THE International Sugar Journal

APRIL 1971

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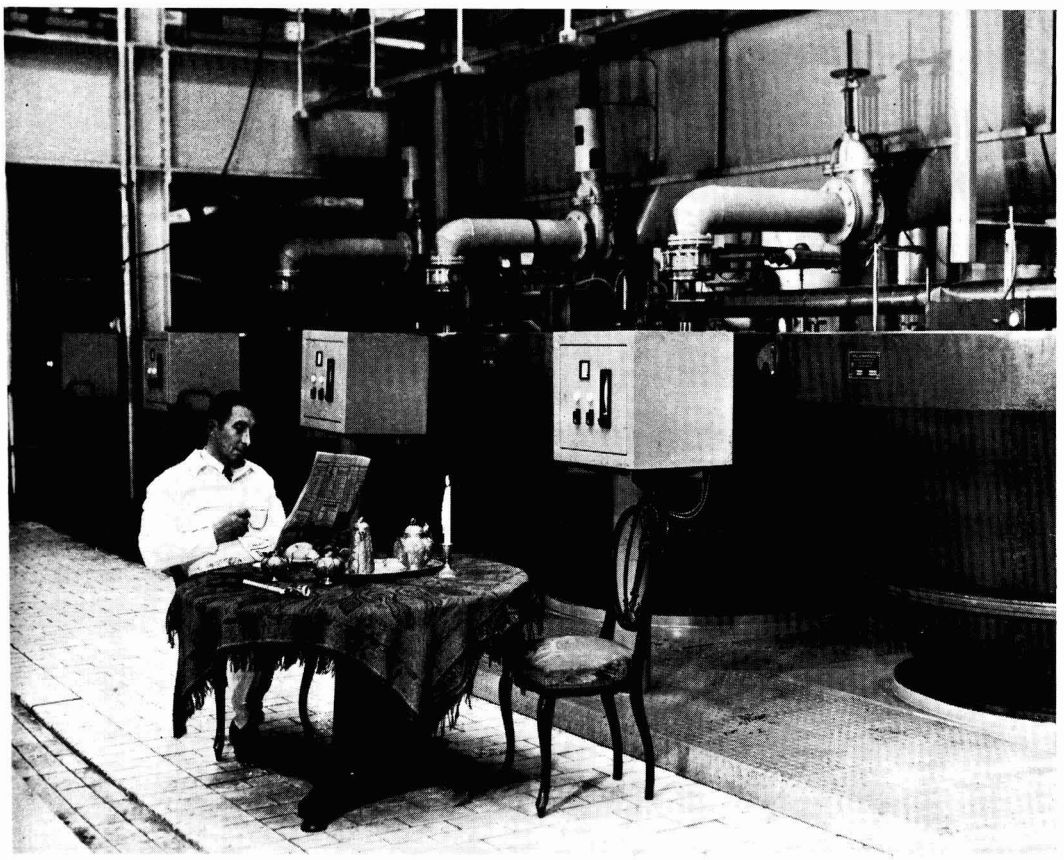

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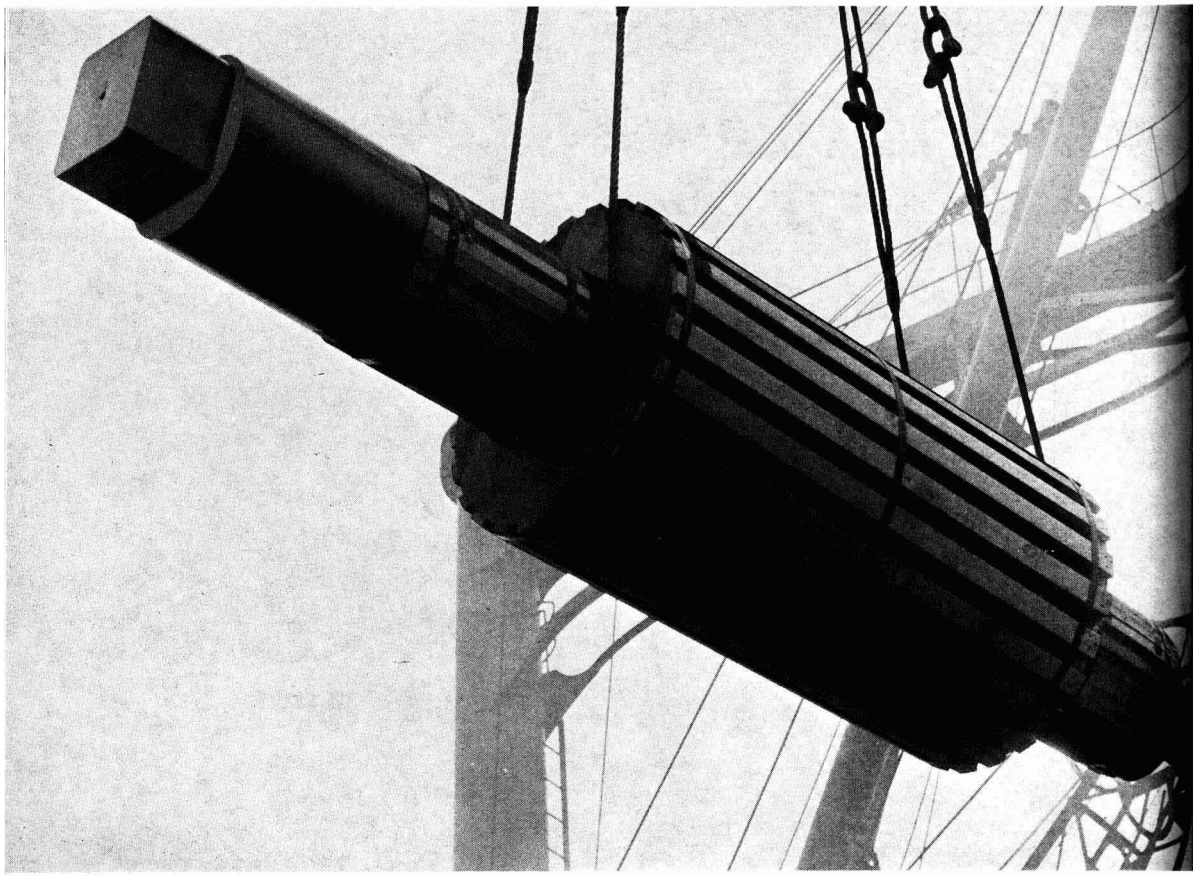

The site is cleared and the ground levelled.

Gula Perak Berhad starts constructing the foundations and the factory buildings begin to go up.

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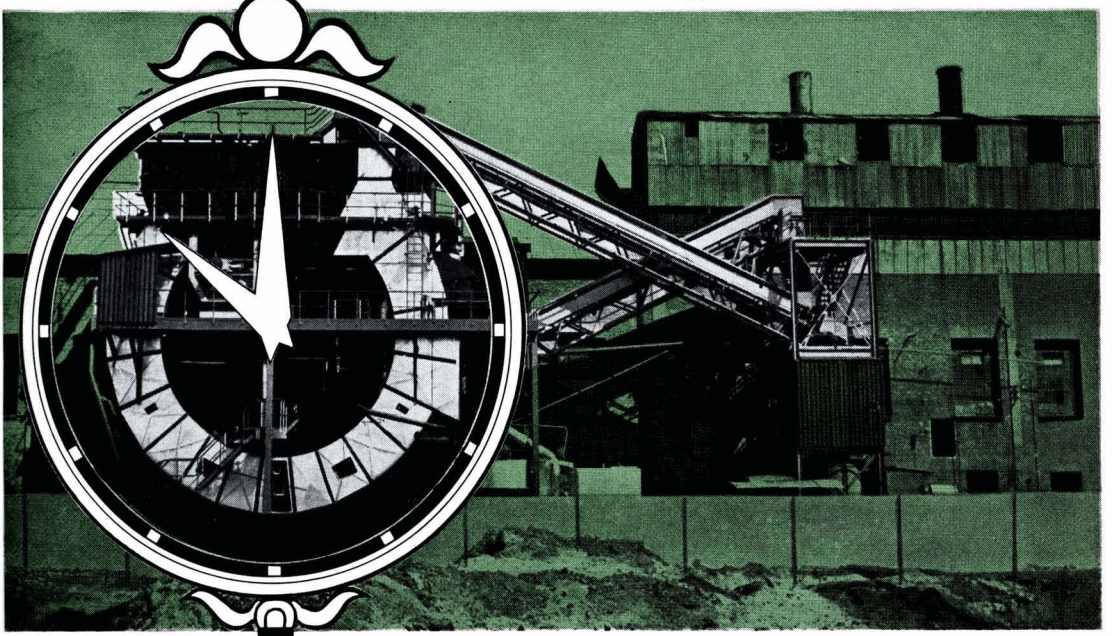

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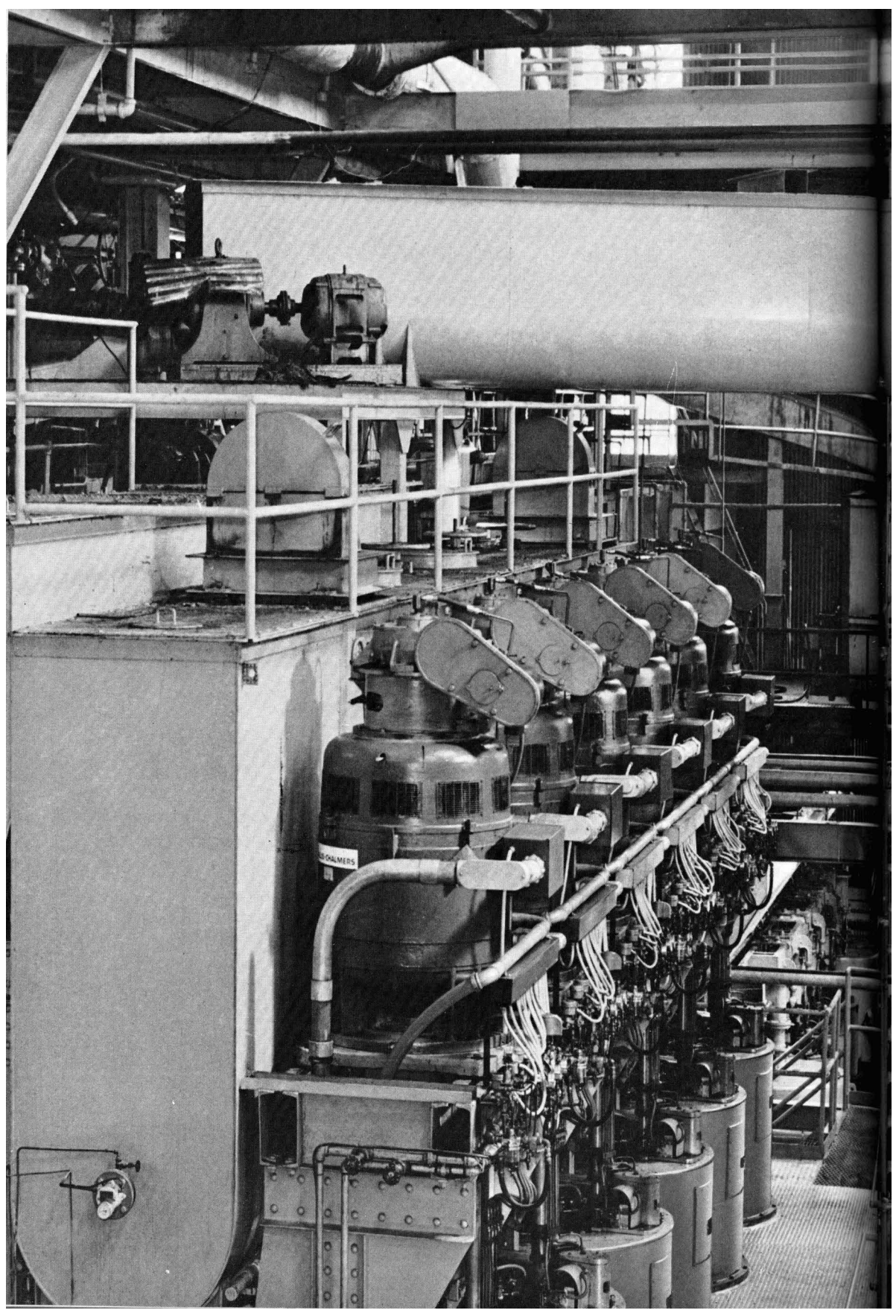
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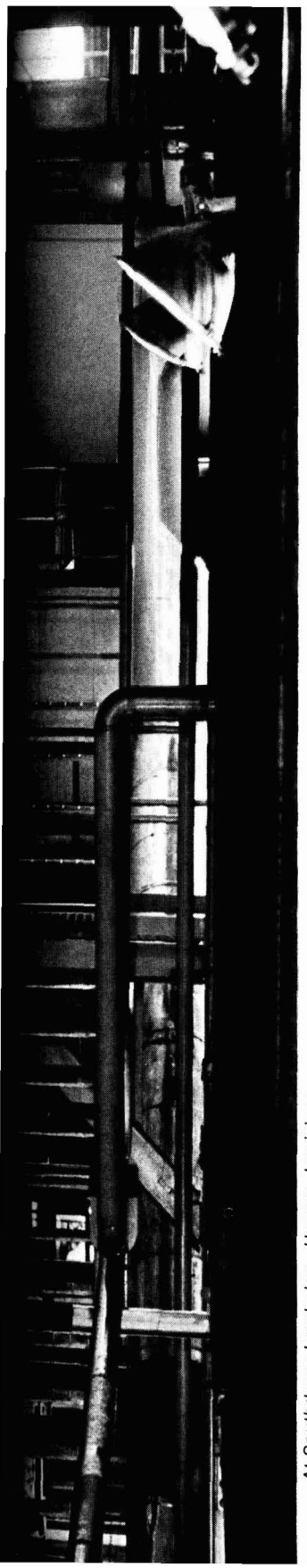

At Southdown Lands Inc., Houma, Louisiana

Southdown's new Houma installation is not just a battery of centrifugals...it's a

western States affination-recovery system

As a manufacturer of sugar processing equipment, Western States' function is to design systems that will produce the desired results most effectively. "This ability," according to Mr. Calvin Walters, President, Southdown Lands Inc., "was tested and proven by our experience at Houma. It was decided to replace our old belt drives, knowing of the promised improvement in process and reduction in labor. That's when we called Western States."

Being a combination seasonal cane milling factory and a year round refinery created complications. Here's how Southdown and Western States handled the problem: All the old belt drives (affination and remelt) were removed. Two existing remelt crystallizers were converted to A and B pan receivers. Six 48 x 36 automatic G-8's were installed. Three centrifugals were for affination only and the other three were arranged by means of mixer tank partitions and partition gates to work affination, A and B or high remelt massecuites.

When the plan was finalized, the detail station design was made by Western States and they furnished the machines, mixer tanks, Stevens reheating coils, and supporting steel work. The erection work was performed by Southdown staff.

"The job was finished on time and," again according to Mr. Walters, "at a cost within 1% of our budget estimate. Performance is as forecast...processing improved and labor and maintenance reduced."

Let Western States help to solve your sugar centrifugal problems. Contact: Mr. A. H. Stuhlreyer, Director of Sales.

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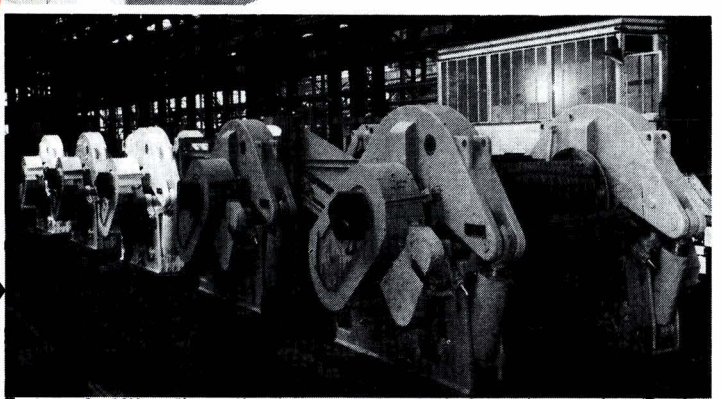

Tandem of five 2 300 x 1 150 mm self-setting cane mills intended for Ingenio Azucarero Aztra (Ecuador)

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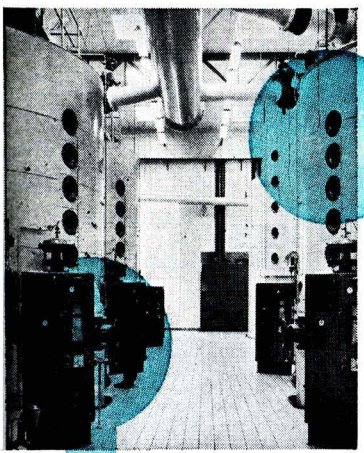

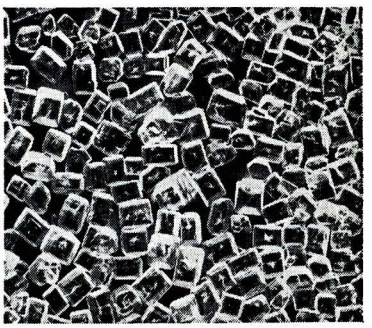

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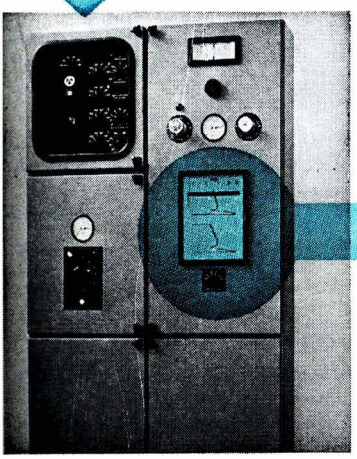

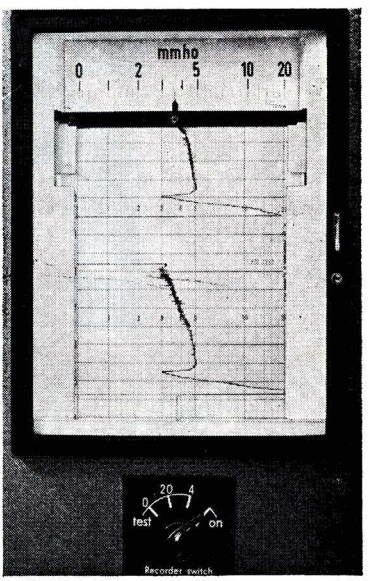

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Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

Annual Subscription: £3.00 or $10.00 post free
Single Copies: 40p or $1 post free

April 1971

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La séparation des colorants du sucre de canne par électrophorèse sur papier a révélé la présence d'acide chlorogénique et de son produit d'hydrolyse, l'acide caféïque.

* * *

Les acides chlorogénique et caféïque dans le sucre. D. GROSS et J. COOMBS. *p.* 100

On a identifié les acides chlorogénique et caféïque comme étant principalement des *o*-diphénols dans les extraits de tissu de canne dont les constituants ont été séparés par diverses méthodes puis décelés par irradiation U.V.

* * *

Etude de la production de sirop d'inverti et de sucre liquide de haute qualité à l'usine d'Euskirchen de Pfeifer & Langen. 2ème partie. H. G. SCHNEIDER. *p.* 100–104

On discute brièvement la stabilité du sucre inverti avec des variations de température et de pH ainsi que l'inversion du saccharose par les acides et les résines cationiques puis on donne des détails sur des essais en usine pilote à petite échelle sur la production de sirop d'inverti par échange d'ions. On donne des informations sur la nouvelle installation d'échange d'ions pour la fabrication de sirop d'inverti à Euskirchen.

* * *

Recherche sucrière en Australie. *p.* 104–107

On résume le rapport annuel 1969 du Bureau of Sugar Experiment Stations qui couvre à la fois les aspects agriculturaux et technologiques de l'industrie sucrière du Queensland.

* * *

Mécanisation de la culture de la canne à Cuba. *p.* 107–111

On passe en revue la mécanisation de la culture de la canne à Cuba en se basant sur des informations présentées à un symposium tenu pendant la 39ème Conférence de l'Association des Techniciens de Sucrerie de Cuba en octobre 1970.

Identifikation von Chlorogensäure und Kaffeesäure als Farbstoffe in Rohrzucker. L. FARBER und F. G. CARPENTER. *S.* 99

Die elektrophoretische Abtrennung von Farbstoffen aus Rohrzucker ergab das Vorhandensein von Chlorogensäure und deren Hydrolyseprodukt, der Kaffeesäure.

* * *

Chlorogensäure und Kaffeesäure in Zucker. D. GROSS und J. COOMBS. *S.* 100

Chlorogensäure und Kaffeesäure wurden als Hauptvertreter der *o*-Diphenole in extrahiertem Zuckerrohrgewebe identifiziert, dessen Komponenten nach verschiedenen Methoden gelöst und durch UV-Licht nachgewiesen wurden.

* * *

Untersuchungen über die Herstellung von Invertzuckersirup und Flüssigzucker hoher Qualität in der Zuckerfabrik Euskirchen der Fa. Pfeifer & Langen. Teil II. H. G. SCHNEIDER. *S.*100–104

Die Stabilität von Invertzucker bei Aenderung von Temperatur und pH-Wert sowie die Inversion der Saccharose durch Säure und Kationenaustauscherharz wird kurz diskutiert. Ferner werden Einzelheiten mitgeteilt über in einer kleinen Versuchsapparatur durchgeführte Versuche zur Herstellung von Invertzuckersirup mit Hilfe von Ionenaustauschern. Schliesslich wird über die neue Ionenaustauscheranlage zur Invertzuckersirupherstellung in Euskirchen berichtet.

* * *

Zuckerforschung in Australien. *S.* 104–107

Der Jahresbericht 1969 des Bureau of Sugar Experiment Stations wird zusammenfassend wiedergegeben. Er behandelt sowohl die landwirtschaftlichen als auch die zuckertechnischen Probleme der Zuckerindustrie in Queensland.

* * *

Mechanisierung der Rohrernte in Kuba. *S.* 107–111

An Hand der auf einem Symposium anlässlich der 39. Konferenz der Vereinigung der Kubanischen Zuckertechnologen gehaltenen Referate wird ein Ueberblick über die Mechanisierung der Rohrernte in Kuba gegeben.

Acidos clorogénico y cafeico identificado como colorantes en azúcar de caña. L. FARBER y F. G. CARPENTER. *Pág.* 99

Separación de colorantes de azúcar de caña por cromatografía a papel reveló la presencia de ácido clorogénico y de ácido cafeico, producto del hidrólisis del dicho ácido.

* * *

Acidos clorogénico y cafeico in caña de azúcar. D. GROSS y J. COOMBS. *Pág.* 100

Acidos clorogénico y cafeico se identificaron como *o*-difenoles principales en extractos del tejido de caña, de que los componentes se resolveron por algunos métodos y se percebiron por irradiación con luz u.v.

* * *

Investigaciones sobre la producción de sirope de azúcar invertido y de azúcar líquido de alta calidad en la azucarera Euskirchen de Pfeifer & Langen. Parte 2. H. G. SCHNEIDER. *Pág.* 100–104

Se discuten brevemente la estabilidad de azúcar invertido con cambio de temperatura y de pH y la inversion de sacarosa por ácido y por resinas de cambio de cationes. Detalles se presentan de ensayos de pequeña escala en planta pilota sobre la producción de sirope de azúcar invertido por medio de cambio de iones, y la nueva instalación en Euskirchen para fabricación de sirope de azúcar invertido por cambio de iones.

* * *

Experimentos azucareros en Australia. *Pág.* 104–107

El informe anual de 1969 del Bureau of Sugar Experiment Stations se resume, tanto del aspectos agrícolas como aspectos de la tecnología fabril en la industria azucarera de Queensland.

* * *

Mecanización del corte de caña en Cuba. *Pág.* 107–111

Se presenta un examen de la mecanización del corte de caña en Cuba que se base sobre información presentado en un simposio en la XXXIX Conferencia de la Asociación de Técnicos Azucareros de Cuba, celebrado en octubre de 1970.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXIII APRIL 1971 No. 868

Notes & Comments

International Sugar Organization.

The prevailing price on the 4th February having risen above 4.50 cents per pound, the quotas in effect under the Agreement were raised to 110% of basic export tonnages from the 5th February. The Executive Committee reviewed the market situation on the 10th February and noted that the prevailing price exceeded 4·75 cents per pound on the 9th and that the provisions of Article 30(2)(a) called for a release of minimum stocks in the event of the prevailing price still being above 4·75 cents on the 19th February. The Committee agreed that 25% of the minimum stocks should be released if the prevailing price were to exceed 4·75 cents on the 19th; in the event it fell on the 16th and so no stocks were released.

The prevailing price started to rise again in March and reached 4·75 cents per lb on the 11th and the Executive Committee arranged to meet on the 16th to examine the operation of Article 30(2)(a) if the prevailing price remained above 4·75 cents. The Committee decided that no action would be taken on the proportion of minimum stocks to be released, i.e. 50%, but no releases were called for when the daily price fell and the prevailing price became lower than 4·75 cents.

In the meantime, the expected declaration of a 150,000-tons shortfall by Poland had been made and was immediately re-distributed under the terms of provisions of Article 48(2)(c) which provide that if the prevailing price rises above 4·50 cents per pound

Member	*Quotas in effect before re-distribution*	*Re-distribution under Article 47(5)(b)* 20% = 30,000 tons*	80% = 120,000 tons	*Total re-distribution*	*Hardship release allocation*	*Quotas in effect at 19th March 1971*
Argentina	60,500	335	941	1,276	—	61,776
Australia	1,210,000	—	18,820	18,820	—	1,228,820
Bolivia	10,000	61	171	232	—	10,232
Brazil	550,000	3,044	8,554	11,598	—	561,598
British Honduras	24,200	134	376	510	—	24,710
China (Taiwan)	693,000	3,836	10,779	14,615	—	707,615
Colombia	180,400	999	2,806	3,805	—	184,205
Congo (Brazzaville)	45,100	250	701	951	—	46,051
Cuba	2,365,000	13,091	36,784	49,875	—	2,414,875
Czechoslovakia	297,000	—	4,619	4,619	—	301,619
Denmark	45,100	—	701	701	—	45,801
Dominican Republic	204,600	1,132	3,182	4,314	17,000	225,914
Fiji	170,500	944	2,652	3,596	—	174,096
Guatemala	11,000	67	188	255	—	11,255
Honduras	11,000	67	188	255	—	11,255
Hungary	56,100	—	873	873	—	56,973
India	275,000	1,522	4,277	5,799	—	280,799
Malagasy Republic	45,100	250	701	951	—	46,051
Mauritius	192,500	1,066	2,994	4,060	—	196,560
Mexico	105,600	584	1,643	2,227	—	107,827
Peru	110,000	609	1,711	2,320	—	112,320
Poland	407,000	—	—	—	—	257,000
South Africa	687,500	—	10,693	10,693	—	698,193
Swaziland	60,500	335	941	1,276	—	61,776
Thailand	39,600	219	616	835	10,000	50,435
Uganda	42,900	237	667	904	—	43,804
West Indies	220,000	1,218	3,422	4,640	—	224,640
TOTAL	8,119,200†	30,000	120,000	150,000	27,000	8,146,200†

* Total of basic export tonnages of developing exporting Members participating in this re-distribution = 4,927,000 tons.
† At the present level of aggregate of quotas in effect, the Philippines have an export entitlement of 60,000 tons under Article 41(2) which is not included in this total.

"the aggregate of quotas in effect shall not be restrained below 110% of the total of basic export tonnages". Under the terms of the Agreement, when quotas are in excess of 100% of B.E.T., the first 20% of shortfalls must be reallocated among developing countries and the remainder among all exporting members. The allocations and current quotas in effect are tabulated above. Since some of the countries will not be able to supply the additional quotas, further reallocations may be expected.

The ISO Hardship Relief Committee had also been meeting and recommended allocations from the Hardship Fund to the Dominican Republic and to Thailand, of 17,000 tons and 10,000 tons, respectively. The normal meeting of the Committee to consider applications for hardship relief in 1971 will be held in the latter part of July 1971.

* * *

World sugar balance, 1970/71.

F. O. Licht's first estimate of the world sugar position is as follows, in metric tons, raw value[1], for the crop years September 1970–August 1971, together with corresponding figures for the two previous crop years:

	1970/71	1969/70	1968/69
Initial stocks.....	21,419,371	19,605,683	20,436,277
Production	73,091,232	74,231,531	68,304,110
Imports	23,931,130	23,047,824	21,369,165
	118,441,733	116,885,038	110,109,552
less			
Exports.....	23,945,000	23,198,725	21,440,238
Consumption	74,865,234	72,266,942	69,063,631
Final stocks	19,631,499	21,419,371	19,605,683

The production figure shows a drop of 1,200,000 tons, largely owing to reduced production expected in Cuba, and the consequent shortfall of 1,800,000 tons is expected to reduce end-year stocks by a similar amount. To maintain a stock which is a constant proportion of annual consumption should involve an *increase* of some 650,000 tons so that the drop in stocks represents a fall from 29·6% to 26·1% of the previous year's consumption.

* * *

UK sugar imports and exports.

Statistics of British imports and exports of sugar during 1970 have now been published[2] and appear elsewhere in this issue, with comparative data from the three previous years. For the first time for many years British exports fell last year below 200,000 tons. There has been no loss of any important market, and in the main the pattern of exports is similar to that of 1969. The leading buyers remained Norway, Switzerland and Tunisia among foreign countries and Nigeria and Jamaica among Commonwealth countries.

South Vietnam is missing from the list this time, but its method of buying means that no seller may feel assured of a regular outlet in that country. It is heartening that the list continues to cover a considerable number of countries, which may make it possible to increase shipments considerably should the demand for high quality refined sugar expand in any of these areas.

Imports as usual exceeded two million tons, with the bulk of the country's needs coming from the Commonwealth. Mauritius was the leading supplier in 1970, with 405,000 tons, followed by Australia. The USSR was again the leading foreign supplier, having raised total deliveries during 1970 to a level just short of 100,000 tons. France, Germany, Cuba and South Africa each shipped a few cargoes for further refining while 41,000 tons of sugar for direct consumption arrived from Holland. The form in which the UK Customs presented statistics in 1970 made it impossible to be sure whether sugar imported was for further refining or not; consequently Czarnikow had to use their judgement when considering into which category the various quantities of sugar imported into the UK should be placed.

The operation of the Commonwealth Sugar Agreement enabled the British consumer to be assured of supplies at a reasonable price during 1970, the ex-refinery price being contained within the range £70–£78 throughout the year.

* * *

West Indies Sugar Co. Ltd. 1970 report.

The Company sustained a very severe financial loss of about £1 million in 1970 due, in great part, to unfavourable climatic conditions which, following the previous year's strikes, produced the worst average yield of sugar from the cane that has been experienced in over 30 years. The low yield meant low sugar production and the final figure was only 137,457 tons compared with the previous five-year average of 164,955 tons. Negotiations are nearly complete for the purchase of the Company's cane lands by the Jamaican Government and their renting until the Government is able to sell or lease them to farmers; eventually the Company could become only millers of cane.

The Negotiated Price under the Commonwealth Sugar Agreement is due for review in autumn 1971 and it has become essential that it be increased over the level which has been virtually unchanged over 12 years during which time costs have escalated very considerably. In respect of British negotiations to join the EEC, it is vital that the developing Commonwealth territories have guaranteed long-term outlets in the EEC for similar tonnages to those they enjoy under the CSA, at properly remunerative prices, and with the opportunity to participate in the future growth of sugar consumption in the EEC. The US Sugar Act is due for re-negotiation in 1971 and the quotas and prices available to the Caribbean producing territories are of vital importance to the continuation of the sugar industries.

[1] *International Sugar Rpt.*, 1971, **103**, (2), 1.
[2] C. Czarnikow Ltd., *Sugar Review*, 1971, (1010), 26–27.

Chlorogenic and caffeic acids identified as colorants in cane sugar

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THE compounds that are responsible for the yellow to brown colour associated with raw and partially refined cane sugar have never been identified. Some of the colorants undoubtedly come from the cane plant. Other sources of colorants could be the decomposition of sucrose, and the reaction of various uncoloured constituents from the cane with one another, or with sucrose decomposition products.

Many specific compounds have been identified in sugars, including monosaccharides, polysaccharides, carboxylic acids, and amino-acids, but no specific compound has been identified as a colorant.

Many of the properties of the colorants have long been known. The colour is always yellow to brown with continuously increasing absorption as one goes farther into the ultraviolet[1]. The colorant acts as an indicator, markedly changing colour with pH[1]. Anion exchangers are effective in removing part of the colour[2], so at least some of the colorants must be anionic. There must be a wide variety of colorants because, in some sugars, mild oxidizing agents effect a decolorization as in the Sucro-Blanc and Perone processes[3], while in other sugars, mild reducing agents are effective[1]. The standard decolorization method is to use carbon adsorbents, which are broad spectrum adsorbents, and remove almost everything equally well. In some sugars an increase in colour upon the addition of iron suggests the presence of phenolic groups[4]. When attempts are made to separate the colorant from the sugar, one always obtains an extremely small amount of material. These are the general properties of the sugar colorant, which suggest that it is a varied mixture of minute amounts of highly coloured materials.

It has been the aim of sugar chemists for years to identify the sugar colorant and many ingenious separation schemes have been employed. However, all investigators reached the same conclusion: that the sugar colorant is a complex mixture.

We have chosen paper electrophoresis[5,6,7] as a highly suitable separation method for sugar colorants. Because of the very small amount of material that is compatible with paper methods, we used other methods, primarily solvent extraction and thin-layer chromatography, for preparation of a usable amount of material. These other methods were always monitored with paper electrophoresis.

In studying some materials that were found in all cane sugar products from cane juice to refined sugar, it was noted that one component from sugar corresponded exactly with a component in coffee. In screening the known constituents of coffee, chlorogenic acid proved to be identical with the material found in cane sugar.

The material from cane sugar and chlorogenic acid responded in the same way in paper electrophoresis in 0·05 molar sodium tetraborate buffer. Both showed the R_f values in thin-layer chromatography on calcium sulphate-free silica gel using three different developers.

Solvent System	R_f
Benzene-methanol-acetic acid (45:8:4)	0·093
Benzene-methanol-acetic acid (5:3:1)	0·86
Methanol-acetic acid (1:2)	0·77

Since chlorogenic acid and the substance from cane sugar responded in the same way in four chromatographic systems, they were considered to be the same. Caffeic acid, which is a hydrolysis product of chlorogenic acid, would be expected to be present, and was indeed found, and its presence proven in a similar manner.

Chlorogenic acid is colourless in neutral solution and orange in alkaline solution. Caffeic acid is yellow in neutral solution and orange in alkaline solution. Both have an absorption peak in the ultraviolet. Both contain phenols. Both thus agree with some of the general properties of sugar colorants.

Chlorogenic acid is also reported as a photosynthesis inhibitor in cane leaves[8].

It is surprising that these rather reactive plant materials should elude all of the various processes used in refining cane sugar, but chlorogenic acid is one colorant of a very few that has been detected in every cane sugar sample we ever examined. The more refined sugars have less, certainly, but it is always easily detectable.

The amounts of materials have not been estimated, and it is not proposed that chlorogenic and caffeic acids are the only colorants, or even the major colorants, in various sugar products. They are merely some of the colorants that do in fact appear in all cane sugar products.

Work is continuing to detect and measure other derivatives of chlorogenic acid, related compounds and other colorants.

[1] GILLETT: "Principles of sugar technology, Vol. I", Ed. P. HONIG (Elsevier, Amsterdam). 1953, pp. 214–285.
[2] RAWLINGS and SHAFOR: *Sugar*, 1942, **37**, (1), 26–28.
[3] MEADE: "Cane sugar handbook", 8th Edn. (Wiley, New York). 1945, pp. 308, 331.
[4] ZERBAN: *Ind. Eng. Chem.*, 1918, **10**, 814–817.
[5] GROSS: *Nature*, 1953, **172**, 908.
[6] *idem*: *J. Chromatog.*, 1961, **5**, 194.
[7] *idem*: *I.S.J.*, 1967, **69**, 323–328, 360–365.
[8] GROSS and COOMBS: *ibid.*, 1971, **73**, 100.

Chlorogenic and caffeic acids in sugar cane

By D. GROSS and J. COOMBS (Tate & Lyle Ltd., Research Centre, Keston, Kent)

DURING investigations into the mechanism of sucrose biosynthesis in sugar cane it was observed that cane leaves and stems contain high concentrations of phenolic compounds[1]. The major *o*-diphenols in extracts from sugar cane tissues have now been identified as chlorogenic acid and caffeic acid.

About 30 g cane tissue were blended in 200 cm^3 water or 80% (v/v) methanol/water using a domestic blender. Cellular debris was removed by filtration and the solution reduced in volume to about 1 cm^3 under reduced pressure. Addition of 100 cm^3 absolute alcohol to the concentrated extract resulted in a fine precipitate (sucrose, salts and proteins) which was removed by centrifugation. The ethanolic solution was evaporated to dryness under reduced pressure and the extract finally taken up in 1 cm^3 distilled water. Components of this extract were resolved by: (*a*) high voltage paper electrophoresis in 0·05 M borate buffer, pH 9·2; (*b*) paper chromatography, using a variety of solvents and one-dimensional development; (*c*) two-dimensional thin-layer chromatography on prepared cellulose adsorbent sheets (Kodak Ltd.), using 6% acetic acid for the first development and *sec*-butanol:acetic acid:water (14:1:4 v/v/v) for the second. The position and colour of ultraviolet light-absorbing or fluorescing compounds were noted under both short and long wavelength U.V. irradiation. Compounds were also located by means of spray reagents such as ferric chloride, ammoniacal silver nitrate, ferric ammonium sulphate, and *bis*-diazotized benzidine. Zones detected under U.V. irradiation were cut from the papers and eluted at room temperature in water or ethanol and their absorption spectra determined under acid and alkaline conditions.

The major U.V. fluorescing compounds in these extracts corresponded to authentic samples of chlorogenic and caffeic acids in the following characteristics: electrophoretic mobility, chromatographic position in a number of solvents, position on two-dimensional chromatographic map, visual fluorescent characteristics under U.V. irradiation both before and after fuming with ammonia, colour reactions with spray reagents, and U.V. absorption spectra. Hydrolysis of suspected chlorogenic acid yielded a product corresponding in the above characteristics to caffeic acid.

The amount of *o*-diphenol recovered in a given sample depended on the method of extraction, the variety and stage of growth of the cane plant, and the type of tissue sampled. Most samples of cane stems or cane leaves contained between 0·1 and 0·5% wet weight in phenolic compounds. This would mean that such compounds may under certain conditions be equivalent to between 1 and 5% by weight of the sucrose present in mature cane. These observations are consistent with suggestions[2,3] that such phenolic compounds may contribute significantly to colour in raw sugar.

[1] BALDRY, BUCKE, COOMBS and GROSS: *Planta* (Berlin), 1970, **94**, 107.
[2] FARBER and CARPENTER: *I.S.J.*, 1971, **73**, 99.
[3] GROSS: *ibid.*, 1957, **59**, 339; 1967, **69**, 323, 360.

Investigations on the production of high quality invert syrup and liquid sugar at the Euskirchen factory of Pfeifer & Langen

By H. G. SCHNEIDER (Pfeifer & Langen, Euskirchen, Germany)

Paper presented to the 20th Technical Conference, British Sugar Corporation Ltd., 1970

PART II

THE PRODUCTION OF INVERT SUGAR

The stability of invert sugar at different temperatures and pH

As this paper deals with the production of invert syrup and liquid sugar the stability of invert sugar or its components glucose and fructose is most important. According to a study by E. J. MCDONALD[3] on the stability of dextrose solutions of varying pH, dextrose is most stable at about pH 4.

Another very comprehensive publication of A. MATTHEWS and R. JACKSON[4] concerns "The stability of levulose in aqueous solutions of varying pH". The final table of this paper is reproduced below as Table X.

This table gives the answer to all questions regarding pH and temperature; it can be seen generally that levulose (fructose) has a maximum stability at pH 3·3.

[3] *J. Research* (National Bureau of Standards), 1950, 45, (3), 200–203.
[4] *Research Paper* (Bureau of Standards, US Dept. of Commerce), Nov. 1968, (611).

Table X. Time required for the decomposition of the first 1% of the total levulose in aqueous solutions at integral units of pH and 10°C intervals of temperature

	Temperature, °C									
pH	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°
—2	17h	87m	8·7m	1m	—	—	—	—	—	—	—
—1	75d	165h	19h	145m	21m	3·5m	0·6m	—	—	—	—
0	8y	310d	40d	135h	22h	240m	49m	11m	2·6m	—	—
1	—	13y	2y	110d	20d	98h	21h	310m	80m	22m	6·8m
2	—	—	11y	2·5y	140d	32d	127h	47h	13h	240m	78m
3	—	—	24y	4.7y	365d	85d	520h	141h	43h	810m	275m
4	—	—	20y	4·0y	320d	75d	480h	138h	42h	810m	280m
5	—	—	8y	1·6y	130d	31d	200h	56h	17h	245m	108m
6	—	11y	1·9y	135d	30d	165h	44h	12h	225m	71m	25m
7	14y	2·1y	132d	25d	130h	30h	7·6h	126m	38m	12m	4·1m
8	2·5y	129d	21d	95h	20h	4·6h	69m	18·5m	5·5m	1·7m	0·6m
9	190d	21d	83h	15h	3·1h	42m	10m	2·7m	0·3m	0·2m	—
10	29d	95h	15h	2·6h	30m	6·9m	1·7m	0·4m	—	—	—
11	185h	20h	3·0h	32m	6·0m	1·3m	0·3m	—	—	—	—
12	40h	5·2h	47m	8m	1·5m	0·4m	—	—	—	—	—
13	13h	102m	15m	2·5m	0·5m	—	—	—	—	—	—
14	6h	45m	6·3m	1·0m	—	—	—	—	—	—	—
15	4h	29m	4·0m								

m = minutes, h = hours, d = days, y = years.

The inversion of sucrose by acid

The outlines of the inversion by acid were published by JACKSON and SILSBEE (N.B.S. 1924). Based on the table of MATTHEWS and JACKSON, it has been worked out that inversion is most easily and gently achieved at pH 1·5 and at a temperature of about 80°C.

The neutralization of the acid should be done with less $NaHCO_3$ than the equivalent of the acid used for inversion. Working in this way, the pH of 1·5 may be raised to 3–4 at elevated temperatures without any local over-alkalization. The inversion is slowed down and, after cooling to about 30°C, the final pH can be adjusted by a stronger alkali, with brisk stirring of the syrup.

It is possible to invert sugar solutions of very high purity without any discoloration. Sugars having an ash content of more than 0·005% normally show a rise in colour probably due to the formation of Maillard compounds.

The inversion of sucrose on cation exchange resins

Inversion on a cation exchange resin is only partially affected by the low pH of the sugar solution after replacement of the cations. Inversion is mainly promoted by contact with the strongly acidic resin which represents a highly dissociated solid acid of about 2–3 normality. There are many papers treating this question from the theoretical point of view.

For us it was essential to find one resin with the *maximum* and one with the *minimum* capability of inversion; the former is necessary for the production of invert syrup and the latter for liquid sucrose.

100 ml of different cation exchange resins were conditioned in the test columns at 40°C, using 3 volumes of 4% HCl as regenerant, and a 1% NaCl solution for exhaustion. After 5 conditioning cycles, the resins were regenerated again with 300 ml of acid and washed with 500 ml of distilled water. A syrup of 60°Bx and an ash content of 0·004% on dry solids was then percolated through the resins at 40°C at a flow rate of 500 ml/hr (5 bed volumes/hr). The apparent purity was used an as indicator for inversion.

As may be seen, Resins No. 20 (Montecatini Kastel C300 AGRP) and No. 21 (Rohm and Haas IR 200) are suitable for minimum inversion. Resin No. 11 (Rohm and Haas XE 100) appears to be the best catalyst for inversion and is, in fact, generally used for the production of invert syrup in the United States, as we learned later.

Table XI

Resin No.	9	11	12	20	21	22
Apparent purity	56	38	65	82	78	72
Capacity, equiv./litr	1·6	1·5	1·9	1·9	2·2	1·9

THE MICRO PILOT PLANTS

Invert syrup by decolorization, ion exchange demineralization and inversion on a cation exchange resin

The following resin combination (A) was used:

100 ml 501 D Cl^- 75°C → 100 ml C 300 P H^+ 25°C → 100 ml IRA 93 OH^- 25°C → 100 ml XE 100 H^+ 43°C →

Flow rate was 330 ml/hr and characteristics of the untreated and final inverted syrup are given in Table XII.

Table XII

	Untreated syrup	*Final syrup*
Brix	63	64
Apparent purity	98·5	15
pH	7·0	4·5
Ash % dry substance	0·040	0·003
Colour, I.C.U.	186	4·7
Invert % dry substance	0·2	64

Inversion is markedly influenced by variation in flow rate and by temperature. Since the temperature during contact with the XE 100 should not exceed 50°C because of colour formation, a more complete inversion should be achieved by increasing the time of contact by use of an additional XE 100 filter. It should be mentioned that the XE 100 resin does not need to be regenerated as often as the other resins; practically no ash is taken up by this resin, as it serves only as a catalyst.

Liquid sucrose by decolorization and demineralization

The following resin combination ("B") was used:

100 ml 501 D Cl^- 75°C → 50 ml C 300 AGRP H^+ 25°C → 100 ml IRA 93 OH^- 25°C → 50 ml IRC 84 H^+ 25°C →

The flow rate was 500 ml/hr, and the capacity of this combination for ash is about 6·5 g per cycle. Characteristics of the untreated and treated syrup appear in Table XIII.

	Untreated	*Treated*
Brix	63	63
Apparent purity	98·4	98·4
pH	7·0	4·3
Ash % dry substance	0·040	0·006
Colour, I.C.U.	186	9
Invert % dry substance	0·2	1·2

The quality and "tank quality" of syrups produced by different methods

Customers of the sugar industry—bakers, confectioners, canners and so on—talk of the "shelf life" of a product. The invert syrup manufacturer should also think of the "tank life" of his syrups. Not every load of syrup is processed immediately and it may happen that at least a part of it is stored in the customer's tank for more than a fortnight at elevated temperatures.

A storage test on invert syrups produced by different methods

To study the "tank life" of differently-produced invert syrups from different sugars, samples were stored in glass bottles in incubators at 30 and 40°C. Of the samples, those indicated as e, f and h were inverted on the cation exchange resin while the remaining samples were inverted with hydrochloric acid. In Table XIV are given the colour of the untreated sugar, that after decolorization and after inversion and concentration, and also the colour of the different products after 4, 14 and 20 days.

The colour of the syrups should stay below 25 I.C.U. and preferably below 20 I.C.U. after a fortnight's storage. All syrups used for this test had an invert content of 65% on dry substance, the Brix was adjusted to 70° and the pH was between 4·8 and 5·2.

(*a*) This was a very pure sugar (A) having an ash content below 0·003% and thus able to be inverted by acid without any discoloration. There was no colour after 4 days; some discoloration (11 I.C.U.) appeared after 14 days. There was no increase in discoloration after 20 days at 30°C while at 40°C the discoloration was not very much higher.

(*b*) The sugar B was an example of a sugar of category I with low colour but relatively high ash (0·010%). When this sugar was inverted there was a major increase in colour and this continued during storage. After 14 days at 30°C the syrup colour had already reached 43 I.C.U.; if this kind of sugar is to be used for the production of invert syrup it must be pretreated with active carbon.

(*c*) When sugar B was given a treatment with 0·1% on dry substance of "Carboraffin ZG" in a 64°Bx solution it was decolorized to zero. There was no increase in colour when the syrup was inverted and concentrated and the keeping quality remained tolerable when it was stored at 30°C.

(*d*) Sugar C had a colour of 80 I.C.U. and an ash content of 0·032%; it needed 0·6% of "Carboraffin ZG" for complete decolorization. After inversion and concentration the syrup was still very bright (3 I.C.U.) and its tendency to discoloration was not high.

(*e*) When sugar C was processed by the resin combination A, the colour of the final product was very low and it had an excellent tank quality.

(*f*) Sugar C could also be processed by ion exchange demineralization only, without a decolorizing resin, and gave a very good product with excellent keeping qualities.

(*g*) The use of a decolorizing resin (a strongly basic anion exchange resin on the chloride cycle) for sugar C was not suitable as a shortened method for production of invert syrups. Colour and keeping quality of the product was poor and it had an unpleasant odour.

(*h*) For the decolorization of sugar D (200 I.C.U., 0·045% ash) at least 0·6% of "Carboraffin ZG" had to be provided. This treatment reduced the colour to 3·7 I.C.U., but the colour increased rapidly on inversion and during storage so that tank life was very short.

(*i*) When sugar D was processed by the resin combination "B" a good commercial product with tolerable tank quality resulted.

COMPARISON OF CARBON AND ION EXCHANGE

(*a*) *Active carbon.* Disadvantages include difficulties in filtration and the occurrence of colloidal dispersions. The cost of the treatment is high with

Table XIV

Test No.	*Sugar*	*Original sugar colour, I.C.U.*	*Original ash content, % on d.s.*	*Decolorization treatment*	*Colour of treated syrup, I.C.U.*	*Ash content after inversion and concn., % on d.s.*	*Colour, I.C.U.*						
							Storage at 30°C				*Storage at 40°C*		
							Days						
							0	4	14	20	4	14	20
a	A	0	0·002	none	—	0·052	0	0	10·8	7·0	0·8	13·2	7·4
b	B	6	0·010	none	—	0·132	14	23	43	42	32	60	58
c	B	6	0·010	0·1% Carboraffin ZG	0 0	0·134	0	1	20	24	8	35	40
d	C	80	0·033	0·6% ,,	0	0·153	2	10	10	10	9	20	20
e	C	80	0·033	resin combn. "A"	—	0·002	1	3	3	3	4	6	9
f	C	80	0·033	resin combn. "A" but without 501D	—	0·004	1	6	6	—	8	8	—
g	C	80	0·033	Kastel 501D only	8	0·154	21	26	23	29	31	31	43
h	D	200	0·043	0·6% Carboraffin ZG	4	0·255	11	26	47	50	37	67	79
i	D	200	0·043	Resin combn. "B"	—	0·005	5	9	17	12	9	19	16

poor quality sugars. There is no removal of ash constituents or amino-acids and, in consequence, the keeping quality of the inverted syrups is poorer. Inversion must be done discontinuously.

Active carbon needs only little equipment, however, and small investment. It is economical when relatively good sugars are used and mainly liquid sucrose is to be produced.

(*b*) *Ion exchange.* The equipment for ion exchange treatment is expensive and the plant complicated. For the production of liquid sucrose there must be an allowance for an invert content of 1–2% on dry substance.

On the other hand, the process works absolutely continuously. The plant is quite flexible, as the flow rate can be varied widely (between 1·5 and 5 bed volumes per hour). Sugars of poorer quality, such as washed raw sugar, can be processed and inversion can be kept under good control when a cation exchange resin is used. The colour and ash content of the final product are very low and the tendency to discoloration is also low. Demineralized syrups are less liable to bacteriological contamination.

For these reasons P & L decided on the use of the ion exchange process.

The New Euskirchen Installation

The new plant at Euskirchen produces a range of different products, including large brown candy crystals, soft brown sugars, brown syrups, caramel and "colour*". To this range is now added white liquid sugars and this paper has been concerned with only the last. The installation has been built to produce

(i) 10 tons/hour of a 80°Bx syrup containing 65% invert on dry substance, referred to as 80/65 syrup, and

(ii) 21 tons/hour of a 67°Bx syrup containing practically no invert, referred to 67/00 syrup.

It is possible for the affination of raw sugar to be incorporated in the process, with recovery facilities for the washings. In addition, sugar from the silos (made from beets during the campaign) can be melted and used in the process.

In some of the liquid sugar refineries in the USA monobed (mixed-bed) filters are in use for the demineralization of syrup. As the anion and cation exchange resins tend to separate in higher density sugar solutions, a good deal of time and experience is needed to get the filters running properly. When monobed filters are used for the syrup treatment, less invert is found in the final syrup, compared with the two-bed system. As Pfeifer & Langen wanted to produce mainly invert syrups in future, there was no justification for using the more complicated monobed system.

For the production of liquid sucrose it is possible to keep invert sugar below 2% on d.s. when suitable resins are used in a two-bed system, so the monobed system was not necessary for this product either.

It was decided to carry out the ion exchange in a conventional manner, i.e. with syrup flow from top to bottom and also regeneration from top to bottom. The filter tanks contain a filtering plate with plastic nozzles. On the filter plate is a 100-mm layer of gravel and above this layer is the resin. The filter tanks and the pipelines for the chemicals are rubber-lined. The pipelines for the syrup are made of stainless steel.

As mentioned above, the resins tend more or less to float up in a syrup of 1·2–1·3 specific gravity. For this reason the level of the syrup in the filter must be well controlled to avoid vagrant currents. This is performed by Fischer and Porter differential pressure transmitters which control the exit valves of the respective filters.

It is not possible for syrup to pass directly through a series of four ion exchange filters, so every filter has a pressure-increasing pump. The free space in the top of each filter is filled with filtered air which has been sterilized by ultraviolet radiation.

The resin content of the two ion exchange banks is given below, together with the average operating temperatures.

Line I

(*a*) Kastel 501D, 3·5 cu.m., 75°C
(*b*) Kastel C 300P, 3·5 cu.m., 30°C
(*c*) R & H IRA 93, 3·5 cu.m., 30°C
(*d*) R & H XE 100, 3·5 cu.m., 43°C

Line II

(*a*) Kastel 501D, 3·5 cu.m., 75°C
(*b*) Kastel c 300 AGRP, 1·5 cu.m., 25°C
(*c*) R & H XE 272, 3·5 cu.m., 25°C
(*d*) Lewatit CNPLF, 1·5 cu.m., 25°C

Two resins in this table have not been mentioned above, namely XE 272 and Lewatit CNPLF. XE 272 is a resin which is quite similar to IRA 93. Recent tests have indicated that this resin has a better capacity for colour. Lewatit CNPLF is used in Line II as a replacement for IRC 84.

Concerning the quality of the different resins there was some scepticism as to whether the test samples were identical with the resins finally supplied, not so much in regard to their capacity but as to the possibility of leaching of unwanted substances from the resins. Before resins go into a food processing operation they must be washed and conditioned to remove soluble substances arising from production of the resins. Usually this requires three runs with acid and alkali.

To ensure that the resins would not give any extractable odour or taste substance into the syrup after such conditioning, it was first applied in the laboratory to samples of the resins which had just arrived from the manufacturers. In the course of these tests it was discovered that one of the resins was not of the purity which had been ordered; it gave a very unpleasant smell to the water used in the conditioning. The leaching could not be eliminated by chemical treatment and the resin could not be used.

Now, with the new plant in full operation, it can be stated that there is absolutely no smell in the final product.

It should be realized that, in this case, a micro-laboratory plant of only 100 c.c. resin volume was

* A nitrogenous colouring matter analogous to caramel but formed by ammoniation of syrup, followed by heating.

the basis for a full-scale technical plant of 3·5 cu.m. filter volume. It is remarkable that the technical ion exchange filters behave quite similarly to the micro-laboratory plant; using the same specific flow rate and the same temperature, the degree of inversion is about the same. The degree of inversion in the technical plant is very even and will vary under constant conditions of flow and temperature by about ± 1% invert on dry substance.

As already mentioned, the unconditioned syrup leaves the evaporator with a pH of 4·5–4·5. Because of the high purity, this syrup has no buffering capacity and when 10 tons are diluted with (sterile) water from the municipal supply, addition of 200 litres may cause a pH increase of about 2 units. When this syrup is then pasteurized, at a pH of higher than 6·0, there is an increase of colour; consequently the water has to be treated by ion exchange as well.

As the white syrup plant has just started production it is too early to report further details at present.

ACKNOWLEDGEMENTS

The author wishes to thank the Board of Directors of Pfeifer und Langen, particularly Mr. ARNOLD LANGEN, for permission to publish this paper.

Sugar research in Australia

(69th Annual Report, Bureau of Sugar Experiment Stations, Queensland, 1969)

CANE RESEARCH

STEPS were taken during the year to obtain extra land in the super-wet belt of Queensland for experiment purposes. The existing four experiment stations are located in districts with annual rainfalls ranging from 40 to 73 inches. But the cane-growing belt from Tully to Babinda—five mill areas, with 17% of the aggregate sugar peak—is located in a rainfall zone approximating 150 inches per annum. An area of such proportions justifies special investigation in the fields of varieties, drainage, weed control and general agronomy. Accordingly, application was made for excision of an area of Crown land in the Tully district, the object being a gradual development as a wet-belt experimental area.

Within the same period advantage was taken of the availability of a small cane farm adjacent to the Bundaberg Experiment Station. This farm was purchased and is now being developed as an integral part of the Station. It will allow much needed extension of research activities in South Queensland.

In Queensland, as in other countries, a question which looms large in the minds of research workers is concerned with what the future may have to offer in results from improved technology, or in the practical implementation of research findings already made but not properly applied.

The Director points out in the report that it is somewhat paradoxical that, whereas cane growers are normally over-enthusiastic in accepting new cane varieties so as to gain small yield increments, they may ignore recommended procedures which could, with little effort, give much larger increments with the old cane varieties. Reference is made to the widespread reluctance, or even refusal, to adopt those farm hygiene procedures which would, by minimizing ratoon stunting disease, increase cane yields by 10 to 20%. Cane producers cannot claim efficiency as farmers while failing to carry out the simple practices of sterilizing cane knives and equipment to prevent the spread of this virus disease. Even though a new cane variety may improve yields by 10% in its clean, disease-free state, how long will it take to lose that advantage if it is not protected against contamination by the disease? This large incremental gain from disease control is in the grower's hands. He can choose the penalty resulting from poor hygiene or the bonus which accrues from disease freedom.

What may be expected from future research? Without doubt the greatest promise lies in cane breeding. In Queensland the annual rise in overall productivity since 1900 has been in the neighbourhood of 1·5%, and it is calculated that about two-thirds of that increase has been due to improved cane varieties. There is ample evidence from recent experimental work that a continuing gain in productivity from cane breeding of an average order of 1% per annum may be expected. But if this is to be realized over a lengthy period, the capital invested in cane breeding research may have to be increased to ensure adequate exploitation of the available genetic material, as well as enlarged and improved breeding and selection programmes.

There are gains to be made from a better understanding of nitrogen fertilizing, by improvement in drainage of lands in most areas north of Townsville, by even better control of insect pests of sugar cane, and by extension of irrigation onto more of the drought-vulnerable cane lands. Great emphasis is placed on the need for planting only disease-free setts. Supervisors and inspectors of cane pest and disease control boards can play an important part in productivity increase. The one-time major diseases have, in many cases, been eradicated or reduced to minor importance by strict controls, including the use of only disease-free planting material. Such remaining diseases as ratoon stunting disease, mosaic and leaf scald will continue their rôle in limiting productivity so long as growers continue to plant suspect material. Officers of cane pest and disease control boards should insist that all growers have designated plant sources, and that those sources be inspected carefully before being approved as suitable planting material.

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Sugar cane breeding

Investigations during the year included the use of plastic liners for containers (a technique first developed in Mauritius) and the substitution of plastic containers for the painted iron ones formerly used for cross-pollination solution. Methods of topping-up with concentrated sulphur dioxide solution instead of changing solution in the polycross were also investigated. A number of changes in method were the subject of a replicated experiment. A large experiment was commenced to investigate methods of estimating the value of breeding varieties. Among the aspects of selection methods which were subjected to investigation were pot yield trials and improvements in the techniques of rapid fibre analysis. Other selection experiments of interest included attempts to develop methods for selection of hardier varieties. The extent to which drought resistance of varieties can be estimated by their resistance to high osmotic pressure in solution and by their resistance to measured applications of salt in pot trials, were two aspects investigated.

At the Southern Experiment Station a large-scale experiment in quantitative inheritance was planted out, in which crosses between all combinations of seven female varieties and eight male varieties were included. The crosses for this experiment were made during the 1968 season. The mutation breeding experiment, initiated last year at Bundaberg, in which irradiation was used in an effort to produce a non-flowering mutant of the variety N:Co 310, is being continued. Because of poor flowering during the year, even in untreated material, effective selection of possible non-flowering mutants had to be deferred until a more normal flowering season. Extensive propagation of the existing treated material is being made.

The success of the Bureau's cane breeding activities over the years is demonstrated in the variety census figures for the 1968 season. In that year the proportion of the total crop produced from Q and S.J. varieties—bred by the Bureau—reached 58%. Imported varieties, principally N:Co 310, H 48-3166 and C.P. 29-116, aggregated 22%. The three last-mentioned canes are grown exclusively in the southern and central districts. The only other imported canes, Badila and Co 475, are restricted to certain areas north of Townsville, but both are decreasing in popularity.

Cane varieties and varietal changes

During the year under review no change in the relative position of the four major varieties in Queensland took place. For the third time N:Co 310 produced more cane than any other variety in the State, but the 600,000 tons greater crop than in 1968 was actually a 1·7% smaller proportion of the total crop than in the previous year. Pindar, still ranking in second position, produced 3·5% less of the total crop than in 1968 but still exceeded the 2·2 million ton mark; this compares with almost 3½ million tons of N:Co 310. Ranking third in production was Q 63 which, at 9% of the total, was 1% less than in the previous year, whilst Q 57, still in 4th position, provided 1½% less of the total than in 1967. Q 58 retained its status of 5th variety with little change in its popularity. Trojan was displaced from 6th position by Q 68, which exceeded one million tons for the first time, whereas Trojan, now in 9th place, dropped below the million mark for the first time in many years. In 7th position, and almost reaching the one million mark for the first time, was Q 83 and north of Townsville this variety ranked third only to Pindar and Q 57 in production of cane. It is displacing the last mentioned in many areas.

With regard to new varieties, Q 87 and Q 88 are two Mackay selections which were released for the first time in 1969 and approved for the eight mill areas in the Mackay and Proserpine districts. The only other variety approved for the first time in 1969 was Apollo, which was bred at Macknade in 1960 by the Colonial Sugar Refining Co. Ltd. and has been approved for the Victoria and Macknade mill areas. Other new varieties for which the range has been extended are Q 84, added to the lists for Victoria and Macknade, and Q 86, formerly approved only for the Isis mill area and for which approval has now been extended for the four Bundaberg mills and Gin Gin. Approval was forecast for 1970 in some of the far northern mill areas for the planting of Q 89 and Q 90. Both these varieties have been extensively propagated. One new variety was given a "Q" number in 1969. This is a variety, formerly known by the number 57N7287, which was selected at Innisfail and Meringa and will become known as Q 91. It has been widely planted out on farms with a view to approval at an early date. It is a cross between Trojan and Co 475.

Sugar cane agronomy

A large number of different projects and investigations were carried out during the year and are dealt with under such headings as sulphur nutrition, P and K trials, lime trials, silica investigations, long range ratooning trials, cane ripeners, Brix-c.c.s. relationships, lysimeter investigations, irrigation trials, soil salinity and leaching, weeds and weed control.

The use of desiccants on weeds to encourage pre-harvest burns gained further popularity, mainly in the wetter areas, and sodium arsenite and "Paraquat" were particularly used. A number of trials with a range of herbicides, many of them concerned with specific weeds, are reported. The weeds concerned include nut grass (*Cyperus rotundus*), Habana oat grass (*Themeda quadrivalvis*), Guinea grass (*Panicum maximum*), Para grass (*Brachiaria mutica*), Billy goat weed (*Ageratum houstonianum*), Stinking passion flower (*Passiflora foetida*) and Spiny spider flower (*Cleome aculeata*).

Insect and animal pests

The total damage due to insect and animal pests during the year was estimated at 121,123 tons of cane, representing 0·72% of the total crop, that for the previous year having been 168,199 tons or 1·07%. The most serious or damaging pest was again the soldier fly which was estimated to have reduced the

crop for the year by 73,677 tons. Rats were of next importance in terms of cane destroyed but cane grubs came second to the soldier fly in terms of farm economics as their control requires considerable expenditure on insecticides. Details are given of investigatory work on cane grubs and soldier fly. In experiments "Dieldrin" with gamma BHC (as crude BHC dust) proved no more toxic to soldier fly than "Dieldrin" or BHC alone. With regard to other insecticides, compared with "Dieldrin" or BHC, "Dursban" proved several times more toxic, "Galectron", "Nuvan", "Kepone", "Dyfonate" and "Bayer 5621" about equally toxic and "Birlane" much less toxic to the larvae.

Results of soil fumigation experiments to control ground pearls (*Margarodidae*) are reported, but results do not appear to have been notably satisfactory. The pest status of ground pearls with sugar cane appears to be difficult to assess, and estimates of crop damage were not made.

Other insect pests discussed, some of them causing minor damage, only, include leaf-hoppers, termites, beetle-borers, black beetles, locusts, cicadas, wireworms and army worms. In addition to rats, other animal pests discussed include wild pigs, wallabies, the striped phalanger, coots and cockatoos. Damage by them is restricted or local.

Nematodes

The harmful effects of nematodes were intensified by the dry weather conditions, damage being often in isolated patches in otherwise well grown crops. Owing to the cost of fumigants, and the price of cane, fumigation continued to be uneconomical generally. An exception to this is a small section of the Mossman area where a low dosage of DBCP ("Nemagon") is used commercially at planting. If this is not done, germination is unsatisfactory. If carried out however, the low dosage of fumigant protects the setts for a sufficient period to allow the young plants to become established.

Cane diseases

During the year under review the unusual weather had several effects on cane disease, some direct, some indirect. Top rot, normally obvious in most years from the Lower Burdekin north, was late and very light. Yellow spot was virtually absent and had no effect on the 1969 crop. The distorted top syndrome which is apparently physiological in origin, occurring on poor lands north from Innisfail, became widespread. Over 7,000 acres of Q 83 were involved but all except a few small patches recovered when rains came early in 1969.

The harsh growing conditions accentuated the effects of ratoon stunting disease and many cane pest and disease control boards were surprised at the amount of disease suddenly obvious in their areas. There was one consolation—the internal symptoms practically everywhere were much better than usual during the summer and autumn, which was a big aid to inspection of plant sources.

Some areas have been noticeably successful over the years in reducing losses due to the disease; others have been more complacent, particularly in such control measures as the sterilization of harvesting machines between farms and between blocks. The losses sustained (at the Pathology Farm, for instance, diseased cane was killed in many varieties) have provided a lever for the more rigid enforcing of control measures. These will be of more importance in the near future than ever before since some of the promising new varieties are very sensitive to the disease.

What might be regarded as the most important pathological event of the year was the finding of Fiji disease at Bundaberg. The massive eradication campaign completed in 1953 was thought to have got rid of the disease. Further outbreaks were subsequently discovered but prompt action was taken.

Mosaic disease showed a slight increase during the year, 15 farms at Hambledon yielding 164 diseased stools. Nearly all were of the variety Q 78. Although this variety is very susceptible to the disease in South Queensland it is much less so in the North and the outbreak has not given cause for alarm. Control measures have been exercised. Unfortunately the new variety Q 88 is susceptible to the disease.

Experimental work on chlorotic streak disease and its causal agent was continued during the year. It involved the relationship of water logging to infection and the effects of various compounds on transmission. The results demonstrated that waterlogging is not essential for chlorotic streak infection to become re-established and increase in the stubble or root system. However, waterlogging appears to enhance the re-infection rate and it was noted that symptoms appeared at an earlier date.

Chopper-harvested cane deterioration

Investigations were continued on the deterioration of chopper-harvested cane, bacterial inoculations being made after week-end storage. Comparatively little work has been done on the microbial flora of such cane, except to establish the almost invariable presence of *Leuconostoc*. Other bacteria were known to be present, sometimes in greater numbers than the *Leuconostoc*. It is thought that a series of inoculations over several years could lead to a better understanding of the deterioration problem, both as a whole and in individual rakes of cane.

Eight series of inoculations were made at the Mulgrave mill from mid-September to mid-November, when crushing ceased. Six varieties of cane were involved and 15 different sources of cane were used. The standard isolation site selected was at a point 5 mm from the billet end. Other sites used were at the middle and on the exposed end of the billet, the interior of small cane chips, and washings from the rind.

A total of 49 *Leuconostoc*-type organisms was obtained, 21 of which were typical of the Group V or D strain of *L. mesenteroides*. This strain was the predominant one from all cane sources, while other strains were usually only present in small numbers. Very few isolates were of the Group VL or A strain,

which had been isolated in large numbers in previous years. Cultural tests, using a broth of similar composition to cane juice, indicated that the predominant *Leuconostoc* obtained from the isolations was one of the most efficient gum producers. The taxonomic position of the genus *Leuconostoc* is unsatisfactory and it is difficult to state which species are present as the main causal agents of sour storage rot. It is obvious that many different strains are involved. These show wide variations in growth rate in culture, in ability to ferment sucrose and reducing sugars, in acid production and final pH of juice and in the amount and type of dextran produced.

Mill Technology Research

An account is given of services to mills in respect of examination of measuring equipment, including balances, saccharimeters, Brix hydrometers etc., and of changes in equipment at the mills in order to strengthen sections shown by the Mutual Control Scheme to be sources of weakness. Sugar quality has been under examination and starch analyses have been made to aid cane seedling selection. Measures to improve heat economy have been suggested to meet needs at mills where low-fibre new varieties meant less bagasse fuel available, where greater power generating efficiency was required, and where crushing rates had outgrown boiler plant capacity. After testing the efficiency of different vapour condensers under factory conditions a model unit was designed and was to be factory-tested. Assistance was given with the tying-in of a new high-voltage generator with the existing low-voltage system at one mill, and recommendations made for increasing capacity at another. Laboratory screening tests were made on nine new flocculants and four were to be given further trials. Trials indicated the higher capacity, heavier mud, greater stability and easier operation of Dorr-Oliver A.T.V. clarifiers compared with two other clarifiers. Comparative trials with Buckau-Wolf 1100V and BMA K1000 continuous centrifugals for low-grade massecuite indicated that the former had a 70% higher capacity and gave sugar and molasses of comparable quality. Dryer performance at two mills was examined, while further work was done on cane sampling and direct analysis at Mossman mill. A cost survey is being undertaken in regard to utilization of bagasse for paper pulp or particle board production, and work on the production of a new edition (the fifth) of the Laboratory Manual for Queensland Sugar Mills was almost completed. An account is given of the 1968/69 milling season in Queensland, with the assistance of a number of tables.

Cane mechanization in Cuba

During the 39th Conference of the Cuban Sugar Technologists' Association in October 1970 a symposium on mechanization of the cane harvest was presented in the form of five papers by Sr. ARMANDO F. BETANCOURT and his colleagues of the Centro do Investigaciones de la Cana and the University of Havana. These papers reviewed cane mechanization in other parts of the world and described developments in Cuba. This article is based on information presented at the symposium.

In order to counter the growing shortage of labour, experiments started in 1961 on the development of mechanical cane harvesters; a number of designs were built and tested in the 1962 harvest. All cut the cane near the ground and removed the tops, laying the stalks in a row parallel to the direction of cutting, for later loading into the carts which took them to the factories. Of these designs, one machine, the ECEA MC-1 harvester, was selected for further trials and 680 units were built for operation in the 1963 harvest.

The machine was not successful, however, requiring too many men for loading and scrapping (clearing up unharvested cane behind the machine). In addition, when the machines broke down, as frequently happened, this labour force was not able to work. Consequently, use and construction of the harvesters were stopped and an order for 500 harvester/loaders was placed with the USSR.

In 1962 mechanical loaders were designed and prototypes built, and 400 units were built for the 1963 harvest, during which they handled 440,000 tons of manually-cut cane, mounted on Rumanian UTO tractors. After the ECEA MC-1 harvester programme ceased, however, production of the Cuban loader was discontinued also, in view of the agreement with the USSR for the supply of cane mechanization equipment which included loaders.

During the 1964 harvest some 3500 Soviet loaders were imported and 20% of the crop was mechanically loaded. This proportion has increased since and by 1969 64% of the crop was mechanically loaded. In 1965 the 500 harvester/loaders were imported from the USSR and these handled 2% of the crop, a proportion which has not risen above 3·5%, however, in subsequent crops.

The mixed system using dry-cleaning stations ("Centros de Acopio") for manually-cut cane was also introduced in 1965 when four plants were built; by 1969 this number had risen to 150 and they handled 15% of the total crop. Construction of 300 centres is planned for 1971 and it is expected that all Cuban cane will be processed in such centres by 1974[1]. Cane handled by such centres is mostly cut manually but

[1] *Cuba Economic News*, 1970, **6**, (48), 1.

not trashed; it might be loaded manually or mechanically.

Current equipment

Machines currently in use include the Soviet-built PG-0.5 ST cane loader, the Soviet KCT-1 tractor-drawn cane harvester/loader, and the Soviet KT-1 self-propelled cane harvester/loader. In addition, the Henderson chopper-harvester/loader and the Libertadora whole-stalk harvester/loader, both designed and built in Cuba, are undergoing trials.

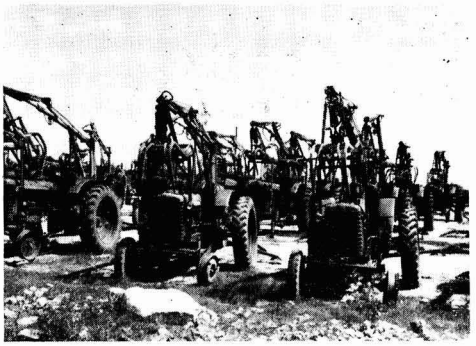

Fig. 1. PG-0.5 ST cane loaders awaiting repairs before the new harvest

The PG-0.5 ST loader (Fig. 1) has a capacity of 500 kg (half a ton) per bite and a loading height of 3·2 metres (10 ft 6 in), an arm radius of 4 metres (13 ft) and a working radius between 2 and 5 metres (6 ft 6 in and 16 ft 3 in). It operates on a cycle of 98 seconds and thus has a loading capacity of 14 tons/hr. It is mounted on a Soviet tractor having a speed of 10 km/hr (6 m.p.h.). During tests over a total period of 314 hours the loaders handled an average of 7808 arrobas of cane (90 tons) per 8 hours, and the official work target is 7000 arrobas (80·5 tons); there have been occasions, however, when this target has been amply exceeded, with 20,000 arrobas and more handled in 8 hours. The average effective operating time has been 5·8 hours per day, however, and cane loaded 4083 arrobas, corresponding to some 5630 arrobas per 8 hours.

Initially, the extraneous matter in the mechanically loaded cane was high (6·16% in 1964 against 2·63% for manually loaded cane) but by 1966 this had fallen (3·09% *vs.* 2·71%) as a result of measures taken after studies on cane analysis. The average figures for 1964–69 are 3·92% for mechanical loading and 2·96% for manual loading.

Soviet harvesters

Between 1964 and 1967 a total of 984 KCT-1 and 35 KT-1 cane harvesters and 8018 PKT-2 cane carts were delivered, importation being stopped in 1968. The KCT machine is drawn by a tractor and operated from its power take-off. When working it travels at 1·65–2·8 km/hr (1–1·8 m.p.h.), covering 0·29 hectares per hour and cutting a single row of cane, the inter-row distance being 1·6–1·8 metres (5 ft 3 in—5 ft 11 in). The harvester is designed to cut the cane at ground level and to remove the tops and trash. It cuts the stalk (1·5–3 metres long) into billets of 35 cm (14 inches) which are then deposited into carts moving alongside the harvester.

At the start of the 1965 season 500 harvesters had been delivered but only 471 were put into service and the number operating fell during the harvest, to 372 on the 15th March, 204 on the 15th April and 46 by the 1st May. Productivity averaged 4517 arrobas (51·94 metric tons) per working day in 1965 and in the 1966 season only 3267 arrobas (37·56 tons), when 728 units had been delivered but the maximum and average number operating were 521 and 300 machines, respectively.

During the 1969/70 crop, between November 1969 and March 1970, of 498 machines available in the "Diname" harvester park, only 149 were operative; effective working time was 2·8 hours/day and cane harvested 466 arrobas/hour or 1304 arrobas (about 15 tons) per day.

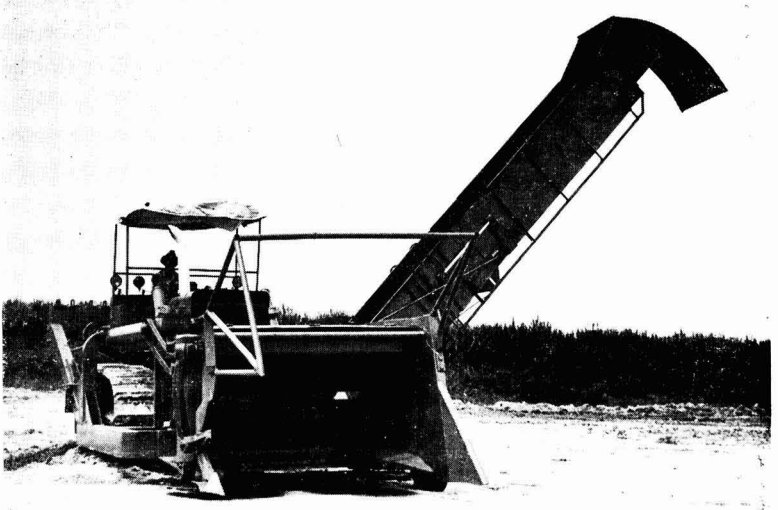

Fig. 2

The cane delivered by the harvesters left much to be desired because of the amount of extraneous matter, principally tops and leaves, which averaged 13·18% over the five years 1965–1969.

Cuban experimental harvesters

The Henderson harvester/loader (Fig. 2) has been under development since 1968. It is mounted on a 108 h.p. tractor the hydraulic lift of which is used to control of the height of the frontal section. This governs the location of the revolving discs, fitted with segmented knife blades, which cut the cane just above ground level. The cane is cut into billets by the

Fig 3.

horizontal knives across the machine, while a knife at the side cuts cane which has fallen from the adjacent row towards the row being cut by the harvester.

The cane billets are elevated and discharged with the tops and trash into the cane cart which travels alongside the harvester and are taken to the centro de acopio for cleaning; it is important to realise that the harvester and cleaning centre are complementary parts of a system and it is not intended that the harvester should separate the tops and trash. Part of the same system is the development and breeding of cane varieties which will be suited to the crop period, will be erect and self-trashing, etc.

The Henderson machine is of simple construction and operates satisfactorily in erect and lodged cane (Fig. 3) cutting an average of 3000 arrobas/hour (34·5 tons/hour) and up to 6000 arrobas/hour (69 tons/hour) in burnt cane of up to 160 tons/acre.

The second Cuban harvester is the Libertadora (Fig. 4) which has been under development since 1967. This has operated in lodged cane up to 100 tons/acre and is powered by a 97 h.p. motor and mounted on the chassis of a Soviet harvester, using a hydraulic system for supplying propulsive power. It is provided with a topper, bottom knives, side knife, etc.

Comparative tests of the two Cuban harvesters were made during 1968, 1969 and 1970 in various parts of Cuba. Interpretation of the results is difficult, however, because of the many interfering factors which modified the performances achieved. For instance, the Libertadora machine cut cane, 50% of which comprised varieties which were not erect and did not allow the topping mechanism to operate properly. Again the machines operated variously in light and heavy stands of cane, and their performance was affected by the rains affecting the regions where they were used at different times during the harvest. Topography of the cane lands also affected operations as did shortage of tractors and cane carts, spare parts, labour, etc.

However, the Henderson machine harvested up to 4239 arrobas per hour (48·6 tons/hour), compared with a maximum of 1665 arrobas per hour (19·1 tons/hour) harvester by the Libertadora. Extraneous matter was 7·0–14·0% in cane from the latter, however, compared with 22·0–32·2% extraneous matter in cane from the Henderson machine. Cane from the Libertadora harvester was, of course, ready for the factory,

Fig. 4

while that from the Henderson machine had to pass through the cleaning centre. Only in one case was the trash content of such cleaned cane determined, and it had then been reduced from 32·2% to 13·7%.

Fig. 5

The effects of cane burning

In tests of the harvesters operating with burnt and green cane, it was found that the productivity of the Henderson machine was more than doubled (to 66 tons/hour) in cane stands of 120 tons/acre and that it would cut 65 tons/hour in a stand of 200 tons/acre. The Libertadora harvested up to 25·7 tons/hour in a stand of 120 tons/acre of burnt cane, compared with 10 tons/hr in green cane of the same density. The extraneous matter in the Henderson-harvested cane was reduced from 26·0% with green cane to 17·6% with burnt cane in a 120 tons/acre stand, while after passage through the cleaning centre this was reduced to 11·2% in the case of green cane and to 9·5% with burnt cane.

From a 200 tons/acre stand, the trash contents of harvested cane were 19·9% (green) and 10·3% (burnt), reducing to 8·4% (green) and 5·3% (burnt) on leaving the cleaning centre. On the other hand, the Libertadora harvested cane contained 12·3% trash when green and 9·2% when burnt, both from stands of 120 tons/acre. Harvesting losses after the Henderson machine, i.e. cane left in the field, were reduced by up to 64% (from 11·9 to 4·3%) in the case of burning the 200 tons/acre cane, and by 46% (from 13·6% to 7·3%) with 120 tons/acre cane. The Libertadora machine left 10·6% in the field when harvesting 120 tons/acre green cane, and this was reduced to 7·2% (i.e. by 32%) on burning.

The Centro de Acopio

The centro de acopio or cane conditioning centre is a stationary mechanical plant, the function of which is to remove the trash from "dirty" cane and to eliminate dust and earth. It also provides a rapid transfer mechanism which eliminates cranes or sidings. It acts as a central point receiving cane from all round for delivery to the factory after cleaning, and it does not detain the field transport vehicles. It receives mainly hand-cut cane, whole-stalk or cut in two and not trashed, and generally mechanically-loaded. Discharge from carts into its receiving hopper is usually by a net system (Fig. 5) but, alternatively, cane can be piled and transferred later to the hopper by means of a jib crane.

The installation consists essentially of a hopper with a moving bottom which delivers the cane to a rubber carrier. This transports it rapidly and longitudinally to two contra-rotating cylinders which carry corresponding knives such that the cane stalk is cut into billets about 40 cm long (16 inches) which then pass on, to fall by gravity onto another carrier. During its free fall the cane is subjected to a strong air-blast and the majority of the trash and dirt is blown away to the outside of the unit (Fig. 6). Some centres have double air-blasts to clean the cane better. The cleaned cane on its carrier is delivered into rail cars which deliver it to the factory.

The maximum capacity of these plants is approximately 70 tons/hour and they can be operated to clean 1120 tons/day using two 8-hour shifts. The extraneous matter in cane which had been processed averaged 7·92% for the period 1964–69, compared with 2·94% for manually cut and cleaned cane, 3·92% for manually cut and mechanically loaded cane and 13·18% for cane harvested and loaded mechanically. It is estimated that the centro de acopio eliminates

(*continued at foot of page* 111

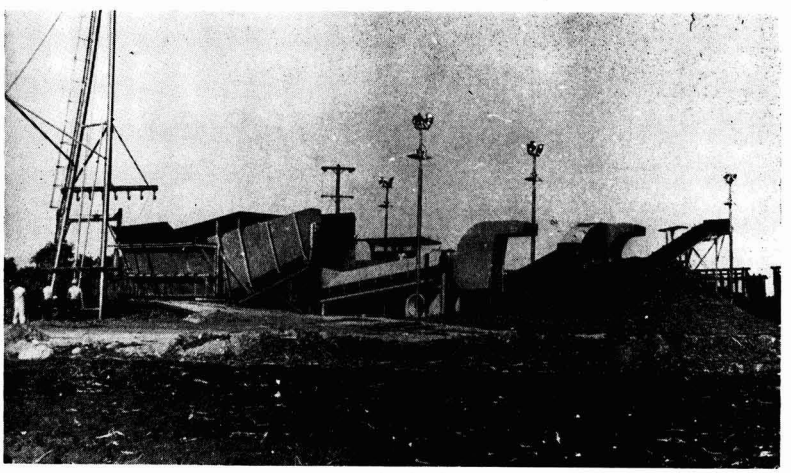

Fig. 6 Double cleaning centre

Sugar cane agriculture

Cyclone damage at Proserpine. A. A. MATTHEWS. *Cane Growers' Quarterly Bull.*, 1970, **33,** 132.—Damage caused to cane by cyclone Ada on 17th January 1970 is explained and graphically illustrated with photographs. It was estimated that it caused a loss of 125,000 tons of cane and A$800,000 worth of damage to buildings, sheds etc.

* * *

Is soil erosion a problem on the farm? J. WRIGHT. *Cane Growers' Quarterly Bull.*, 1970, **33,** 134–136. In Queensland sugar cane areas the percentage of erosion-prone soils is fortunately low, but in some districts the soil erosion problem can be severe. The problem is discussed in all its aspects and the value of graded banks stressed, associated with them being the construction or shaping and grassing of waterways and often the construction of diversion banks.

* * *

Are short rows necessary in contoured cane fields? E. SYPKENS. *Cane Growers' Quarterly Bull.*, 1970, **33,** 137–141.—The nuisance of short rows, accentuated by the rapid increase in the use of mechanical harvesters or other heavy equipment, is discussed. Today many Queensland growers are installing contour bank systems on non-uniform slopes, in which sharp curves have been smoothed out and short rows have been totally eliminated or reduced by up to 75%. The principles involved are explained by means of photographs and diagrams.

(*Continued from page* 110)

more than half the extraneous matter originally present in the cut cane. When it is considered that almost all the cane cut in Cuba is green, the trash content achieved compares favourably with any other cane country.

It is recognised that impurities in the cane result in lower recovery, higher molasses production, etc., and that efforts must be made to reduce the trash content. This must be part of an effort to arrange a number of factors (layout and preparation of the land, selection of the harvesting cycle and of appropriate cane varieties, and adaptation of irrigation, drainage, cane cutting and transport systems) in order to achieve optimum results. For it is realised in Cuba, as in many other cane-growing countries, there is no alternative to mechanization.

Cane fields insecticides not causing pollution hazard. N. J. KING. *Producers' Rev.*, 1970, **60,** (3), 71.—In the light of present-day knowledge it would appear that there is little likelihood of recommended insecticides constituting a hazard. Commonly used insecticides are placed deeply in the soil and are unlikely to reach rivers and streams.

* * *

The influence of nitrogen on c.c.s. K. C. LEVERINGTON. *Producers' Rev.*, 1970, **60,** (3), 79.—Normally under Queensland conditions K and P do not affect the c.c.s. of cane appreciably but N may cause large changes in it. Heavy N applications in December or early January could cause quite a low c.c.s. if the cane were harvested early in the season, but not if it were harvested later.

* * *

Concern at cane damage by rats. ANON. *Producers' Rev.*, 1970, **60,** (3), 81.—Inspectors in the Babinda district of Queensland estimated that about 8000 tons of cane were lost each year because of rat damage. A zoologist attached to the Bureau of Sugar Experiment Stations is now working on the rat problem.

* * *

Night harvesting not wanted "under any conditions". ANON. *Producers' Rev.*, 1970, **60,** (3), 125.—Proceedings of a conference of cane growers in Queensland are recorded from which it would appear that many growers are against the harvesting of cane outside daylight hours, in spite of the arguments put forward by the mill owners. Night harvesting of various crops takes place in the USA and elsewhere.

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Deep tillage. ANON. *Producers' Rev.*, 1970, **60,** (3), 127. Reference is made to a paper by ARANETA[1]. Some of the assertions or views expressed are challenged. Reference is made to experience in other cane-growing countries such as Jamaica and South Africa. Much depends on the nature of the soil and subsoil, as to whether this operation, requiring high-powered equipment, is worthwhile.

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Replenishment of Burdekin underground water supplies. J. R. ANDERSON, T. D. CAMPBELL and I. H. CHISHOLM. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 11–22.—An account is given of the successful artificial replenishment of the underground water

[1] *I.S.J.*, 1971, **73,** 15.

supplies in this important cane-growing area where increased cane cultivation coupled with a series of dry years seriously threatened the industry. A detailed account of the scheme, which was financed by the sugar growers and mills, is given.

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Ground water corrosion in Queensland. G. J. KELLY. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 23–34.—In Australia in recent years there has been great development in the utilization of ground water supplies for municipal, industrial and agricultural purposes, notably sugar cane. This has been activated partly by the unreliability of surface supplies. Severe corrosion of metal equipment used for obtaining ground water supplies commonly takes place. This is discussed in all its aspects including the possibility of using less corrodable materials.

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An experiment in irrigation scheduling. K. C. LEVERINGTON, G. KINGSTON and S. O. SKINNER. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 51–56.—Cane was subjected to controlled irrigation on a basis of frequent irrigation, infrequent irrigation and no irrigation at all as a control. It was concluded that as a severely stressed plant cannot make immediate use of rain or irrigation water, crops which are to be maintained by supplementary irrigation should not be allowed to reach this stage of water deficiency. It would seem that a much higher rate of water efficiency would be obtained, in cases of inadequate water supplies, if some fields were omitted from the irrigation schedule, so that certain selected ones could be watered frequently enought to prevent the occurrence of high moisture stress conditions.

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Climate, sugar yields and irrigation response in Queensland. B. J. WHITE. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 57–64.—During the last 20 years the proportion of Queensland cane that is irrigated has risen from 14 to 24%. At present sugar cane accounts for 40% of the total area of all crops irrigated in Queensland. Sugar yields over the period 1954–69 were analysed as a function of rainfall in ten predominantly non-irrigated mill areas along the Queensland coast.

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Rainfall effects on soil salinity build-up during irrigation. D. R. RIDGE. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 65–73.—In some Queensland sugar cane areas expansion of irrigation and consequent depletion of underground water supplies has led to deterioration of the quality of the irrigated water, i.e. a build-up of the salt or mineral content, and it becomes necessary to determine whether such poor quality water may be used without damage to crops and soils. Fortunately in Queensland, unlike many other countries, a high summer rainfall has a modifying effect, i.e. it removes accumulation of salts from the root zone by leaching. An account is given of experimental work to evaluate this factor and a potential general method of rating irrigation waters.

The evaluation of irrigation waters in the Central District. M. B. C. HAYSOM. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 75–84.—Irrigation of cane is increasing in the district and most irrigation water is derived from underground sources where the quality of the water can easily change. Growers should not hesitate to have their irrigation water analysed. A special laboratory at Mackay undertakes this work. This paper outlines the methods used in classifying irrigation waters and discusses quality of irrigation water, which depends upon mineral or salts content.

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The cable/hose irrigator. R. W. FRAZIER. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 85–88.—The cable/hose irrigation system has been operating successfully in Hawaii for over a year and it is thought it might well be used more in Australian cane fields. It is particularly attractive because of its labour saving features. The machine needs to be moved only once every 24 hours and each move represents 10 acres. Moving the machine is simple and only takes about 30 minutes. The machine and its operation are fully described and a photograph shows it in action.

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Chemical ripening of sugar cane. G. C. BIESKE. *Proc.* 37th *Conf. Queensland Sugar Cane Tech.*, 1970, 117–124.—Trials at Bundaberg are reported with two experimental ripeners, D.A./5 (Dupont) and C.P. 41845 (Monsanto). Both exhibited the ability to retard growth, induce side-shooting and increase c.c.s. Unfortunately the trials took place during an abnormally dry year. Nevertheless it was thought that both ripeners might prove of value in arresting c.c.s. decline which commonly takes place. Some fears are felt that the ripeners might persist over to the ratoon crop.

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Predicting order of harvest for maximum return. R. B. MOLLER. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 125–129.—Five different methods of predicting the order of harvest of fields to achieve the highest average c.c.s. for the season were systematically tested. It was concluded that hand refractometer Brix was as reliable as laboratory mill c.c.s. for assessing the order of harvest of fields. Mid-point Brix, being the simplest to obtain, is recommended. Fields should be sampled monthly and records kept from just prior to the commencement of harvest.

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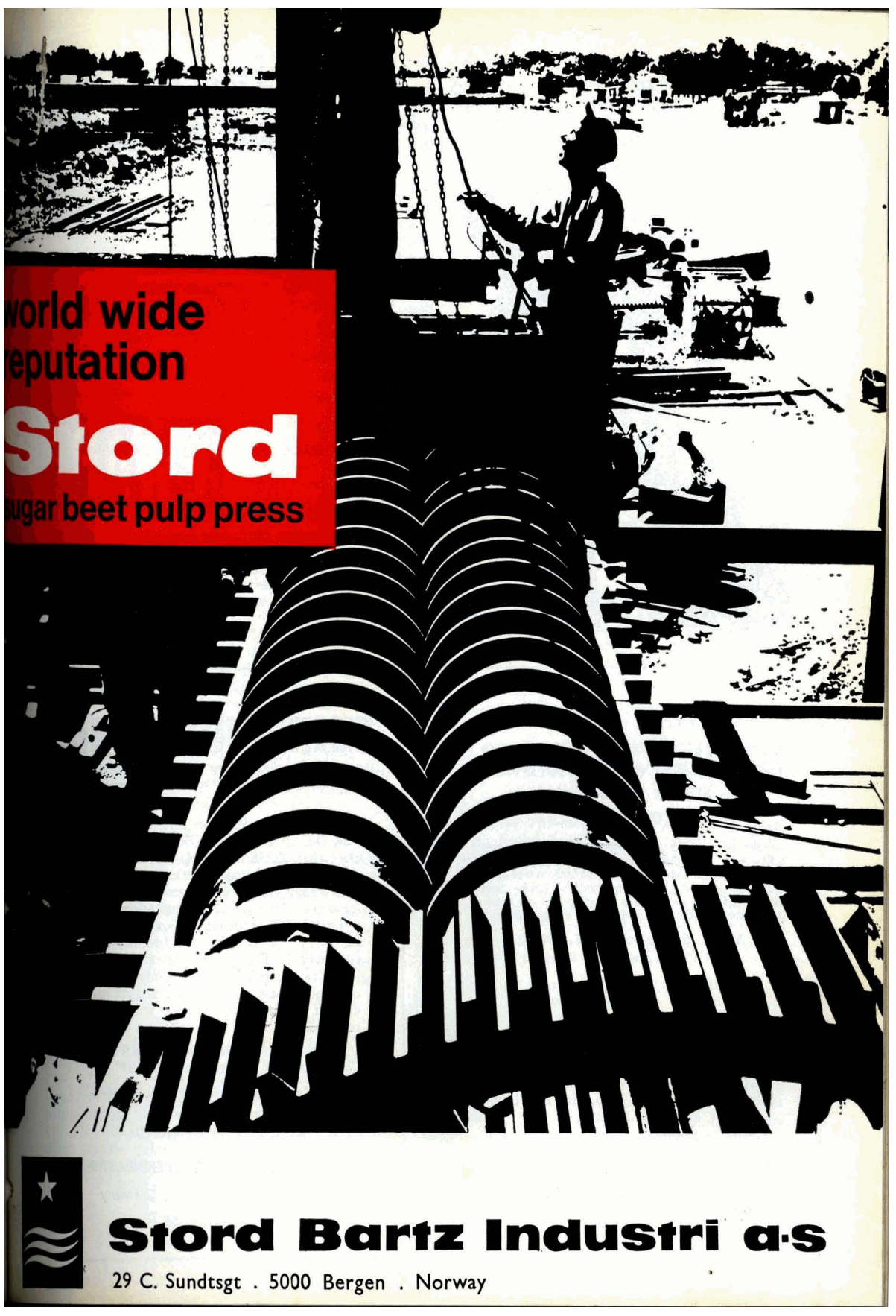
Further data on sulphur nutrition of sugar cane. J. M. SEDL. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 137–141.—In connexion with sulphur trials currently being carried out on sugar cane, this paper summarizes the results of field experiments and data relating to atmospheric fall-out of sulphur. Rain water was collected and sampled each month from five different sites in the Bundaberg and Cairns regions. It was estimated that sulphur deposited in this way varied from 4·15 to 11·51 lb per acre during



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a year. Sulphur-containing compounds in the air may originate from marshlands, industrial areas and the sea.

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Soil conservation in relation to cane growing. P. J. AMIET and A. W. JONES. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 143–155.—Soil and water are major raw materials on which the sugar industry is based and the conservation of both is all-important. In many cane-growing areas in Queensland the application of soil conservation techniques has increased markedly in recent years but in other areas progress has been slow. All aspects of the subject are here discussed and a great deal of useful information set out for the cane grower.

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The soldier fly pest. B. E. HITCHCOCK. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 207–216.—An interim report is here given of recent studies that have been made on the two soldier fly pests of Queensland cane (*Altermetoponia rubiceps* and the less known *A. flava*). Interesting facts about their life histories are presented. By some it is thought that increased irrigation may have something to do with the increased incidence of the pest in recent years. A puzzling feature is that so far no parasite or predator of the pest has been detected in spite of strong evidence that at least one must exist.

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Notes on mosaic disease in the Mackay district. S. GREENAWAY. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 217–220.—What is known of the history of this disease in Queensland and steps taken to contain it are outlined. The disease is believed to have been present for a long time, certainly since pre-1914 days. Recently the overall position has become worse with several new outbreaks in the area. There is ample evidence of natural spread. The variety Q 50 is notably susceptible.

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R.S.D. in North Queensland. B. T. EGAN. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 221–224.—Drought conditions have been largely responsible for the great increase of ratoon stunting disease in Queensland in recent years. The present position is reviewed as is hot water treatment of seed cane and the problem of control. It is considered that inspections of seed cane sources must be greatly increased in most areas.

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Hot water cane treatment equipment. A. R. TAYLOR. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 225–227.—Details are given of a tank and equipment (for treating cane against ratoon stunting disease) which have been successfully used since 1964. It is thought these details may be helpful to other growers or organizations contemplating the erection of a similar tank and equipment.

Leaf scald in Q 63 in the Mackay district 1960-70. S. GREENAWAY. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 235–242.—An account is given of outbreaks of the disease in Queensland during the last decade. It has been prevalent especially in the variety Q 63 (Trojan × C.P. 29/116). Symptoms of the disease and some curious features associated with it are discussed. Outbreaks in three different areas are considered separately.

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Conditions affecting hot-water treated cane germination. R. H. EDMONDSON. *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 229–233.—Two beliefs held by some cane growers were shown by experiment to be erroneous, viz. that the more the cane is handled the greater are the chances of poor germination, and that cane cut some days before treatment gives lower germination than cane heat-treated immediately after cutting. There is some variation in the effects of heat treatment among different varieties of cane. Advice to growers on the selection of seed cane for hot water treatment against ratoon stunting disease and the subsequent handling or planting is given under six headings.

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Studies on the profiles of concentration of carbon dioxide in a sugar cane field at Tainan, Taiwan. C. C. CHU. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–1969, 1–7.—The work described is part of a long-range project aimed at studying the photosynthesis and production potential of sugar cane. The diurnal fluctuations of the profiles of CO_2 concentration in a well developed cane field were notable and are described. CO_2 concentration was always highest at 1 m or less from the ground, attributed to root and soil organism respiration and low wind velocity.

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A note on the efficiency of sugar cane. G. O. BURR. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–1969, 8–11. The sugar cane plant is very efficient in dry matter production, being superior to most crop plants. The efficiency of the variety F 146 in Taiwan, where the cold winter stops cane growth, is emphasized. It is thought that this may be partly due to its leaf arrangement, the near-vertical position of the leaves resulting in their good illumination.

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Destruction of excess cane. ANON. *Producers' Rev.*, 1970, **60,** (4), 17.—A conference discussion of this subject is reported. Normally the problem does not arise but it may do so in the case of cane killed by drought, made unharvestable by floods or cyclones, etc. With mechanical harvesting it is not possible to leave much dead cane in the fields for it gets caught up with the harvester. Methods of disposal will depend upon whether fields are to be ratooned or ploughed out. These are discussed.

Sugar beet agriculture

Hardstanding for sugar beet. P. D. CHAMBERLAIN. *Agriculture*, 1970, **77**, 240–241.—The advantages of a concrete base or hardstanding for sugar beet storage and manipulation are pointed out and the best location for it and manner of construction discussed.

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Prospect of sugar beet cultivation in Madras as a supplement to sugar cane. C. EKAMBARAM. *Indian Sugar*, 1969, **19**, 579–581.—Results are given of some successful preliminary trials with sugar beet in soils with good irrigation and drainage at the Sugarcane Research Station in Madras. Farmers growing this cool-season crop could take a cereal crop off the land in the same year.

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Seed control investigations. H. GERM and A. GRAF. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 14–15.—Investigations are reported on the comparative performances of different kinds of ordinary, balled and monogerm beet seed.

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Irradiation of seeds. K. NAGL. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 19–20.—In 1966 experiments on the irradiation of sugar beet seed in five different doses were commenced, using the variety Monohil. An account of these and of the work in 1967 is given.

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Comparative performance of seed sowing machines for sugar beet. W. HRUBESCH. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 20–22.—An account is given of trials with three different makes of machine, viz. "Pneumasem" (from France), Stokland (from Norway) and Stanhay (used as control). The performance of the machines is discussed and results of the trials tabulated.

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Trials on the effects of different methods of singling on the final stand of sugar beet. W. HRUBESCH. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 22–24. Different methods of singling, including hand singling and the use of modern singling machines, are discussed.

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Combating weeds in anticipation of fully mechanized sugar beet cultivation. H. NEURURER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 26–28. Chemical weed control can be effected considerably by climate and location. Results are given of experiments carried out in four different regions of Austria: Oberfellabrun, Stetteldorf, Andau and Hargelsberg.

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Spacing and hoeing with sugar beet. A. GRAF and W. HRUBESCH. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 29–31.—Results of hand-hoeing and mechanical rotary hoeing are discussed and tabulated.

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Variety trials. A. GRAF and H. MOLLER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 31–35. During the year under review sugar beet variety trials were carried out at 12 different centres with 11 multigerm and 6 monogerm varieties. Results are tabulated and discussed.

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Investigations on growth stimulants (with sugar beet). H. MÜLLER. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968–69, 35–37.—Experiments are discussed on the use of various chemicals for hastening the maturity of sugar beet.

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Experiments on nitrogen fertilization. A. GRAF, V. JANIK, H. MÜLLER, T. REICHARD, O. STEINECK and G. VINEK. *Jahresber. Zuckerforschungs-Inst.* (Vienna), 1968/69, 37–38.—Experiments carried out on sugar beet in various parts of Austria are discussed.

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"Betanal" and the herbicide programme. H. LENZNER and H. LUZY. *Zeitsch. Zuckerind.*, 1970, **96**, 185–187. The importance of herbicides in modern sugar beet cultivation is discussed along with two programmes involving the use of the post-emergence herbicide "Betanal".

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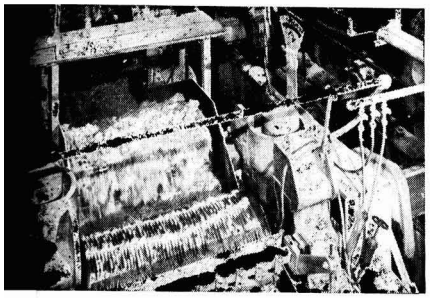
Influence of agricultural techniques on the weed flora of sugar beet fields with special reference to chemical weed control. G. BACHTHALER and B. DANCAU. *Zucker*, 1970, **23**, 294–299.—A comparison is made of weed surveys in sugar beet fields (mainly in south Bavaria) made in 1962 and 1969 with surveys made in 1955–1961. Perennial broad-leaved weeds, with the exception of *Cirsium arvense* (creeping thistle), showed decreasing prevalence. With annual broad-leaved weeds different trends were observed depending on the tolerance to herbicides and adaptability of individual species. For 3 of the 5 grass weeds considered there was increased prevalence.



Cane sugar manufacture

Investigation of the filtration characteristics of fabric partitions and possibilities of their application in the cane sugar industry. N. PUSHANKO and J. MARINELLO. *Bol. Ofic. Asoc. Técn. Azuc. Cuba*, 1970, **25**, 51–70. Experiments are described which were designed to provide information on the possibility of using filter-thickeners for cane juice clarification instead of sedimentation clarifiers. Cloths of various synthetic materials and of cotton were used as septa for filtration of various juices, measurements being made of flow rates, pressures, etc., and resistance coefficients calculated. It was found that synthetic fabrics of low resistance coefficients did not adequately separate the solids content of the juices. Cotton cloths, with high resistance coefficients, gave good filtrate quality and, if they were washed from both sides with mechanical assistance, their filtration characteristics were restored. Filtration rate changes were measured at 3-minute intervals for the different cloths and juices; the low filtration rate of juice as normally sent to the clarifier would not permit the use of filter-thickeners since the size of the station would have to be too large. The restoration of filtration characteristics was examined after cake removal; washing from both sides was essential, with a mechanical action at the surface. Structural resistances of the cakes were measured and confirmed that the technique is only reasonable for filtration of clarifier muds. Rates of filtration proved lower than rates of sedimentation and the technique is thus not suitable for cane juice clarification; it is recommended that the newer types of clarifier, with individual juice feed and withdrawal from each compartment, should be studied as a means of reducing retention time and juice deterioration.

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East Pakistan's sugar industry—10 years' progress. H. KAMPF. *Zeitsch. Zuckerind.*, 1970, **95**, 413–414. A brief survey is presented of the East Pakistan cane sugar industry, which includes 14 sugar factories and one bagasse paper mill. A further two sugar factories are under construction.

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Plant for external treatment—a simplified description. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (245), 2–13. Raw water treatment for use as boiler feed is discussed with data on tolerable limits of pH, hardness, SiO_2, O_2 and soluble solids content. The three phases of treatment—deaeration, softening and sedimentation—are discussed and brief attention given to filtration and softening by means of zeolites. A flow-sheet on water treatment is reproduced.

Extra costs. A. R. GILBERT. *Bol. Azuc. Mex.*, 1970, (245), 44–47.—The loss in heat value of bagasse of moisture content higher than the standard 45% is discussed, calculated and tabulated.

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New aid for boiling low grade massecuites in increasing the exhaustibility of final molasses. S. C. GUPTA and S. K. D. AGARWAL. *Sugar News* (India), 1970, **2**, 32–41.—Details are given of low-grade boiling experiments with two unnamed oil-based surface-active agents, A and B. The tests, carried out at four Indian sugar factories, indicated that both agents showed great promise for improving boiling and curing as well as molasses exhaustion.

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Molasses purity. J. H. PAYNE. *Ind.-Agric. Research & Management Newsletter*, 1970, **10**, (1), 2; (2), 2. After defining final molasses and molasses purity, the author discusses the effects of reducing sugars and ash on molasses purity and explains the system used in Hawaii to predict theoretical minimum purity of molasses (expected purity), which is based on the relationship between reducing matter content and molasses standard viscosity (600 poises at 50°C). The difference between the target purity and the actual purity attained is known as "Points Above Expected". Factors influencing the actual purity achieved by a given factory are discussed. Other systems used to calculate expected purity are also presented. Finally, the question of how close to the attainable expected purity a factory should choose to aim is discussed in terms of the major factors influencing the decision, viz. those discussed above and the economic aspect.

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Commercial sugar cane diffuser installations. ANON. *Sugar y Azúcar*, 1970, **65**, (7), 21.—A list is presented of cane diffusers installed since 1962, including units for installation in 1971 and experimental units. The factory locations, diffuser capacities and manufacturers are given.

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BMA cane diffusion. ANON. *Sugar y Azúcar*, 1970, **65**, (7), 22–23.—The BMA cane diffuser and its operation are described and performance data given for Montelimar (Nicaragua), Dalton and Empangeni (South Africa) sugar factories.

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Buckau-Wolf-Burnett sugar cane diffusion. ANON. *Sugar y Azúcar*, 1970, **65**, (7), 24–26.—The Buckau-Wolf/Burnett cane diffuser and its operation are described and operational results given for Fairymead sugar factory in Queensland.

Extraction De Smet sugar cane diffuser. ANON. *Sugar y Azúcar*, 1970, **65,** (7), 27, 30–32.—The De Smet unit is described and operational data given for Malelane and Entumeni sugar factories (South Africa), Tanuku (India) and Nchalo (Malawi).

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Operation of (a) screw press in (a) Florida mill. L. DE ARMAS, E. TONARLY and F. C. SCHAFFER. *Sugar J.*, 1970, **33,** (2), 23–24.—Results of the use of a French Oil Mill K-70 screw press, installed instead of two additional cane mills at Moore Haven sugar factory in 1968, are discussed. At an average mill throughput increased from 4033 to 4513 tons/day, extraction was raised from 91·59% using four 30 × 54-in Farrel and two 38 × 78-in Dibert mills to 94·13% using mills plus screw press. At a maximum throughput of 5000–5500 tons/day, extraction ranged from 94·00% to 96·25%. The average increase in extraction is equivalent to 5 lb of additional 96% raw sugar per ton of cane, or, at a US domestic price of 8 cents per lb, an additional income of $200,000 for the average 500,000-ton crop at the factory.

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Passi (Iloilo) sugar mill starts milling April 18 (1970). ANON. *Sugarland* (Philippines), 1970, **7,** (3/4), 20–31. Details are given of the cane sugar factory erected at Iloilo in the Philippines by The Mirrlees Watson Co. Ltd. Numerous illustrations, some coloured, are reproduced, showing the factory under construction and in operation.

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Honiron's 24th sugar mill inaugurated. ANON. *Sugarland* (Philippines), 1970, **7,** (3/4), 34–36.—Information is given on the Passi Iloilo sugar central equipment installed by Honiron Philippines Inc. as sub-contractors to The Mirrlees Watson Co. Ltd. A number of black-and-white illustrations are reproduced.

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Sugar in the Philippines. H. J. DELAVIER and H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1970, **95,** 481–484.—A survey is presented of the Philippine sugar industry, including a map showing the approximate locations of the sugar factories and refinery.

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"Meinecke" intermediate carrier—the simplest and most economical and efficient equipment for transferring cane between mills. R. QUESADA G. *CubaAzúcar*, 1969, (Jan./March), 12–25, 47–54.—Types of intermediate carrier are described, viz. mat, dragging and sliding, the first two being of various types, all of which are subject to wear of moving parts. The "Meinecke" carrier, with bagasse travelling up from the earlier mill through a closed chute and over a peak down the chute into the feed of the later mill, has no moving parts, so that wear is very small, but imbibition is difficult and the later mill feeding uneven. To counter these faults, modifications have been made to Cuban installations; the peak has been changed to circular arcs of various radii, and the ascending and descending angles have been varied. Suitable radii and angles gave uniformity in the bagasse feed and feeding problems were eliminated by the use of a lower feed roller at the later mill entrance. Imbibition was best applied at the top of the arc. Performance of the modified "Meinecke" carrier is as good as with other types while it is cheaper to build, install and maintain, and is more reliable and robust, as well as cleaner and requiring less space.

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Determination of the rates of precipitation of particles and their dependence on the method of juice treatment. N. PUSHANKO and J. MARINELLO. *Bol. Ofic. Asoc. Técn. Azuc. Cuba*, 1970, **25,** 186–191.—Measurements were made of rates of sedimentation of particles for various clarification methods, as follows: simple liming to pH 7·5 – 0·75–1·0 cm/min; two-stage liming to pH 10–10·5 – 1·3–1·4 cm/min; simple liming to pH 10–10·5 – 2·0 cm/min; liming with supplemental magnesite to pH 10–10·5 – 1·3–2·2 cm/min; liming with only powdered magnesite to pH 10·5 – 3 cm/min. The last technique also gave the lowest colour but the rate of reaction is low and the compact precipitate may give difficulties in a clarifier.

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Advances in sugar cane and sugar factory technology during the year 1969. S. N. G. RAO and S. C. SHARMA. *Indian Sugar*, 1970, **20,** 105–116.—A survey of cane agricultural and sugar factory technological developments is presented for 1969, with 95 references to the literature.

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Technological advances of (the) sugar industry in India. M. MOHAN. *Indian Sugar*, 1970, **20,** 117–119. The author gives a brief look at advances in Indian sugar technology as represented in the literature for 1969.

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Developments in (the) sugar industry during the last decade. J. S. HUJA. *Indian Sugar*, 1970, **20,** 121–127. Developments in sugar factory equipment that have taken place in recent years are surveyed and their application to Indian conditions briefly discussed. Mention is also made of modifications to processes in Indian sugar factories.

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Trends in (the) sugar industry. R. S. KANITKAR. *Indian Sugar*, 1970, **20,** 129–134.—Trends in the Indian sugar industry, both agricultural and technological, are examined.

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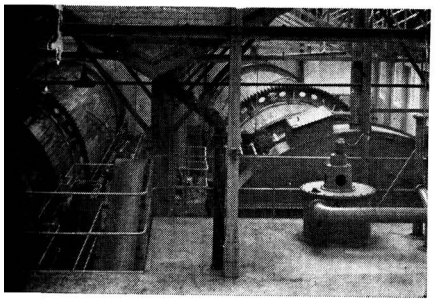
A few milestones in sugar technology in India. B. B. PAUL. *Indian Sugar*, 1970, **20,** 141–142.—Some developments in Indian sugar factory technology are mentioned, including the author's own equipment designs.



Beet sugar manufacture

Effect of the design of carbonatation vessels on their scaling-up. W. STANKIEWICZ. *Gaz. Cukr.*, 1970, **78,** 139–142.—Investigations on scale formation in carbonatation vessels at the end of the campaign in Polish sugar factories are discussed and diagrams presented showing locations of the scale. Hints are given on modifications to vessel design and other measures whereby scaling and stoppage for cleaning can be avoided. Among these is the use of gas feed jets in preference to bubblers, which were found to scale-up within a few weeks.

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Hydraulic resistance during plug flow of beet sugar factory liquid products in tubes. I. M. FEDOTKIN and A. S. ZAETS. *Pishch. Prom.*, 1969, (9), 67–84.—Plug flow of sugar solutions of varying concentration in tubes was investigated using a number of equations, starting with a differential form of Bernoulli's theorem, to process experimental results. The various stages in calculation of flow resistance and attenuation are explained and the effects of various parameters discussed, particularly pulsation frequency and amplitude, distance of a given point in the liquid stream from the source of pulsation and tube diameter. The various relationships are expressed in graph form.

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Heat transfer increase in beet sugar factory vessels by air injection. I. M. FEDOTKIN, L. P. ZARUNDEV and G. F. KALENICHENKO. *Pishch. Prom.*, 1969, (9), 84–92.—An experimental set-up, including a combined horizontal and vertical section, each containing two heating units, was used in investigations on heat transfer to sugar solutions when air was injected into the system. The results, discussed in terms of Reynolds' and Nusselt's numbers and compared with the findings of other authors, show that heat transfer is increased by air injection, chiefly because of the greater turbulence created, the increase being greater the higher is the air content in the two-phase mixture.

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Effect of pulsations on heat transfer in preheaters. A. S. ZAETS. *Pishch. Prom.*, 1969, (9), 92–95.—The effect of pulsations on heat transfer was studied over a frequency range of 0·17–17 Hz, amplitudes of 0·027–82·7 mm and sugar solution concentrations up to 60°Bx. The experimental unit used contained both a horizontal and a vertical tube section. The frequency at which the greatest increase in heat transfer was obtained depended on the values of the other variables. Results are given in graph form.

Some aspects of the 1969/70 (beet) campaign (in West Germany). F. SCHNEIDER. *Zucker*, 1970, **23,** 465–471. Included in the aspects discussed are: juice-cossette mixture screening to separate juice required for cossette pre-scalding; adding formalin to diffusion; sugar determination in filter cake by a method involving acetic acid, found to be better than a nitrate and a total sugar method; separation of filter cake from kieselguhr after filtration; sugar determination in boiler feed water; filter cake disposal; operation of the Fives Lille-Cail continuous vacuum pan; and white sugar coloration in storage. Mention is also made of comparative tests in a US beet sugar factory which showed that a BMA tower diffuser plus the Braunschweig 65 carbonatation scheme gave a higher purity thin juice than did a Silver diffuser followed by Dorr-Oliver defeco-saturation. Both treated raw juice of the same purity. It is considered, on the basis of a large-scale factory test and laboratory tests, that the carbonatation scheme most widely used in the USA (defeco-saturation) gives poorer juice than does the system in which the liming and gassing are separate. Reference is made to the automatic control of boiling operations at Puttershoek in Holland, where one white and three raw grades are produced.

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Comparison of steam consumption in a number of multiple-effect evaporator schemes. S. ZAGRODZKI. *Gaz. Cukr.*, 1970, **78,** 157–163.—The schemes compared involve: (1) a quintuple-effect evaporator, (2) a quintuple-effect evaporator with 3rd effect vapour bled-off to the pan station, (3), a quadruple-effect evaporator, (4) a quadruple-effect evaporator with thermo-compression, and (5) a quadruple-effect evaporator with thermo-compression and use of pan vapours to heat the raw juice. The total hourly steam consumption is calculated for a number of steam temperatures within each scheme. Scheme (5) is shown to use least steam.

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Problems of automation in the sugar industry in world literature. J. DOBRZYCKI. *Gaz. Cukr.*, 1970, **78,** 167–169.—The subject is reviewed under the following headings: instruments and measuring elements, diffusion and carbonatation, evaporation, pan boiling, etc.

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Experiences in the storage and ventilation of sugar beet. K. STIEMERLING. *Zeitsch. Zuckerind.*, 1970, **95,** 397–400.—Experience at Ameln beet sugar factory is discussed. It is calculated that a forced air feed of

20–30 cu.m./cu.m. beet/hr will bring the temperature within the pile approximately to the level of the ambient temperature, although relative humidity must also be considered. It is emphasized that forced ventilation not only reduces sugar losses but also maintains the beet in a suitable condition for processing.

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Storage of washed beet with forced ventilation—results from seven campaigns at Tulln, Austria. L. WIKLICKY. *Zeitsch. Zuckerind.*, 1970, **95,** 401–402.—The beet invert content and colour, hardness and lime salts content of thin juice from washed beet subjected to forced ventilation during storage were slightly higher than the corresponding values for unventilated, unwashed beet stored for a 10-day shorter period (57·4 days). The differences were greater when the initial beet invert content was higher than normal. Thick juice purity, on the other hand, fell with increase in storage time but was the same for both washed and unwashed beet. The values given for all factors are campaign averages.

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Sucrose extraction from beet cossettes by osmotic pumping and not diffusion. W. RATHJE. *Zeitsch. Zuckerind.*, 1970, **95,** 410–413.—Based on earlier findings[1,2,3] that sucrose is extracted from cossettes by liquid exchange, the author postulates a working hypothesis, in which the liquid exchange is effected by osmotic "pumping" through the denatured cells of the cossette. To support his hypothesis, the author explains the physico-chemical fundamentals of diffusion and osmosis and describes a number of experiments with slices of sugar beet and beetroot.

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The sugar industry in Hungary. K. VUKOV. *Sucr. Belge*, 1970, **89,** 401–402.—A brief survey is presented of the Hungarian beet sugar industry and of some of the sugar factory equipment used.

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Application of the "Cepi" apparatus for protection of sugar factory evaporators. D. SPANOVIC. *Sucr. Belge*, 1970, **89,** 403–407.—Results are given for Kovin sugar factory, in Yugoslavia, where passage of juice through a "Cepi" electromagnetic induction device is claimed to have increased evaporator heat transfer by scale reduction and to have increased diffusion juice draft and given an extra 0·08% sugar on beet.

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Sugar beet agriculture in Bulgaria. I. KUNSAY, L. LUKÁCS and I. RÖHRIG. *Cukoripar*, 1970, **23,** 128–134.—The article surveys beet agriculture, beet reception, unloading and piling in Bulgaria. The aim by 1975 is to concentrate each beet-growing district within 30 km radius of the sugar factory.

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Sugar factory condenser water economy. A. ZSIGMOND. *Cukoripar*, 1970, **23,** 135–138.—Causes of difficulties with condenser water are discussed, particularly inefficient pipeline connecting and tube constriction, which may hinder draw-off and cause short-circuiting. How to overcome the problems is explained.

The rôle of chemistry in improving sugar industry technology. M. Z. KHELEMSKII. *Cukoripar*, 1970, **23,** 143–148.—The application of chemical knowledge to improving beet quality, storage, processing and by-product utilization is discussed. In the section on processing much attention is devoted to carbonatation and the use of ion exchange resins.

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Cleaning and surface treatment of metals with phosphoric acid solution. F. LEITOLD. *Cukoripar*, 1970, **23,** 157–161.—The theory and possible use of phosphoric acid treatment for rust removal are explained. Tests involving use of a preparation which included 19–22% phosphoric acid, 0·02% Mineralimpex CAB II-GEN 40 inhibitor and 0·06% wetting agent are described and illustrations reproduced showing the effects of the treatment.

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Decomposition of reducing matter in defecation. V. A. KOLESNIKOV and V. A. MAKSYUTOV. *Sakhar. Prom.*, 1970, **44,** (8), 16–21.—The extent of decomposition of reducing matter in raw juice under the effect of liming was found to be independent of initial content but at constant lime usage (2·5% CaO on weight of beet) was linearly dependent on the period of liming at a given temperature, the time necessary for a given degree of decomposition falling with rise in temperature up to 80°C. However, since the colour of limed juice increased with rise in temperature and with initial raw juice reducing matter content, it is preferable to lime for a longer period at a lower temperature. Lime salts in the treated juice rose with increase in the raw juice reducing matter, but when this was constant was little affected by liming temperature and time. The findings have been used to establish a table of optimum conditions for liming time and temperature at a given reducing matter content in order to give a maximum carbonatation juice reducing matter content of 0·016–0·022% on weight of juice.

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Disaggregation of mud particles in first carbonatation juice by centrifugal pumps. R. OSVALD and E. HAVLOVÁ. *Listy Cukr.*, 1970, **86,** 105–109.—Analysis of 1st carbonatation juice mud particles by a granulometric method used previously[4] showed that, provided the centrifugal pump used to deliver the juice to clarification is operated efficiently, particle breakage will be only moderate. However, if the pump is not properly adjusted, there will be considerable particle breakage caused by whipping of the juice in the pump. Hence, attention is called to the need for care where the juice cannot be fed to the clarifiers under gravity, since particle breakage will cause a drop in settling and filtration efficiencies.

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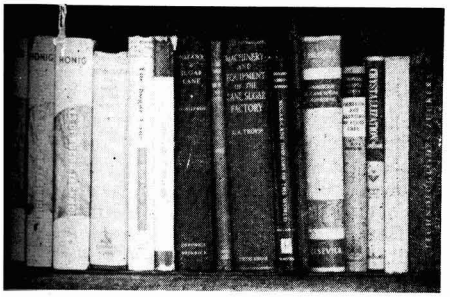
[1] *I.S.J.*, 1961, **63,** 349.
[2] *ibid.*, 1962, **64,** 243.
[3] *ibid.*, 1966, **68,** 89.
[4] *ibid.*, 1967, **69,** 375.



New books

The Gilmore Hawaii sugar manual, 1969. Ed. A. C. BLOOMQUIST. 145 pp; $8\frac{1}{2} \times 11$ in. (Bloomquist Publications, 516 South Seventh Street, Moorhead, Minnesota, 56560 USA.) 1970. Price: $10.00.

The Gilmore Hawaii sugar manual was first published in 1931, and the latest edition follows its predecessors in providing the most detailed information on the Hawaiian industry. It has a different format, however, and includes a statistical section, US sugar industry organizations section and a section on the US Sugar Act which are identical with those to be found in the Louisiana-Florida manual. A brief general account of the industry is presented, however, as well as the individual factory surveys which contain a wealth of detail ranging from officers and personnel to field practice and factory information, with tables showing factory results in 1967 and 1968. The 1969 Hawaii manual is a mine of information on the industry.

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Recueil des méthodes d'analyses sucrières. 130 pp; $8\frac{1}{4} \times 11\frac{3}{4}$ in. (Société Technique et Chimique de Sucrerie de Belgique, 182 Avenue de Tervueren, Brussels, Belgium.) 1970. Price: 600 Belgian francs.

Dr. J. HENRY in his introduction to this work, as President of the Chemistry Section of the Society, refers to the lack of a manual of the principal methods of analysis used in the sugar industry which could be used by young Belgian chemists. This new publication is intended to meet this need and is designed in an ingenious way which will allow it to be brought up to date continuously so that it can remain a valid and modern aid to its users. The techniques have been described in a clear fashion and conform as far as possible to those recommended by ICUMSA.

The book is divided into eight sections, apart from the preface, introduction and index, these sections A–H being entitled General; Diffusion; Dried pulp; Purification; Syrup and molasses; Sugars; Waters and Tables. The various sections are subdivided for different materials to be analysed (e.g. D.1–D.6), and the latter again subdivided for the individual analyses to be carried out (e.g. D.3.2). Each analysis is separately paged and all are assembled as loose leaves held in a metal clip within a robust plastic binder. Thus with addition of new methods or materials or replacement of out-dated techniques, the relevant pages can easily be removed and new pages inserted.

The book is in French and will undoubtedly find a great welcome among sugar chemists whose familiarity with English is not sufficient to render easy the use of the various modern works on sugar analysis which have been published in this language. In addition, there are a considerable number of determinations which are not given in these books, being peculiar to the beet sugar industry (e.g. first carbonatation juice sedimentation aptitude) and Belgian and French chemists will undoubtedly find it most useful to have these available in written prescribed form which will serve the larger aim of the Society, i.e. to facilitate the adoption of uniform methods of analysis in the sugar industry.

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Official methods of analysis of the Association of Official Analytical Chemists, 11th Edition. Ed. W. HORWITZ, P. CHICHILO and H. REYNOLDS. 1015 pp; $7 \times 10\frac{1}{4}$ in. (Association of Official Analytical Chemists, P.O. Box 540, Benjamin Franklin Station, Washington, D.C., 20044 USA.) 1970. Price: $30.75.

The 11th Edition of the AOAC "Official Methods" is a handsome detailed instruction book of analytical techniques, printed in a form of shorthand in small but clear type and provided with illustrations. The methods are reliable and reproducible and hence suitable for determining compositions of commodities subject to legal control in the USA. They cover a very wide range of products and analyses and it is not surprising, therefore, that the text without the index should run to 964 pages. Most of these will, of course, be of little interest to readers in a specific industry such as ours, although there will no doubt be some chemists who will find useful guidance in the whole of the book.

So far as our readers are concerned, however, interest will be centred on Section 31 "Sugar and sugar products" and the subsection on extraneous matter isolation from sugar and sugar products. These total only some 36 pages, of which confectionery, honey and maple products account for 12. Some of the methods described are not those recommended by ICUMSA while the full range of ICUMSA methods obviously is not covered by the AOAC procedures. Thus we would suppose that the work will tend to find more use in the US sugar industry than in the rest of the world, although a valuable feature which could well be adopted by the publishers of other analytical textbooks is that, between editions, a series of works entitled "Changes in Methods" is published at intervals, at a cost of $3.00.

Zuckerwirtschaftliches Taschenbuch 1970 (Sugar economic pocket book). 224 pp.; 4 × 5¾ in. (Verlag Dr. Albert Bartens, D-1000 Berlin 38, Lückhoffstr. 16, Germany.) 1970. Price: DM 19.40; £2.23.

The 17th edition of this well-known, plastic-bound pocket book contains 67 tables, 7 graphs and 7 maps. As before, it is divided into three main sections. Section I includes world, European, West German and East German data covering sugar production, consumption, imports, exports, balances and prices as well as beet and cane areas, yields and factory outputs. Section II includes world, West German and EEC trade regulations, and Section III contains addresses of West and East German sugar authorities and organizations, West German buying and selling agencies, and details of European and West German sugar factories. While the basic language used is German, headings and captions are in English, French and German. The information has been updated to 1968/69 and, in some cases, to 1969/70. A useful addition to the book is a short glossary in the three main languages of terms used in EEC sugar marketing. The publishers of this book are to be congratulated on producing a most useful collection of data, particularly for those seeking information on the German and EEC sugar industries, and presenting them in such a handy form.

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Sugar year book 1969. 372 pp.; 4 × 5½ in. (International Sugar Organization, 28 Haymarket, London S.W.1, England.) 1970. Price: £2.00.

This is the 23rd edition of the annual collection of sugar statistics published by the ISO and covering all the sugar-producing countries of the world. The data in most cases are for the period 1963–69, although sometimes the 1969 figures are only estimates. The information, submitted by members of the International Sugar Agreement under the terms of the Agreement or by governments of non-member countries (or extracted from statistical publications), covers world centrifugal sugar production in calendar years tabulated by countries in alphabetical order. The book also includes tables of a more general nature (world sugar production, imports, exports, consumption, stocks, world prices, British Commonwealth export quotas and US supply quotas, sugar wholesale and retail prices, etc.). The tables are clearly set out, making reference an easy matter and the book a very handy source of world sugar data.

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Glucose syrups and related carbohydrates. G. G. BIRCH, L. F. GREEN and C. B. COULSON. 118 pp; 5½ × 8¾ in. (Elsevier Publishing Co. Ltd., 22 Rippleside Commercial Estate, Barking, Essex, England.) 1970. Price: £3.25.

An industry-university cooperation symposium was organized by the National College of Food Technology in association with the UK Institute of Food Science and Technology on the 21st April 1970, and the present volume is a record of the papers presented, together with the ensuing discussions. Most of these are naturally concerned with glucose syrups produced by starch hydrolysis and are thus will be of interest to our readers more on a comparative basis than anything else. However, a paper by K. J. PARKER of Tate & Lyle Ltd. Research Centre is included which discusses the syrups containing only sucrose or partly-inverted sucrose; their advantages and disadvantages for the manufacturer and consumer are discussed, and an account given of the principal applications found for their use.

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In the mutual interest. ANON. 25 pp; 8¼ × 8 in. (The Colonial Sugar Refining Co. Ltd., 1–7 O'Connell Street, Sydney, N.S.W., Australia.) 1970.

This is an expanded version of the recent booklet "CSR—100 years a sugar miller" which was published earlier[1] and it also provides an account of the diversification of the CSR company from refining only into sugar cane milling. Such a risky enterprise by the founder of the company, EDWARD KNOX (later Sir Edward), met great difficulties and the booklet describes how these were overcome to help lay the foundations of the Australian sugar industry.

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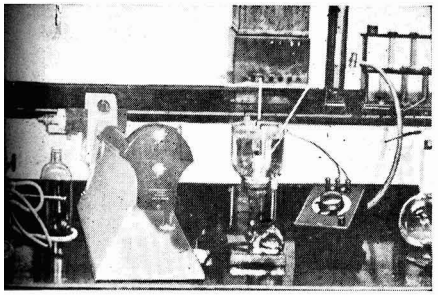
The Gilmore Louisiana-Florida sugar manual, 1969. Ed. A. C. BLOOMQUIST. 227 pp; 8½ × 11 in. (Bloomquist Publications, 516 South Seventh Street, Moorhead, Minnesota, 56560 USA.) 1970. Price: $10.00.

This manual is in a new format compared with its predecessors. Cloth bound, it now includes new sections giving more information on the US Mainland cane sugar area and its industry, with a section of sugar statistics covering not only the domestic cane area but also certain data from Hawaii, Puerto Rico, the US beet area and some figures for world sugar production up to preliminary data for 1968/69. The second section provides general information on the various organizations of the US industry including their personnel and officers, while a third section provides background information as well as the text of the Sugar Act of 1948 as amended at invervals up to 1965.

As usual, the largest section of the book is devoted to detailed accounts of individual sugar factories, providing addresses, names of executives and staff, and detailed field and factory information ranging from fertilizer usage on company fields to mill grooving and equipment in operation. For each factory a résumé of manufacturing results is tabulated for 1967 and 1968 in the case of Louisiana and for 1967/68 and 1968/69 in the case of Florida. The volume closes with a Buyers' Guide. As a detailed source of information on the US mainland cane sugar industry Gilmore's manual has no equal.

[1] *I.S.J.*, 1970, **72**, 312.



Laboratory methods & Chemical reports

Raw sugar quality—producers' point of view. J. C. P. CHEN. *Sugarland* (Philippines), 1970, **7**, (2), 15, 28–29, 33.—The author's experience on the subject of raw sugar quality, more recently as chairman of the Sub-Committee of Technical Advisers of the Raw Sugar Sellers Committee in New York, and the question of raw sugar quality standards under the terms of the No. 10 Contract are briefly mentioned and tables given showing the premiums granted and penalties imposed for ash, safety factor, grain size, filtrability and colour of raw sugar imported by US refiners in 1968. Comments made by raw sugar producers in various exporting countries to whom were sent questionnaires prepared by the Sub-Committee of Technical Advisers are summarized.

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Refractive index of sucrose solutions. ANON. *Sugar J.*, 1970, **33**, (1), 9–12.—A computer print-out is reproduced showing refractive indices of sucrose solutions measured in yellow sodium light in the Brix range 0·009–86·399°. The table is part of a work published earlier[1] which gives refractive indices in both yellow sodium light and green mercury light and is based on the equation developed by ROSENHAUER and adopted by the 14th Session of ICUMSA in 1966.

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A study of some physical and chemical parameters affecting non-sugar:sugar partition with cellulose acetate membrane. L. T. ZANTO, L. M. CHRISTOFFER and S. E. BICHSEL. *J. Amer. Soc. Sugar Beet Tech.*, 1970, **16**, 26–33.—Reverse osmosis experiments on non-sugar separation from dilute molasses solution by passing it through a tube having an inside layer of cellulose acetate are reported. The outer and middle layers were composed of glass fibre. The maximum non-sugar separation was effected at a feed pressure of 400–600 p.s.i.g., while at 200–400 p.s.i.g. the non-sugar:sugar ratio in the product increased. With increase in the molasses solids content from 11·2 to 18·7°Bx (refractometric) sharp increases in total non-sugar and total sugar in the product were observed, compared with only slight changes with increase in the range 18·7–29·5°Bx. Total sugar in the product increased at a slightly faster rate than the total non-sugar content. At 15°Bx almost the maximum quantity of non-sugars was removed, whereas the sugar loss was minimum. Higher feed Brix values than this cause increased loss of sugar while removing the same quantity of non-sugars. The flow rate increased by 35% with increase in feed temperature from 28° to 45°C, higher temperatures being inadvisable because of possible membrane destruction. Sugar passed through the membrane at a slightly higher rate than the non-sugars with increase in temperature. In a 4-stage system, 1·68% of the initial sugar, 4·36% of the non-sugar content, and 22·3% of the water were eliminated from a feed of 10·15°Bx and 59·83 apparent purity flowing at a rate of 4450 cm³/min at 45°C and 600 p.s.i.g. Studies on membrane fouling were carried out with raw and thin juice and high raw pan stock diluted to 10–11°Bx. These showed that, after 11 days, hydrolysis of the membrane caused it to become soft and pliable with a 30% decrease in flow as a result of irreversible fouling. A polyurethane foam plug pumped through the tubes every 24 hr to remove the colloidal build-up on the wall did not affect the flow rate, which fell considerably. After 9 days, a 2% HCl solution pumped through the system did not increase the flow. The development and testing of membranes not subject to permanent fouling and decomposition in a process juice environment is considered necessary before reverse osmosis can be regarded as a practical possibility.

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Organic acids in beet sugar factory products. G. P. VOLOSHANENKO and G. N. TARASENKO. *Pishch. Prom.*, 1969, (9), 19–21.—Samples of raw, carbonatation and thick juices, green syrup and molasses were subjected to a previously described conductimetric titration method[2] for quantitative and qualitative determination of organic acids after passage of the sample through a cation exchanger in H^+ form. Titration curves are given for each type of sample. Malonic acid was found in raw and carbonatation juice and molasses, lactic acid in carbonatation juice, green syrup and molasses, oxalic acid in thick juice, citric acid in molasses, and unidentified dibasic acids in carbonatation juice and green syrup.

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Molasses nitrogen and sugar losses. E. A. GRIVTSEVA, N. L. IZBINSKAYA and V. G. KOVAL'. *Pishch. Prom.*, 1969, (9), 21–26.—Data from 4 campaigns are tabulated showing the molasses total nitrogen, betaine N and glutamic acid N contents for Ukrainian sugar factories during September–December. These show that glutamic acid N % total molasses N tends to decrease as the campaign progresses, whereas betaine N % total molasses N increases slightly. Most of the molasses samples contained 0·6–1·4% N (on dry solids) in addition to the betaine and glutamic acid

[1] *I.S.J.*, 1970, **72**, 312.
[2] VOLOSHANENKO & BOBROVNIK: *ibid.*, **72**, 250.

N contents, which combined to make up 40–70% of the total molasses N. Values of total, glutamic acid and betaine N % molasses non-sugars showed no relationship with molasses yield and sugar losses, in contrast to findings of other authors.

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Content of some oligo-elements in Cuban sugar cane final molasses. M. L. RODRÍGUEZ and G. NUÑEZ. *Bol. Ofic. Asoc. Técn. Azuc. Cuba*, 1970, **25,** 6–12. Spectrographic analyses were made of Ca, Mg, Fe, Mn and Cu in 25 samples of molasses from 11 factories, taken at various times through the 1968 season. Details are tabulated, with information also on the corresponding juice purities, etc. Ca averaged 1·19% on molasses in a range of 0·8–1·80%, while corresponding figures were 0·51% (0·23–0·73%) for Mg, 0·017% (0·006–0·031%) for Fe, 0·022% (0·012–0·047%) for Mn and 0·0016% (0·0007–0·0030%) for Cu. Emission spectroscopy gave values for Ca and Mg in agreement with those obtained by the EDTA method and is confirmed as a precise and rapid technique.

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Separation of raw sugar colorants using AB-16G ion exchange resins. R. RUSO G., L. D. BOBROVNIK and R. FAJARDO G. *Bol. Ofic. Asoc. Técn. Azuc. Cuba* 1970, **25,** 13–20.—Raw sugars, in 30°Bx solution, were applied to columns of AB-16G resin, of USSR origin, until the effluent colour was the same as that of the feed. The resins, considered to be saturated, were then eluted with 10% NaCl solution and the fractions collected and examined. This chromatographic technique showed that the products of sugar degradation were retained more strongly than melanoidins and were largely absorbed irreversibly.

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Variation in the composition of bulk raw cane sugar in storage. E. BATULE D. *Bol. Ofic. Asoc. Técn. Azuc. Cuba*, 1970, **25,** 21–28.—Analyses were made at 10-day intervals of pol, moisture, safety factor, colour, etc., of sugar from the top, centre and bottom of a pile in a Cuban bulk sugar store, the period of storage being 100 days. The results are tabulated and show that the quality of the sugar remained high. Pol and sucrose in the samples increased and decreased randomly as storage progressed. However, there was a consistent increase in colour which was least at the top of the pile and was greater when there was a higher pH; colour was also influenced by sugar temperature. The reducing sugars and pH fell in all zones of the pile with length of storage, and there was a certain amount of compaction of the sugar in the bottom of the pile after 60 days.

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Mechanized raw material laboratory for determination of beet dirt and sugar contents. V. M. CHERNIKOV. *Sakhar. Prom.*, 1970, **44,** (8), 46–49.—Information is given on a Soviet tarehouse design for analysis of 60 beet samples per hour in which some of the operations are automatically controlled.

Determination of the technical value of beet in a fully-automatic tarehouse. H. HARTL. *Zucker*, 1970, **23,** 472–482.—Details are given of the fully-automatic tarehouse at Tulln sugar factory in Austria. The unit can normally handle 120 50-kg samples per hour, with a possible maximum of 180. The equipment and sequence of operations used in sampling, washing and preparation of the beets for analysis are described, and details given of the automatic analysis procedure, from weighing of the brei to recording of the data. A punched strip is used for data processing and evaluation, and a Bendix NPL 143D automatic polarimeter is included in the equipment, together with a Marius flame photometer, a Venema colorimeter, and an automatic dilution unit. Some analyses are given from the 1969/70 campaign.

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Frequency of beet cossette analysis. S. GAWRYCH, K. METELSKI, R. KACPRZAK and M. RUTKOWSKI. *Gaz. Cukr.*, 1970, **78,** 164–166.—Polarimetric determination of cossette sucrose was carried out every 10 min over a period of 48 hr. The arithmetical means were then calculated for measurements made every 20, 30, 60 and 120 min during the 2 days, from which it was found that the mean of the measurements made every 60 min was sufficiently accurate for a factory sugar balance to be drawn up.

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Analytical methods for mass determination of the technical quality of sugar beet in breeding. M. BURBA. *Zeitsch. Zuckerind.*, 1970, **95,** 403–409.—Methods and equipment used at the Institut für Pflanzenzüchtung der Kleinwanzlebener Saatzucht AG for determination of beet sucrose, dry solids, potassium and sodium, ash, amino-acids and amides are described and illustrated, and information given on a unit for automatic determination of sucrose, potassium, sodium and amino-N[1]. Ninety-nine references are given to the literature.

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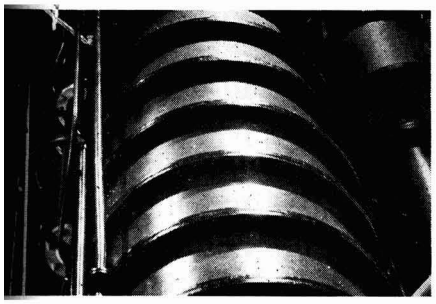
Polarographic determination of reducing sugars. R. BRETSCHNEIDER, J. KRATKA and P. KADLEC. *Listy Cukr.*, 1970, **86,** 120–128.—The invert sugar content in model invert solutions, refined and raw sugar and molasses solutions and various factory products was determined by three different polarographic methods: (i) determination of unreduced Cu^{++} ions, (ii) determination in a LiOH medium, and (iii) determination with *o*-phenylenediamine. Method (i) was more rapid and more suitable than the Ofner iodometric method and was outstanding with the pure and impure sugar solutions. The LiOH method gave good results with the invert solutions and pure sugar solutions, but was not suitable with impure solutions. Method (iii) was sensitive to the concentration of sugar present with the invert sugar, so that the values for the same quantity of invert in water and in sugar solution differed. It is considered that insufficient tests have been made for any one of the polarographic methods to be recommended.

[3] *See* HARTL: *I.S.J.*, 1971, **73,** 122.



By-products

Molasses and sugar as energy sources for pigs. N. A. MACLEOD, T. R. PRESTON, L. A. LASSOTA, M. B. WILLIS and M. VELAZQUEZ. *Sugar News* (India), 1970, **1**, (11), 17–21.—See *I.S.J.*, 1970, **72**, 218.

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Sucrose esters. C. J. O'BOYLE. *Proc. 1st Int. Sugar Research Conf.* (Brussels), 1970, 73–86.—The transesterification process of SNELL *et al.*[1] for sugar ester production and modifications of the original dry extraction process patented by Dai Nippon Sugar Co. and the Colonial Sugar Refining Co. Ltd. are described and general characteristics of the various esters and surface-active properties of sucrose monoesters obtainable are listed. The costs of producing sucrose "tallowate" and of the fatty esters used as raw materials for sucrose ester preparation are also given together with the sources of the fatty esters, and finally the possible applications and functions of the various sucrose esters are tabulated with their unit prices based on the current market situation in the U.SA

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Sugar-based surfactants. G. DUCHATEAU. *Proc. 1st Int. Sugar Research Conf.* (Brussels), 1970, 87–89. Work at Raffinerie Tirlemontoise on sucrose-based surface-active agent preparation is discussed and reference made to various process patents.

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New chemical stabilizes bagasse. R. ORMEROD. *S. African Sugar J.*, 1970, **54**, 403.—The addition of 1% of phosphoric acid to semi-dried bagasse effectively prevents deterioration in storage and the rise of temperature which lead to the development of the organisms causing the human disease bagassosis. It is thought that this may considerably extend the use of bagasse.

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Rumen volume, liquid outflow and the onward passage of soluble carbohydrate from the rumen in animals fed high molasses diets. C. M. GEERKEN and T. M. SUTHERLAND. *Rev. Cubana Cienc. Agríc.*, 1969, **3**, 217–220.—Rumen volumes and outflows were measured in three young Holstein bulls fed on high-molasses diets (30 kg forage + undiluted final molasses containing 3% urea fed *ad libitum*, and 7 kg forage + 6 kg molasses containing 3% urea diluted with 24 kg of water). The rumen volumes were high, corresponding to 20% of the body weight, but outflows were relatively low. Mean soluble carbohydrate concentrations in the rumen were below 1 g/litre. It is concluded that no appreciable quantity of soluble carbohydrate entering the rumen escapes fermentation, so that high-molasses diets have a negligible physiological effect.

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Production of bio-fertilizer and bio-gas from agricultural waste materials. ANON. *Sharkara*, 1970, **12**, 18–20.—Operation of a pilot plant for fermentation of agricultural waste (bagasse, cane trash, leaves, corn stalks, etc.) together with nutrients (e.g. urea, bone meal, animal dung) at the National Sugar Institute in India is reported[2]. The practical applications of the system and its advantages are discussed.

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Studies on composition and flow of duodenal contents in cattle fed diets high in molasses and urea. J. KOWALCZYK, A. RAMÍREZ and C. GEERKEN. *Rev. Cubana Cienc. Agríc.*, 1969, **3**, 221–226.—Holstein bulls had free access to final molasses with 2% urea (diluted 1:1 with water) and were given daily 2 kg of freshly cut elephant grass and 400 g of a supplement containing 68·5% ground maize, 20% soybean meal, 10% final molasses and 1% mineral mixture, fed in two equal portions. Mean daily N consumption was 50 g (70% as non-protein N), while soluble carbohydrate consumption was 1·9 kg. From the duodenal flow, analysis of rumen and duodenal fluid and determination of the passage of the components through the duodenum, it was found that rumen function in the animals was normal.

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Investigation of dried pulp briquetting. YU. M. KOROBOV, G. A. PREIS and V. P. YARES'KO. *Sakhar. Prom.*, 1970, **44**, (9), 29–30.—Experimental studies to increase knowledge on briquetting with rotary presses showed that optimum pressure with maximum compression was 350 kg/cm². At this level, complete removal of the pressure caused the briquette to expand to 30% of its original height in the die, while above this pressure there was no expansion. The relationship between pressure and briquette height:diameter ratio was also determined, a ratio of 2·75 corresponding to the optimum pressure. The coefficient of friction of dried pulp along a case-hardened steel surface was 0·55–0·66, a value considered sufficiently high as to explain rapid wear of surfaces in Soviet rotary presses.

[1] *I.S.J.*, 1959, **61**, 381.
[2] *ibid.*, 1967, **69**, 91.

Manurial value of factory by-products in cane culture under wet land conditions in the Vadapathimangalam sugar factory zone. T. K. G. RAO, S. D. RAJAN and A. K. KADIRVELU. *Proc. 2nd Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1970, 50–52.—Filter press mud applied at the rate of 10 tons/acre as a basal feed in trenches before planting of Co 419 and Co 449 cane increased cane yield by about 3 tons and sugar yield by about 1 ton/acre compared with the control, to which 200 lb of nitrogen per acre was applied as a top dressing. A molasses-bagasse mixture gave only slightly better yields than the control, while molasses on its own and river sand gave lower cane yields but slightly higher sugar yields per acre. For higher cane yields, 10 tons of filter cake plus 200 lb N per acre was the economical optimum.

* * *

Cane trash for paper. Y. MOISEEV and O. ILL. *Cuba-Azúcar*, 1969, (Jan./March), 26–36, 54–62.—Cane dry cleaning stations separate the trash or leaves from harvested cane and studies were therefore made to assess its suitability for paper manufacture. The composition was determined and length and diameter measured for the three types of fibre present. Pulping tests were made and it is considered that the trash is a suitable raw material, while a mixture with bagasse can be used to give a wrapping paper pulp.

* * *

Recovery of alcohol and carbon dioxide produced by fermentation at the José Antonio Echeverría distillery. R. ALEMÁN G. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Eng. Section), 142–155.—Recovery of alcohol and carbon dioxide gas from the fermentation gas after it has passed through the coolers is to be obtained by passing it through a packed column against a counter-current of water. Details are given of the method of calculating the optimum conditions as to gas and water flow, and column dimensions and packing.

* * *

Bagasse pulp in India. S. R. D. GUHA. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 1–20.—The position of bagasse as a raw material for paper pulp in India is compared with that of the main source, bamboo. Problems which have hindered utilization of bagasse are discussed, and an account given of the work of the Forest Research Institute on the chemical analysis of bagasse, its fibre dimensions, production of writing and printing papers as well as various boards, etc. A description is given of the various processes in use for the manufacture of paper and board.

* * *

Development of some furanic pesticides. O. JANUZKIEWICZ and E. ZAYAS. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 21–39. The synthesis of a number of furan derivatives is described, furfural being produced from bagasse by treatment with sulphuric acid, and this then converted to hydrofuramide, furanacrylic acid and its ethyl ester, and furanacrolein. These materials were then studied for their fungicidal properties and were found to compare satisfactorily with "Maneb-80" commercial fungicide. The activity of furfural as a herbicide and defoliant was also studied; it was quite low although herbicidal activity was higher when used after emergence.

* * *

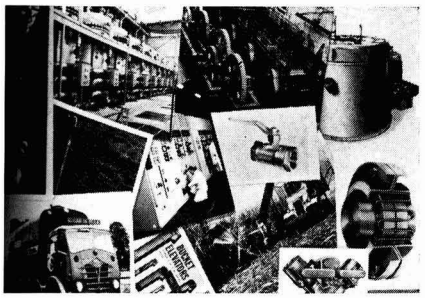
Study of the influence of the recirculation of black liquor on alkaline bagasse cooking processes. I. The soda method. M. DE LA BARRERA M. and Y. MOISEEV. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 53–67.—Advantages observed with recirculation of black liquor during wood pulping are also found in the case of bagasse; the density of the residual liquor is higher, giving better heat economy and chemical products recovery. The amount of fines is slightly higher, but the milling and physico-mechanical properties of the pulps do not appear to be affected. No appreciable differences in brilliance of the pulps can be attributed to black liquor recirculation. Chlorine consumption is increased but is acceptable up to 60% recirculation, which results in an increase of 6 kg chlorine per ton of pulp.

* * *

The effect of variations in the monomeric composition on the polymerization of furfural acetone resins catalysed with polyamines. M. BARRETO Q., R. DELGADO, N. LA SERNA T. and M. A. YOUNG. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 68–86.—Furfural, obtained from bagasse, reacts with acetone to produce furfurylidene (FAc) and di-furfurylidene acetone (F_2Ac). These two monomers react with themselves and with furfural to produce resins usable as adhesives, in moulding powders, laminated products and anti-corrosion paints, etc. The activity of some amino compounds as catalysts for polymerization of furfural-acetone and in the presence of epoxy resin is reported and preliminary investigations made of the properties of the resins. The effect of variations in the ratio of FAc to F_2Ac has also been studied.

* * *

Catalytic action of sea salts on the process of obtaining furfural from bagasse. E. CORONA F., O. TORRES A., M. SOSA S. and A. MILOVANOV. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 87–110.—A method has been developed for furfural production from bagasse by distillation at atmospheric pressure or slightly above, using sea salts and sulphuric acid as catalysts. The raw material is saturated with concentrated sea water in the presence of sulphuric acid and is treated with superheated steam; alternatively, the natural raw material may be treated with superheated steam containing hydrogen chloride. The furfural yield is 60–70% of theoretical and the residues may be used as fuel, fertilizer or raw material for obtaining sugars, levulinic acid and hydroxymethyl furfural. In the first alternative, the residues may be used as a source of commercial sodium sulphate.



Trade notices

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

The RT4 continuous beet diffuser. Soc. Sucrière d'Etudes et de Conseils S.A., 1 Aendorenstraat, Tienen, Belgium.

The RT drum has been a familiar sight in beet sugar factories throughout the world for many years and was the first commercial continuous diffuser design to succeed in replacing the old discontinuous batteries which required so much labour. The original RT1 design, installed at Raffinerie Tirlemontoise S.A. in Belgium in 1930, comprised a rotating drum in which a helical channel was formed by welding spiral sections to the drum. Radial perforated plates were welded between the sections at diametrically opposite positions, so dividing the channel into compartments. Juice flowed by gravity from one end of the drum to the other while cossettes entering at the lower end were transported from one compartment to the next by the conveying action of the rotating drum.

The RT2 design, introduced in 1947, is characterized by a second helicoidal band parallel to the first within the drum, so providing two channels for the liquid. Cossettes pass alternately from one to the other and are carried by the internal scroll from the lower to the higher end of the drum, while the juice streams pass in counter-current under gravity, each twice as fast as the cossette flow. Compared with the earlier design, the RT2 required a 33% higher speed of rotation to give the same cossette residence time; juice residence time was thus reduced (and hence bacterial losses), and the throughput of the drum was greater.

This design has been installed in many countries and has proved efficient, reliable and flexible in operation. It has the disadvantage, however, of a relatively high cost per unit capacity, and modifications have been made to the design to increase the throughput of a drum. This has involved higher speeds of rotation which have been made possible by increasing the screen area of the compartments and changing the perforations and their location in order to achieve better and faster separation of the juice from the cossette-juice mixture as it is lifted by the radial plates. The latter have also been extended and their screen area increased to permit a greater fill within the drum and so a greater throughput. In this way the initial capacity of an RT2 drum has been extended by up to 40%.

At Coulommiers sugar factory, just outside Paris, the first of a new generation of drum diffusers was installed for trials during the 1969/70 campaign. The RT4 design, as it is called (the RT3 was another development which has been abandoned), is fundamentally different from its predecessors in that juice does not flow under gravity but is carried along the drum by an internal conveyor mechanism, as are the cossettes. Photographs of a model illustrate this mechanism (Fig. 1); compartments are formed by lateral sections welded to the interior of the drum, with oblique transfer plates for the cossettes which pass from left to right as the drum rotates (clockwise as viewed from the left-hand side of the axis in the photographs). Behind the screen plate which lifts the cossette-juice mixture is a solid plate forming a

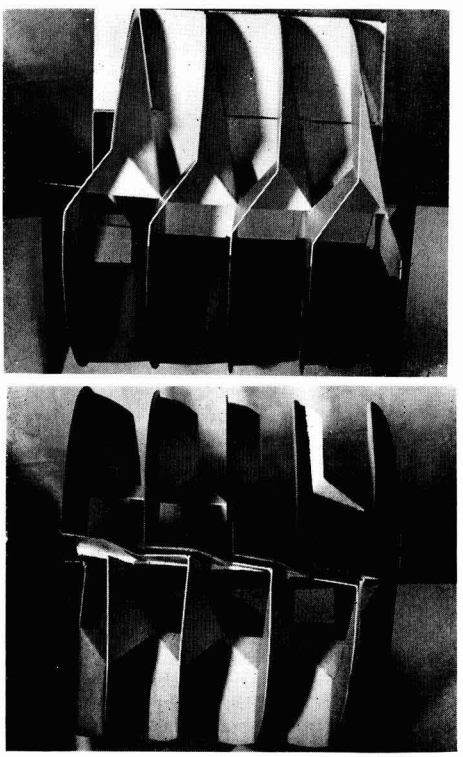


Fig. 1

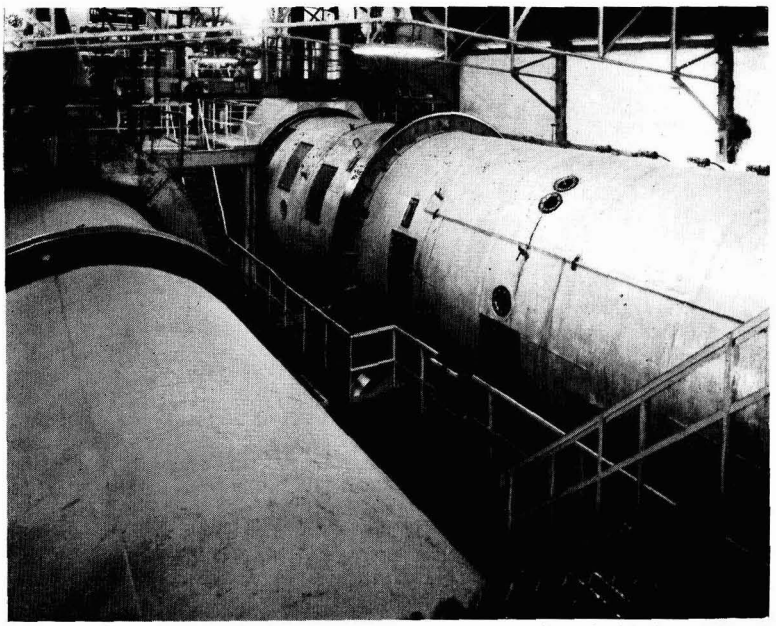


Fig. 2. The RT4 diffuser at Coulommiers (shown on right); the unit on the left is an RT2 unit

channel for the juice which drains from the mixture so that it is transported from right to left. In a complete 360° turn of the drum each fraction of cossettes passes from one compartment to the next (being raised and drained without axial movement during one 180° and then falling by gravity into the next compartment and being moved along by the oblique plate in the second 180°). At the same time, the juice moves a net one compartment in the other direction, draining to two compartments along during the first 180° and then travelling the length of one compartment with the cossettes during the second 180° of drum rotation.

This positive conveying of the juice and the design of the interior screens and plate-work has permitted a greater fill in the diffuser, giving a much higher throughput. The axial length of the compartments must be such as to allow sufficient drainage area in relation to the volume, and the number of cells (preferably 36) such as to allow sufficient exhaustion of the cossettes; the combination of these factors governs the length of the drum.

At Coulommiers, the new RT4 drum is of 4·2 m diameter and 30·38 m long; it replaces a 4 m RT2 drum 24·13 m long which was provided with a wider head section for adequate pulp drainage. The old unit had an initial design capacity of 800 tons of beet/day but by modification had been brought to 1100 tons/day. A 4·2 m RT2 unit would have had an initial capacity of 1100 tons, raised to 1400 tons/day. The new unit sliced an average of 2041 tons/day during the first 34 days of the second campaign (1970/71), averaging 2120 tons/day after the first week. Losses averaged 0·22% on beet, at an average draft of 108·1% in a range of 104–112%. Sugar content of the cossettes averaged 16·70% and their length (Silin measurement) 15 m/100 g. The drum speed was 30 r.p.h. and the diffuser operated at pH 5·9–6·2 and at 74–75°C. Diffusion time is 70 minutes.

It is anticipated that capacity can be further increased by modification of the screen perforations in accordance with experience gained during the first campaign, but it is evident already that a diffuser of the RT4 design will cost about 30% less for the same capacity than the RT2: alternatively, a unit of the same size and cost will have a 50% higher capacity.

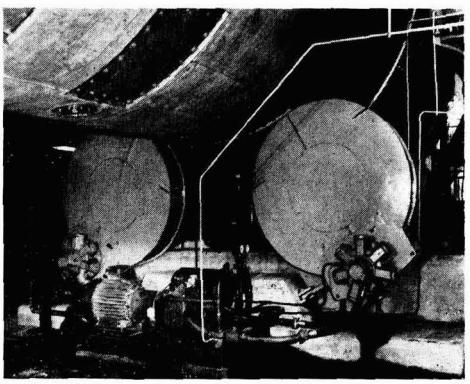


Fig. 3. Infinitely-variable hydraulic drive built by Soc. Fives Lille-Cail for the RT4 diffuser at Coulommiers

* * *

Corrigendum.—It has been pointed out that the full-scale pilot plant mentioned in the Trade Notice concerning the "Saturne" cane diffuser[1] has a rated capacity of 2000 t.c.d. and not 1000 t.c.d.

* * *

New process control company.—Bailey Meters & Controls Ltd., a member of the Babcock & Wilcox Group, has formed a new company, Digimatics Ltd., to build and supply low-cost, highly flexible, computer-based, process control systems and provide associated engineering and application services. The systems, engineered largely from bought-in components, will be supplied as self-contained systems for advanced control which will permit the design, commissioning and on-line development of both simple and comprehensive control schemes incorporating a wide variety of techniques.

* * *

BMA continuous centrifugals.—BMA have received from Société des Raffineries & Sucreries Say an order for 17 K 850 continuous centrifugals to be installed in a number of factories.

[1] *I.S.J.*, 1971, **73**, 61.

United Kingdom sugar imports and exports

IMPORTS	1970	1969	1968	1967
		long tons, tel quel		
Refined and White Sugar for direct consumption				
Canada	—	3	2	163
W. Indies & Guyana	—	1,997	3,071	1,129
Other Commonwlth.	—	40	30	11
Belgium	973	2,095	916	1,452
Czechoslovakia	15,265	15,406	15,849	26,528
Denmark	—	4,067	14,619	—
Finland	—	5,733	—	—
France	—	1,249	2,227	882
Germany, East	3,131	2,413	4,522	5,136
Germany, West	—	1,147	906	104
Holland	41,542	4,274	12	25
Ireland	12,072	10,118	10,127	10,725
Norway	—	63	—	29
Poland	—	606	2,336	2,187
Sweden	34	492	—	—
Other Foreign	26	31	32	23
Total	73,043	49,734	54,649	48,394
Raw sugar and sugar for further refining				
Australia	341,618	500,000	358,353	433,162
Barbados	118,481	117,622	130,310	114,088
British Honduras	20,491	13,673	22,810	15,786
Fiji	136,916	185,826	130,112	143,809
Guyana	172,172	184,906	141,718	140,666
India	19,282	24,925	24,791	76,902
Jamaica	238,079	216,833	213,653	198,541
Leeward Is.	30,801	23,089	29,660	34,416
Mauritius	405,692	400,950	484,257	370,241
Swaziland	95,835	98,360	84,466	87,539
Trinidad & Tobago	145,874	129,648	129,587	142,914
Other Commonwlth.	149	—	299	818
Commonwealth Raws	1,725,390	1,895,832	1,750,016	1,758,882
Belgium	5,762	5,527	—	4,055
Bulgaria	—	—	—	3,995
Brazil	—	16,731	11,898	17,826
Colombia	—	—	9,812	11,706
Cuba	31,228	9,465	19,494	79,923
Czechoslovakia	—	7,809	—	—
Dominican Repub.	—	—	—	9,949
France	42,790	—	28,372	—
Germany, West	28,856	11,821	5,915	—
Holland	—	15,870	42,832	26,013
Poland	13,533	20,115	44,314	31,792
Réunion	—	—	9,451	—
Rumania	4,460	—	—	—
South Africa	31,826	20,899	42,548	158,539
Spain	2,192	6,293	—	—
Switzerland	1,053	—	—	—
USSR	93,694	51,257	—	—
Yugoslavia	—	—	—	1,008
Other Foreign	25	2	—	2
Foreign raws	255,419	165,789	214,636	344,808
Total Raws	1,980,809	2,061,621	1,964,652	2,103,690
TOTAL IMPORTS	2,053,852	2,111,355	2,019,301	2,152,084

EXPORTS	1970	1969	1968	1967
		Long tons, tel quel		
Bahamas/Turks & Caicos Is.	935	1,001	1,242	1,101
Bahrein	126	136	1,755	102
Barbados	1,537	920	447	259
Bermuda	779	854	949	583
British Honduras	1,574	1,686	873	716
Canada	578	75	3,036	2,032
Ceylon	4,085	1,345	3,314	665
Cyprus	6,962	8,462	9,025	11,541
Gambia	107	130	548	775
Ghana	2,398	3,900	11,335	19,301
Gibraltar	1,156	1,215	1,217	1,184
Guyana	232	93	117	90
Indian Ocean Is.	34	58	46	246
Jamaica	12,692	15,832	31	35
Kenya	1,073	1,894	3,183	3,580
Leeward Is.	2,241	2,218	2,235	1,367
Malaysia	102	562	498	523
Malta	380	506	551	935
Nigeria	16,884	14,057	8,544	24,469
St. Helena	169	171	232	—
Sierra Leone	2,574	2,823	4,450	8,281
Singapore	5	16	999	5,535
South Arabia	*	*	*	216
Trinidad & Tobago	154	159	91	26
Trucial States	141	186	589	100
Windward Is.	2,040	1,782	2,005	2,298
Zambia	809	1,797	1	2,017
Other Commonwlth.	65	345	293	570
Total Commonwealth	59,832	62,223	57,606	88,547
Belgium	287	10	18	968
Burma	373	—	335	—
Cameroons	4	61	45	6
Chile	—	295	1,498	1,287
French Pacific	433	1,603	2,276	2,353
Germany, East	12	—	10	5,000
Germany, West	1,160	726	827	583
Greece	82	45	311	34,168
Holland	3,992	2,036	17,431	45,329
Iceland	2,617	2,639	2,864	3,354
Iran	304	1,184	1,453	1,723
Ireland	686	426	562	590
Israel	104	270	354	426
Italy	—	13	8	26
Kuwait	158	98	2,180	249
Lebanon	276	26	1,574	1,627
Liberia	346	411	523	555
Libya	205	171	203	294
Malagasy Republic	506	—	—	—
Mozambique	1,049	—	—	—
Muscat & Oman	48	41	705	89
Norway	38,462	38,574	38,481	43,473
Saudi Arabia	357	2,190	9,043	486
South Yemen	—	—	1,968	*
Spain	969	21	104	252
Spanish Possessions Overseas	2	62	261	168
Sweden	370	26	89	9,859
Switzerland	37,115	43,144	45,240	56,566
Togo	—	50	429	246
Tunisia	32,454	23,657	15,781	12,817
USA	3,629	145	314	7
Vietnam, South	—	19,643	—	9,550
Other Foreign	556	223	171	943
Total Foreign	126,556	137,790	145,058	232,994
GRAND TOTAL	186,388	200,013	202,664	321,541

UK beet price for 1971/72.—In the Annual Review of guaranteed prices presented to Parliament on the 17th March, the Minister of Agriculture, Fisheries and Food announced that the basic price for sugar beet having a content of 16·0% sugar had been set at £7.60 per ton, representing an increase of £0.65 over the revised price set in October 1970 (when it had been raised from £6.825 to £6.95 per ton). The price will apply to beet grown on an area of 443,000 acres, the same as for the 1970/71 guarantee.

[1] C. Czarnikow Ltd., *Sugar Review*, 1971, (1010), 27.

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

Brevities

India sugar exports 1970[1].—Indian sugar exports during the calendar year 1970 are estimated at 329,000 metric tons, compared with 94,000 tons in 1969. The above was announced by the Indian Minister of Agriculture following a request in the Indian Parliament. Out of the total quantity, 95,000 tons were exported to preferential markets in the United States and United Kingdom, and 50,000 tons to Canada.

* * *

Mauritius sugar production[2].—Harvesting of the 1970 crop started on the 2nd July and ended on the 11th December. The 21 factories crushed 5,039,355 long tons of cane, about 693,000 tons less than in 1969. Total sugar output amounted to 567,130 tons in 1970, as against 658,142 tons the previous year. The average cane yield reached 25·4 tons/acre as against the record figure of 29·1 tons/acre in 1969. The average sugar recovery was 11·25 and the yield of sugar per acre amounted to 2·86 tons as against 3·35 tons in 1969. The 1970 crop was affected by a cyclone which caused much damage to plantations. Total sugar output showed a reduction of 13·8% on the previous year. Exports during 1970 totalled 572,401 tons, compared with 582,290 tons in 1969; destinations included the UK with 402,191 tons (380,000 tons in 1969), Canada with 154,610 tons (176,140 tons in 1969) and the US with 15,600 tons (15,000 tons in 1969). In 1969 there were shipments of 11,150 tons to Malaysia but no sugar went to this destination in 1970. Local sales were marginally higher at 31,444 tons compared with 30,488, and final stocks were 125,278 tons compared with 161,927 tons at end-1969. The Mauritius Chamber of Commerce has officially estimated the 1971 crop at 665,000 long tons[3].

* * *

The late Rafael Pedrosa Puertas.—The death occurred in February of Sr. Rafael Pedrosa Puertas, President of the Cuban Sugar Technologists Association. His connexion with the sugar industry started when be became a laboratory assistant at Central Ulacia at the early age of twelve years and he rose to be Superintendent of Fabrication at a number of centrals owned by Cía. Azucarera Atlántica del Golfo, meantime graduating as a Sugar Chemist and Agronomic Engineer. During 1953–57 he occupied high technical positions in factories and the Estates Association of Venezuela, returning to Cuba to become General Superintendent of Fabrication for all the factories of the Galban Lobo Trading Co. In 1960 he became General Superintendent of Refineries while with the formation of the Cuban Ministry of the Sugar Industry he became Director of Production which post he held at his death. He had been the moving spirit behind the re-activation of the A.T.A.C. after 1960 and, in spite of illness, presided over the 39th Conference in October last.

* * *

Commonwealth Sugar Agreement price increase call[4].—On his return from London early this year, Sir ROBERT KIRKWOOD, Chairman of the Sugar Manufacturers' Association of Jamaica, and of the West Indies Sugar Association, said that the sugar industry in Jamaica and elsewhere in the Commonwealth Caribbean was battling for survival in the face of steeply rising costs of production while the price received for sugar under the Commonwealth Sugar Agreement had remained steady since 1967. What was needed now, he said, were prices more realistically aligned to existing costs of production if the industry were to remain alive. It was Sir ROBERT's hope that action would be taken this autumn at the CSA triennial price review talks in London.

US sugar imports authorization[5].—On the 19th January the US Dept. of Agriculture approved applications for the importation from 22 foreign countries of 1,411,865 short tons, raw value, of raw sugar during the second quarter of 1971. The limit authorized for importation during the first quarter of 1971, originally 788,135 tons, was raised on 9th February by 100,000 tons[6] and later removed entirely[7].

* * *

US sugar consumption, 1970.[8]—Sugar production in the USA during 1970 totalled 9,271,308 long tons, an increase of 372,670 tons over the 8,898,638 tons consumed in 1969. Population growth of the United States is such that the usage of sugar can be expected to increase by some 100–200,000 tons each year; the increase between 1969 and 1970 is far more than can normally be expected from population growth alone and in part must reflect the expansion in consumption which followed the banning of cyclamates, although it is not possible to measure this with any degree of accuracy. The large increase has brought the per caput level to more than 100 lb for the first time on record.

* * *

Commonwealth Sugar Agreement Negotiated Price.—The UK Sugar Board has announced that, in the case of invoices presented for payment before April 1971, they have decided to reinstate the provisional payment of £1.50 per ton over and above the £45 per ton paid on Negotiated Price sugar originating in developing members of the Commonwealth Sugar Agreement. These countries receive a special increment which varies inversely with the world market price and ranges from nil to £2.50 per ton. The year on which prices for 1971 will be based runs from April 1970 to March 1971. The Sugar Board announced in January that, in view of the rise in world market prices, they were withdrawing the provisional payment of £1.50 per ton[9]. It is this payment which is now being restored.

* * *

Sugar Industry Technologists Inc.—The 30th Annual Meeting of Sugar Industry Technologists Inc. is to be held in the Waldorf-Astoria Hotel in New York City during the 2nd–4th May 1971. Further information may be obtained from the Executive Secretary, Mr. CURTIS L. TAGGART, P.O. Box 47, Medford, Mass., 02155 U.S.A.

* * *

China sugar beet production, 1970[10].—According to the Chinese News Agency "Hsinhua", a good sugar beet crop has been reached in 1970 in the province of Heilungkiang in Mainland China. The report mentions that the 1969 crop was exceeded by 20%; however, actual figures have not been published by the news agency.

* * *

Hawaii sugar production[11].—Sugar production in Hawaii in Hawaii in 1970 totalled 1,162,071 short tons, raw value, compared with 1,182,414 tons in 1969 and 1,232,182 tons in 1968.

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[1] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (1), 6.
[2] *Mauritius Sugar News Bull.*, 1970, (12).
[3] *Public Ledger*, 13th March 1971.
[4] *W. Indies Chronicle*, 1971, **86**, 117.
[5] *Lamborn*, 1971, **49**, 16.
[6] *ibid.*, 22.
[7] *ibid.*, 32.
[8] *Willett & Gray*; through C. Czarnikow Ltd., *Sugar Review*, 1971, (1012), 35.
[9] *I.S.J.*, 1971, **73**, 96.
[10] F. O. Licht, *International Sugar Rpt.*, 1970, **103**, (1), 6.
[11] *Lamborn*, 1971, **49**, 19.

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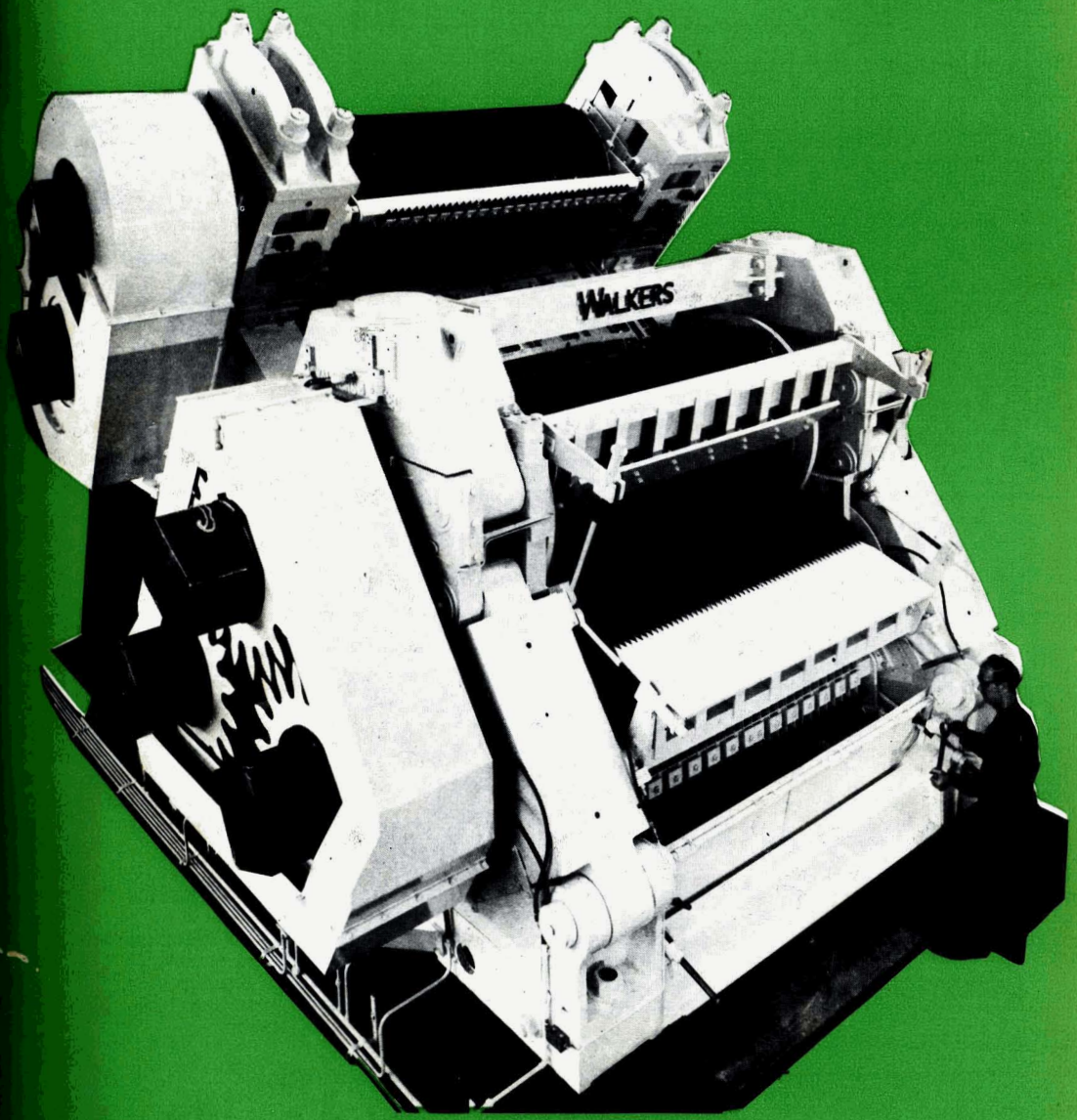

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL Ltd., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.