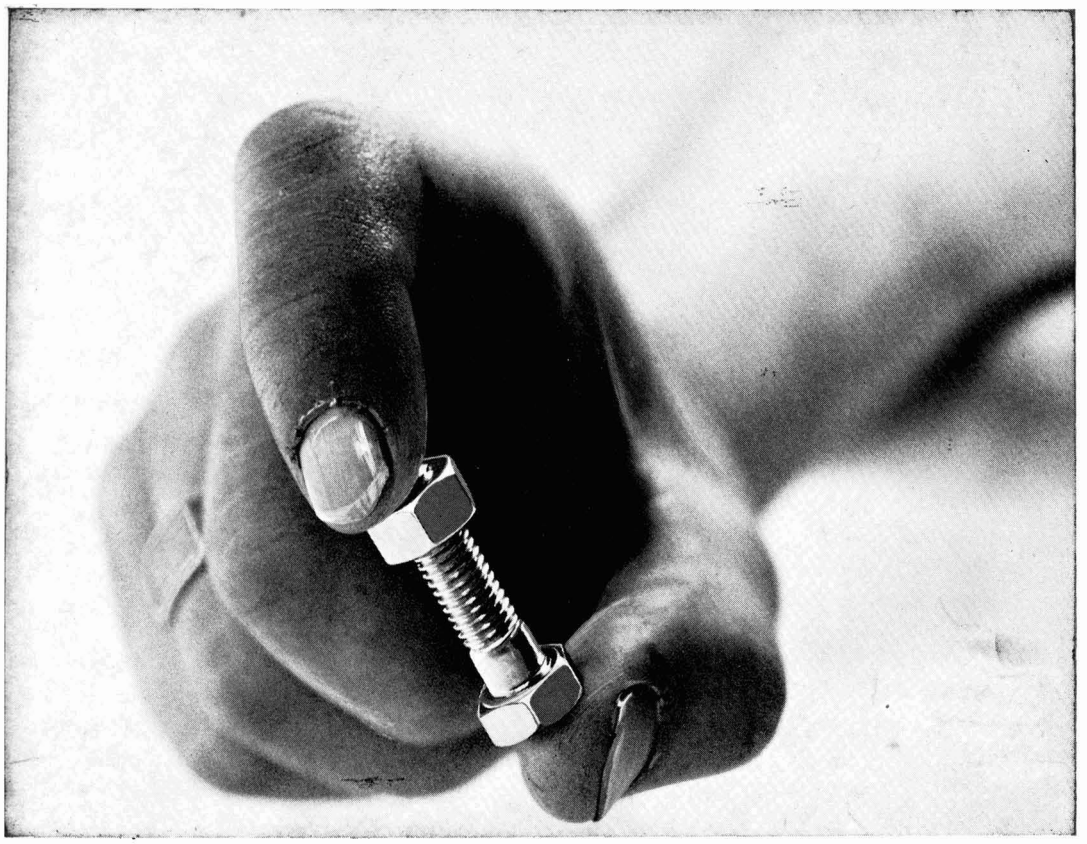

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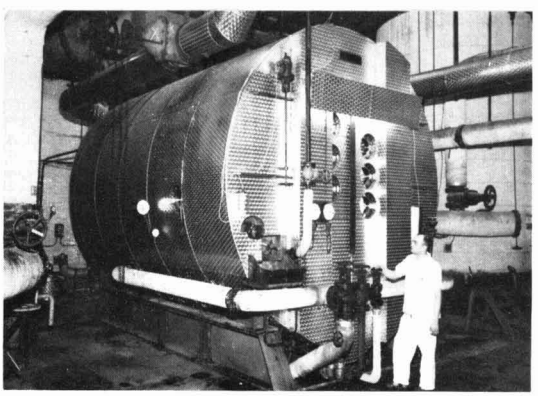
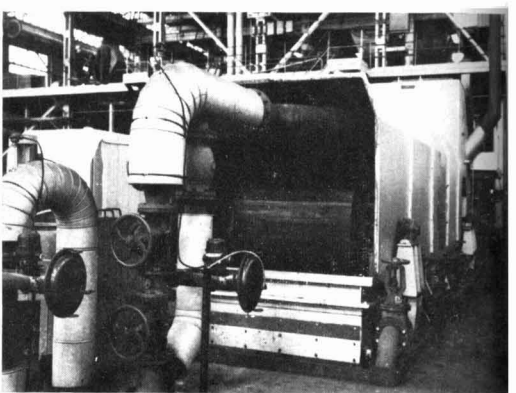
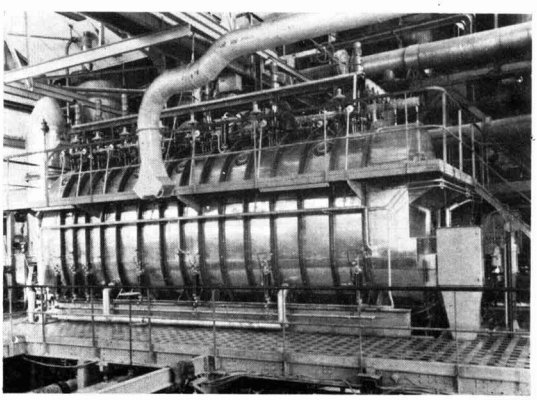


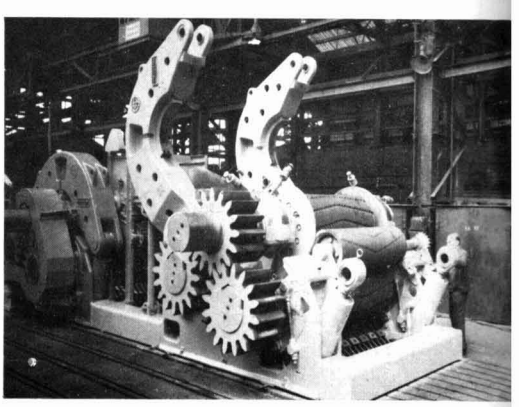
Horizontal vacuum pan with plate type heating element



Prescalder



Continuous vacuum pan



Self-setting cane mills (top housing members raised)

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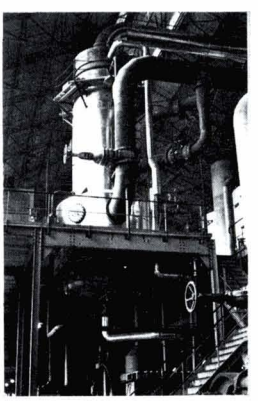
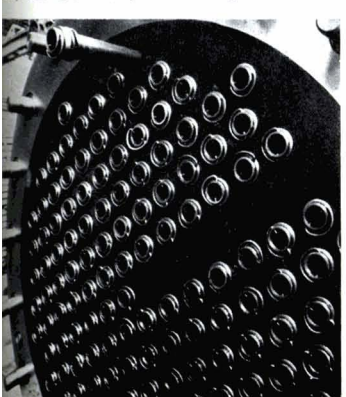
Annular space overflow evaporator



Falling film evaporator



Coaxial juice heater (upper tube sheet)

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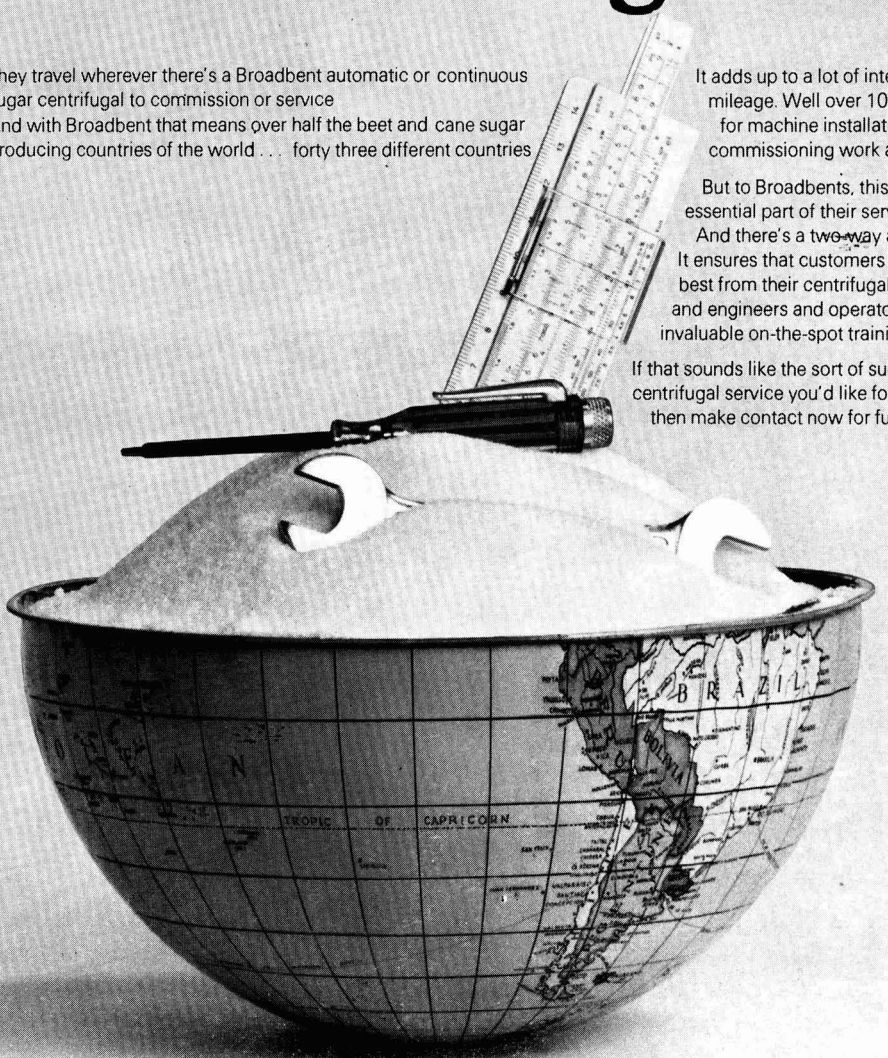

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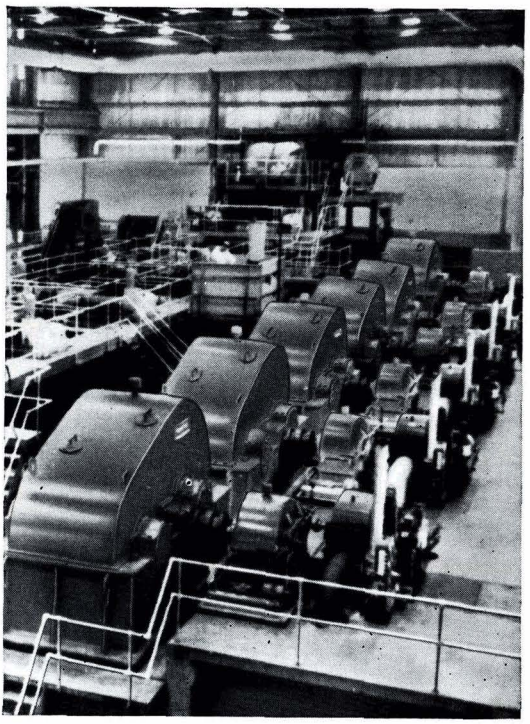

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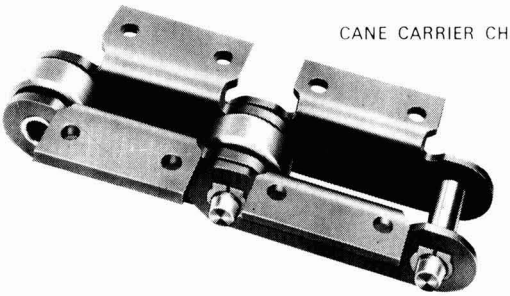
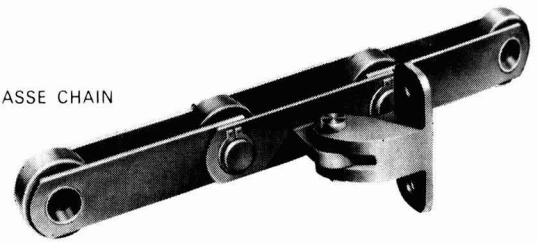
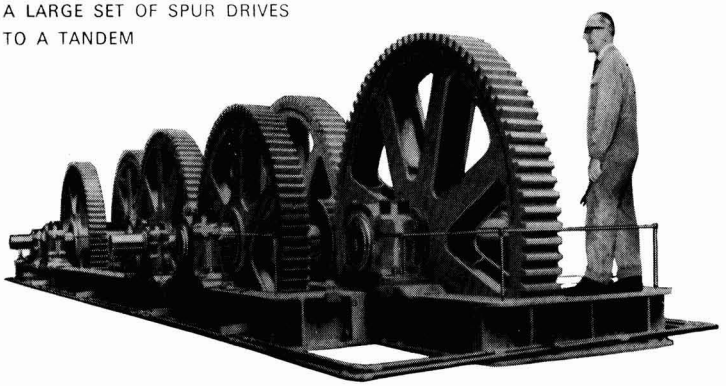


BAGASSE CHAIN



A LARGE SET OF SPUR DRIVES TO A TANDEM



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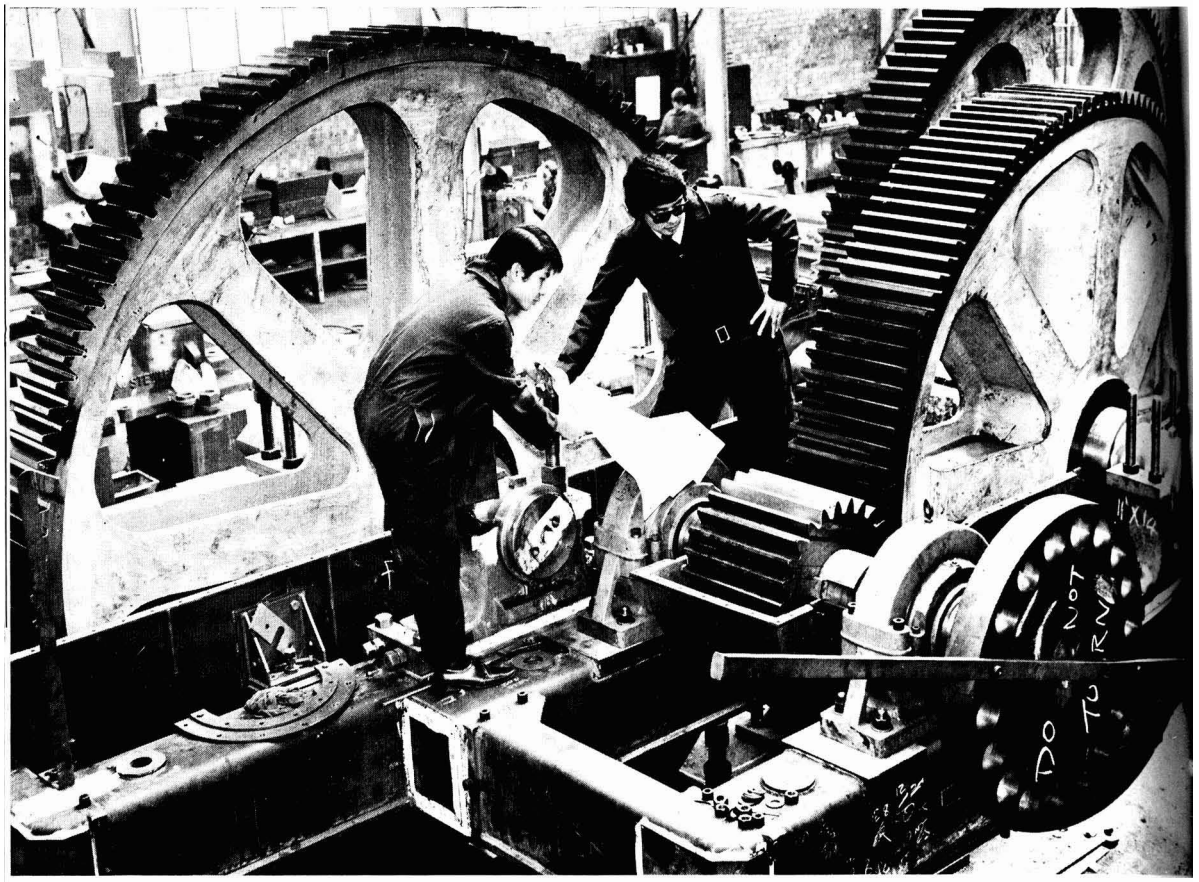

Roads laid, cane fields prepared and cane already growing, foundations completed, factory and office buildings well under way. Much of the machinery has arrived on site and erection has commenced.

Contract engineers and supervisors from Derby are on site and the big "build-up" towards commissioning date has started.

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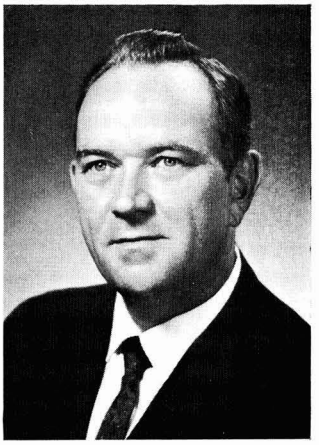
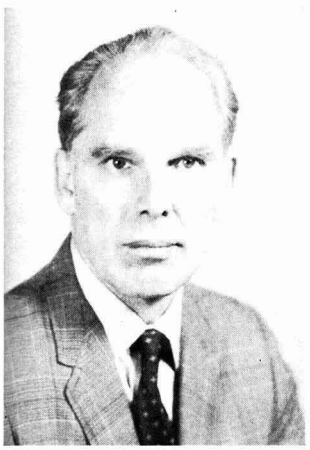


John Bersch, Research and Development

A specialist in sugar factory operations, Mr. Bersch is well known for his achievements in increasing factory output and successful plant expansion programs.



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Identification des anhydrides du D-fructose à l'aide de "l'empreinte digitale" dans le spectre infra-rouge. W. W. BINKLEY, R. W. BINKLEY et D. R. DIEHL. *p.* 259–261

On montre que les sept anhydrides cristallins connus du D-fructose donnent des spectres infra-rouges qui sont distincts pour chaque anhydride et qui permettent donc une identification facile de chacun des sept composés.

* * *

Dessiccation chimique de la canne à sucre. A. G. ALEXANDER et R. MONTALVO-ZAPATA. *p.* 261–265

On passe en revue les travaux sur la défioliation de la canne à sucre en applicant des dessiccants chimiques au lieu de brûler la canne avant la récolte. On note en particulier les effets du "Paraquat" et du "Diquat", des herbicides à base d'ammonium quaternaires.

* * *

Le décanteur rapide Eis. 1re partie. R. A. MCGINNIS, F. G. EIS et O. V. BONNEY. *p.* 265–268

On donne des détails sur le décanteur continu rapide Eis pour le jus de betteraves dans lequel la décantation des boues de 1re carbonatation se fait en moins que 10 minutes. Le jus entre en bas du décanteur par un tuyau d'entrée central et est distribué radialement par une plaque déflectrice vers un lit de boues épaissies. Le jus clair déborde en haut du décanteur. La première partie de l'article décrit l'équipement et le mode opératoire et il cite les avantages du décanteur.

Identifizierung der Anhydride der D-Fructose aus dem "Fingerprint"-Gebiet ihrer Infrarotspektren. W. W. BINKLEY, R. W. BINKLEY und D. R. DIEHL. *S.* 259–261

Es wird gezeigt, dass die sieben bekannten kristallinen Anhydride der D-Fructose Infrarotspektren geben, die für jedes Anhydrid verschieden sind und daher leicht die Identifizierung aller sieben Verbindungen ermöglichen.

* * *

Chemisches Austrocknen von Zuckerrohr. A. G. ALEXANDER und R. MONTALVO-ZAPATA. *S.* 261–265

Es werden die Arbeiten über das Abblatten von Zuckerrohr durch Anwendung chemischer Trocknungsmittel als Ersatz für das Abbrennen vor Ernte besprochen. Hierbei wird besonders auf die Wirkung der Herbizide "Paraquat" und "Diquat" eingegangen, die quaternäre Ammoniumverbindungen sind.

* * *

Der Eis-Schnelleindicker. Teil I. R. A. MCGINNIS, F. G. EIS und O. V. BONNEY. *S.* 265–268

Es werden Einzelheiten mitgeteilt über den kontinuierlichen Eis-Schnelleindicker für Rübensaft, in welchem die Abtrennung des Schlamms der 1. Carbonatation in weniger als 10 Minuten möglich ist. Der Saft tritt am Boden des Eindickers durch ein zentrales Einlassrohr ein und wird durch eine Ablenkplatte radial über die Absetzzone für den Dickschlamm verteilt, während der Klarsaft aus dem oberen Teil des Eindickers in eine Ringleitung fliesst. In Teil I der Arbeit wird die Apparatur und die Arbeitsweise beschrieben. Ferner werden die Vorteile des Eindickers aufgeführt.

Identificación de los anhidridos de D-fructosa de la zona "huella dactilar" de sus espectros infra-rojos. W. W. BIBKLEY, R. W. BINKLEY y D. R. DIEHL. *Pág.* 259–261

Se demuestra que los siete conocidos anhydridos cristalinos de D-fructosa tienen espectros infra-rojos que son distintos para cada anhidrido y por consiguiente permiten identificación sencilla de todos.

* * *

Desecación química de caña de azúcar. A. G. ALEXANDER y R. MONTALVO-ZAPATA. *Pág.* 261–265

Se presenta un examen de trabajo sobre desfoliación de caña de azúcar por aplicación de desecantes químicos en lugar de quemar antes de la cosecha, con atención especial a los efectos de los herbicidos "Paraquat" y "Diquat".

* * *

El decantador tipo "Eis-rápido". Parte I. R. A. MCGINNIS, F. G. EIS y O. V. BONNEY. *Pág.* 265–268

Se presentan detalles del decantador continuo tipo "Eis-rápido" para jugo de remolacha en que separación de la cachaza de la primera carbonatación requiere menos de 10 minutos. El jugo entra al fondo del decantador por un tubo central de entrada y una placa desviadora distribuyele radialmente en una cama sedimentando de cachaza concentrada. El jugo clarificado se desborda a la cabeza del decantador en un artesa. El primer parte de este artículo describe el equipo y su método de operación y escora los ventajes del decantador.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIII SEPTEMBER 1971 No. 873

Notes & Comments

Cuban sugar crop, 1970/71

The 1970/71 season ended in Cuba on the 19th July with a total output of 5,924,335 tons. According to a News Agency report[1], the trade union national executive has stated that, to compensate for this low production figure it will be necessary to bring the 1971/72 harvest forward. As was the case last year, the season will start in November but to avoid grinding in June and July, when the sugar content drops sharply, it will close in May.

In view of the importance of the Cuban crop in the world market, some significant remarks were made by Dr. CASTRO in his speech[2] marking the anniversary of the start of the Cuban revolution. He forecast there there would be no serious improvement in Cuba's sugar production before 1973; the effects of this year's deficit would also be felt in 1972 and recovery would only be possible the following year.

He gave as reasons for the disappointing 1971 results a combination of a reduced sowing of spring and winter cane in 1970, drought, delays in repairing sugar factories, and prolongation of the harvest. Another factor was the use of smaller quantities of herbicides because hard currencies could not be spared for their purchase. However, he noted that twice as much spring cane had now been planted as in 1970 and a special effort was being made throughout the island for winter plantings.

* * *

International Sugar Agreement

Following meetings of the Hardship Relief Committee in July, British Honduras, the Dominican Republic and Fiji received allocations from the Hardship Fund, effective from the 10th August. The allocations were 5000 tons, 60,000 tons and 10,000 tons, respectively, raising the quotas in effect to 28,911 tons, 273,602 tons, and 178,090 tons. The Dominican Republic figure is effectively only a small increase since in March a temporary relief of 60,000 tons had been granted but this was to be reduced progressively by any additional entitlement received under any provision of the Agreement. These had totalled 2541 tons up to July so that, while the balance of the temporary relief has been converted by the new allocation into a firm export entitlement, the quota is only raised by the 2541 tons.

Following rumours in July, Thailand announced that she had decided to leave the Agreement because of an inadequate export quota. She had requested a quota of 120,000 tons but had only received 35,000 tons. Production in the coming season had increased by 10% to 650,000 tons, leaving an exportable surplus of 270,000 tons[3]. However, the difference between requested and actual quotas was not really 85,000 tons as Thailand had previously been awarded a hardship allocation of 10,000 tons and a temporary relief of 34,508 tons. Further, by withdrawing from the Agreement, Thailand loses her rights to all but a small proportion of her former sales to Japan, an important outlet for her sugar. Nevertheless, the requisite notification was given to the Secretary-General of the UN and Thailand also let it be known that she did not wish to be considered for further award from the Hardship Fund. Malaysia welcomed the Thai decision and is reported to be intending to buy sugar from Thailand; other arrangements are reported for sales to Indonesia, Singapore and South Korea, which should offset the loss of the greater part of the Japanese market.

* * *

US Sugar Act

The draft Bill approved by the House of Representatives[4] went to the Senate for study and further hearings and representations were made before its Finance Committee. In July the Committee produced another draft Bill restoring the cuts made by the House in the entitlement of five Latin American sugar producers and also restoring the quota for the French West Indies. The new quota holders suggested by the House were eliminated while the Dominican Republic quota was raised, and that of Peru lowered. For other countries the Senate draft Bill provisions were very similar to existing legislation. The Senate approved its draft Bill, two motions for elimination of the South African quota being defeated. A joint House-Senate conference committee has to be called

[1] Through C. Czarnikow Ltd., *Sugar Review*, 1971, (1033), 125.
[2] *The Times*, 30th July 1971.
[3] *Public Ledger*, 17th July 1971.
[4] *I.S.J.*, 1971, 73, 226.

to produce final legislation for 1972 and this was expected to be done in September 1971.

* * *

The Soviet sugar industry

According to the Soviet sugar journal, *Sakharnaya Promyshlennost'*, the 1971–75 five-year plan of the USSR has as one of its aims a 34% increase in sugar production compared with that of the period 1966–70 in which an average of 8·6 million tons of sugar were produced from 74·4 million tons of beet. Hence a target of 10·9 million tons of sugar from 87 million tons of beet has been set for 1975. This will, of course, be in addition to any white sugar produced from imported raws (2·1 million tons was produced in 1970). The *per caput* consumption of sugar has continued to rise steadily, reaching 39·5 kg in 1970 from 34·2 kg in 1965. Although the number of sugar factories has risen considerably over the years to 310 as at 1st January 1971 (compared with 223 in 1955), representing a total daily slice of 622,000 tons, the campaign length is still somewhat excessive by comparison with other beet growing countries, averaging 139 days in 1969/70 and 143 days in 1970/71.

The longest average campaign was in 1968/69 when 179 days were needed to process 84·1 million tons of beet. It is felt that the campaign could be cut to 90–100 days by further expansion of the industry. A major problem concerns beet sucrose content which in 1970–71 was 0·8% down on the previous campaign average and represented a loss of 1,000,000 tons of sugar. Apart from the reconstruction of new factories and reconstruction of existing plants, much re-equipment has been done since 1966, including the installation of 119 continuous diffusers and 1986 automatic centrifugals. However, some factories operate below rated capacity and with high sugar losses. In 1971–75 capital investment is to be increased by 150% compared with the previous five-year plan, and the daily slicing capacity is to be raised by some 115,000 tons of beet, including the erection of 13 new factories of 43,000 tons/day total slicing capacity.

* * *

European beet sugar production, 1971/72

F. O. Licht K.G. recently issued their 3rd estimate of sugar beet areas for 1971/72[1]. The figure are almost unchanged from the previous estimate[2], the greatest change being a 13,832-hectare increase in the estimate for Turkey while the Italian figure is reduced by 10,000 tons.

As with the previous estimate, Licht have also published estimates of sugar production possibilities based on the new area estimates and the lowest, average and highest yields of the past five campaigns[3]. On the basis of average yields sugar production would be 25,122,000 tons, somewhat above the outturn of 1970/71 (24,771,000 tons) while with the same yields as in their individual highest years, the European countries could produce 27,988,000 tons. On the basis of the highest all-Europe yield in the past five years, the production of sugar could reach 27,219,000 tons. How near this figure actual production will reach will depend on several factors, but the principal one—the weather—has provided good growing conditions in many countries this year.

* * *

India partial sugar decontrol[4]

The Indian Government recently announced the immediate removal of all controls on price and movement of sugar from wholesalers into the channels of distribution. This removes the distinction between the price of rationed sugar and free sugar and all sugar is now sold at free market prices. Excise duties, formerly levied at 37·5% on free sugar and 25% on rationed sugar are now combined in one general rate of 30%. Releases from factories to wholesalers will continue to be subject to control while minimum prices for sugar cane will still be fixed for each season. It is anticipated that these measures will lead to some easing of prices in India and consequently an expansion in consumption.

For the past two years India has been plagued with the problem of overhanging and unsaleable stocks, but it is interesting to note that these new arrangements have been brought into operation at a time when production is expected to fall. According to current estimates the 1971/72 crop will not exceed 3·4 million tons, tel quel, while, even before the introduction of these measures, it was anticipated that domestic consumption this year would be of the order of 3·75 million tons. If the current rate of expansion is maintained, domestic usage will reach 4·0 million tons in 1971/72, to which must be added exports of some 400,000 tons. It is estimated that stocks on 1st October 1971, when the new campaign year starts, will be in the region of 1·8 million tons; by the end of the year, if current estimates are borne out, they will be down to 800,000 tons; this is the level originally recommended in the SEN Commission report of 1965.

* * *

Brazil sugar law[5]

A recent law established guidelines for sugar production, on which plans for 1971/72 output are to be based, as follows: total production by mills may not exceed 6 million metric tons; official production quotas are to apply to regions rather than states and may not be transferred from one region to another; the registrations with the Instituto do Açúcar e do Alcool (IAA) of mills that have ceased production for three consecutive crop years from 1968 are to be cancelled; the IAA is to approve annual crop plans by 31st May instead of 30th April; and the period during which the IAA may revise mills' production quotas is reduced from five to three years. The plans of the IAA for sugar production in 1971/72 call for an output of 5·1 million tons, including 3,420,000 tons in the Centre-South region and 1,680,000 tons in the North and North-East.

[1] *International Sugar Rpt.*, 1971, **103**, (20), 1–2.
[2] *I.S.J.*, 1971, **73**, 162.
[3] *International Sugar Rpt.*, 1971, **103**, (21), 1–3.
[4] C. Czarnikow Ltd., *Sugar Review*, 1971, (1027), 102.
[5] *Bank of London & S. America Review*, 1971, **5**, 411.

Identification of the anhydrides of D-fructose from the "fingerprint" region of their infrared spectra

By W. W. BINKLEY* with R. W. BINKLEY and D. R. DIEHL†

DURING the production of sucrose from cane juice, an accumulation of reducing sugars occurs, reaching 20 to 25% in the final molasses. These sugars, largely D-glucose and D-fructose, are subjected in the processing to conditions of high temperatures and intense dehydrations (water removal under vacuum). These conditions promote the condensation, polymerization and decomposition of these sugars[1], especially D-fructose, which is more labile. Heated aqueous solutions of D-fructose yield anhydrides and melassigenic polymers (caramels). One of these anhydrides has been isolated from cane molasses distillery slop[2] and their probable presence noted in the products of the high Brix inversion of sucrose[3]. Seven crystalline D-fructose anhydrides are known[4,5].

Identification of the individual anhydrides by classical methods is laborious. However, the "finger print" region (1000 to 700 cm^{-1}) of the infrared spectrum of each of these anhydrides is characteristic and different from each of the others and offers a facile and rapid method for their identification. We wish to record herein the "fingerprint" regions of the infrared spectra of the reported D-fructose anhydrides.

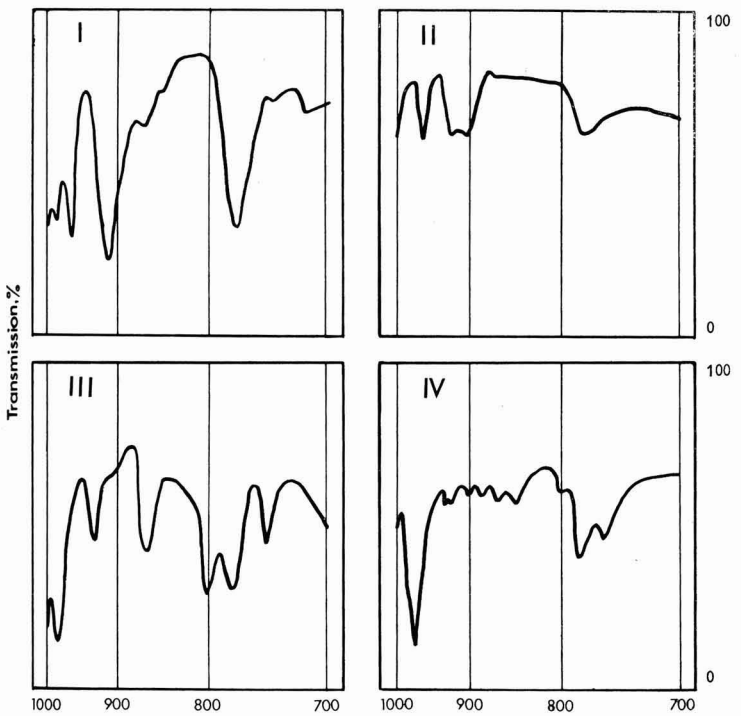

Fig. 1.

Experimental

Materials.—Di-D-fructose anhydrides I, II and III were prepared from inulin by the methods of JACKSON and GEORGEN[6] (I) and JACKSON and MCDONALD[7] (II and III).

Diheterolevulosans I, II, III and IV were prepared from D-fructose as described by WOLFROM and BLAIR[8] (I and II), WOLFROM *et al.*[4] (III) and WICKBERG[5] (IV).

Technique.—The sugars were dispersed in potassium bromide (about 1 mg per 100 mg KBr). The spectra shown in Figs. 1 and 2 and the data presented in Tables I, II and III were obtained with an infrared spectrophotometer‡.

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[1] BINKLEY: *I.S.J.*, 1961, **63**, 75.
[2] SATTLER & ZERBAN: *Ind. Eng. Chem.*, 1945, **37**, 1133.
[3] STACHENKO: "Notes on the Formation of Organic Substances in the Production of Liquid Invert", Inter-Company Report of Canada and Dominion Sugar Co. Ltd., Montreal, Canada.
[4] WOLFROM *et al.*: *J. Amer. Chem. Soc.*, 1952, **74**, 2867.
[5] WICKBERG: *Acta Chem. Scand.*, 1954, **8**, 436.
[6] *J. Research* (Nat. Bur. Standards), 1929, **3**, 27.
[7] *ibid.*, 1931, **6**, 709.
[8] *J. Amer. Chem. Soc.*, 1948, **70**, 2406; see also WOLFROM *et al.*: *ibid.*, 1951, **73**, 3553.

‡ Model IR-8, Beckman Instruments Inc., Fullerton, Calif., USA.

Table I. Bands (cm^{-1}) observed in the "fingerprint" region of the infrared spectra of the diheterolevulosans

Diheterolevulosan	*Type*[9]					
	1 *or* A	I *or* B	2 *or* C	IIA	3 *or* D	
I	910	868			747	
II	922/ 904				781	
III	929	867		803	778	747
IV	931/ 914/ 902	887/ 867	846	801	783	761

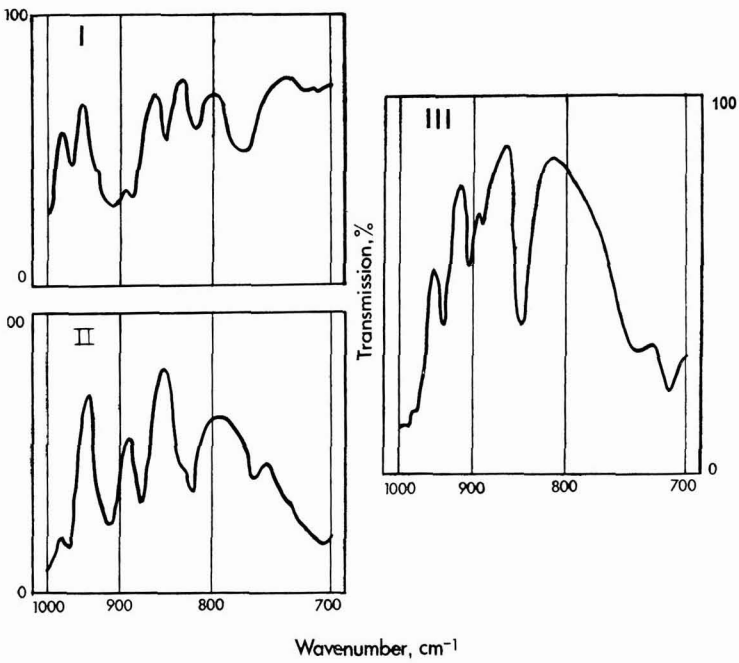

Fig. 2.

Table II. Bands (cm^{-1}) observed in the "fingerprint" region of the infrared spectra of the di-D-fructose anhydrides

*Di-*D*-fructose anhydrides*	*Type*[9]					
	1 *or* A	I *or* B	2 *or* C	IIA	3 *or* D	
I	909	890	850	817	773	
II	916	867		823	765	
III	941	899	849			713

Table III. Bands (cm^{-1}) observed in the "fingerprint" region of the infrared spectra of sucrose, D-glucose and D-fructose

Sugar	*Type*[9]					
	1 *or* A	I *or* B	2 *or* C	IIA	3 *or* D	
Sucrose	943/ 909	870	851			732
D-Glucose	917		844		766	
D-Fructose	967/ 914	861		815	776	

Results and Discussion

The infrared spectra of sugars are often quite similar in the range of 4000 to 1000 cm^{-1}; however, in the range of 1000 to 700 cm^{-1} (the "fingerprint" region) bands often appear which are characteristic of individual sugars. Thus, small differences in the structures of the D-fructose anhydrides are reflected in distinct band patterns. All of these sugars possessed bands or groups of bands in the 900 to 940 cm^{-1} region (Type 1 or A)[9,10]. These bands indicate the probable presence of a cyclic structure in these anhydrides. The infrared spectra of the diheterolevulosans (Table I) showed in common only one other band, 774 to 783 cm^{-1} (Type 3 or D)[9], which has been attributed to the pyranose structure in 2-ketoses[11]. Diheterolevulosans I, III and IV spectra possessed bands at 867 and 868 cm^{-1} (Type I or B)[9]. Since some aldoses also show these bands[12], they have no diagnostic significance in this instance. Each of the di-D-fructose anhydrides exhibited also Type I or B bands, 867 to 899 cm^{-1}. Di-D-fructose anhydrides I and III displayed bands at 850 and 849 cm^{-1}[11] (Type 2 or C)[9] attributable probably to the furanose structure[11]. Type 2 or C band was not present in the spectra of di-D-fructose anhydride which possesses two furanose rings[7]. The bands at 773 and 765 cm^{-1} (Type 3 region)[9] in di-D-fructose anhydrides I and II must result from contributing factors other than the pyranose structure[11] which is not present in these sugars. Other bands useful in the identification of certain of these sugars were observed in the range of 713 to 761 cm^{-1} [diheterolevulosans III (747 cm^{-1}) and IV (761 cm^{-1}), di-D-fructose anhydride III (713 cm^{-1}) and sucrose (732 cm^{-1})]. Although their significance has not yet been determined, it was noted that in this instance these bands were present in the

[9] VERSTRAETEN: *Anal. Chem.*, 1964, **36**, 1040.

[10] BARKER & STEPHENS: *J. Chem. Soc.*, 1954, 4550.

[11] VERSTRAETEN: *Carbohyd. Res.*, 1966, **1**, 481.

[12] TIPSON: *National Bureau Standards Monograph*, 1968, (110).

spectra of certain of these disaccharides, absent from the spectra of the monosaccharides, D-glucose and D-fructose.

The infrared spectra of the anhydrides of D-fructose are readily distinguished from those of the principal sugars of cane products, sucrose, D-glucose and D-fructose (Table III).

Summary

The seven known crystalline anhydrides of D-fructose give readily distinguishable different infrared spectra which permits their facile identification.

Acknowledgement

Diheterolevulosan IV was kindly supplied by Dr. B. WICKBERG.

Chemical desiccation of sugar cane

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INTRODUCTION

PREHARVEST burning or "detrashing" is a common practice designed to lower the percentage of extraneous material shipped to the factory and to facilitate harvest procedures. It has been estimated that when leaves accompany stalks during milling operations the sugar recovery is lessened in the order of one pound of sucrose for every 30 pounds of leaves delivered with the cane[1]. Similarly, the milling of fresh unburned cane will produce a minimum loss of 5 pounds of sucrose per ton of stalks. ARCENEAUX[2] estimates that trash deliveries to the factory in Puerto Rico reduced sugar recovery in the order of 22 pounds per ton of cane.

BIRKETT[3] lists four kinds of losses caused by trash in harvested sugar cane:

1. Harvesting and transportation costs accrue for trash just as though it was millable cane.

2. Trash contributes fibre without contributing sugar; hence, there is an increase of bagasse which contains unextractable sugar residue.

3. Extractable fluids in the trash contain impurities which in turn lower the purity of cane juice.

4. Trash and extra fibre increase milling time and add to the wear on factory machinery.

Additional problems related to the presence of trash include greater insect infestations, larger rat populations, and reduced effectiveness of pre-emergence herbicide treatments. No less important is the fact that trash removal, even moderate trash removal, will increase enormously the effectiveness of mechanical harvesting operations. Recent studies in Puerto Rico[4] have shown that reducing extraneous material by as little as 3·9% markedly eased the work of the harvest-machine operator and increased harvest efficiency.

Although the need to eliminate trash before milling is widely recognized this is seldom accomplished to the satisfaction of growers and factory managers. Under humid conditions the preharvest burn is frequently rendered ineffective with the result that the TC/TS ratio and trash/cane ratio is increased significantly. Even with ideal weather there is no assurance of uniform burn, and BATES[5] concluded from aerial observations that fires tend to "channel" even within an apparently uniform field. In Puerto Rico preharvest burning has been practised since the late 1940's with but very limited success in the humid and semi-humid areas. More recently there has been an added problem of cane held over from the previous season owing to a diminishing labour force and insufficiency of harvest machines. In such instances there are masses of fallen stalks sheltered by a younger green canopy which resists alike the penetration of sunlight and artificial drying agents. For these reasons there is an urgent need for safe and inexpensive compounds that will consistently produce favourable burning conditions just prior to harvest.

THE SEARCH FOR CHEMICAL DESICCANTS

A theoretical means of accomplishing desiccation is by chemical defoliation. Defoliants are used successfully on such crops as cotton, potatoes and certain legumes. In these instances burning is not an objective and the defoliation process is helped immensely by a sensitive abscission layer localized at the base of the petiole. No such structure exists in sugar cane. As in most grasses, leaf fall is usually prompted by mechanical disturbance after the death and partial decomposition of a leaf sheath which clings tenaciously to the stalk.

A more practical means of leaf removal from sugar cane is by desiccating the attached leaf and disposing of it by fire immediately before or after cutting the stalk. In order for any chemical to aid this process appreciably it must produce an enormous amount of drying and it must do so cheaply and without harming cane quality. BATES[5] lists three requirements of a chemical desiccant suitable for use on sugar cane:

1. It should be inexpensive, safe to handle, and readily dispersed with low-volume aerial equipment.

[1] ARCENAUX and DAVIDSON: *Sugar Bull.*, 1944, **22**, 151.
[2] *Tech. Bull, Commonwealth of Puerto Rico, Dept. of Agriculture*, 1963, (1).
[3] BIRKETT: Private Report, Bookers Sugar Estates, Guyana, 1962.
[4] CAYERÉ-ECHEVARRÍA: *Proc. Ann. Congr. Assoc. Sugar Tech. Puerto Rico*, 1969.
[5] *Proc. B.W.I. Sugar Tech.*, 1960, 43–48.

2. It should have a rapid systemic action, essentially independent of post-application weather conditions, and it should leave no undesirable residues.

3. It should not affect the quality of the current crop nor the growth of ratcon crops.

Early desiccant studies generally centred around oils, applied either singularly or "fortified" with another compound, and inorganic salts such as chlorates, borates, nitrates and phosphates. Characteristic of these types was a localized non-systemic action requiring large solution volumes in order to contact a maximum leaf area. A third group consisted of organic desiccants having some systemic action and low-gallonage requirements that could be approached by aerial application. Regardless of materials being tested the early investigator was mainly interested in practical results, that is, the extent of desiccation, time required to produce desiccation, and chemical effects on juice quality. After more than two decades this approach has failed to discover a totally satisfactory desiccant.

In 1945 ARCENEAUX and DAVIDSON[6] tested cyanamide as an aerial dust at rates of 30, 60, and 90 pounds per acre on the variety C.P. 29-320. Results showed that only fully-exposed leaves were desiccated while the bulk of the green top remained unaffected. Desiccation improved with increasing cyanamide level but no appreciable improvement in burning was obtained even at 90 pounds per acre. Moreover, treated cane failed to accumulate sugar after receiving the chemical while control plants continued to accumulate sugar at the rate of some 22 pounds per ton of cane over a 27-day interval.

According to YOUNG[7], the first desiccant trials in Hawaii were established by R. K. CONANT at the Olau Sugar Company early in 1944. Materials included straight diesel oil, a diesel oil emulsion, and sodium chlorate, each applied by a roadside spray truck. Sodium chlorate produced rapid drying and improved subsequent burns but damaged the ratoon crop. YATES and BATES[8] severely lowered juice quality with sodium chlorate tested as a sugar cane defoliant. Other early compounds tested in Hawaii were "Chile potash nitrate" and trisodium phosphate. Later trials included sodium monochloroacetate, CMCA (also termed "Dow Defoliant"), "Shed-A-Leaf", "De-Fol-Ate" (magnesium chlorate) and S-4069[7]. Drying proficiency varied among the compounds while each tended to lower juice quality.

In 1951 COLEMAN and HEBERT[9] tested "Shed-A-Leaf" combined with sodium chlorate and sodium pentaborate at the rate of 30 pounds per acre on the variety C.P. 36-105. Quality decline was noted at 18, 25, and 39 days after treatment. Tests with "Dalapon" begun in 1953 showed that rates sufficiently high to produce desiccation also lowered the sucrose yield. COLEMAN and HEBERT likewise obtained poor results with pentachlorophenol and "Endothal". Other agents tested in Hawaii include "Magron" (another formulation of magnesium chlorate), dinitrobutylphenol (applied alone and combined with oils), "OSA" in oil, "WSA" in water, aqueous ammonium sulphate, and ocean water[7].

In 1960 BATES[5] summarized desiccant trials performed in Guyana with 12 chemicals already giving positive results in cotton or other crops. The majority produced negative or inconclusive results when applied to 8–12 months old cane (varieties B. 41227 and B. 37161) at rates of 12·5 to 25 gallons per acre. Butynediol, an unsaturated glycol used as a defoliant of cotton, castor and soya bean, and fruit trees at 2 to 6 pounds per acre, failed to desiccate sugar cane at less than 7·5 pounds per acre, and then only after 96 hours had elapsed. Combination of butynediol with aminotriazole and chelated copper failed to produce a synergistic effect as had been reported for other crops. An organic compound, cacodylic acid (dimethylarsinic acid), used experimentally as a cotton desiccant[10], did not appreciably desiccate sugar cane within 10 days when applied at two, four, and eight pounds per acre. Sodium monochloroacetate produced "mediocre" results when tested on cane at 15 to 40 pounds per acre. This compound is effective on forage legumes but appeared to be of little value for sugar cane even at 40 pounds per acre.

According to DAVIDSON[11], COLEMAN conducted additional desiccant studies (unpublished) at the Houma Station between 1957 and 1959. Results showed that sodium chlorate and magnesium chlorate, polychlorobenzoic acid, and "Ammate" at 100 to 400 pounds per acre were slow-acting and required six or seven days to achieve a drying level suitable for burning. Each chemical significantly lowered juice quality. The compounds "Golden Harvest" (pentachlorophenol) and C-56 (hexachlorocyclopentadiene) were effective within two days when applied in diesel oil. Also tested during this period was sodium pentachlorophenate, which was unsatisfactory as a cane desiccant, and "Diquat" (1:1′-ethylene—2:2′-dipyridylium dibromide) which proved to be the most promising chemical of the series.

Other compounds offering some early promise as cane desiccants included "Folex", "Endothal", "Borochlor" (sodium chlorate plus sodium borate), "Magron" (magnesium chlorate hexahydrate) and "Monuron" (CMU). Diesel oil continued to be tested for many years. Aerial application of diesel oil at 5 gallons per acre or less produced phytoxicity without appreciable desiccation in Guyana[5]. When fortified with PCP or dinitrobutylphenol there was good desiccation within 24 hours; however, the mixture's extreme toxicity was regarded as prohibitive against general use. "Folex" also has a high degree of mammalian toxicity which precludes safe testing with hand equipment. BATES[5] obtained general desiccation with "Endothal" but "Borochlor"

[6] *Sugar Bull.*, 1948, **26**, 230.
[7] YOUNG: *Rpts. Hawaiian Sugar Tech.*, 1955, 96.
[8] *Proc. B.W.I. Sugar Tech.*, 1957, 174–189.
[9] *Sugar Bull.*, 1957, **35**, 389.
[10] SKOGLEY and AHLGREN: *Proc. Northeastern Weed Control Conf.*, 1955, **9**, 401.
[11] *Proc. 11th Congr. I.S.S.C.T.*, 1962, 319.

lowered sheath moisture less than 1% even at the "high" level of 40 pounds per acre. BATES was also unable to produce desiccation with CMU at 2·5 and 5 pounds per acre over a 2-week interval. Earlier tests in Hawaii had shown CMU to be effective between 2 and 5 pounds per acre[12].

QUATERNARY AMMONIUM HERBICIDES

In recent years the compounds "Paraquat" and "Diquat" have become almost synonymous with the term "desiccant" in sugar cane-growing regions. Herbicidal properties of "Diquat" [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazidinium salt] and "Paraquat" (1,1'-dimethyl-4,4'-dipyridinium salt), were first discovered by BRIAN *et al.*[13] in 1955, although certain quaternary ammonium compounds had been used as redox indicators under the name of "viologens" since 1933[14,15]. While evaluating several quaternary ammonium compounds at Jealott's Hill Research Station, investigators found one chemical having particularly striking herbicidal activity. It was originally prepared by R. J. FIELDEN at Blackley by quaternizing 2,2'-dipyridyl with ethylene dibromide, a reaction which produces the single crystalline product 1:1'-ethylene-2:2'-dipyridylium dibromide. Since the compound is usually formulated in water and used in aqueous solution, the monohydrate is the form usually obtained and this product was given the common name "Diquat"[16].

BATES[5] reported that initial "Diquat" evaluations as a sugar cane desiccant were highly promising even when spray applications were followed by rainfall. Applied at rates of 1, 2, 3 and 4 pounds per acre, each treatment produced clear phytotoxic action in the leaf lamina within 48 hours and pronounced desiccation within 72 hours. BATES also tested a second quaternary ammonium compound, "Paraquat" (then identified only as P.P. 910), in direct comparisons with "Diquat". A claim that P.P. 910 was more active in grasses than "Diquat" appeared to be verified although both compounds produced good desiccation. DAVIDSON[11] obtained similar results with "Diquat". Application with knapsack sprayers of 1–2 pounds per acre in 125 gallons of water produced marked drying within 2 to 3 days in clear weather. Lesser drying was noted during cloudy weather. In Queensland, VALLANCE[17] obtained comparable desiccation with "Diquat" ranging from 2·5 to 10 pounds per acre. However, in a later report[18] VALLANCE stated that "Diquat" applied as a foliar spray for weed control severely damaged the cane and lowered c.c.s. values at rates of 2 and 4 pints per acre. VALLANCE appears to have been the first to recognize a danger in delaying harvest after treating sugar cane with this chemical. Holding the varieties Pindar and Q.57 for 16 and 11 days, respectively, led to reduced sugar yields.

In general, investigators working with "Diquat", and later with "Paraquat", found these materials to be superior to earlier desiccants. Among their desirable properties are low mammalian toxicity, solubility in water, rapid absorption, and inactivation upon contact with the soil. More recently they have been used with success in sugar cane flower control[19,20] and in weed control[21,22,23]. In fundamental research both "Paraquat" and "Diquat" have been useful in studies of photosynthetic reactions and mechanisms of enzyme control [24,25,26,27].

"Diquat" has also been described as a contact herbicide whose unusually rapid desiccation is limited to aerial tissues[28]. It has been used as a desiccant on Irish potatoes[16,29] and cotton[28], as an arboricide[30], and as a crabgrass killer in tomatoes[31]. Both "Diquat" and "Paraquat" have given post-emergence weed control under fruit trees[32] and have controlled aquatic weeds[33,34]. Owing to its ease of handling and low mammalian toxicity, CALDERBANK[28] describes "Diquat" as "a very pleasant alternative" to such compounds as sulphuric acid, arsenite, pentachlorophenol, and dinitrobutylphenol.

ROBSON and PROCTER[35], of Plant Protection Ltd., quite generously depict "Paraquat" in the following terms:

"'Paraquat' treatment ensures an almost perfect burn of the green tops and sets in motion a long chain of economic savings, terminating in less trash going to the factory and a significant increase in sugar recovery."

Unfortunately, neither "Paraquat" nor "Diquat" have performed this well for the majority of workers testing them. The most frequent complaint has been quality deterioration within a few days after treatment, i.e. the third requirement listed by BATES[5] has not been met. Other workers find that outward symptoms of "scorch" or desiccations do not necessarily lead to better burns, apparently owing to unaffected leaf tissue more or less protected from the spray within or beneath the green canopy.

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[12] ANON: *Ann. Rpt. Exp. Sta. H.S.P.A.*, 1956.
[13] *Nature*, 1958, **181**, 446.
[14] MICHAELIS and HILL: *J. Gen. Physiol.*, 1933, **16**, 859.
[15] *idem: J. Amer. Chem. Soc.*, 1933, **55**, 1481.
[16] CRONSHEY: *Weed Res.*, 1961, **1**, 68.
[17] *Rpt. Queensland Bur. Sugar Exp. Sta.*, 1960, 25.
[18] *ibid.*, 1961, 25.
[19] HUMBERT *et al.: Proc. 13th Congr. I.S.S.C.T.*, 1969, 462.
[20] TANIMOTO and NICKELL: *Proc. 12th Congr. I.S.S.C.T.*, 1967, 113.
[21] THOMPSON and GOSNELL: *Proc. S. African Sugar Tech. Assoc.*, 1963, 143.
[22] THOMPSON: *S. African Sugar J.*, 1962, **46**, 313.
[23] GOSNELL and THOMPSON: *Proc. S. African Sugar Tech. Assoc.*, 1964, 166.
[24] ALEXANDER and MONTALVO-ZAPATA: *J. Agric.* (Univ. Puerto Rico), 1969, **53**, 230.
[25] *idem. ibid.*, 1970, **54**, 28.
[26] *idem. ibid.*, 247.
[27] *idem. ibid.*, 264.
[28] CALDERBANK: *J. Agr. Vet. Chemicals*, 1960, **1**, 197.
[29] CALDERBANK *et al.: Analyst*, 1961, **86**, 569.
[30] GUNN and TATHAM: *Nature*, 1961, **189**, 808.
[31] COLBY and WARREN: *Science*, 1963, **141**, 362.
[32] AMLING *et al.: Proc. S. W. C.*, 1963, **16**, 164.
[33] LAWRENCE *et al.: Proc. 16th Southeastern Assoc. Game and Fish Comm.*, 1962.
[34] *idem.: Proc. S. W. C.*, 1963, **16**, 366.
[35] *World Crops*, 1963, 264.

YIELD AND QUALITY EFFECTS OF DIPYRIDYL DESICCANTS

The quaternary ammonium herbicides have shown a number of excellent properties as fast-acting sugar cane desiccants. However, inconsistencies have been reported relative to their effects on cane tonnage and quality, and in some instances they have not performed according to expectation even as drying agents. In general terms the problems of adequate application and absorption have not been solved. In a strictly physiological-biochemical context the problem of having a large portion of sugar-synthesizing tissue destroyed, albeit only temporarily, has not been reconciled with the minimal sugar needs for growth and ripening. The systemic action needed to make low-volume application feasible has not been obtained in spite of promising early reports. In short, the best desiccants presently available to the sugar cane industry, i.e. "Diquat" and "Paraquat", destroy too much sugar and perform too little drying to meet the requirements of producers and factory operators.

Initial tests with "Paraquat" and "Diquat" in Natal underscored their unusual proficiency as sugar cane herbicides[21,22,23]. THOMPSON and GOSNELL[21] found that "Paraquat" was more effective than other herbicides in controlling two of the most serious weeds, *Cyperus esculentus* and *Panicum maximum*, as well as other weed species, where normally reliable compounds such as CMU and DCMU have not been satisfactory. However, "Paraquat" at 4 pints per acre produced a typical leaf desiccation or "scorch" requiring about a month for recovery[22]. It was also claimed that "Paraquat" at 4 pints per acre and "Diquat" at 2 pints per acre significantly increased cane "vigour" within about 3 months[21]. Experiments conducted at Mt. Edgecombe[23] showed that "Paraquat" caused no reduction of yield in trials carried through to harvest. Yields were actually increased as greater quantities of the chemical were applied, and the herbicidal effect was reportedly extended more than 12 weeks by combination with "Bromacil".

Subsequent studies by GOSNELL and THOMPSON[36] with five varieties at different stages of growth did not bear out their earlier observations of increased vigour in response to "Paraquat". It should be noted that the later report was based upon a more complete set of data whereas the earlier interpretations of increased vigour were apparently based on visual rankings. In one instance "Paraquat" at the rate of ¾ pound per acre caused a loss of stalks amounting to 28,000 stalks per acre. There was a reduction of the length, diameter, and weight of stalks which was not reversed with time. The net effect was a 5–12% reduction in yield with the loss more pronounced as applications were delayed.

"Paraquat" and "Diquat" have been implicated repeatedly in sugar cane quality decline. Unpublished work by COLEMAN, as described by DAVIDSON[11], revealed that "Diquat" produced but little drying action during cloudy weather, and in bright sunlight sucrose ceased to accumulate for about 3 weeks after treatment. Other unpublished work by COLEMAN[11] suggests that sucrose accumulation is restricted up to 70 days after "Diquat" treatment. VALLANCE[17], in Queensland, obtained excellent drying and trash reductions amounting to about 5% with 2·5 to 10 pounds of "Diquat" per acre; however, sugar losses occurred in the order of 1·5 c.c.s. units. Furthermore, VALLANCE noted that "Diquat" was not translocated and therefore thorough coverage by the spray treatment was needed to effect good desiccation. This observation contrasts sharply with the highly systemic action of "Diquat" reported by BATES[5] under humid conditions in Guiana. In Louisiana, DAVIDSON[11] used "Diquat" to improve the post-harvest burn for variety N:Co 310, but lost sugar in the process. The smallest loss of sucrose at 4 days was approximately 6 pounds per ton of cane, an effect which DAVIDSON estimates is roughly equivalent to milling fresh or unburned cane. Additional delay before grinding greatly increased the sugar losses in "Diquat"-treated material.

CHEN and LIU[37], studying the effects of "Paraquat" as a foliar desiccant in Peru, found that juice quality declined concurrently with leaf desiccation, particularly in the upper half of the stalk. These authors stressed the importance of correctly timing the harvest. Cutting the cane too early gave insufficient time for desiccation and cutting too late permitted excessive juice deterioration. They concluded that no net gain of sucrose could be obtained by trash reduction unless juice quality was retained. ARVIER[38] obtained similar results with "Paraquat" in Queensland. He concluded that sucrose losses occur too rapidly to be offset by improved burning efficiency.

Recent "Paraquat" trials in Puerto Rico[4] have shown a marked visible desiccation while actual trash reduction has been so small as to preclude economical use of the chemical. This information came at a time when the P.R. sugar industry was urgently in need of a suitable desiccant owing to inclement weather, labour shortage, and large acreages of held-over cane. In a series of experiments during 1968 and 1969, 2 pints of "Paraquat" per acre in 16 gallons of water produced good desiccation of all tissues contacted by the spray. Little additional desiccation was produced with 4 pints per acre. An average sucrose loss of 5·6% was obtained. It was concluded that use of more than 2 pints of desiccant per acre, or delay of more than 6 days before harvest, would result in significant sucrose losses. In addition it was estimated that a minimal trash reduction of 5% was needed to cover treatment costs amounting to $12.00 per acre. Since the average reduction of extraneous material was only 3·9%, it was felt that "Paraquat" does not offer an acceptable trash reduction.

[36] *Proc. 12th Congr. I.S.S.C.T.*, 1967, 493.
[37] *Sugar J.*, 1965, **27**, 22.
[38] *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 125.

The less than satisfactory performance of "Paraquat" in Puerto Rico tended to verify earlier results obtained by GUMBS[39] in Guyana. Anong other observations GUMBS noted that "Paraquat" increased the stalk moisture content, apparently as a result of restricted transpiration at a time when water uptake from the soil continued unabated. He concluded that the savings made on trash reduction did not compensate for sucrose losses: ". . . The reduction in the absolute sucrose % cane is found to be between 0·5 and 1·0%. This represents a loss of 4·5 to 9·0% of the total sugar even after correction is made for the increase in moisture content of the stalk. It is therefore concluded that the use of 'Gramoxone' ('Paraquat') as a desiccant prior to harvest is entirely ruled out on economic grounds."

CONCLUSIONS

The dipyridyl herbicides constitute an apex in the development of chemical desiccants to meet the needs of today's growers and factory operators. The limited systemic action of such compounds in sugar cane is a major shortcoming since it is virtually impossible to contact more than a fraction of the green canopy under field conditions by aircraft application. Moreover, indiscrete chemical activity against sugar-synthetic and metabolic systems prevents the plant from sustaining a well-ripened stalk for more than a few days after treatment. Similar shortcomings are likely to accompany future compounds having rapid desiccative action against the green tops.

For these reasons additional research is needed: (a) To gather basic information relative to desiccant absorption and translocation; (b) to increase the efficiency of desiccant movement and action; and (c) to control the atypical photosynthetic and metabolic activity induced by the desiccants. Control of abnormal photosynthetic activity, i.e. loss of CO_2 assimilation via loss of chlorophyll, is not a reasonable expectation; however, excessive sugar metabolism might be delayed much longer by incorporating invertase inhibitors into the stalk[26]. By increasing trash reduction a few more percentage points, with parallel retention of the sucrose in storage at the time of treatment, the sugar cane scientist will meet in large measure our industry's demand for a sugar cane desiccant.

[39] GUMBS: *Proc. B.W.I. Sugar Tech.*, 1966, **2**, 249.

The Eis rapid clarifier

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PART I

THE use of lime in both the beet and cane sugar industries for purification of the extracted sugar juices is complicated by problems in the removal of the lime after its work has been accomplished. Indeed, often far more attention is given to problems of lime removal than to assuring the optimum conditions for its use. Originally lime was removed by direct filtration. However, this method is expensive of both labour and materials, and it is troublesome even with good quality beets. Considerable water dilution is involved in removing the traces of sugar remaining in the filter cakes. On the other hand, direct filtration retains the juices only for brief times, avoiding degradations including inversion and lime salts formation.

Systems using multi-tray sedimentation-type clarifiers in combination with rotary vacuum filters were introduced some four decades ago as an alternative to direct filtration. These systems have found wide acceptance in North America, and increasingly more in Europe. Vacuum filters are unequalled in their ability to sweeten-off filter cakes with minimum quantities of wash water, and this part of the sludge removal operation is almost free of difficulties. The major shortcoming of these systems is the degradation of the juices in the multi-tray thickener-clarifiers. Hot juices are held for relatively long periods of time, resulting in inversion, colour and lime salts formation, the peptization of colloidal substances which were coagulated by the initial action of the lime, and in the lowering of pH and purities, with definite loss of sucrose.

This paper describes the development and application to beet sugar processing of a new clarification method which accomplishes the solid-liquid separation by sedimentation in less than 10 minutes.

The new clarification method makes use in unique fashion of the full potential of chemical flocculating agents. The method can be advantageous in any operation in which sedimentation-type single or multi-tray thickeners are now used. Such uses include water softening, separations in the manufacture of various chemicals, and the clarification of domestic and industrial wastes. Specifically, in beet juice purification, the equipment offers all the advantages of direct filtration of first carbonatation juice, without the high direct costs.

For at least 25 years[1] chemical flocculating agents have been used to accelerate the rates of clarification and sludge thickening. In particular, algin, or its sodium salt, has had considerable use in increasing

[1] MOORE: US Patent 2,679,464 (1954); *I.S.J.*, 1955, **57**, 25.

capacities of multi-tray thickeners in the beet sugar industry. While these agents were useful, their use carried with it the disadvantage that if too-large quantities were inadvertently used, sludge filtration was frequently impeded by sliming.

SEQUEIRA[2] has capably reviewed the development of the modern, widely-used, synthetic flocculating agents. The type currently most used includes polymers of acrylamide, carefully controlled in molecular weight, and frequently partially hydrolysed for enhanced effectiveness.

Since first carbonatation juices comprise highly complex colloidal systems, the explanation of the physical chemistry of flocculation is, to a degree, uncertain. The primary action of flocculation—the agglomeration of small solid particles to form larger structures—is brought about through the formation of macromolecularities, involving loose, three-dimensional net-works. While the unagglomerated particles are usually in the size range of lyophobic colloids, the flocculated units are visible to the unaided eye, and can be settled or filtered out with reasonable facility. SEQUEIRA has concluded that successful flocculation probably operates through a variety of mechanisms, such as viscosity effects, hydrogen bonding, metal-ion bridging, and stereochemical entanglement.

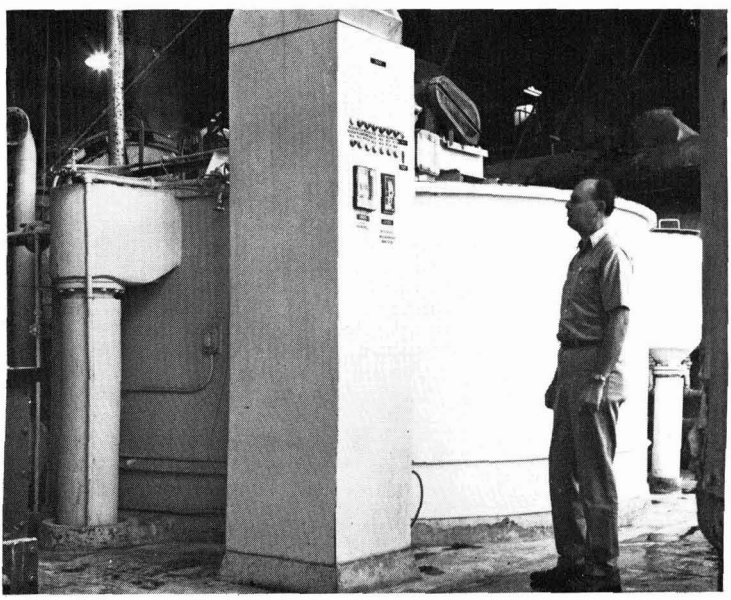

Fig. 1. Eis clarifier at Woodland sugar factory

Development

A continuously-operating, small-scale thickener-clarifier was constructed at the Spreckels Sugar Company research and development laboratory to furnish clarified juice for second carbonatation from a 200 cm³ per minute laboratory experimental first carbonatation unit[3]. It was observed that, when using small quantities of settling aids, the sludge particles are quickly removed from the first carbonatation juice by passage through a previously-formed sludge bed. When using 3 to 5 ppm of, in this instance, polyacrylamide settling aid, first carbonatation juice flow rates of 5 gpm/sq.ft. clarifier area yielded thickened sludges of about 40° hydrometer Brix, with perfectly clear over-flow juices. At lower rates, sludge mixtures of over 70° Brix were easily obtained.

Further work using a 22-inch diameter unit of the laboratory design led to the construction of a 14-ft diameter unit for a full factory-scale test. This full factory size unit was installed early in 1969 in the Woodland factory of the Spreckels Sugar Co. where it replaced a 26 ft diameter 4-tray thickener-clarifier. When the factory was started in the spring of 1969 the unit handled the full factory flow and has been in satisfactory operation since that time. The new equipment has been designated the Eis Clarifier, and it is marketed by the Enviro-Clear Co. Inc.[4]. Fig. 1 shows the Eis Clarifier installed in the Woodland factory.

Settling aids had previously been used with the multi-tray clarifier because of an increase of the factory slicing rate to some 188% of design—and thus the use of settling aids was not an innovation for factory operation.

Equipment Design

As may be seen in Fig. 2, the incoming feed juice, previously mixed with the necessary flocculating aid injected by means of small chemical supply pump, enters the clarifier from the bottom, through the central standpipe. The juice flow is directed radially from the inlet by the deflector plate just above the standpipe opening. The feed juice is thus distributed into a settling bed of thickened sludge, through which

[2] "Beet Sugar Technology" 2nd Edn. Ed. R. A. MCGINNIS (Beet Sugar Development Foundation, Fort Collins, Colorado, USA), pp. 248–252.

[3] EIS: *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 249–251.

[4] F. G. EIS, U.S. Patent 3,523,889, world-wide patents pending. Enviro-Clear Co. Inc., 120 Wall St., New York, N.Y., USA, subsidiary of Amstar Corporation.

the entering juices percolate upward. The flow pattern gives a rolling action to the sludge bed, which provides additional contacts of solids, promoting agglomeration. As the agglomerates increase in size, they settle at faster rates. The suspended solids content of sludge bed increases from top to bottom. Conventional sludge rakes move the sludge toward a central discharge boot, through which the sludge is removed, either by gravity flow or with a pump.

Clarified juice overflows the top of the clarifier into a launder. The sludge bed level is controlled by any suitable level-sensing system. In the Woodland factory unit a photoelectric sensor is used, which controls the valve regulating the underflow discharge. If necessary the underflow density can be precisely controlled by recirculating a portion of the underflow back to the feed juice, the recirculation being actuated by a density-sensitive system installed in the underflow discharge stream.

Table I lists physical data comparing the conventional 4-tray thickener, and the Eis clarifier which replaced it at the Woodland factory.

Principle of operation

As was first pointed out by COE and CLEVENGER in 1916[5], in a thickener in which all possible mixtures of sludge particles and clear juice are found, ranging between the clear overflow juice and the thickened underflow sludge, the tray area of thickener required is that of the particular mixture requiring the largest area. This "limiting" mixture is almost invariably found in the zone of "free settling" in sugar-juice lime suspensions. The mass flow of suspended solids in the zone of "true thickening" or "hindered settling," in which the solid particles partially rest on each other, is much more rapid. Studies have shown that in the Eis clarifier the free settling zone is bypassed, and virtually all thickening is in the zone of concentrated mixtures. This elimination of the zone of free settling accounts for the great acceleration of thickening provided by this unit. The presence of the flocculating aid increases the probability of particle agglomeration resulting from physical collisions of the small particles while the gentle rolling action of the sludge bed does not tend to destroy the agglomerates.

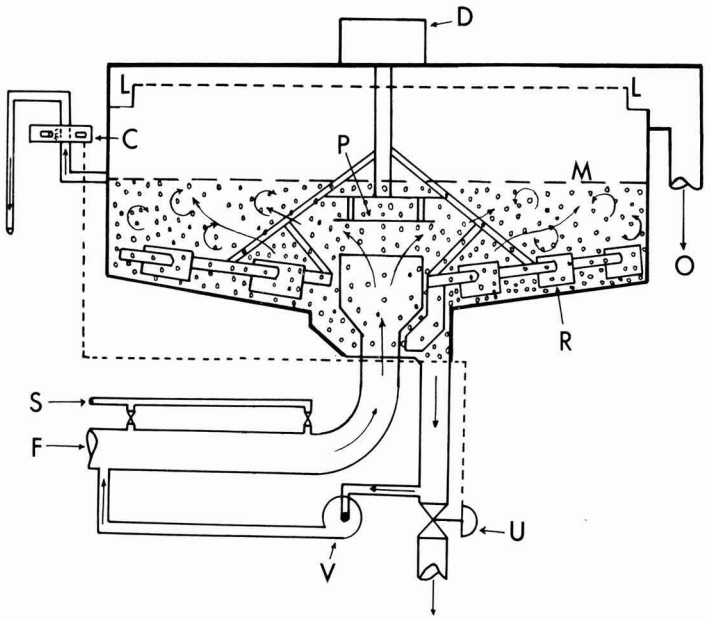

Fig. 2. Eis clarifier flow pattern. Key: D Rake drive, L liquid level, M mud bed level, C mud bed level controller, P deflector plate, O overflow, R mud rakes, S settling aid addition, F feed, V variable speed recirculation pump, U underflow control valve.

Table I

Physical comparison of conventional 4-tray and Eis clarifier at the Woodland, California, factory

	Tray Thickener	*Eis Clarifier*
Liquid height in unit, ft	17·8	4·5
Diameter, ft	26	14
Utilized volume, cu.ft.	9400	770
Number of trays	4	1
Settling area, sq.ft.	2100	154
Settling rate at 800 gpm, 4·5% suspended solids, in lb solids/sq.ft./hr	9	120
Juice retention time, min	90	7
Juice feed rate in gal/sq.ft./min at 800 gpm	0·38	5·2

As is necessary for satisfactory operation of a multi-tray clarifier, the feed juices entering the Eis clarifier must be comparatively free of gas bubbles, which tend to adhere to the lighter solid particles—particularly small fragments of beet fibre which may then carry over into the otherwise clear overflow juices. The design of a simple degassing unit of the type found effective at the Woodland factory is shown in Fig. 3.

[5] COE and CLEVENGER: *Trans. Amer. Inst. Mining Met. Eng.* 1916, **55**, 356.

Advantages of the Eis clarifier

Most of the unit's advantages arise from the improved efficiency of sludge thickening.

(1) The very short juice retention periods reduce the amounts of sucrose and non-sucrose degradations, which occur to an appreciable extent in present multi-tray thickeners: (*a*) sucrose inversion to invert sugars, which in turn degrade to organic acids with soluble lime salts, and to colouring matter, is decreased; and (*b*) peptization of pectic and proteinaceous colloidal substances, which have been coagulated in defecation, is minimized. The end results are a 30% reduction in the colour of thin juice—and consequently thick juice and granulated sugar—depending on the chemical composition of the juices; and reduction in thin juice lime salts—for California beet, about 50%. This brings the well-known benefits of reduced evaporator and vacuum pan scaling, improved juice boiling qualities, lower granulated sugar turbidities, and reduction in molasses production. Further, (*c*) less remelting of white sugar strikes for reasons of off-quality is needed, and (*d*) improvement in factory extraction can be expected.

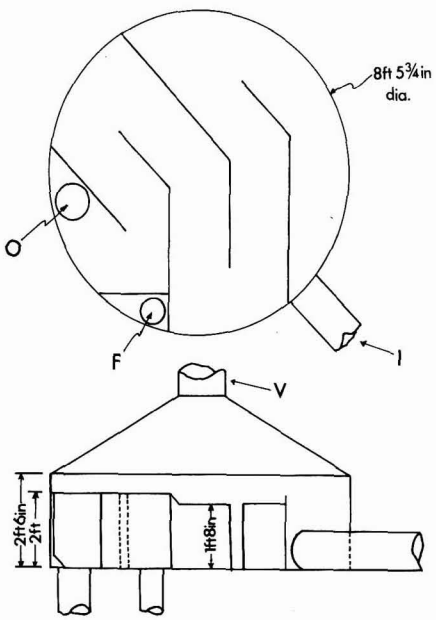

Fig. 3. First carbonatation degasser. Key: O outlet, F foam outlet, I inlet, V vent.

(2) The higher efficiency of clarification and thickening, in addition to permitting smaller equipment size, make it possible to operate first carbonatation in the high alkalinity regions yielding best thin juice quality, thus reinforcing the benefits described above.

(3) Similarly, the small volume of the Eis unit allows detection of small carbonatation upsets, which lower thin juice quality, and which may be undetected in a thickener of large volume. Likewise major upsets are apparent and may be corrected at once. When using a multi-tray thickener, sometimes hours are required to recover from such serious disturbances. Because of this, the tendency is usually to operate first carbonatation too far on the safe side for good quality when using a multi-tray unit.

(4) The small physical size of the unit greatly reduces the requirement of factory floor space and volume, since in cold climates it is necessary to locate thickening equipment within the factory building. For the same reason, the times required to start up or shut down the purification system are much shortened, almost eliminating the sugar losses usually suffered.

(5) The short juice retention times and small equipment surface areas mean lowered heat losses, with improved fuel economy, and improved vacuum filter operation with the hotter feed slurries.

(6) It is well known that finely-divided field dirt particles, such as those from clay-type soils, which may not be removed from the beet in the beet washer, form fine suspensions in the factory juices. These fine suspensions are comparatively unaffected by flocculating aids and do not settle out in the tray thickeners. This silt usually carries through to second carbonatation, impeding filtration in the second carbonatation filters. Since the juices entering the Eis clarifier are actually filtered through the dense, settling sludge bed through which they pass, such silt particles are removed in the Eis unit without difficulty, to a degree matched only by direct filtration.

(*To be continued*)

Brevities

Ghana sugar discussions[1].—A team of World Bank experts has held discussions on the future of the Asutuare and Komenda sugar factories. It is reported that a new company is to be formed to take over the assets, liabilities and estates of the two factories. The factories are presently under the management of the Ghana Industrial Holding Company.

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Yeast production in Portuguese East Africa[2].—A factory is under construction near the new sugar complex at Mafambisse for processing of agricultural and vegetable garden products; in addition to citrus concentrates, etc., it will produce yeast grown on molasses.

* * *

Singapore sugar imports, 1970[3].—Imports of sugar by Singapore in 1970 totalled only 108,262 metric tons, tel quel, as against 172,950 tons in 1969. Principal sources included Cuba with 58,407 tons (nil in 1969), Czechoslovakia with 15,522 tons (21,548), Australia with 11,735 tons (82,145) and Fiji with 11,734 tons (23,466 tons in 1969). China, which supplied 29,412 tons in 1969, provided only 6406 tons in 1970.

[1] *Standard Bank Review*, June 1971, 17.
[2] *Barclays Overseas Review*, June 1971, 45.
[3] *Willett & Gray*, 1971, **95**, 195–196.

Sugar cane agriculture

Giant sensitive plant. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1970, **34,** 30–31.—A fresh outbreak of this troublesome sugar cane weed is described. It is thought all the plants may have originated from a single seed established in a travellers' rest area, the seed having come from a vehicle or person from an infected area. As it was thought seed may have been carried away by a nearby stream, downstream cane growers were alerted. Comparative descriptions of the common and the giant sensitive plant with photographs are included with the article. They may assist cane growers.

* * *

A comparative study of varieties of cane obtained during 1959-63 and clones from San Isidro and Jaronú. M. ANDÉREZ V. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 1–14.—Nine varieties were obtained in 1959, 12 in 1962, 2 in 1963, 6 from San Isidro and 1 from Jaronú. Some varieties suffered from chlorosis or other disease. Agronomic characters are outlined by means of a table where details are given regarding germination, average diameter of stalk, height, number of stalks per stool, habit (erect or spreading), extent of flowering, etc.

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Report on the studies located in red soils of Camagüey province (First and second harvests). N. COMPANIONI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 15–63.—Details are presented in terms of cane and sugar yields from a total of 32 varieties, extending over two harvests (plant cane and first ratoon), cultivated in the typical slightly acid red Matanzas clay soils.

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A study of long cutting cycle cane varieties. H. MUÑÍZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 64–72.—An experimental square of four groups, involving 65 varieties, was planted in Matanzas red clay soil for harvesting at the age of 25 months. Performance was poor with most varieties, the best being My 5463, My 5346, My 53177, My 53173 and C 236-51, which also had the least number of dead stalks.

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A comparative study of varieties. O. PINA and A. F. BETANCOURT. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section). 74–135.—An account is given of experiments involving twelve varieties, grown under similar conditions, regarding behaviour, habit, growth characteristics and yield. The best performance and highest yield was given by the variety C236 51, followed by B 42231, My 5329, PR 980 and My 53-118.

Cytological and embryological investigations of sugar cane in Cuba. S. ZAMOTAILOV, J. M. ROSILLO and R. C. ZABALA. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970 (Agric. Section), 136–152.—In 1967 a cyto-embryological laboratory was established at the Sugar Cane Institute in Cuba. An account is given of its early work which consisted mainly of making chromosome counts of the commercial varieties of sugar cane in Cuba.

* * *

Study on sugar cane cultivation practices. H. MUÑÍZ and F. PÉREZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 153–163.—The types of cultivation practices included manual cultivation, mechanical cultivation and application of herbicides, and combined mechanical and manual cultivation. Labour requirements were 144·25, 39·93 and 98·35 man-hours/hectare, respectively. The control used no cultivation and provided yields of 37·30 metric tons/ha of cane and 3·28 tons/ha of sugar while the three cultivation practices above yielded 105·97 tons/ha of cane (284·10% relative to the control) and 9·15 tons/ha of sugar (278·96%), 100·91 tons/ha of cane (270·54%) and 9·10 tons/ha of sugar (277·44%), and 104·42 tons/ha of cane (279·95%) and 9·02 tons/ha of sugar (275·00%), respectively.

* * *

Deterioration of green and burnt cane in four varieties. S. RODRÍGUEZ and W. RUDZKI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 164–196. Variations in weight, Brix, sucrose content, yield and sugar yield were determined each day for 15 days in the case of four varieties (POJ 2878, PR 980, B 4362 and B 42231) left in the field after cutting, green and burnt. The values are recorded in charts, which the authors emphasize do not give absolute figures to be applied universally but indicate the character and order of the changes in the parameters studied.

* * *

Cutting order during harvest. R. FERNÁNDEZ A. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 212–219.—Based on the process of ripening, internode by internode, which is negatively correlated with growth, rules for use of a hand refractometer are established. When the refractometer is not used, the rules are based on a study of the green leaf part of the cane stalk. Rules are also defined for over-ripe or deteriorated, e.g. uncut, cane. No correlation has been found with the probable yield calculated according to results with a laboratory mill.

Banded sclerotial disease of sugar cane in Cuba. E. SOSA. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 252–266.—This disease was first reported in Java and later in Australia, India, Philippines, Taiwan, Fiji, New Guinea, Thailand, Malagasy Republic, Louisiana and Puerto Rico. It was first noticed in Cuba in 1966. The localities are given as are symptoms of the disease, which are illustrated.

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Preliminary report on studies of the induction of mutations with a 60 Co gamma ray source in sugar cane in Cuba. M. ANDÉREZ V. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 267–274.—The methodology of the experiments is described as are preliminary results in the gamma-irradiation of six cane varieties. The work will need to be completed before pertinent conclusions may be drawn.

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Microflora of the sugar cane in Cuba. O. MARTÍN, R. GONZÁLEZ and F. ALONSO. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 275–290. The Sugar Cane Research Institute has found 24 new species of fungi in sugar cane, bringing the total to 59, which are listed. The locations in each province where the different species have appeared are listed, as well as the part of the plant where they were found.

* * *

Results of fertilization studies in sugar cane in tropical red soils in the Provinces of Pinar del Río, La Habana and Matanzas. J. ALOMÁ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 291–314.—A detailed account is given of the studies. Response to nitrogen was found to be greater with ratoons than with plant cane. Applications of more than 100 kg/ha of nitrogen under potassium deficiency conditions affected juice quality. Best results were obtained with a combination of N and K.

* * *

Influence of cane burning and mechanical harvesting on the physical properties of the soil. O. AGAFONOV, J. E. ROLDÓS and F. ALONSO. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 320–356. No major changes were found in the physical properties of a tropical red clay soil after burning cane, the factors studied being porosity of the aggregates, infiltration and specific weight of the surface layer. There was a slight increase in the aggregates which were stable to water. Slight evaporation was observed during burning and a greater evaporation after burning, especially in the surface layer, as well as an increase in the biological activity in the surface. When mechanical harvesting was employed, a certain amount of compaction could be observed in the superficial horizon, dependent on humidity and soil density, as well as crushing of the larger aggregates, increase in hardness and reduction of infiltration.

* * *

A study of attack by the root-knot nematode (*Meloidogyne* sp.) on some commercial varieties of sugar cane in Cuba. J. P. O'REILLY. *XXXIX Conf. Asoc. Técn. Azuc. Cuba.*, 1970, (Agric. Section), 357–363.—Several different nematodes may attack sugar cane in Cuba. Results of a survey are given covering seven different varieties of sugar cane and the degree of infection found, results being expressed in a table.

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Attack by the basal borer of cane (*Anancentrinus insularis* Buch.) in Central Candido González in Camagüey. E. RODRÍGUEZ L., A. FUENTES A. and R. CARDOSO M. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 364–370.—The history of this borer is described from its discovery in 1964. Until recently there have been no reports of serious damage by it but in August 1969 an attack was reported in the cane area of Central Candido González. The insect is described as is the damage caused.

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Susceptibility of the variety C.236-51 to mosaic disease. I. OTERO, E. RODRÍGUEZ and I. POUYOU. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 371–381.—Results are given of inoculation and resistance studies with seven different commercial varieties of sugar cane in Cuba. The variety C.236-51 gave an infection rate of 46·4% which was the second highest, exceeded only by C.P.31-294 with 58·3%.

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Compilation of data on yield of different cane varieties in different months in the Province of Havana and Pinar del Río. J. ALOMÁ and M. DE ARMAS. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 383–403.—Monthly yield data collected for 18 varieties in 1964 and 1965 are tabulated.

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Compilation on data on yield of different cane varieties in different months in the Province of Matanzas. J. ALOMÁ and H. MUÑÍZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 404–431.—Monthly yield data collected for 18 varieties in 1963–65 are tabulated.

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Compilation of data on yield of different cane varieties in different months in the Province of Camagüey. J. ALOMÁ and N. COMPANIONI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 432–496. Monthly yield data collected for 18 varieties in 1965–66 are tabulated.

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Compilation of data on yield of different cane varieties in different months in the Province of Oriente. J. ALOMÁ and J. COSTA P. *XXXIX Conc. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 497–587.—Monthly yield data collected for 18 varieties in 1965–66 are tabulated.

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Cross-rule planting of CG 127-45 cane variety with 4 stalks of 3 buds per stock. M. MENÉNDEZ A. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 588–604.—It has been demonstrated that the method of cross-rule planting is more efficient in the production of stalks and demands less hand-labour than other methods used in Cuba.

Optimization and mechanization of the harvesting programme. M. AMADOR A., C. GONZÁLEZ, F. PÉREZ R., J. REY and A. RICO G. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 615–634.—Studies are reported on the establishment of a cane harvesting schedule system, calculated using a computer or by means of tables, using the estimated juice purity as the prime indicator and the apex:base ratio and reducing sugars:sucrose ratio as indicators of over-ripeness.

* * *

Evaluation of the nutritional status of sugar cane fields of Central Rubén Martínez Villena. A. AMARAL. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 635–652.—A study made during the harvest period allowed detection of a number of factors affecting plant nutrition. It was also shown that cane was not harvested at the proper maturity and that excessive nitrogen assimilation plus high rainfall had stimulated a great degree of water absorption and consequent high dilution of juice; these may have been the cause of the low juice quality observed in the cane.

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Improving human relations with the sugar planters in Egypt (U.A.R.). H. M. EL ZEINI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 653–662.—Attempts to improve relations between sugar factory officials and cane growers in Egypt include incentives for agricultural engineers responsible for the cane deliveries, incentives for cultivators to improve their crop and sugar yields and to reduce the delay between cutting and processing cane, and the provision of sterilized and treated setts in order to combat ratoon stunting disease.

* * *

Deterioration of burnt cane. A. AMARAL and R. DE ARMAS. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 663–678.—Analysis of Brix, pol, purity, glucose ratio, yield (96° basis) and losses in sugar and weight were determined in cane which had been burnt but not harvested. In all cases the results showed a linear fall in quality although the fall would have followed a parabolic curve had the period been extended.

* * *

Application of the R/B ratio and experimental laboratory data for the calculation of sugar yield in the refractometric analysis of cane. R. BERNAL C. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 679–708.—Detailed studies are reported which indicate that the probable yield of sugar (R) may be estimated from a refractometric measurement of cane juice Brix (B) in the field without the necessity of a laboratory analysis.

* * *

The rôle of the pesticide industry in the cultivation of sugar cane in India. P. R. MEHTA. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Agric. Section), 709–715.—A review is presented of facilities in India for research into pest and disease control, the principal pests and diseases, chemical products made in India or imported for their control and equipment and methods of application of these chemicals.

* * *

Project of fertilization by means of foliar analysis in the sugar factory laboratories. A. AMARAL and B. R. PAMPIN. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Lab. Section), 69–112.—A detailed account is given of the project, based on the CLEMENTS system, of measuring the nutrient status of the soils by means of foliar analysis of cane grown therein. Organization of the project, sampling, laboratory methods and equipment are described, as are the application of the results to control of fertilizer application and irrigation. The project is to start in the area of Central Rubén Martínez Villena and will gradually spread to other areas.

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Study on the mechanized collection of leaves and tops. E. SUÁREZ and V. GONZÁLEZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 156–173.—An account is given of the successful use of a modified Czech silo-harvester for gathering tops and leaves from harvested cane fields to be used as fodder. Savings in time and man-power are considerable.

* * *

Study on the rail traffic of Central Uruguay and its influence on the possible crush. A. MORALES P. *et al. XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 88–112.—The investigation of problems of the Transportation Dept. of the factory and the working out of solutions to permit the crushing of cane to its full capacity are described.

* * *

Cane payment system in the UAR. M. H. TANTAWI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 195–202.—A description is given of the growing of cane and production of sugar in Egypt, and the systems of cane payment used before 1965 are discussed. The system adopted in 1965 is described in detail. Payment is in accordance with the theoretical yield of sugar from each supply; the price is set by the Government for clean cane of approved varieties containing no more than 2% extraneous matter (a deduction is made in accordance with an established table) and is proportional to the yield of 99·7° pol sugar, this figure being calculated from the pol % cane and juice purity according to a set formula. The analyses are carried out by factory staff under the inspection of a committee with members representing the Government, growers and sugar producers.

* * *

Effect of cane burning during the harvest. G. TRUEBA G. and L. PEREIRA T. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 273–299. A report is presented of a study undertaken during

the 1970 harvest on the effects of burning cane fields on the whole sugar production system. The desired objectives are likely to be attained, namely: increased cane harvester productivity, and increased cane cutter productivity and improvement of transport utilization, but much attention must be paid to organization of the campaign whether burning is total or partial, e.g. cane milling priorities, etc.

* * *

Economic evaluation of systems of harvesting by manual cutting for cane cleaning stations and traditional cutting in burnt fields. V. GONZÁLEZ E. and A. SOTOLONGO A. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 300–313.—A comparison of the two systems was made on a basis of the delivery of 60,000 arrobas of clean cane to the mill during a 16-hour working day, from loading and transport equipment, cane cleaning stations and transfer cranes. As a consequence of field burning in the traditional system, the cane cutter's productivity is increased by about 39%, the mill receives about 60% less extraneous matter and transport utilization is increased by about 28%. Investments in foreign currency are reduced by 34% and the cost of the clean cane is reduced by 15%. It is concluded that it is not necessary to install the cane cleaning stations for hand-cut cane where the fields are burnt before cutting. It is recommended that the air-blast system of the cleaning station be studied to obtain higher cleaning efficiency and reduce losses.

* * *

Sugar cane transport. Relation between sugar cane cutting and the regulation of transport. D. S. JEYASEELAN. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 328–337.—The losses in cut cane through sucrose inversion are pointed out and steps proposed for the correct organization of cane transportation from the field in order to minimize the delay before milling and so reduce losses.

* * *

Linking of cane areas with optimization of the use of transport resources. V. VELASCO B. *et al. XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Econ. Org. Section), 339–408.—Details are presented of a series of investigations made by a group of economists from the Central University of Las Villas aimed at the analysis of cane transportation in the province by means of which its organization can attain optimum efficiency.

* * *

Use of digital computers in rail transport of cane. L. O. SUÁREZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, (Econ. Org. Section), 409–415.—Characteristics of the CIC-201 computer are described and its application to control of cane train schedules recommended in order to avoid uneven supplies of cane to the mills.

Optimum requirement of seed rate and nitrogen for sugar cane in Uttar Pradesh. U. S. SINGH, L. SINGH and M. M. S. SAXENA. *Sugar News* (India), 1970, **2** (2), 21–28.—An account is given of experiments carried out over 3 years (1956–59) at the Sugarcane Research Station, Shahjahanpur, U.P. Seed rates were 20,6000, 37,000 and 53,500 setts per ha and levels of nitrogen 0, 112 and 224 kg/ha. N levels did not have any effect on germination. Tillering was adversely influenced by the increased seed rates. N levels did not affect tillering. Mortality of tillers increased with the increase in seed rate and was higher with the 0 level of N. In general the medium seed rate (37,000/ha) and moderate N dose of 112 kg/ha was regarded as the most suitable and economical combination.

* * *

Propagation of sugar cane using stored stalks. G. T. A. BENDA. *Sugar J.*, 1970, **33,** (3), 14–17.—Storage of cane for propagation is sometimes necessary in experimental work. In these experiments stalks of 4 varieties were stored at about 50°F for 5 to 13 months. They were treated with fungicides and wrapped in plastic. After 5 months a germination rate of 50% was obtained. At 13 months the rate ranged from 13% to 51%.

* * *

Poultry manure as fertilizer for sugar cane. W. H. C. KNOWLES and C. A. HERON. *Jamaican Assoc. Sugar Tech. J.*, 1968, **29,** 25–29.—The expanding poultry industry of Jamaica has resulted in greatly increased supplies of poultry manure becoming available. The materials had already been successfully used on bananas as a source of N, P and K and it was decided to use it on cane. Results were very satisfactory, especially on a cost basis compared with the traditional N-P-K fertilizers. For large-scale use on cane the question of storage would need consideration, poultry manure being a bulky material. Satisfactory means of large scale distribution would also have to be considered.

* * *

Observations on the performance of pre-emergence herbicides in sugar cane. R. A. BURGESS. *Jamaican Assoc. Sugar Tech. J.*, 1968, **29,** 46–53.—A brief summary is given of the history and use of pre-emergence herbicides with sugar cane in other parts of the world, especially Hawaii. Results of trials under Jamaican conditions are then given. The difficulty of comparing results from different sites because of the far-reaching effects of soil moisture and other factors is emphasized. Of the residual pre-emergence herbicides "Gesaprim" was the most consistently effective on all sites. It is lethal to *Cleome* and controls such troublesome weeds as *Leptochloa*, *Euphorbia* spp. and *Ipomoea* spp. quite well. A number of herbicide combinations were tested. The "Gesaprim-Karmex" combination (at 1½ lb/acre each) gave satisfactory results and was the best combination. Further trials are envisaged.

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Increased demand for new vibrator plough. ANON. *S. African Sugar J.*, 1970, **54,** 609.—There is said to have been a big demand for a new type of plough designed and manufactured in South Africa. Production has increased fivefold and a second factory is to be erected. The plough has been patented in 15 countries. This new vibrator plough does not turn over the upper layers of the soil like the conventional plough but vibrates so as to loosen the ground. Although penetrating deeply into the soil the plough is easy to pull. A 17 kW tractor can pull a four-share vibrator plough.

* * *

The sugar cane scale insect, *Menalaspis glomerata.* V. P. RAO. *Indian Sugar*, 1970, **20,** 279–282.—The increasing amount of damage to sugar cane caused by this insect is referred to. Details are given about the insect and the nature of the damage it causes. Cultural and chemical control are discussed. The latter is difficult or impracticable as the insects are protected by the leaf sheaths. Growers should be careful to use clean seed cane. Hot water treatment (110°F) is efficient. The desirability of biological control is discussed.

* * *

The effect of frosts on sugar cane. J. DELGADO H. *Bol. Azuc. Mex.*, 1970, (246), 6–10.—In Mexico, as in some other cane growing countries, such as the United States, the Indian sub-continent and Iran, sugar cane is liable to be damaged by cold or frost. Those cane areas of Mexico where cold damage may occur are listed. The general effect of low temperature on cane and of freezing are discussed, as is the question of varietal susceptibility.

* * *

Effects of green manuring in the cane fields of Taiwan. S. C. WANG and C. C. YANG. *Taiwan Sugar*, 1970, **17,** (3), 2–13.—For some time there has been a steady falling off in the amount of green manuring carried out in Taiwan sugar cane fields. Reasons for this are given. It is demonstrated how the price of one crop of green manuring is the equivalent of 4 tons of sugar under Taiwan conditions. The wide range of experiments here discussed, on light and heavy soils, do not give much support for the practice of green manuring in Taiwan cane fields. As far as supplying humus to the soil is concerned it is argued that the roots of a suitable cash crop would do this equally well. Future policy should be to study economical crops to substitute for green manure.

* * *

Solar radiation and photosynthesis of sugar cane in the field. C. C. CHU. *Taiwan Sugar*, 1970, **17,** (3), 14–21.—In 1968–69 photosynthesis of sugar cane (variety F157) was investigated using a high precision infra-red CO_2 analyser on an open circuit system. Relation between solar radiation and photosynthetic rate was linear up to 0·4 ly/min. Young cane showed higher photosynthetic activity than did old cane. The maximum efficiency of total photosynthesis recorded in these investigations was 4·9% at very low light intensity. The efficiency decreased while light intensity increased.

* * *

MF201 trials in Mexico and Jamaica. J. M. BRISCOE. *Sugar y Azúcar*, 1970, **65,** (9), 23–26, 50.—The first trials with chopper harvesters in these two cane producing countries are here recorded. The harvesters performed well in both countries in spite of ground or field conditions far from ideal for this kind of harvesting. Observers were agreed that field conditions will need to be modified or improved to obtain maximum efficiency from chopper harvesters.

* * *

All weather weed control in sugar cane. P. D. COCHRANE and G. C. PROCTER. *Sugar y Azúcar*, 1970, **65,** (9), 28–29, 50.—The different types of chemical weed killer now available to the cane grower are discussed with special emphasis on "Paraquat". Other uses of "Paraquat", such as pre-harvest desiccation and weed control in water courses, are discussed.

* * *

Overcoming boron salinity problems in growing sugar cane in the Tambo valley of Peru. R. P. HUMBERT, R. B. BAHME, E. FERNANDES D. and L. I. THOMPSON. *Sugar y Azúcar*, 1970, **65,** (9), 32–34.—With high soil salinity and boron content, toxicity symptoms are observed in cane grown under conditions where irrigation water has to be used and re-used, with accumulation of high minerals content. Studies have been started on determining the toxic effects, but the answer to the problem lies in good water management so that the Andean rainfall can be used for leaching of the soils One technique is the temporary growing of rice in flooded conditions in cane soils, sometimes with cane intercropping.

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Performance of adsali and eksali crop at the sugar cane research sub-station, Melalathur, North Arcot District (Madras State). S. C. DANIEL *et al. Proc. Third Joint Conv. All India Sugar Tech.*, 1969, A-1.1–A-1.10. The nature of the adsali and eksali crops are explained. Adsali is generally planted during August–September and harvested at 15 to 18 months. It has the benefit of two rainy seasons. Early maturity and higher tonnage are advantages. The eksali crop is planted mainly December–April but also in August–September in South India; in both cases it is harvested after 12 months. It is concluded that the success of adsali depends upon agri-climatic conditions and that it was not profitable under the conditions of the trial.

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***Studies on increase of sugar recovery by maturity-wise* cane supply.** A. P. GUPTA and S. P. SHUKLA. *Proc. Third Joint Conv. All India Sugar Tech.*, 1969, A-2.1–A-2.14.—Cane yields and sugar recoveries in the factories of Uttar Pradesh are poor and it is necessary to mill cane supplied in accordance with maturity testing if sugar production is to be improved.

Sugar beet agriculture

A total weed control programme for sugar beets. W. F. MEGGITT. *Sugar Beet J.*, 1970, **33,** (3), 4–5. As many growers are moving to more or less complete mechanization and are using little or no labour for weeding, the need for chemical weed control to be nearly 100% effective becomes more pressing. The herbicides now used, pre- and post-emergence, are discussed. Recommended rates for different kinds of soil are indicated. Early planting is a must for good weed control. A pre-emergence application of "Pyramin" plus TCA followed by a post-emergence application of "Betanal" or "Pyramin" plus "Dowpon" and crop oil will provide the necessary control of annual broadleaved and grass weeds. Sugar beets to be grown without hand labour will have to be grown on land essentially free of perennial weeds.

* * *

Keep in front of insect pests! R. F. RUPPEL. *Sugar Beet J.*, 1970, **33,** (3), 6–9.—Many species of insect may attack sugar beet in Michigan. Generally the damage they do is of a minor nature. Suggestions as to what growers should look for in the field are made, the information being summarized in a table. The pests discussed include soil insects, cutworms, flea beetles, spinach leaf miner and other foliage pests, root aphid and sugar beet nematode.

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Observations on the viral progeny of mixed infections with beet yellows virus. K. BJÖRLING. *Socker Handl. II*, 1970, **24,** 1–11.—Both severe and mild strains of the virus were combined in pairs by simultaneous vector inoculations of beet plants. By serial selective transfers to highly inbred beet plants, different virus isolates were obtained, some indistinguishable from the parent strains with respect to symptoms and to yield-reducing effects, some obviously divergent from the parent strains in these respects. The mechanism responsible for the development of such new isolates or strains is not understood. It is thought that possibly the simultaneous multiplication of two distinct strains in the beet plant involves interferences and may disturb the normal virus replication and facilitate the development of new viable isolates which may be selected.

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The effect of straw and straw-green manuring on yield and sugar content of sugar beets. E. VON BOGUSLAWSKI and J. DEBRUCK. *Zucker*, 1970, **23,** 377–384.—Field trials over a period of nine years on two types of soil (one sandy) are described. It was concluded that straw should be ploughed in or rotavated and not left on the surface and that the addition of nitrogen is necessary to adjust the carbon:nitrogen ratio. The combination of straw and green manuring proved to be especially favourable.

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Thinning: manual or mechanical? G. ROUSSEAU. *Hautes Etudes Betterav. Agric.*, 1970, (5), 8–10. Factors affecting successful use of mechanical thinning are discussed and a description given of three types of machine.

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Pests and diseases of sugar beet. ANON. *Hautes Etudes Betterav. Agric.*, 1970, (5), 13–20.—Six insect pests of sugar beet and two fungal diseases are described and illustrated with drawings.

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Effect of vanadium on sugar beets. B. SINGH and D. J. WORT. *Sugar J.*, 1970, **32,** (12), 19–24.—Results are given of observations made on sugar beet 7, 12 and 21 days after spraying the foliage with vanadyl sulphate. These include changes in leaf growth, alterations in chemical composition of the root and some metabolic processes in both root and leaves. It is suggested that application of vanadium in this way to sugar beet plants in the field may induce "ripening" and that the late autumn growth of the beet, which frequently occurs at the expanse of stored sucrose, may be considerably reduced.

* * *

The possibility of controlling annual grass weeds in sugar beet. L. DETROUX and J. M. BELIEN. *Sucr. Belge*, 1970, **89,** 339–349.— Arguments are put forward for weed control measures to be carried out over the whole area of a beet field before or at sowing time. Results are given of trials with mixtures of "Lenacyl" with "Diallate", "Cycloate" and "Phenmedipham". Mixing of pre-emergence and post-emergence herbicides is envisaged.

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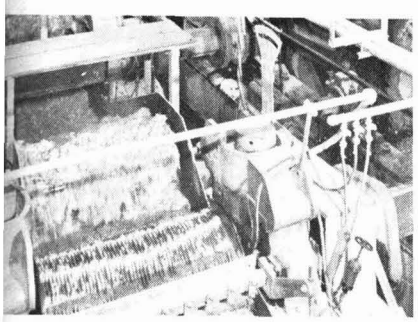
Results of sugar beet variety trials carried out in Belgium from 1965 to 1969. N. ROUSSEL, R. VAN STALLEN and W. ROELANTS. *Publ. Trimest. Inst. Belg. Amél. Betterave*, 1969, **4,** 81–136.—Some 41 varieties, monogerm and multigerm, were under trial at three different locations. Sowing was done with a precision drill equipped with special discs. Harvesting was done with a one-row machine fitted with a device to put samples directly into bags. With each trial there were two harvesting dates, one early and one late. Results of the trials are given in detail by means of tables.



Cane sugar manufacture

Technical information on centrifugals. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (246), 4–5.—The mathematical relationships of mass, radius, angular velocity, etc. are presented, as are a table of common basket sizes for centrifugals and characteristics of machine and massecuite for an automatic centrifugal.

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The resistance of electrical installations against short circuiting. W. SIEBE. *Bol. Azuc. Mex.*, 1970, (246), 22–28.—The nature of a short circuit and calculations of peak current intensity, resistances, etc. are presented for various types of components in an electrical system.

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Mechanized loading station for bulk sugar in port of Vera Cruz (Mexico). I. GURZA I. *Sugar J.*, 1970, **33,** (4), 15–16.—The bulk installation at Vera Cruz, which is described, includes a 40,000-ton capacity warehouse which houses muscovado discharged from rail cars and delivered to store by a conveyor complex. For transfer of the sugar to ships' holds, a conveyor system is used which includes a mobile gantry tower. This is provided with a control room which directs the sugar into one of a number of chutes (according to the ship's location) feeding to a gangway conveyor. The sugar passes from this conveyor via a link conveyor, forming part of the mobile tower, to a rotating crane, which is provided with a telescopic tube and thrower for discharging the sugar into the holds.

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Ingenio Tamazula. F. SERNA S. *Sugar J.*, 1970, **33,** (4), 23–24.—Details are given of the equipment at Ingenio Tamazula, Jalisco State, Mexico. This cane sugar factory/refinery has a capacity of 6500 t.c.d. A distillery producing 20,000 litres of alcohol per day forms part of the complex.

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Utilization of condensates and heat in sugar factories. A. MISELERN. *Sugar J.*, 1970, **33,** (4), 26–27.—A scheme is described in which condensate and flash vapour is discharged from boilers, evaporators and juice heaters to a flash tank by a continuous purging system which makes use of inverted tray-type vapour traps. Effluent water from the flash tank, which is connected to a steam exhaust line, passes to drainage via a heat exchanger where flash evaporation is used for deaeration and useful heat is recovered. Automatic incondensable gas ejectors are provided in the boilers, evaporators, juice heaters and flash tanks. Automatic control of the system is provided for in the scheme, for which a flowsheet is presented.

Ingenio "Los Mochis". F. SERNA S. *Sugar J.*, 1970, **33,** (4), 29–31.—This cane sugar factory/refinery is the second largest in Mexico, with a maximum crushing capacity of 15,000 t.c.d. and an annual maximum sugar production of 200,000 metric tons. The equipment of both raw house and refinery is described. A distillery to produce 30,000 litres of alcohol per day from blackstrap molasses was put into operation for the 1967/68 crop.

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Ingenio Zapoapita—Panuco. A. ARREOLA. *Sugar J.*, 1970, **33,** (4), 32.—A brief report is given on this cane sugar factory which was moved from Fortin to Panuco, in the state of Vera Cruz, Mexico, in 1963 after it had been found impossible to find suitable land for growing more cane. Its capacity of 4000 t.c.d. is to be raised to 7500 t.c.d. by adding two mills to the existing four-mill tandem.

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Storage of gur in potato cold storage godown. A. S. CHACRAVARTI, S. R. MUKHERJEE and R. D. SHAHI. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, A-13.1–13.11.—Experiments showed that it was possible to store blocks of gur packed in polyethylene or coated with wax in the main cooling chamber of a potato godown (at 1·5–3·0°C and 92–95% R.H.) or uncovered or merely covered with hessian in a precooling chamber at 18–22°C and 55–60% R.H. without any deterioration, in contrast to results obtained with storage in a conventional gur godown. Even the taste remained unimpaired, so that it was difficult to distinguish stored from fresh gur.

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Studies on the working of (the) milling diffusion system in Sakharwadi. D. P. KULKARNI and J. R. UNDE. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-1.1–1.19.—See *I.S.J.*, 1970, **72,** 308.

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Roller groovings and mill settings. S. C. ROY. *Proc 3rd Joint Conv. All India Sugar Tech.*, 1969, E-2.1–2.16. Mill settings and relevant factors are tabulated for the Smith tandem (comprising one crusher and five mills) at Vuyyuru sugar factory, and these data are compared with calculated settings obtained by applying HUGOT's formula, the Farrel system and the method of ARNOLD to the same initial data. A number of important factors to be considered in establishing optimum milling conditions are discussed in turn, including cane preparation and bulk density, roller grooving, tramp iron removal, bagasse density, roller dimensions, top roller rise, feed:discharge compression ratio and trash plate settings.

A glimpse at basic cane mill design. A. V. NARAYANARAO. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-3.1–3.3.—The advantages of the inclined mill housing are discussed with reference to concrete examples of such mills. Particular mention is made of two important factors involved in the question, i.e. top roller load and the feed:discharge opening ratio.

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Milling *vs.* diffusion. A. C. CHATTERJEE. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-4.1–4.5. The principles and advantages of cane diffusion over milling are listed and features of the Silver ring, De Smet and DDS diffusers enumerated.

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Mill setting calculations. J. S. KALSI. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-5.1–5.7.—A method is presented for calculation of mill settings based on bagasse density (derived from bagasse fibre, Brix and water determinations) and weight, from which is found V, the volume of bagasse passing through the mill per min, using the formula $V = S.L.O.K.$, where S = roller surface speed (ft/min), L = roller length (ft), O = operating discharge opening (ft), and K = reabsorption factor. The feed opening is then calculated by assuming a suitable ratio between discharge and feed openings.

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Performance of milling-cum-DDS diffuser in India. P. C. RAO and K. VENKATARAMANAN. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-6.1–6.9 + v tables.—Performances of the systems at Sakharwadi and Belapur sugar factories are discussed and guidance given on a number of points relating to DDS cane diffusion.

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How the crushing capacity is doubled at the Andhra Sugars Ltd. A. V. NARAYANARAO. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-7.1–7.5—To double the cane crushing capacity at the Tanuku sugar factory of Andhra Sugars Ltd. a 3-roller crusher was installed to feed cane to the existing 6-mill tandem, which was divided into two 3-mill tandems. The first tandem operated as normally, while the second was reversed, so that bagasse from No. 3 and No. 4 mills was passed to the same belt conveyor for discharge to the boilers. With the installation of a De Smet diffuser, the mills were used for bagasse dewatering.

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The optimum quantity of imbibition water to be added. B. L. MITTAL. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-8.1–8.7.—A method is described for determining the optimum quantity of imbibition water to be applied, in which an earlier formula[1] is used to find the ideal Brix of the juice from individual mills in a tandem corresponding to different amounts of imbibition water. The values obtained are used to plot curves showing the pattern of extraction as a function of imbibition.

Some critical observations on the reversal of second cutter knives. B. B. PAUL. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-9.1–9.9.—Tests at an Indian sugar factory with reversal of the second set of cutter knives[2] showed that because of considerable changes in the pattern of flow of the cane, there was need to pay attention to the hood design and modify it if necessary, so as to prevent blockage. It was found that the cut cane was finely chopped, with the result that reduced mill extraction rose by 1·5–2%. However, because of the fineness of preparation the mill roller grooving had to be modified and a closer setting adopted. The optimum quantity of maceration % fibre was reduced, provided hot water was used.

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Cane sugar mill lubrication. R. MALHAN. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-10.1–10.4. Lubrication of mill roller journals, mill hydraulic systems, mill gears, steam engines and centrifugal bearings is discussed and advice given on the most suitable type of lubricant to apply.

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A concept and design for vapour cell and evaporator body. B. B. PAUL. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-11.1–11.7 + ii tables.—See *I.S.J.*, 1970, **72**, 243.

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Juice cells in sugar cane and their rôle in extraction of juice. M. ANAND, P. R. MURTHY and P. V. V. RAO. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-12.1–12.7 + i table.—The percentage of broken cells in cane and bagasse samples was determined by subjection to vibrations for 30 sec in a stainless steel column after mixing with water in calculated proportions, and a wet disintegrator was used for total pol determination. The results showed that preparation with two knife sets ruptured more than 50% of the cane juice cells, while shredded cane contained about 65% ruptured cells. The crusher opened 22–30% cells, giving an average primary extraction of 68–70%, so that only a small proportion of the cells remained to be ruptured and the juice extracted by the other 5 mills in the tandem, the final bagasse pol depending mainly on maceration extent and efficiency as well as the mill settings needed to squeeze out the maximum quantity of juice without reabsorption. Hence, leaching and not diffusion is of importance in milling.

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A vibrating feed regulator—an addition to mills. B. M. TIWARI. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, E-13.1–13.2.—A brief description and diagram are provided of a vibratory feeder chute designed by the author and installed between the 2-roller crusher and the 1st mill of a 14-roller Stewart tandem. The device has eliminated chokes and has helped improve mill performance while raising the crushing rate from 42 to 44 tons/hr.

[1] *I.S.J.*, 1958, **60**, 231–233.
[2] *See also* CHETTY: *ibid.*, 1969, **71**, 323–324.

Improvement in clarifier efficiency. A modified mud scraping arrangement. S. N. G. RAO, S. C. SHARMA and M. N. SINGH. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-1.1–1.8.—A pH drop of 0·8–1·0 from sulphitation juice to clarified juice has been reduced to 0·2 units by installing specially shaped hinged plates supported on the original squeezer blade holders for mud removal. The plates permit mud to be removed even from pockets formed by sagging and bulging of the trays as a result of excessive mud accumulation.

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Why resistance heating. K. S. G. DOSS. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-3.1–3.6. The advantages of resistance heating over other forms of reheating of massecuite are discussed and reference made to earlier experiments and the experience of other authors, whereby a reduction in molasses purity is shown to be possible.

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Automatic control for sulphur burning and saving of sulphur. J. R. MODI. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-4.1–4.9.—Details are given of an automatic pH control system which is based on a photoelectric cell. When the pH falls to below a pre-determined point, the needle of the pH meter incorporated in the system interrupts the light source and the photocell energizes two solenoid valves which in turn actuate a power cylinder acting on a baffle plate which will than be moved into position to cover 50% of the tray area over the burning sulphur, thus reducing SO_2 gas production. Alternatively, the solenoids can be energized by a micro-switch and adjustable cam system. Once the juice pH has regained the minimum required value, the automatic control process is reversed.

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A concept and design of vacuum pan for low-grade massecuite. B. B. PAUL. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-5.1–5.12.—See *I.S.J.*, 1970, **72**, 308.

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Factors affecting conditioning and efficient grading of white sugar. S. K. CHATTOPADHYAY. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-6.1–6.3. Factors affecting the grading of Indian white sugar in terms of grain size are discussed, including centrifugal operation, sugar drying, angle at which vibratory screens, hopper and elevators are operated and sugar flow in hoppers. Ways in which grain can be damaged are briefly mentioned.

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Use of orthophosphoric acid in post clarification operation in a carbonatation factory. M. MOHAN, H. A. SHAH, K. K. SHARMA and S. K. MURTHY. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-7.1–7.11. Addition of 30–35 mg of orthophosphoric acid (of 85% purity) per litre of clear juice was found to result in a 0·86 unit increase in the purity drop from *C*-massecuite to molasses and gave an unsulphited syrup lighter in colour than was obtained without phosphate addition. The sugar obtained from *A*-massecuite had a lower colour content, although no reduction in evaporator scaling was observed. The reducing sugar:pol ratio increased from clear juice to unsulphited syrup by an average of 0·59 compared with 0·44 where no phosphate was used. The economics of phosphate treatment are briefly indicated.

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A study on the behaviour of *C*-massecuites in the crystallizer. M. MOHAN, H. A. SHAH, K. K. SHARMA and P. K. AREN. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-8.1–8.10.—Low-grade massecuite cooling experiments in water-cooled crystallizers showed that the initial one-third of the total cooling time of 33 hours provided the greatest molasses purity drop, which decreased with time. The optimum cooling rate was 3·5–4°C/hr and the optimum final temperature 40°C. Molasses exhaustion was only slightly increased by cooling for 12 hours at a constant temperature of 42–45°C, whereas a temperature of 39°C gave a much better result. Dilution to help massecuite purging did not cause increased molasses purity at 10 litres/ton of massecuite, corresponding to a Brix of molasses discharged from the centrifugals of 97°. Thereafter, molasses purity did increase with dilution.

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Vapour cell and associated steam economy. S. K. GHOSH. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-9.1–9.5.—The author considers the effect on steam consumption and evaporation capacity of adding a pre-evaporator, composed of a number of bodies working in parallel, to a multiple-effect evaporator. The two specific cases discussed are (i) where the evaporator plus pre-evaporator are operated at full capacity, and (ii) where they are operated not at full capacity but at the capacity of the evaporator where the bodies comprising the pre-evaporator are added in series.

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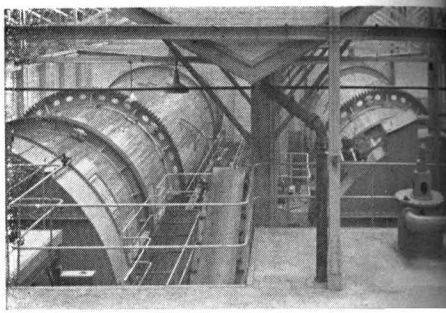
A study of the abnormal behaviour of juices during clarification. S. N. G. RAO, S. C. SHARMA and N. S. GUPTA. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, M-10.1–10.9.—Low juice, syrup and white sugar quality at Marhowrah sugar factory was investigated. Clarification with 2·5% milk-of-lime (by volume) and sulphitation to pH 5·3–5·4 solved the problem and give considerably improved sugar quality. Subsequent studies to explain the reasons for the previous poor performance and its improvement showed that the cane variety most widely grown in the area, Bo 14, gave juice of 20% greater CaO content than juice from Bo 17, a well-known later variety, while the reducing sugars content was about 50% higher and the organic non-sugars 1·71% higher. Further investigations showed that the juice from Bo 14 suffered a greater purity drop and the reducing sugars increased to a greater extent after 48 hours' keeping than with juice from stale Bo 17 cane.

Beet sugar manufacture



Regeneration of cation exchange resin used for softening of thin juice. K. Číž, M. Rohlík, V. Čejková and V. Hobíková. *Listy Cukr.*, 1970, **86,** 204–207.—Trials in which cation exchange resin in Ca^{++} form, used to soften thin juice, was regenerated with softened thick juice, as described in a Hungarian patent, are reported. Results of factory experiments were compared with those obtained by regeneration with NaCl. These showed that the Ca, Na and K contents of the thin juice were changed from 30·9%, 7·2% and 61·9% to 11·1%, 19·7% and 69·2%, respectively, after treatment with NaCl-regenerated cation exchanger, while the corresponding values for juice treated with thick juice-regenerated resin were 21·5%, 14·5% and 64·0%. Although the Ca content of the latter thin juice was higher, the juice has a lower melassigenic content by virtue of the reduction in Na and K, which nevertheless are present in sufficient quantities to be of use for regeneration. The best regeneration results were given by adding 28 volumes of thick juice per volume of resin. Alternating the two regeneration processes is recommended. The economics are briefly discussed.

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Some thoughts on juice extraction and purification. R. Pieck. *Zucker*, 1970, **23,** 689–694.—The question of diffusion water pH and the advantages of acidification to minimize pectin extraction are first discussed. The most suitable source of water for diffusion when there is insufficient fresh water available is also considered, and reference made to the advantages of using $CaCl_2$ instead of SO_2, as demonstrated by results obtained at Quévy and Oreye factories. The disadvantage of greater molasses yield is felt to be outweighed by the advantages of increased pulp dry solids, and hence reduced fuel requirements for drying, and reduced SO_2 consumption, as well as better cossette exhaustion (found at Oreye) and the possibility of drying much greater quantities of pulp. The point is emphasized, however, that no generalization can be made regarding use of $CaCl_2$, and it is even possible that water of very low pH and of low non-sugars content is not desirable. Descriptions are given of the Novi Sad carbonatation scheme and of the RT scheme used at Oreye. The advantages of both are discussed, and details then given of the RT scheme which has operated for two campaigns at Brugelette sugar factory and which was designed to combine the advantages of the Novi Sad and the RT-Oreye systems. The Brugelette scheme comprises preliming, precarbonatation, clarification, liming, 1st carbonatation, filtration, 2nd carbonatation and filtration. 1st carbonatation mud is returned to preliming, for which precarbonatation juice (200–300%) is used instead of milk-of-lime; the preliming temperature (72–75°C) permits coagulation at pH 10·6–10·7. At precarbonatation 0·45 g CaO/100 cm^3 is added, the total quantity of lime used (1·05 g per 100 cm^3) being lower than with the normal RT system and yet permitting purities about 0·5 units higher to be obtained under normal conditions.

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Continuous sugar crystallization process. Anon. *Sugar y Azúcar*, 1970, **65,** (10), 29.—See *I.S.J.*, 1970, **72,** 221.

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Water re-use and disposition system for modern beet sugar factory. G. W. Miles. *Sugar J.*, 1970, **33,** (5), 9–12.—A survey is presented of waste water treatment and disposal systems used at sugar factories owned by Holly Sugar Corporation in the USA, and the scheme at the Hereford, Texas, beet sugar factory of 6600 tons/day slicing capacity is described in some detail. This involves: the use of a cooling tower recirculating about 4,200,000 gal of water/day (primarily condenser water); recirculation of 6,000,000 gal/day of flume water after treatment in a clarifier to remove most of the dirt, mud and sludge, plus passage through a set of screens to remove trash and organic matter, which is used for cattle fodder (a make-up system permits the quantity of recirculation water to be kept constant while allowing about 1,500,000 gal/day of waste water to be sent to the lagoons). The waste water has a BOD of about 600 p.p.m., a suspended solids content of 129 p.p.m. and a pH of about 7·0. None of the effluent is discharged to the local environment. Overflow water from the lagoons is returned to the final waste lagoon system to permit the sludge ponds to be dried and cleaned. Six stabilization ponds are included in the scheme, which permits the water consumption to be considerably reduced compared with that at other, much smaller beet sugar factories.

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Continuous analysis of boiler feed water. P. H. Miller, W. O. Bernhardt and F. G. Eis. *Sugar J.*, 1970, **33,** (5), 27–29.—At Woodland beet sugar factory in California, USA, boiler feed water was monitored for sugar by photocolorimetric measurement using α-naphthol reagent, for potassium by flame photometry and for sodium by potentiometric measurement with a Na^+ ion glass electrode in a Beckman "Analyzer". All three detectors were connected in parallel to the condensate line from the evaporator 2nd effect and the detector outputs fed to a multi-point recorder.

Charts show the closeness between the trends of the K and sugar plots, slight differences being attributed to reaction between α-naphthol and compounds other than the furfural compounds formed by the sulphuric acid-sugar reaction, and to scale formation on the absorption cell. The Na and K levels were close together, although the K-sugar relationship was closer than the Na-sugar relationship. Difficulties were encountered in the operation of all three detectors, but these have been overcome except in the case of the Na detector which had to be abandoned.

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Critical study of the process of diffusion. G. D'ORAZI. *Ind. Sacc. Ital.*, 1970, **63,** 159–169.—Calculations are presented concerning the operation of a cell-type beet diffuser, i.e. a batch-type diffusion battery. The relationships developed show, in a general form, the "diffusibility limit" as a function of the number of active cells and the draft, independent of the other factors controlling the diffusion process.

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Dissociation of non-sugar in moderately acid medium and theoretical study of the possibility of deionizing sugar solutions at ambient temperature. P. BALDASSARI. *Ind. Sacc. Ital.*, 1970, **63,** 170–174.—Examination of ionic dissociation has shown that at pH 3·5 265 meq % non-sugars, representing 54% of the salt content of the juice, are liberated. Thus, by treatment of a juice with a moderately acid cation exchanger of pKa between 3 and 5·5 it is possible to eliminate 54% of the mineral ash cations with liberation of the corresponding organic acids; these can then be removed by treatment with a weakly basic anion exchanger. Such a system can eliminate 41% of the non-sugars, including 54% of the mineral ash, which includes all the calcium and heavy metals. In addition, about 60% of the colour is removed during the process, which can be carried out at ambient temperature without inversion of sucrose. The process is the basis of a commercial purification system (the "Reggiane 3D" process of Reggiane Officine Meccaniche Italiane S.p.A.).

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Pilot plant tests of the "Reggiane 3D" process. P. BALDASSARI. *Ind. Sacc. Ital.*, 1970, **63,** 174–182. Tests of the process (see previous abstract) have given better results than those theoretically to be expected, and it is deduced that the process will be much more economical than other processes in current use because no juice cooling is required since operation is at room temperature, there is a lower consumption of regenerating chemicals, and there are no harmful industrial waste products.

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Effect of raw juice purification methods on the level of chemical losses of sucrose. V. A. KOLESNIKOV and V. A. MAKSYUTOV. *Sakhar. Prom.*, 1970, **44,** (11), 10–14.—Losses in settling of 1st carbonatation juice from fresh beets were considerably greater than in all the other carbonatation stages, but the combined losses in all stages were about the same as those in evaporation (where the losses in the 1st and 2nd effects were much greater than in the 3rd and 4th effects) and both were lower than the losses in 1st and 2nd massecuite boiling. Evaporation and boiling losses were considerably greater when poor quality beet required modification of the carbonatation scheme used (15 min liming at 50–55°C followed by 15 min at 85–90°C).

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The effect of formalin on the durability of metals. N. A. SOLCGUB and B. P. SHTEFAN. *Sakhar. Prom.*, 1970, **44,** (11), 14–15.—Friction pairs of metals were immersed in 88 purity, 15°Bx raw juice of pH 6·0–6·3 and subjected to loads of 20, 40 and 80 kg/cm² at 0·5 m/sec speed of slip. In all cases the wear of steel paired with bronze and cast iron was increased by addition of 2% formalin (40% formaldehyde solution) to the juice, and the coefficient of friction and working surface unevenness rose with pressure load. The steel-bronze pair suffered intensive hardening and wear at 80 kg/cm² even in the absence of formalin. The bronze and cast iron components were less affected by formalin than was the steel. Heat treatment of steel and increasing the hardness of cast iron by raising the perlite content are recommended.

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Change in the quality of products during continuous boiling. YU. D. KOT *et al. Sakhar. Prom.*, 1970, **44,** (11), 22–25.—Laboratory tests under conditions simulating batch pan boiling and continuous boiling in a single-compartment or multi-compartment pan are reported. These involved boiling an artificial massecuite for varying periods of time at different pH values. Determination of the increase in colour as a function of pH and time showed that a small number of compartments in a continuous pan would not give a massecuite colour the same as obtained in batch boiling, confirmed by earlier tests which showed that 8 hours' boiling and no less than 10 compartments were necessary to give satisfactory colour as in batch boiling.

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Grinding Chizhek beet knives. V. N. SHCHEGOLEV, G. T. SULIM and V. T. RUD'. *Sakhar. Prom.*, 1970, **44,** (11), 25–26.—Grinding tests on Chizhek beet knives are discussed and recommendations arising out of these are given.

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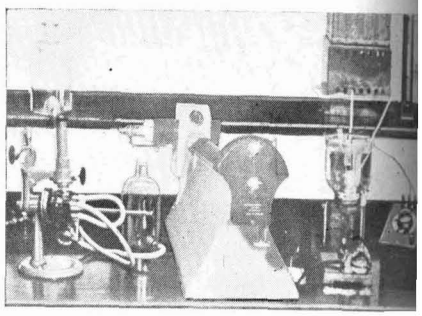
Rate of moisture evaporation from sugar beet. A. A. MOVCHAN. *Izv. Vuzov, Pishch. Tekhnol.*, 1970, (5), 12–14.—Tests were conducted on beets in experimental stands to determine the value of the coefficient of effectiveness of a wet surface (ε_f), which is the ratio of the moisture lost from beets with open, wet surfaces (β_w) to that lost from beets with their integuments intact (β_n). Experimental values of ε_f agreed closely with values calculated by means of two equations which are presented. It was found that the integument plays a considerable rôle in preventing moisture loss. Because of the low moisture content of beet, it is considered important to maintain optimum air conditions during storage, particularly a high R.H.

Laboratory methods & Chemical reports



The determination of Brix of final molasses for export. M. RANDABEL, M. ABEL and J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1969, 153–156.—Brix of final molasses solution (1:1) was determined by spindle under three different sets of conditions: (i) in a cylinder into which the solution had been poured gently after centrifuging for 30 min at 2600 r.p.m.; (ii) in a cylinder in which the solution had been subjected to vacuum for 30 min; and (iii) after a number of samples had been stood in cylinders for up to 6 hours. In all cases the aim was to settle out solid, suspended particles and remove air bubbles. Centrifugation gave the lowest Brix reading, followed by standing for at least $2\frac{1}{2}$-3 hr, and finally by vacuum treatment which, although it removes air bubbles, is not continued for a sufficient length of time to allow the solid particles to settle. Brief hints on use of the Brix spindle are given.

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Measurement of pol in rotary vacuum filter cake by the cold extraction method. E. R. DE OLIVEIRA and A. A. DELGADO. *Brasil Açuc.*, 1970, **76,** 280–284. Two methods of determining pol in filter cake have been compared, using 35 samples. The first method is that of PEDROSA PUERTAS[1], and the second a method in which 100 g of filter cake is mixed for 10 min in a blender with 400 ml of water and 1–2 g Horne's dry lead. The extract is filtered, the first 25 ml being discarded and the funnel being covered with a watch glass. The pol of the filtrate is measured using a 400-mm tube, and the moisture content of a sample of the original cake is also determined. The pol is then calculated from the saccharimeter reading and the water content of the mixture (400 ml + water in the original cake). Statistical analysis of the results showed that the second method was more accurate and that there were significant differences between the results using both methods. The second method was quicker.

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Deterioration of juice by microbial action. R. DESMONTS. *Brasil Açuc.*, 1970, **76,** 287–294.—Definitions are presented of terms used—Brix, true dry matter, polarization, etc.—and the acidity present in cane juice discussed in regard to the various origins, i.e. natural salts present of diverse nature and the action of bacteria to produce acetic, lactic, butyric acids, etc. The differences between the properties of mixed and clarified juice are indicated and the effects of the clarification process discussed. The harmful effects of lime salts in juice are discussed, i.e. scaling of heating surfaces, reduction of crystal sugar yield and increased loss in molasses. The harmful effects of organic acids in cane juice are also discussed and their minimization recommended. The relationship between inversion and acid formation in a milling tandem is illustrated by means of a graph and a table, and the economic cost of this form of sucrose loss is briefly discussed.

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Indian standards and (the) sugar industry. INDIAN STANDARDS INSTITUTION. *Proc. 3rd Joint Conv. All India Sugar Tech.*, 1969, G-9.1–9.4.—Details are given of some Indian standard specifications on sugar and sugar products, and lists given of standards relating to by-products, water and water treatment, and miscellaneous subjects within the sugar industry.

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Induction meter for measurement of sugar factory juice alkalinity. S. ZAGRODZKI and S. M. ZAGRODZKI. *Gaz. Cukr.*, 1970, **78,** 229–232.—See *I.S.J.*, 1971, **73,** 150.

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Determination by turbidimetric method of inverted sugar content in sucrose and simple syrup. K. LUDWIKOWSKA. *Acta Polon. Pharm.*, 1969, **26,** (2), 159–167; through *S.I.A.*, 1970, **32,** Abs. 70-1378. A 10 g sample of sucrose was mixed with 20 ml of water, 4 ml of 1N NaOH and 4 ml of a 1% solution of HgI_2 in KI. The mixture was kept at 30°C for 20 min, after which the turbidity due to Hg_2I_2 was measured at 470 nm. The extinction varied linearly with invert sugar content in the range 0·5–2·5 mg. The method was applied to refined sugars and other products with a low invert sugar content; it was more accurate than the BERTRAND method or the gravimetric method which involve conditions conducive to sucrose inversion. The invert sugar content of sucrose syrups stored for 8 months at 3°C or room temperature was determined turbidimetrically; untreated and sterilized syrups were unstable at room temperature and stable at 3°C, but syrup to which *p*-hydroxybenzoate had been added could be stored at room temperature without significant inversion. The method detects invert concentrations of 0·005% and may be used to measure concentrations of 0·001%.

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Laboratory extractor for sugar beet cossettes. I. VAVRA. *Zeitsch. Zuckerind.*, 1970, **95,** 569–575.—The laboratory diffuser described, which has a capacity

[1] "Manual para el laboratorio azucarero." (Edit. Técnico Azucarero, Havana) 1952.

of 300 g of cassettes, consists of a vertical 400 cm^3 cage of diameter only slightly smaller than that of the outer vessel in which it is located, so that 200 cm^3 of water is sufficient for complete immersion of the cassettes. The cage is raised and lowered in the water under constant temperature conditions, each cycle of the upward and downward movement taking 5-6 sec. Tests at various temperatures and for varying periods of time are reported; the use of two vessels to increase extract concentration is also described, Extraction was found to be not only a result of leaching-out of the denatured cell contents through diffusion, but was also a result of a sudden discharge of cell juice when the turgor (balance between osmotic pressure of cell juice and elasticity of the cell wall) was destroyed by denaturing. From the quantities of feed and discharged material, found by weighing, it was established that 10% more juice was extracted from fresh beet than constituted the diffusion liquid. This phenomenon should be allowed for in determination of sucrose diffusion coefficients and existing values should be corrected.

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The concept of purity **loss—a** versatile efficient indicator. T. T. OOMMEN and B. S. GURUMURTHY. *Sugar J.*, 1970, 33, (5), 21-24.- See *f.S.J.*, 1971, 73, 92.

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The reduced boiling house recovery formulae of Noel Deerr and Gundu Rao (a critical study). T. T. OOMMEN and B. S. GURUMURTHY. *Indian Sugar*, 1970, 20, 399-406.- See *f.S.J.*. 1970,72,243; 1971, 73, 92.

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Automatic polarimeter for the sugar industry. H. RIEGLER and O. SCHtEK. *Die LebellSmittelind., 1970*, 17, 422-423.- Details are given of the VEB Carl Zeiss "Polamat S" automatic, photoelectric polarimeter which uses a mercury vapour lamp as light source (wavelength of 546·1 nm) and a quartz plate modulator rotating in resonance with a half-period of 50 Hz. An optically-active substance placed between the modulator and the analyser causes the D.C. signal transmitted by the receiver when the polarization planes of the polarizer and the analyser are perpendicular to each other to be superimposed by an A.c. signal, which is amplified and causes a servo-mechanism to rotate the analyser and the arcuate scale fixed to it. The instrument is available with two sugar scales, one for a 26 g/cm' sample and covering the range from - llO°S to -I- II0°S at O'I°S intervals with a reading accuracy of ± O·03°S, and the other for 13 g/cm' samples covering the range **0–100°S** and giving a reading accuracy better than ± 0·05°S.

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Test on the "Polamat S" automatic polarimeter. W. STRUBE and D. SCHOLZE. *Die Lebensmittelind.*, 1970, 17, 423-425.- Results are given of comparative tests with a "Polamat S" photoelectric polarimeter (see previous abstract), a Schmidt & Haensch visual model with quartz wedge compensator and bichromate light filter, and a Hilger & Watts photoelectric "Microptic" model, which uses a sodium vapour lamp as light source and where the matching of the planes of light is carried out by a coarse and a fine control. Tabulated data for sucrose and molasses solutions show that extremely close agreement was obtained between the value given by the "Polamat S" and the "Microptic", although the Schmidt & Haensch instrument gave only slightly higher values, which were subject to greater scatter than those of the other two polarimeters. Both the Hilger & Walls and Schmidt & Haensch instruments operate in accordance with ICUMSA recommendations. The "Polamat S" was little affected by voltage fluctuations or light intrusion from other sources, and its operation was rapid.

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Correlations between some criteria of white sugar quality. P. DEvtLLERS, J. ROGER and N. RAMIN. *Suer. Franç.*, 1970, 111, 563-570.- An investigation to find if any correlations exist between various criteria for white sugar quality (colour and colour type, conductimetric ash, floc formation, filtrability and insolubles content) showed that correlations do exist between pairs of criteria and that all show approximately the same trends with the exception of floc formation. However, while general correlation was excellent for 1968/69 samples, it was only moderately good for 1969/70 samples for no apparent reason. Moreover, it is emphasized that the trends are only general, and that divergent characteristics may occur, such as a low ash content with high colour and high insolubles content but good filtrability.

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Investigation of the nature of the coloured products of the interaction of invert sugars with bases. V. K. POTROJOV and J. V. BOGDANOVA. *Sobre los derivados de la eana de aZllcar*, \968, 2, (2), 38-46.- Pure solutions of 0·02M, 0'05M and 0·1 M glucose and fructose were heated at 100°C in a water bath with equimolar amounts of NaOH, KOH (as 0'02M, 0'05M and 0·1M solutions) and Ca(OH), and Ba(OH), (as 0·2M solutions). The reactions were followed calorimetrically and polarimetrically, and it was found that there was a stoichiometric relationship between the sugar and base reacting to give coloured products. the ratio (2:1, 1:\ or I:2) depending on the sugar and base involved. Different bases had different effects on the epimerization of glucose and also on the intensity of colour formation.

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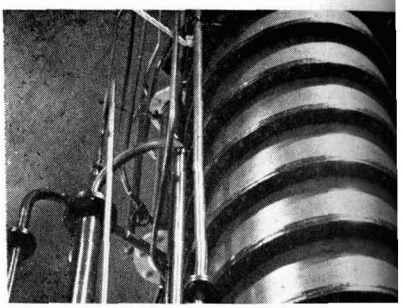
"Sucromat"- an automatic third generation sugar polarimeter. W. KERNCHEN. *Zeitsch. Zuckerind.*, 1970, 95, 628-631.- Details are given of the "Sucromat" automatic saccharimeter which is provided with a photoelectric cell and has a measuring range of between - 120'S and -I- 120'S. The instrument is fitted with integrated circuits, the advantages of which are listed, and its low power requirements reduce the heating effect. Accuracy is claimed to be ± O·OlcS.

By-products



Notes on the development of rum production plants. M. ANDRÈS. *Ind. Alim. Agric.*, 1970, **87**, 901–906. The subject of rum production is dealt with under three main sections: treatment of raw material, fermentation and distillation. Treatment of molasses can be carried out by two main methods: with and without clarification, the latter being the one most widely used. Cane juice used for production of heavy white rum is not generally treated before fermentation, whereas for lighter and sweeter rums it may undergo certain treatments. The author considers two or three fermentation vats necessary in order to handle the large differences in concentration between the various rums and to minimize infection. The larger the fermentation plant, the more justifiable will be automatic control of the process, which should be continuous. For distillation, stainless steel columns have advantages and disadvantages. They are outstanding for stripping, whereas they are very disappointing for concentration because of the excessive passivity relative to the constituents of the distillate, particularly sulphur derivatives. In copper columns, SO_2 attacks the copper but is eliminated, while in a stainless steel column it remains, ruining the taste of the rum in one example cited.

* * *

Possibility of providing normal conditions for processing Cuban cane molasses into alcohol. S. LUCHEV. *Nauchni Trudove* (Sofia), 1967, **9**, 189–204; through *S.I.A.*, 1970, **32**, Abs. 70–1193.—Increasing acidity of the fermenting mash and thick scaling of distillation vessels have been observed in the past. Tests showed that satisfactory processing is achieved by: using molasses previously clarified by the hot acid method; adding 1–2 kg of urea, or an equivalent quantity of NH_4 salts, plus 100 g of H_3PO_4/ton of molasses, and 0·5–1% of 27% dry solids pitching yeast. Simultaneous heating and aeration are advisable, and the mash should be distilled at low (7–7·5%) alcohol content.

* * *

High-test and integral molasses as energy sources for growing pigs. M. VELÁZQUEZ and T. R. PRESTON. *Rev. Cubana Cienc. Agric.*, 1970, **4**, 55–58.—Pig feeding tests were conducted with diets containing high-test molasses (partially inverted clarified juice concentrated to 80–85°Bx) or with integral molasses (concentrated unclarified juice). Fish meal was incorporated at two concentration levels. With 18% fish meal high-test molasses tended to produce fatter carcasses and give an overall higher mean daily growth rate (607 g) than did the integral molasses (508 g). When 24% fish meal was incorporated, the performance with the high-test molasses was unaffected, whereas the mean daily growth rate with integral molasses was increased from 476 to 541 g. It is considered that integral molasses should not be used as the only energy source in diets for growing pigs but preferably should be used as a partial substitute for other energy sources. More tests are necessary to determine the maximum level of integral molasses incorporation at which growth rate is not affected.

* * *

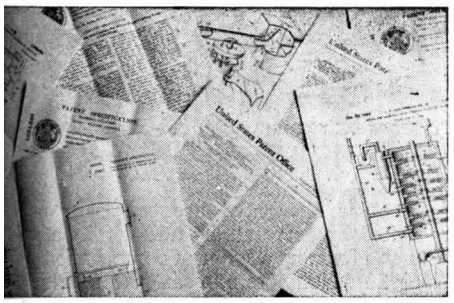
Theoretical considerations on the formation of scale in distillation apparatus. F. CABALLERO P. *Bol. Azuc. Mex.*, 1970, (248), 2–3.—Scale deposited on heating surfaces in a distillery is principally composed of crystallites of calcium sulphate with a small proportion of other Ca salts (oxalate, carbonate, phosphate, silicate) bound by calcium aconitate which acts as a cement producing an intractable deposit. The $CaSO_4$ is deposited because its solubility is decreased at higher temperature. The minimum solubility of $CaSO_4$ is at pH 4·5 and by adjusting the fermentation must to this pH with H_2SO_4, the $CaSO_4$ is rendered insoluble and less remains in solution to be deposited on the heating surfaces.

* * *

Economy and perspectives on the utilization of bagasse in the manufacture of particle boards. R. HESCH. *Bol. Azuc. Mex.*, 1970, (249), 2–16.—See *I.S.J.*, 1971, **73**, 93.

* * *

Commercial fattening of bulls on molasses/urea, fish meal and restricted forage under feedlot conditions. F. MUÑOZ, F. MORCIEGO and T. R. PRESTON. *Rev. Cubana Cienc. Agric.*, 1970, **4**, 91–96.—An economic evaluation is presented of feedlot fattening of some 15,000 crossbred and commercial Brahman bulls fed *ad libitum* on molasses/urea mixtures and on limited quantities of fish meal and pangola forage. Mean daily weight grain was 0·88 kg for feed intakes of 10·5 pangola, 8·81 molasses, 0·28 urea, 0·36 fish meal and 0·11 minerals, all expressed as kg/day. Molasses toxicity affected 10% of all animals, causing an overall mortality of 1·21% and emergency slaughter of 4·7%. Compared with the same period in the previous year, when forage was fed *ad libitum* and molasses and concentrates were given in restricted quantities, animal throughput from the same facilities increased by 88% and total live weight sold was increased by 123%. The daily live weight gain per animal was 105% compared with the previous year.



Patents

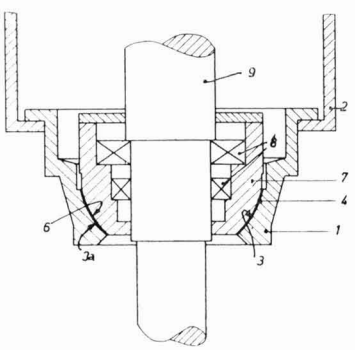
UNITED KINGDOM

Continuously producing crystals from solution. TATE & LYLE LTD., of London E.C.3, England. **1,210,512.** 5th March 1968; 28th October 1970.—(Sugar) Crystal nuclei are introduced into the first of a number of series-connected crystallizers and fresh (sugar) solution introduced into at least one of the series. The solution, after passing through the series, enters a crystal classifier where crystals of or in excess of a predetermined size are collected while the smaller crystals are returned to one of the crystallizers; similar classifiers may be located between each crystallizer so that the crystals passed to the succeeding crystallizers in the series are of predetermined adequate size while the smaller crystals are returned for further growth.

* * *

Bearing assemblies (for suspended centrifugals). BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,210,648.** 16th January 1969; 28th October 1970.

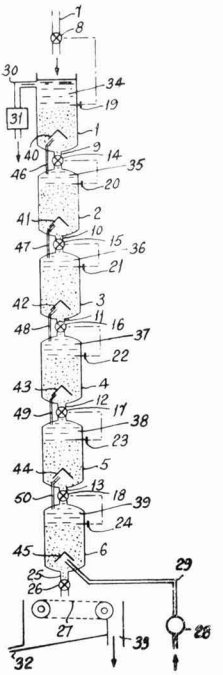
The shaft 9 of a centrifugal is suspended from a bearing support 2 by means of a cup 1 having a hollow



spherical surface 3a against which rests a corresponding surface 6 on the shaft; thus oscillations resulting from imbalance during loading are compensated. The surfaces are liable to wear, however, and the clearance between them is too small to permit protection by a lubricant. Wear is avoided by provision of a self-lubricating layer 4 between the surfaces in the form of polytetrafluorethylene which is sufficiently strong to withstand the stresses of interaction between the surfaces and which can be applied preferably in the form of strips glued to the cup 1.

* * *

Recovery of liquid from spent granular adsorbent. TATE & LYLE LTD., of London E.C.3, England. **1,215,578.** 6th March 1967; 9th December 1970.



The vessels 2–6 in the vertical series are closed at the top and joined to the one above by pipes 9, 10, 11, 12, 13 fitted respectively with valves 14, 15, 16, 17, 18. The valves are controlled by level sensors, 20, 21, 22,

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 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., 20231 U.S.A. (price 50 cents each).

23, 24 in the vessels below, while a corresponding sensor 19 governs the admission of a slurry of adsorbent (granular carbon or bone char) through valve 8 from pipe 7 into the open-topped uppermost vessel 1. The vessels thus remain filled to the levels of the sensors and flow into the top vessel 1 is permitted when slurry of sweetened-off char is withdrawn from the bottom vessel 6 through pipe 25 and the manually or automatically controlled valve 26; it is then separated from its water content on the belt 27 and discharged into channel 33.

Water is admitted to the bottom vessel from pump 28 by pipe 29 and enters beneath the conical baffle 45. After passing through the adsorbent it enters the free space 39 and is transferred by pipe 50, entering vessel 5 under the baffle 44. It thus passes up through the series in counter-current against the flow of adsorbent, finally overflowing from the top vessel into pipe 30 and passing through strainer 31 to process. The free spaces 34, 35, 36, 37, 38, 39 provide a means of ensuring mixing of the water and adsorbent and of preventing channelling in the latter.

* * *

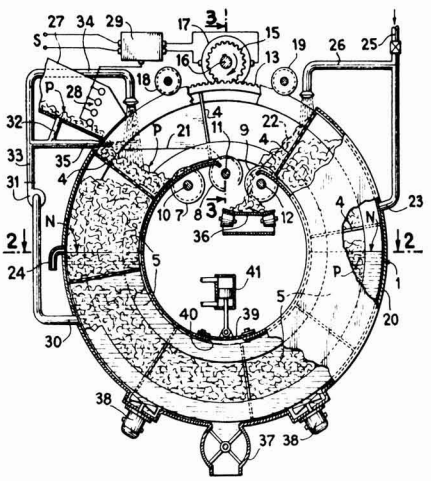
Antifoaming products. RAFFINERIE TIRLEMONTOISE, of Brussels, Belgium. **1,216,987.** 30th November 1967; 23rd December 1970.—The antifoam product is prepared by reacting together, in a single stage, without solvent and in the presence of an oxyalkylation and transesterification catalyst, 5–25% of one or more carbohydrates [maltose and/or sucrose (raw sugar, molasses, liquors, syrups, thick juices)], 50–80% of one or more (methyl and/or ethyl) esters of (C_6–C_{30}) fatty acids in the form of an animal and/or vegetable oil or fat, and 10–40% or one or more alkylene oxides (ethylene and/or propylene oxide). The product may be used in the form of a solution in a non-aqueous (liquid hydrocarbon) solvent.

* * *

Citric acid production by fermentation. SHIBAURA SEITO K. K. and H. IIZUKA, of Tokyo, Japan. **1,218,476.** 18th December 1968; 6th January 1971. Citric acid is produced by culturing a strain of *Candida oleophila* under aerobic aconditions [at 22–30°C and pH 4–8 (6), for 96 hours] in a nutrient medium containing [at least 100 (at least 170) g/litre of] an assimilable carbohydrate [a starch hydrolysate or saccharide (glucose, fructose, high-test molasses, beet or cane molasses, raw sugar)] and, if desired, a basic agent ($CaCO_3$) to at least partially neutralize the citric acid (and forming an insoluble citrate). The carbohydrate medium is hydrolysed and sterilized by prior heat treatment with a strong acid or ion exchange resin at 80°C. It also contains nutrients including an assimilable source of nitrogen, to a concentration of 0·5–1 g/litre, and the maximum number of organisms present is between 0·8 and 1×10^9 cells/cm³.

Beet and cane sugar extraction. SOCIÉTÉ SUCRIÈRE DE L'ATLANTIQUE (ENGINEERING), of Paris, France. **1,218,870.** 26th March 1968; 13th January 1971.

Within the annular element 1 are two pairs of annular rings linked by perforated plates 4, fastened radially to them and forming a series of compartments 5 within housing 20 which communicate through the perforations, which are of a size appropriate to the product P being treated (beet, cane or bagasse). The inner rings are supported on three pairs of rollers 7, 8, 9 mounted on horizontal shafts 10, 11, 12 which thus bear the weight of the apparatus. The outer rings are integral with ring gears 13 which are driven by motor 29 through gear pinions 15, so causing rotation of the rings and compartments within the housing 20. Two pairs of rollers 18, 19 cooperate with the outer surfaces of the rings to prevent tilting during rotation.



Extraction liquid is admitted to the housing 20 through pipe 23 and also is supplied through branch pipe 26 to aid removal of the exhausted product as it is discharged from the open end 22 of the housing onto the conveyor 36. On the opposite side of the housing is a port 24 for removal of the sugar-rich juice which overflows by gravity or may be pumped out. Fresh product enters the other open end 21 of the housing through channel 27, a series of photocells 28 recording the amount of material entering and governing the motor 29 and so the speed of rotation of the rings. Juice is withdrawn from the lower part of the housing through pipe 30 and sent by pump 31 to pipes 32, 35 to aid feeding of the material and to ensure even filling of the compartments. A mud sump 37 at the bottom of the housing is operated at intervals to remove mud, while the liquid is subjected to the action of agitators 38 and the pulsing of a diaphragm 39 by piston 41 to create oscillating currents and aid lixiviation.

International Society of Sugar Cane Technologists

14th Congress 1971

THROUGH the courtesy of Dr. S. J. P. CHILTON, Technical Programme Committee Chairman, we are able to list below the papers to be presented at the 14th Congress in New Orleans, 22nd October–5th November 1971.

AGRICULTURE

AGRICULTURAL ENGINEERING (*Chairman:* J. E. CLAYTON)

Development of an auger harvesting system for recumbent sugar cane (J. E. CLAYTON)
Systems for cleaning immature tops and other trash from sugar cane (J. E. CLAYTON and H. D. WHITTEMORE)
Two-row sugar cane harvesting combine (R. FANJUL)
A mechanical equipment management system (J. F. CYKLER)
Field mechanization in the Puerto Rican sugar industry (R. T. SYMES)
Mechanical harvesting in Jamaica (J. C. VAN GROENIGEN)
The power budget of sugar cane production (R. O. PETERSEN)

AGRONOMY (*Chairman:* G. SAMUELS)

Long-term effects of manuring, cropping and cultivation practices on cane yield and soil properties (P. M. JOSHI and G. K. ZENDE)
Cultural methods for sugar cane production in the sub-tropics (R. R. PANJE)
Sweet sorghum as a potential sugar crop in south Texas (W. R. COWLEY and B. A. SMITH)
Effects of varying numbers of cultivations on sugar cane production in Louisiana (R. RICAUD)
Influence of inter-row spacing and planting rate on stalk population and cane yield in Louisiana (R. J. MATHERNE)
Sugar cane planting date trials in Mozambique (F. MENDES RAMOS and J. DE SOUSA MELO)
Effects of flooding on sugar cane growth. I. Stage of growth and duration of flooding (P. W. D. WEBSTER and B. W. EAVIS)
Effects of flooding on sugar cane growth. II. Benefits during subsequent drought (B. W. EAVIS)
The effect of water table depth on the yield of sugar cane (R. PÉREZ ESCOLAR, W. F. ALLISON and J. JUÁREZ)
Water, a key to sugar production (R. P. HUMBERT)
Root studies of outstanding sugar cane varieties of Bihar, India (O. P. NEGI, S. P. NAITHANI and S. PODDAR)
Anatomy of the branch roots of sugar cane (B. B. EXNER)
Factors affecting the sprouting and growth of sett roots in sugar cane (R. R. PANJE, P. S. MATHUR and M. P. MOTIWALE)
Effectiveness of nitrification inhibitors formulated with anhydrous ammonia when applied to sugar cane in Louisiana (J. F. PARR, B. R. CARROLL and S. SMITH)
Appraisal of soil salinity for land reclamation in lower Iraq (D. P. GOWING and N. ROZEFF)
Foliar symptoms of silicon deficiency in the sugar cane plant (Y. WONG YOU CHEONG, A. HEITZ and J. DEVILLE)
The effect of silicon on enzyme activity *in vitro* and sucrose production in sugar cane leaves (Y. WONG YOU CHEONG, A. HEITZ and J. DEVILLE)
Effect of burning and chopping on sugar cane deterioration in the UAR (M. H. AMIN, A. A. EL-BELDAWI, G. EL KAREEM SAYED and A. T. HABIB)
Inversion control in sugar cane juice by sodium metasilicate (A. G. ALEXANDER, N. ACÍN-DÍAZ and R. MONTALVO-ZAPATA)

BREEDING AND GENETICS (*Chairmen:* J. DANIELS, J. C. SKINNER, B. T. ROACH, A. H. D. BROWN, H. F. CLEMENTS and D. J. HEINZ)

Description of sugar cane clones. I. Agricultural description (J. DANIELS)
Description of sugar cane clones. II. Genetical and disease resistance information (P. B. HUTCHINSON and J. DANIELS)
Description of sugar cane clones. III. Botanical description (J. C. SKINNER)
A rating scale for sugar cane characteristics (P. B. HUTCHINSON and J. DANIELS)
Effect of maturity on milling quality of five sugar cane varieties (L. P. HEBERT)
Maturity studies of commercial sugar cane varieties in Florida (L. P. HEBERT and E. R. RICE)
The Louisiana varietal programmes and their impact on yields of cane and sugar (S. J. P. CHILTON)
Selection in sugar cane: a review (J. C. SKINNER)
The mass stool population technique of sugar cane selection (J. DANIELS, D. R. HORSLEY, A. S. MASILACA, K. G. MILES, H. SINGH, N. D. STEVENSON and B. WILSON)
A mass reservoir approach to selection in sugar cane (A. H. D. BROWN, J. DANIELS, A. S. MASILACA, K. G. MILES, H. SINGH, N. D. STEVENSON and B. WILSON)
Morphological and physiological bases of differences in quality between sugar cane clones (D. MACCOLL)
Selection methods to increase mosaic resistance and sucrose content (L. ANZALONE)
The reduction of the intergeneration interval in the Fiji breeding programme (J. DANIELS and N. D. STEVENSON)
Review of sugar cane breeding in Taiwan (C. S. LOH)
Nobilization of sugar cane (B. T. ROACH)
The rôle of *Saccharum spontaneum* in sugar cane breeding (R. R. PANJE)
Utilization of noble and *Saccharum spontaneum* germ plasm in the West Indies (D. I. T. WALKER)
Breeding sugar cane varieties for Louisiana with new germ plasm (P. H. DUNCKELMAN and R. D. BREAUX)
Taxonomy of *Saccharum* relatives: *Sclerostachya*, *Narenga* and *Erianthus* (C. O. GRASSL)
Iso-enzymes as a method of varietal identification in sugar cane (J. C. WALDRON and K. T. GLASZIOU)
Some current issues in population genetics in relation to sugar cane breeding (A. H. D. BROWN)
Genetic behaviour of resistance in sugar cane to the sugar cane borer *Diatraea saccharalis* F. (D. P. VIATOR and M. T. HENDERSON)
Starch inheritance in *Saccharum*. Enzyme polymorphism for β-amylase in interspecific and intergeneric hybrids (P. G. ROUGHAN, J. C. WALDRON and K. T. GLASZIOU)
Selection for erectness in sugar cane in Louisiana (R. D. BREAUX)
Associations among yield and quality components in sugar cane hybrid progenies (J. A. MARIOTTI)
Cytogenetics of sugar cane (D. JAGATHESAN)
Flower induction of *Saccharum* species and hybrid clones (H. F. CLEMENTS)
The photoperiodic control of flowering in *Saccharum* (M. H. R. JULIEN)
Shoot apex development in early-, mid- and late-season flowering sugar cane clones (N. I. JAMES and J. D. MILLER)
Photoperiod control in the USDA sugar cane crossing programme (N. I. JAMES and J. D. MILLER)
Growth and flowering of sugar cane in relation to photoperiod and air humidity (M. H. AMIN, E. S. KASSEM, N. M. BAYOUMI and Z. A. MENSHARWI)
Flowering of sugar cane with reference to induction and inhibition (E. D. PALIATSEAS)
The rôle of leaves in production of flowering stimulus in sugar cane (T. L. CHU and J. L. SERAPIÓN)
New procedures for sugar cane breeders (D. J. HEINZ)
Brittleness of sugar cane varieties in Louisiana (H. P. FANGUY)
Rapid screening methods for sugar cane. IV. A pot method of growing and ripening sugar cane. (N. D. STEVENSON and J. DANIELS)
A field method for selecting for fibre content in sugar cane varieties (J. E. IRVINE)
Gamma irradiation-induced mutations in sugar cane (R. URATA and D. J. HEINZ)
Radiosensitivity and mutants in sugar cane (P. S. RAO)

BREEDING AND GENETICS with PLANT PATHOLOGY (*Chairman:* C. G. HUGHES)

International exchange of varieties: Introduction (C. G. HUGHES)
Disease resistant sugar cane clones (P. B. HUTCHINSON)
The world collection and international exchange of sugar cane varieties (R. E. COLEMAN)
Post-entry sugar cane quarantine (G. M. THOMSON and J. WILSON)
How the Louisiana sugar cane industry helps in variety development and increase programmes (L. L. LAUDEN)

ENTOMOLOGY (*Chairmen:* G. E. WILSON, S. D. HENSLEY and L. CHARPENTIER)

Accidental introduction of *Diatraea centrella* Moschl. into Abaco, Bahamas, and attempts at its control (M. N. BEG and F. D. BENNETT)
Effects of dates of planting on infestations of *Chilo agamemnon* Bles. in the UAR (M. T. KIRA and H. EL-SHERIF)
Estimation of losses in cane and sugar yields caused by infestations of *Chilo agamemnon* Bles. (M. T. KIRA and H. EL-SHERIF)
Eldana saccharina Wlk. (Lepidoptera: Pyralidae), a pest of sugar cane in East Africa (D. J. GIRLING)
A consolidated list of wild and cultivated plant species attacked by sugar cane borers in North India (K. R. NAIR, S. PRAKASH and S. NAGARKATTI)
Differential survival of *Diatraea saccharalis* F. larvae on two varieties of sugar cane (G. E. COBURN and S. D. HENSLEY)
Rôle of predaceous arthropods of the sugar cane borer *Diatraea saccharalis* F. in Louisiana (A. A. NEGM and S. D. HENSLEY)
Control of the sugar cane borer *Diatraea saccharalis* F. in Louisiana (S. D. HENSLEY)
A comparison of three artificial diets for the sugar cane borer (J. W. SANFORD)
Biological control of sugar cane insects in the continental United States: a historical review (L. J. CHARPENTIER, J. R. GIFFORD, T. E. SUMMERS and R. D. JACKSON)
The white scale *Aulacaspis tegalensis* Tehnt. on sugar cane (J. R. WILLIAMS)
Mating behaviour and dispersion of the pasture soldier fly *Inopus rubriceps* (A. W. OSBORN and E. J. HALBERT)
Host-parasite inter-relations of the West Indian cane fly *Saccharosydne saccharivora* Westw. (Homoptera: Delphacidae) (J. H. FRANK)
Lixophaga diatraea Towns. reared on non-congeneric lepidopterous hosts (J. ETIENNE)
Rat damage and control in the Florida sugar cane industry (H. H. SAMOL)
Insecticidal control of the sugar cane froghopper (D. E. EVANS and D. A. BUXO)
Insecticide use against *Numicia viridis* Muir (Homoptera: Tropiduchidae) (A. J. M. CARNEGIE)
Notes on a recent outbreak of *Aulacaspis tegalensis* (Homoptera: Diaspididae) on sugar cane in Tanzania (D. W. FEWKES)
Nymphal growth of *yangula guttulata* Sign., a harmful cicada of sugar cane in Madagascar (M. BETBEDER-MATIBET)
Fungi parasitic on the nymph of *Mogannia hebes* Walker in Taiwan (L. S. LEU and Z. N. WANG)
Dynamics of a sparse population of the rat *Melomys littoralis* Lönnberg (Muridae) in sugar cane and natural vegetation (T. D. REDHEAD)
Zinc phosphide as a rodenticide for rats in Hawaiian sugar cane (H. W. HILTON, R. D. NASS, W. H. ROBISON and A. H. TESHIMA)
A study of destructive rodents of Haft Tappeh (H. AZIZI and K. A. SUND)
Rat damage to sugar cane in Florida (H. H. SAMOL)
Pocket gopher pest species in Mexico cane areas (C. M. RIESS and S. FLORES)

EXTENSION EDUCATION (*Chairman:* C. A. MILLER)

Progress report on training of personnel in Mexico for the sugar industry (A. GONZÁLEZ G. and S. FLORES C.)
Scope of extension education in the Indian sugar industry (A. C. RAHA)
Extension education in South Africa (C. WHITEHEAD and J. WILSON)
Louisiana sugar cane cultural practices and extension activities (C. A. MILLER and D. T. LOUPE)
The cooperative extension function in Louisiana (L. L. PESSON)
4-H Club activities in the Louisiana sugar industry (D. P. LANDRY)

FOLIAR DIAGNOSIS AND CROP LOGGING (*Chairman:* G. SAMUELS)

Influence of water deficiency and excess on growth and leaf nutrient element content of sugar cane (G. SAMUELS)
The crop logging system for sugar cane production, 1971 edition (H. F. CLEMENTS)
Light- and nitrogen-sensitive ATP-ases in sugar cane leaves (A. G. ALEXANDER, R. MONTALVO-ZAPATA and A. KUMAR)
Effects of ground-water table and soil compaction on nutrient element uptake and growth of sugar cane (T. C. JUANG and G. UEHARA)
Crop logging as a means of controlling sugar cane fertilization in small-holdings (M. LAKSHMIKANTHAM, G. N. RAO, P. H. RAO, P. V. R. RAO, P. V. N. RAO and M. R. RAO)
Relationship between fertilizer and leaf-blade P and S and sugar cane yield in Louisiana
Effect of time of sampling in sugar cane on foliar analysis in Venezuela (F. GOMEZ-ALVAREZ)

IRRIGATION (*Chairman:* T. G. CLEASBY)

Use of water by sugar cane in Hawaii measured by hydraulic lysimeters (P. C. EKERN)
Estimating water use by sugar cane from meteorological and crop parameters (G. D. THOMPSON and J. P. BOYCE)
The sugar cane plant in the soil-plant-atmosphere continuum (J. C. MONGELARD and L. G. NICKELL)
Significance of the atmosphere in sugar cane irrigation (P. C. PRASAD and J. H. CHANG)
Some effects of water-table level on the growth of sugar cane (J. M. GOSNELL)
Effect of irrigation intervals on sugar cane yield in the UAR (M. H. AMIN, M. BAYOUMI, Z. A. MENSHAWI and M. M. ABDALLA)
Soil moisture régimes and N levels: effects on yield and quality of sugar cane (P. P. SINGH and G. SINGH)
Determination of the value of water in sugar cane production: a plantation method (P. SCOTT)
Irrigation of sugar cane on an estate and its integration with other operations (J. N. S. HILL)
Methods of surface irrigation in sugar cane (J. M. GOSNELL and T. L. PEARSE)
Land grading for surface irrigation of sugar cane (T. CHINLOY and J. A. KELLY)
Soil water infiltration and redistribution under furrow and sprinkler irrigation (G. UEHARA, T. C. JUANG and M. ISOBE)
Irrigation practices in the Queensland sugar industry (K. C. LEVERINGTON)

PHYSIOLOGY (*Chairman:* H. W. HILTON)

Soluble polysaccharides as a quality indicator in sugar cane (J. E. IRVINE)
Essentiality of chlorine for optimum growth of sugar cane (J. E. BOWEN)
Biochemical and physiological effects of boron in sugar cane (J. E. BOWEN)
A review of recent work on chemical ripening of sugar cane (R. A. YATES)
Photosynthetic rate in sugar cane: effect of virus diseases, genetic disorders and freezing (J. E. IRVINE)
Sugar cane anthocyanins as colour precursors and phytoalexins (P. SMITH and P. M. HALL)
Recent results of research on photosynthesis in sugar cane (D. GROSS, C. W. BALDRY, J. COOMBS, C. BUCKE and A. W. GORDON)

PLANT PATHOLOGY (*Chairman:* C. G. HUGHES)

Leaf scald disease: an introduction (B. T. EGAN)
Testing sugar cane varieties for leaf scald resistance (H. KOIKE)
Breeding for resistance to leaf scald disease (B. T. EGAN)
The elimination of leaf scald from infected planting material (D. R. L. STEINDL)
Occurrence of strains A and F of sugar cane mosaic virus in Uttar Pradesh, India (K. S. BHARGAVA, R. D. JOSHI and N. RISHI)
Control of sugar cane mosaic by serial heat treatment (G. T. A. BENDA)

Sugar cane mosaic virus: purification (A. G. GILLASPIE)
Reciprocal transmission of sugar cane and Johnson grass mosaic viruses: a summary report (I. L. FORBES, M. GIAMALVA and G. COBURN)
Purification and serology of sugar cane mosaic virus (H. HANDOJO and D. NOORDAM)
Reaction to ratoon stunting disease of new sugar cane varieties grown commercially in Louisiana (R. J. STEIB)
The IISR hot-air seed cane treatment plant (R. G. MENON, K. SINGH, N. S. L. SRIVASTAVA and S. R. MISRA)
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The cut-load system of harvesting sugar cane (MASSEY-FERGUSON CO., Coventry, UK)
The J & L system for cutting and loading sugar cane (J & L ENGINEERING CO., Jeanerette, La., USA)
The Cameco system for harvesting and handling sugar cane (CANE MACHINERY AND EQUIPMENT CO., Thibodaux, La., USA)
Combined efforts of producers, manufacturers and researchers to harvest and clean recumbent sugar cane (J. E. CLAYTON)

Brevities

New sugar factory in Spain[1].—A cooperative sugar factory is to be built at San Martín del Campo, in the province of León, on the initiative of the provincial beet sugar syndicate, and will cost 900 million pesetas. There are already three sugar factories in the province.

* * *

Bolivian State sugar company[2].—A State company, Sociedad Industrializadora de Cacao y Azúcar, has been set up with a capital of 400,000 pesos (£14,000) to process sugar and cacao.

* * *

Fiji Government purchase of South Pacific Sugar Mills Ltd.[3] The Colonial Sugar Refining Co. Ltd. has approved an agreement under which the Government of Fiji would buy the CSR shareholding in its subsidiary, South Pacific Sugar Mills Ltd., for $Aus. 10,117,000. The four Fiji mills will operate under CSR ownership until 31st March 1973. The price is equivalent to 27·625 Fiji cents per share, as against the 50 cents valuation in the CSR balance sheet; however, the company's general reserve and unappropriated profits are more than adequate to cover the write-off.

* * *

"Sugar in Nutrition" symposium.—On 20th September 1971 a symposium on "Sugar in Nutrition" is to be held at the Congress Centre of the Utrecht State Fair. Sponsored by the Netherlands Sugar Foundation, the symposium will include lectures by specialists and will be organized in two sections, the first concerned with the relations between sugar and dental caries, heart and vascular diseases, and the second of a more general nature. About 1000 doctors, biochemists and food specialists are expected to participate. Further information is available from the Foundation, Nassau Ouwerkerkstraat 14, The Hague.

* * *

Uganda sugar factory[4].—The foundation stone of Uganda's new National Sugar Works at Kinyala near Masindi was recently laid. The Kinyala sugar project will be the fourth major sugar enterprise in which the Uganda Government will be participating, in this case to the extent of 90%. The Government will invest 72 million Uganda shillings while Walchandnagar Industries Ltd. of India and the Mehta Group will supply machinery and equipment worth 32 million shillings. In addition, the Mehta Group will provide a loan of 8 million shillings to cover local costs. The project will cover 28,000 acres and sugar production will commence during the last quarter of 1973. The scheme when completed will employ between 3000 and 4000 people. The crushing capacity of the plant is to be 1500 tons of cane per day, producing approximately 1500 100-kg bags of sugar per day.

* * *

El Salvador sugar factory proposal[5].—The Asociación Salvadoreña de Agricultores has suggested that a large sugar mill should be installed at a cost of 12 million colones (£2,000,000) in the Valle de Jiboa, to process cane from the departments of San Vicente, Cabañas, La Paz and possibly Cuscatlán. It would be operated by a cane-growers' cooperative.

* * *

Tongaat Group Ltd. 1970/71 report.—Cane yields fell during the 1970/71 season and sugar production consequently fell by 17% to 141,571 metric tons, as compared with 171,148 tons in the previous season. Fortunately the adverse effects on profits were cushioned by an increase in the industrial average sugar price from R78.41 to R83.53 per ton. Improved agricultural practices and mechanization are being studied and introduced as feasible in order to raise cane crop yields. With excellent rains during the summer, the cane crop for 1971/72 is in outstanding condition and sugar production should be restored to a higher level.

Cuba sugar statistics[6]

	1970	1969	1968
	(metric tons, raw value)		
Stocks 1st January	405,858	306,793	286,132
Production	7,558,569	5,534,180	5,315,197
	7,964,427	5,840,973	5,601,329
Exports	*6,906,286	4,798,817	4,612,923
	1,058,141	1,042,156	988,406
Consumption	†619,376	‡636,298	§681,613
Stocks 31st December..	438,765	405,858	306,793
Exports			
Albania	10,807	—	17,098
Algeria	37,691	41,832	43,494
Belgium/Luxembourg ..	1,027	516	12,859
Bulgaria	231,170	205,308	186,431
Canada	65,411	79,900	46,739
Ceylon	—	46,098	68,525
China	530,430	444,554	431,108
Czechoslovakia	226,605	224,356	193,490
Denmark	—	2,065	—
Finland	—	—	30,267
France	—	—	20,634
Germany, East	352,666	252,508	243,656
Germany, West	1,027	—	—
Greece	—	—	34,169
Guinea	—	—	3,792
Holland	2,074	—	58,520
Hong Kong	10,405	—	—
Hungary	16,304	16,663	16,574
Iran	—	—	10,664
Iraq	21,286	21,795	53,124
Japan	1,220,941	1,017,689	555,422
Korea, North	149,110	154,851	74,910
Lebanon	9,915	—	—
Libya	10,832	—	—
Malaysia	214,536	104,938	—
Malta	2,283	—	5,482
Mongolia	—	—	5,193
Morocco	106,035	175,760	85,635
Norway	—	—	10,467
Poland	24,177	28,134	20,713
Rumania	99,178	69,143	53,552
Singapore	47,467	36,679	—
Spain	143,401	181,577	175,678
Sudan	14,229	—	—
Sweden	60,323	10,177	40,893
Switzerland	1,334	516	3,443
Syria	97,959	87,217	64,133
USSR	3,105,030	1,352,329	1,831,727
UAR	31,689	68,720	65,599
UK	—	42,912	20,065
Vietnam, North	56,512	60,129	49,777
Yugoslavia	—	67,360	75,685
Other Countries	4,432	5,091	3,405
	*6,906,286	4,798,817	4,612,923

* Of which 1,087 tons for animal feed.
† Of which 85,338 tons for animal feed.
‡ Of which 93,994 tons for animal feed.
§ Of which 20,052 tons for animal feed.

* * *

New USSR sugar factory[7].—The construction of the seventh sugar factory in Kirgiziya, at Belovodskoe, near Frunze, is drawing to a close. All the equipment, apart from the power plant, has been supplied by Poland. The factory, which will have a daily slicing capacity of 3000 tons of beet, is the sixteenth to have been built by Poland in the Soviet Union.

[1] *Consudel*, March 1971; through *Sucr. Belge*, **1971**, **90**, 290.
[2] *Bank of London & S. America Review*, 1971, **5**, 408.
[3] *Australian Sugar J.*, 1971, **63**, 64.
[4] *Standard Bank Review*, June 1971, 15.
[5] *Bank of London & S. America Review*, 1971, **5**, 415.
[6] *I.S.O. Stat. Bull.*, 1971, **30**, (4/5), 32–33.
[7] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (17), 5.

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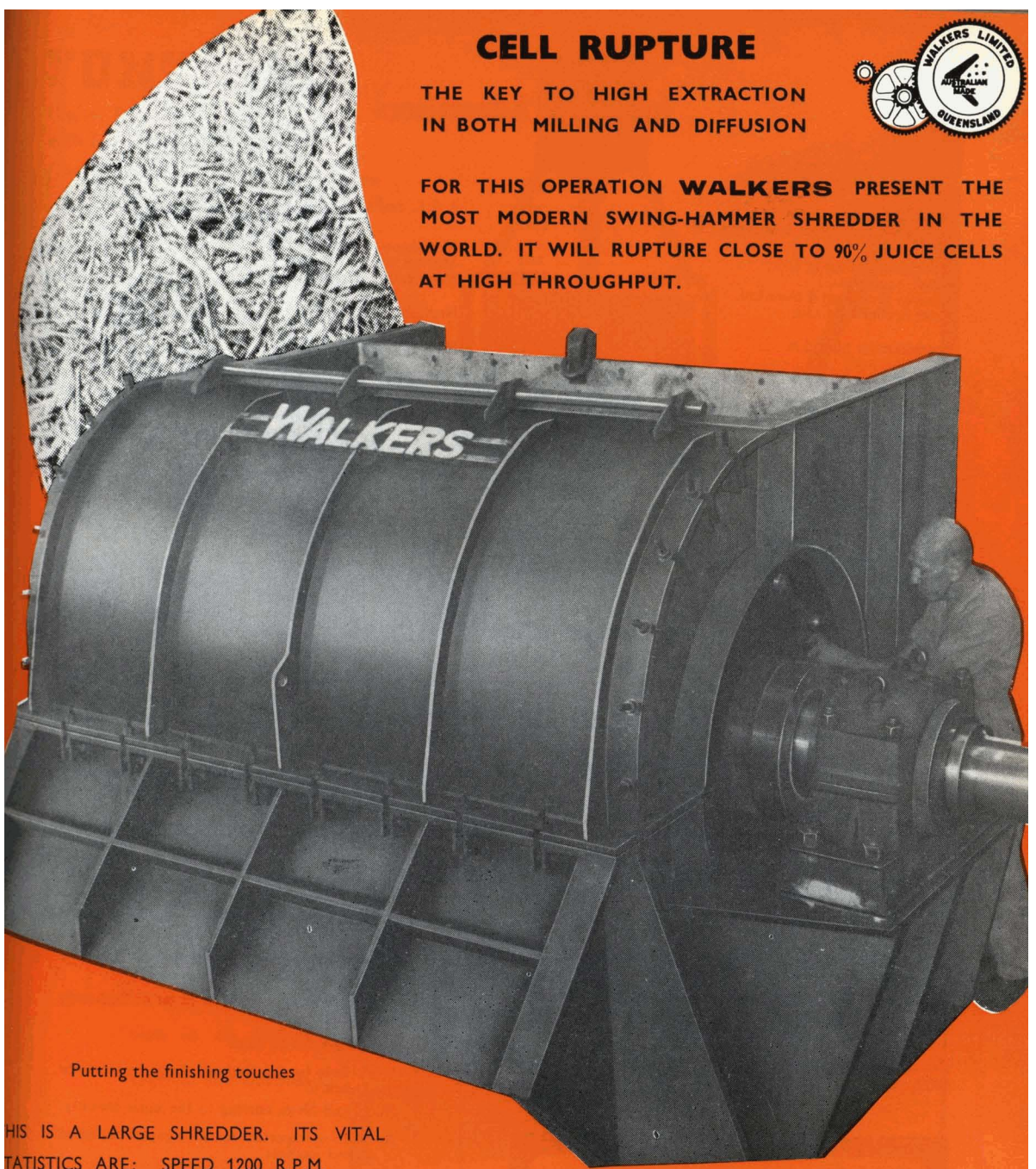

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