THE International Sugar Journal

AUGUST 1972

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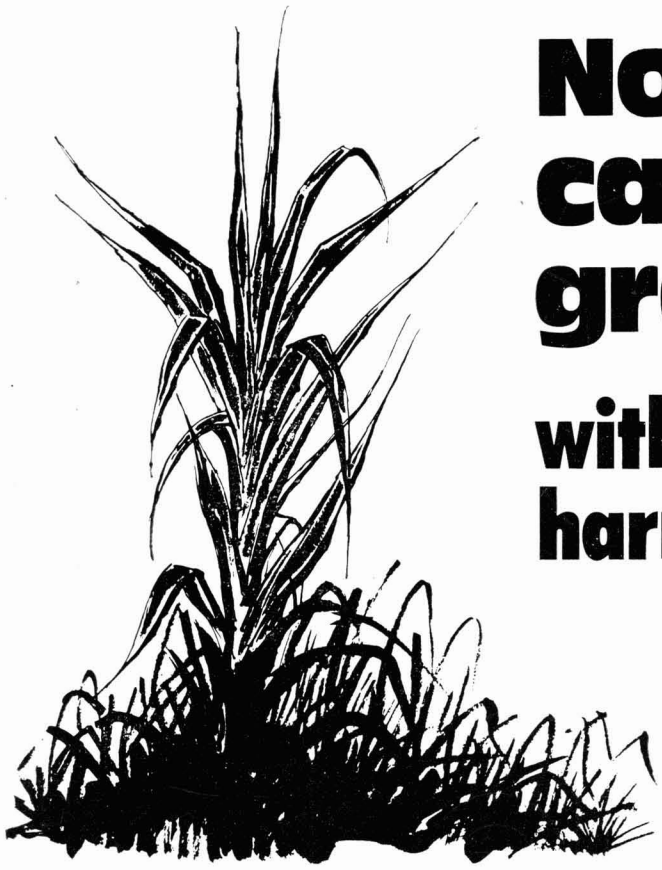

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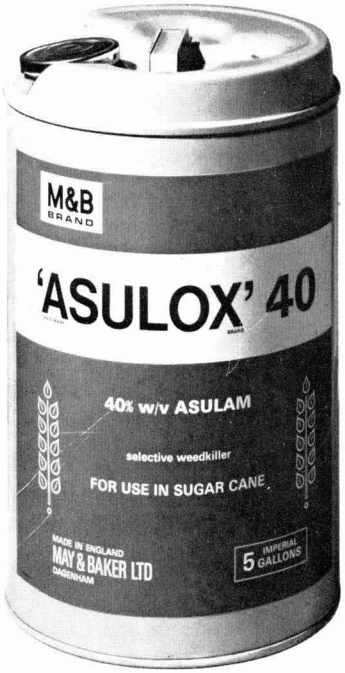

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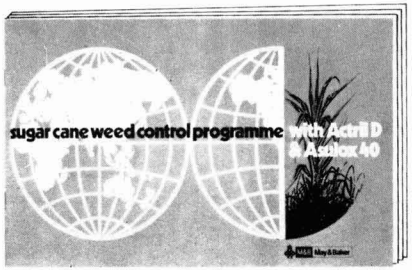

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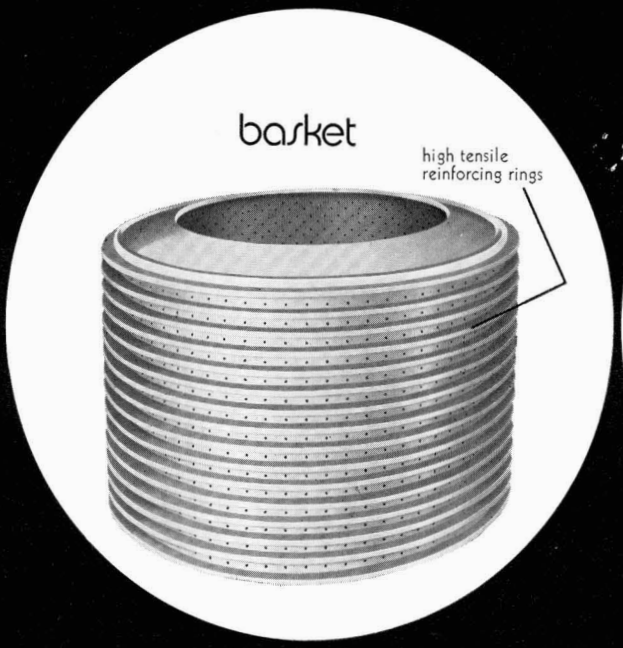

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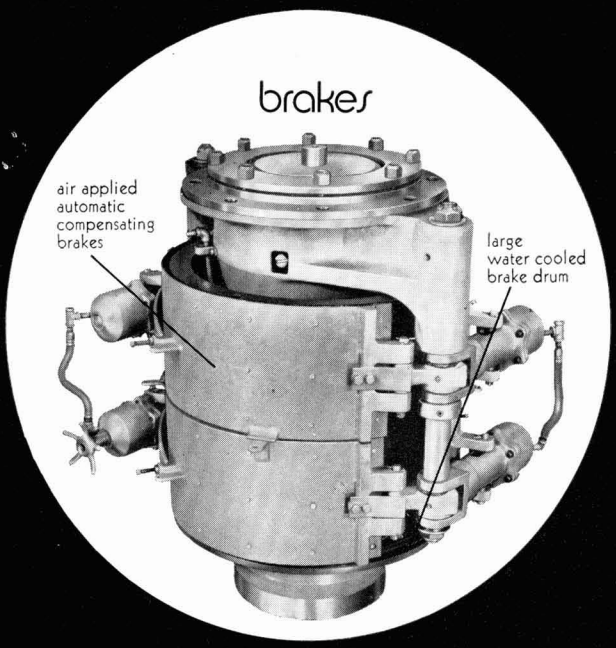

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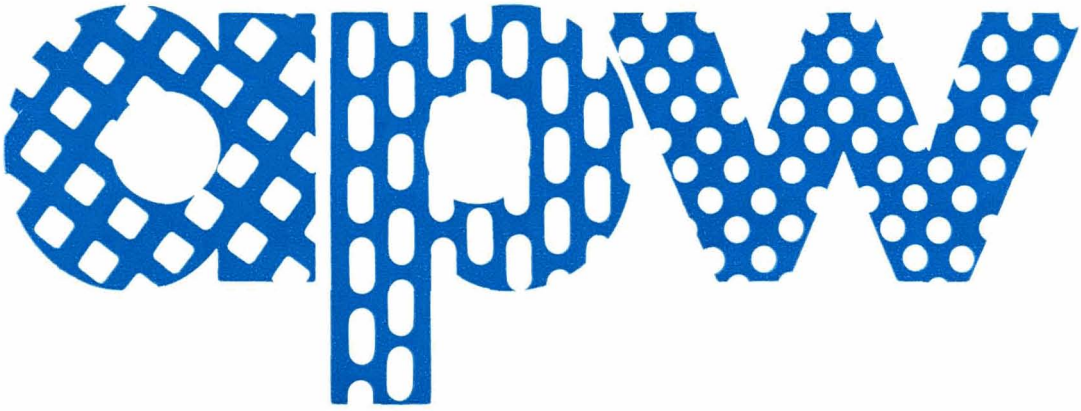

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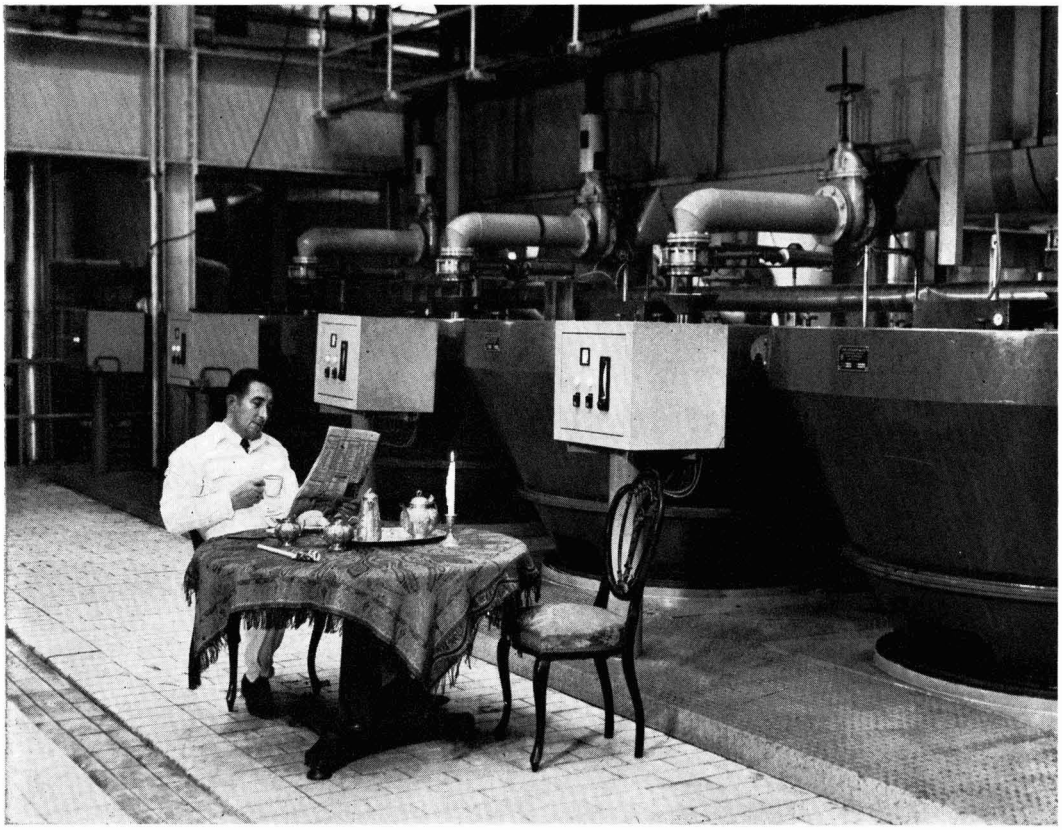

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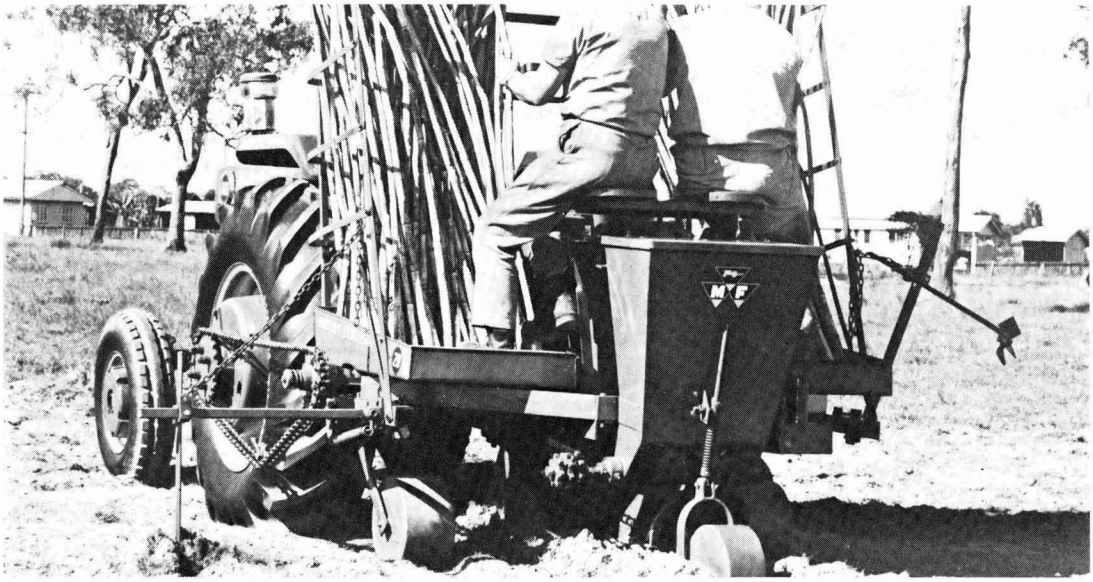

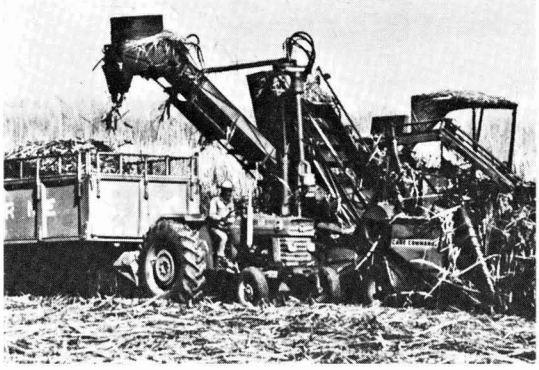

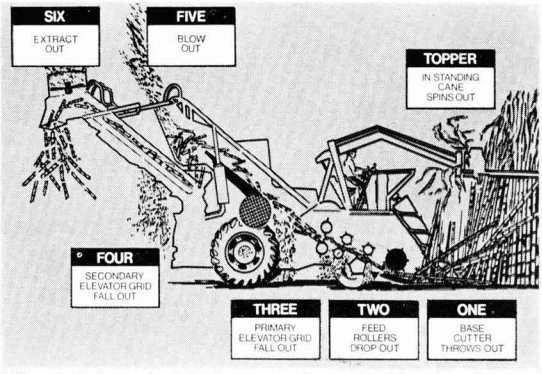

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They will send you copies of the MF Systems Manual, literature on the MF 20 and MF 201, and the latest edition of Cane News.

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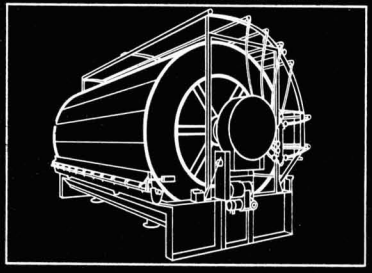
How to pick a winner in the mud.

There's a rich payoff in being able to handle mud. We've got a sure thing for you in our Oliver-Campbell® Cane Mud Filter. It literally sucks up the sugar and leaves mud behind.

The Oliver-Campbell filter offers you new component design that gives you more efficient operation with minimal maintenance. Stainless steel construction of the filter drum, internal piping, filtrate valve and perforated screens over a polypropylene waffle grid decking assure long, trouble-free life.



You get greater hydraulic capacity because of the much larger internal piping (8' drums have 1¼" piping, 10' drums 1½"), the larger capacity filtrate valve and the increased deck depth. You get better control with the new totally-enclosed Varispeed drive. And you get maximum utilization of the filter area with the new design of the scraper discharge unit.

The Oliver-Campbell filter provides great flexibility of operation. It can be used with or without chemical additives. It can be used as a Rapifloc™ type of filter with only minor modification. Or as a conventional filter with or without coagulating equipment and chemicals.

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We have the skill and technology to design a complete, efficient and economical filtrator station for your mill. One that's perfectly suited to your local conditions.

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Other information includes engineering data, horsepower charts and application case histories. Learn why other producers rely on Farrel Sugar Cane Machinery. Send for bulletin 312-B. Write to Farrel Company, Division of USM Corporation, Ansonia, Connecticut, U.S.A. 06401.

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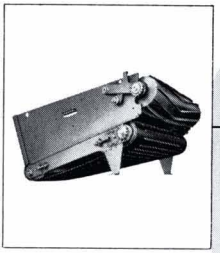
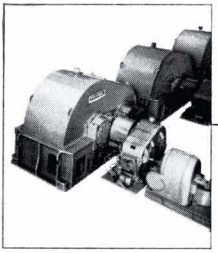
New brochure gives you the full story on Farrel Sugar Cane Machinery

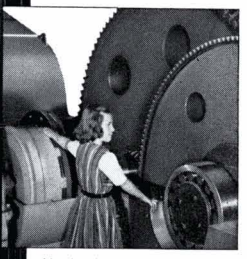


Durable rubber belt carriers feature many advantages.

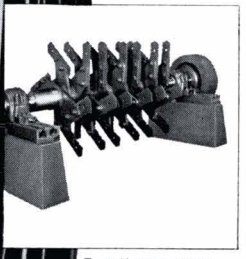


Modern gear design offers speed flexibility.

Patented side-cap construction permits fast vertical roll removal.



Air clutches between the two units of turbine drives provide slippage to prevent damage to mill or coupling.



Type K-4 cane knife units improve sucrose extraction and increase grinding capacity.

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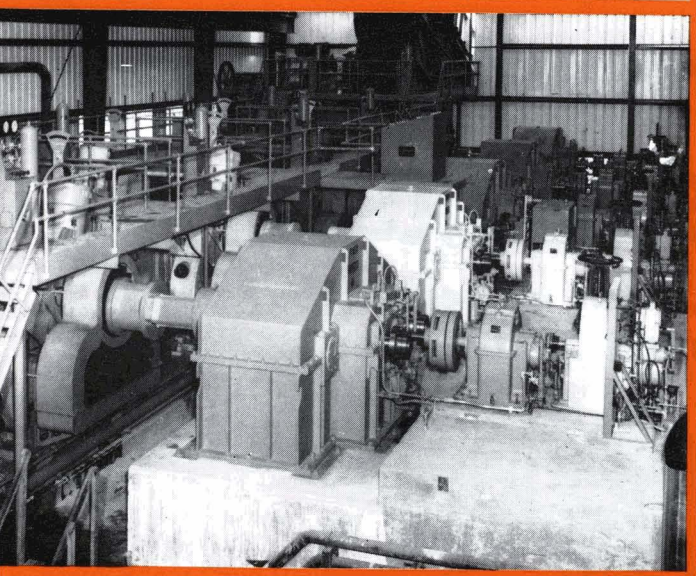

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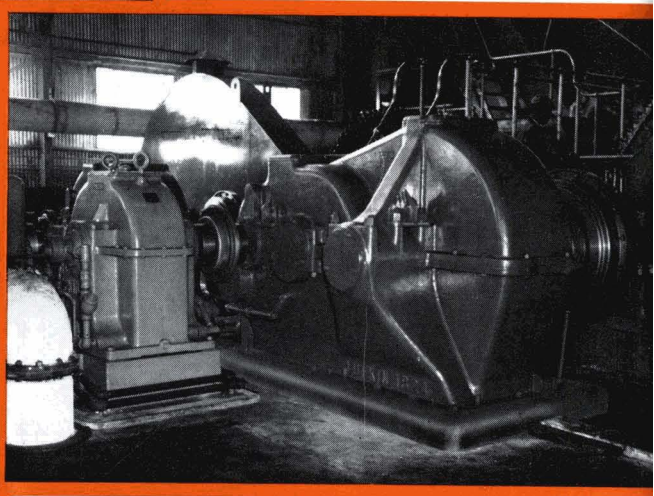

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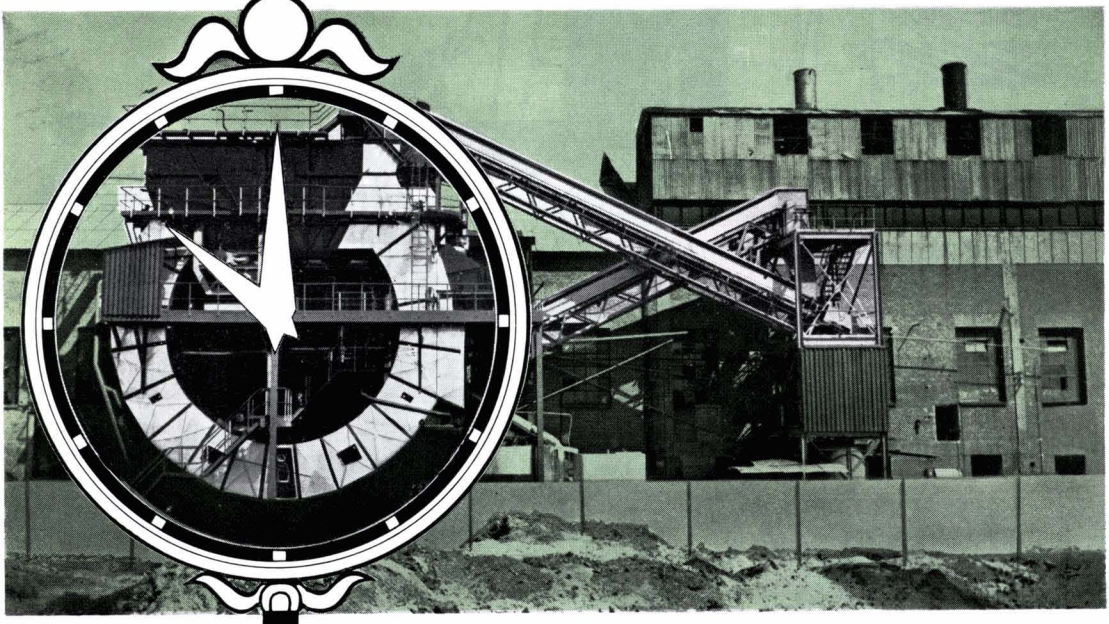

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August 1972

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Le développement d'un nouveau sucre brut Sud-Africain. J. B. ALEXANDER. *p.* 227–230

On décrit les dispositions en vue d'améliorer les propriétés de raffinage de sucre brut Sud-Africain. On a trouvé qu'il était préférable d'utiliser des mélasses high-test au lieu de mélasses finales pour enrober les cristaux de sucre afin de réduire sa polarisation élevée au niveau requis par l'acheteur. On compare du sucre brut pour l'exportation fabriqué selon les nouvelles techniques à des sucres bruts à haute et basse polarisation fabriqués selon les méthodes antérieures.

* * *

Données sur la solubilité du saccharose obtenues par calculateur numérique. L. BIASINI, C. A. ACCORSI et G. MANTOVANI. *p.* 230–235

Une méthode analytique systématique faisant appel à un calculateur numérique a été appliqué à des mesures de solubilité du saccharose dans des mélasses ayant des proportions constantes d'équivalents cationiques mais des compositions différentes, en pourcentage, de K^+, Na^+, Mg^{++} et Ca^{++}. Les valeurs obtenues sont comparées aux données expérimentales et calculées, obtenues par VAVRINECZ, démontrant les avantages de la nouvelle méthode sur celle faisant appel à l'équation de VAVRINECZ.

* * *

Caractérisation du comportement spectrophotométrique et mesure de la coloration en solution de sucres commerciaux. IIe Partie. S. K. D. AGARWAL et D. S. MISRA. *p.* 235–238

Des études effectuées dans la région du visible ont montré que la fréquence et la position des pics d'absorption relevés antérieurement dans la région des 420 nm se distribuaient entre 410 et 460 nm suivant la concentration en matière colorante. Une divergence notable avec la loi de Beer apparaissait ainsi de sorte que le calcul de la concentration en sucre sur la base de l'indice couleur n'est pas possible.

Die Entwicklung eines südafrikanischen Rohzuckers mit "New Look". J. B. ALEXANDER. *S.* 227–230

Es werden Massnahmen beschrieben, die zur Verbesserung der Raffinationseigenschaften von südafrikanischem Rohzucker unternommen wurden. Der Autor stellt fest, dass es vorteilhafter ist, zur Umhüllung der Zuckerkristalle Abläufe höherer Reinheit anstelle von Melasse zu verwenden, um ihre hohe Polarisation auf den vom Käufer geforderten Wert zu reduzieren. Nach dem neuen Verfahren hergestellter Rohzucker wird mit nach den üblichen Methoden erzeugten Zuckern hoher und niedriger Polarisation verglichen.

* * *

Die Behandlung von Werten für die Saccharoselöslichkeit in einem Rechner mit digitalem Ausgang. L. BIASINI, C. A. ACCORSI und G. MANTOVANI. *S.* 230–235

Die Autoren verwendeten eine systematische analytische Methode, bei der ein Rechner mit digitalem Ausgang benutzt wurde, für die Messung der Saccharoselöslichkeit in Melassen, die eine konstante Menge Kationenäquivalente, aber verschiedene Prozentanteile an Kalium-, Natrium, Magnesium- und Calciumionen enthielten. Die erhaltenen Werte wurden mit experimentellen und von VAVRINECZ berechneten Daten verglichen. Dabei zeigten sich die Vorteile der neuen Methode gegenüber derjenigen, bei der die Gleichung von VAVRINECZ benutzt wurde.

* * *

Charakterisierung des spektrophotometrischen Verhaltens und Bestimmung der Farbe in Lösung von Handelszuckern. Teil II. S. K. D. AGARWAL und D. S. MISRA. *S.* 235–238

Untersuchungen im sichtbaren Gebiet zeigten, dass das Auftreten und die Lage des früher bei etwa 420 nm gefundenen Absorptions-Peaks je nach der Farbstoffkonzentration zwischen 410 und 460 nm schwankt und dass eine starke Abweichung vom Beerschen Gesetz besteht, so dass die Ermittlung der Zuckerkonzentration mit Hilfe des Farbindexes unmöglich ist.

La evolución de un azúcar crudo sudafricano de nuevo aspecto. J. B. ALEXANDER. *Pág.* 227–230

Se describen medidas tomado para mejorar les propriedades para refinación de azúcar crudo sudafricano. Estaba encontrado preferible usar melaza semi-invertido en lugar de melaza final para cubrir los cristales de azúcar para reducir su alto pol al nivel requerido por el comprador. Azúcar crudo para exportación y fabricado por la nueva técnica se compare con azucares de alto y bajo pol fabricado por antiguos métodos.

* * *

Dados de solubilidad de sacarosa tratado por un procedimiento a un computador digital. L. BIASINI, C. A. ACCORSI y G. MANTOVANI. *Pág.* 230–235

Un método sistemático de analisis que envuelve el uso de un computador digital se ha aplicado a mediciones de solubilidad de sacarosa en melaza que contiene constantes proporciones de equivalentes catiónicos pero diferentes composiciones por ciento de K^+, Na^+, Mg^{++} y Ca^{++}. Los valores obtenido se comparen con dados experimentales y calculados obtenido por VAVRINECZ, y demuestran los ventajes del nuevo método sobre aquel que envuelve la ecuación de VAVRINECZ.

* * *

Caracterización de comportamiento spectrofotométrico y medida de color-en-solución de azucares comerciales. Parte II. S. K. D. AGARWAL y D. S. MISRA. *Pág.* 235–238

Estudios en la región visible demostraron que la aparición y situación del pico de absorción observado previamente acerca de 420 nm se mueve entre 410 y 460 nm como función de la concentración de material colorante, y que una divergencía amplia existió entre las observaciones y las provisiones del ley de Beer tanto como calculación de la concentración de azúcar sobre el base del indice de color no es posible.

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Notes & Comments

World sugar production estimates, 1971/72

F. O. Licht K.G. have recently published their third estimate of world sugar production[1] and, as might be expected, the European beet sugar figures are almost all the same as their previous assessments of mid-March. The exception is the USSR and the 500,000-ton reduction in the Soviet crop to 8,400,000 is responsible for nearly all the 518,000 tons difference for Europe. The new Soviet figure, incidentally, represents a fall of over a million tons from the 9,500,000 tons crop of 1970/71.

Total production of sugar has been set by Licht at 72,439,391 tons, about 1½ million tons below the earlier estimate and slightly below the figure for 1970/71 which was itself below the crop of 1969/70. The Cuban figure is reduced to 4,000,000 tons while Indian output, although the third largest among the cane sugar producers, is set at 3,440,000 tons and represents a considerable fall from the levels of the previous two crops.

* * *

World raw sugar prices

At the beginning of July the London Terminal price for raw sugar declined to £58 per ton, its lowest point during the year. It has subsequently recovered slightly but the "prevailing price", as specified in the International Sugar Agreement, reached the point of 6·50 cents/lb in its decline on the 7th July (when the ISA daily price was 5·173 cents/lb). The price had been subject to fluctuation and uncertainty owing to floating of the pound sterling, but there have been supplies of sugar available to meet all demands and values have tended to weaken, although a good price obtained for a Brazilian sale improved the market.

With the fall of the "prevailing price" below 6·50 cents, importing members of the ISA are no longer able to call on their traditional suppliers to deliver sugar within the supply commitment arrangements of the agreement. Should values continue to fall, however, the ISO Executive Committee do not take action until the prevailing price reaches 5·25 cents/lb, while from that value to 5·00 cents the Committee may, if they so decide, set quotas at such a level as will meet the situation. Below 5·00 cents/lb, quotas must not exceed 115% of basic export tonnages unless the Committee believe higher levels are warranted.

This year, however, C. Czarnikow Ltd.[2] point out, "whatever notional export limits might be imposed by the operation of quotas, exporters will, in any case, have had so long a period during which no limitations have been put on their sales that it seems most unlikely that there will be any which find themselves unable to export sugar by reason of the operation of the Agreement. It will be recalled, of course, that, provided sales are made before the reimposition of quotas, exports effected within ninety days of the date of sale are exempt from quota restrictions".

* * *

Cane sugar industry for Texas

An allocation of 25,700 acres to be planted to sugar cane in the Lower Rio Grande Valley area of Texas was announced on the 11th May by the US Dept. of Agriculture[3]. The new area is the first to be designated in nearly half a century. The Rio Grande Valley Sugar Growers Inc., a cooperative, have 2500 acres in cane which they expect to provide seed cane for a full crop for processing, which is scheduled to commence in November 1973[4]. With an estimated yield of 42 tons of cane per acre and a recovery of 10·5%, the 25,700 acres should yield 113,000 tons of sugar. The allocation will thus provide the acreage required to yield a quota of not more than 100,000 short tons, raw value, of sugar and provide a normal carryover inventory for a new cane sugar producing area as authorized in the 1971 amendments to the Sugar Act.

The engineering contract, including process design and detailed engineering, was granted to F. C. Schaffer & Associates Inc., of Baton Rouge, La., who performed the feasibility study in 1969. Full procurement and erection of the plant and facilities will be completed by Lurgi-Knost Inc., an international industrial contractor with headquarters in Baton

[1] *International Sugar Rpt.*, 1972, **104**, (16), 1–4.
[2] *Sugar Review*, 1972, (1082), 117.
[3] *Lamborn*, 1972, **50**, 87.
[4] See also *I.S.J.*, 1972, **74**, 95.

Rouge, which is 51% owned by the Lurgi company of Frankfurt, Germany. The plant is to incorporate the most modern facilities, will be located ten miles north-west of Harlingen, Texas, and will operate for 4½ months per crop at a design capacity of 7500 tons of cane per day (with provision for expansion to 10,000 t.c.d.); it will include raw sugar processing facilities, steam and electric power generation, sugar and molasses storage and handling equipment. The plant will cost approximately $22,000,000 and was due to start construction in June 1972 with completion in November 1973.

* * *

UK Sugar Board

In view of further falls in the level of the world price of raw sugar on the London Market, the distribution payment made by the Sugar Board was reduced from £8 to £4 per ton with effect from the 30th June 1972.

* * *

USSR beet sugar expansion[1]

The USSR has announced a programme designed to boost sugar production over the next three years, Reuter reported from Moscow on the 30th June. The aim is to increase the sugar production target for the current five-year plan, ending in 1975, but no specific details have been given. The resolution of the Communist Party Central Committee and the Council of Ministers calls for more tractors, more machinery and fertilizers, a better organization of seed supply and a speeded-up building programme for sugar processing plants.

The announcement was made during the visit to Moscow of the Cuban Prime Minister, Dr. FIDEL CASTRO. The USSR is keen to expand home production because of the uncertainty of Cuban supplies and in order to re-export sugar for hard currency. The announcement follows a disappointing sugar harvest in 1971 and a shortfall in planned deliveries from Cuba, the Soviet Union's biggest supplier.

* * *

Cuban crop, 1971/72[2]

President DORTICOS told a sugar industry trade union meeting in Havana in early July that the recently-finished 1971/72 harvest was "bad" and former sugar commitments to other socialist countries could not be met, although reduced commitments would be honoured. No figures have been published this year by Cuba but the Chairman of the Japan Sugar Refiners' Association who recently visited the island guessed that production would amount to nearly four million tons, an estimate in line with that of F. O. Licht K.G. and a number of other statisticians and observers. This would be a little above the 3·8 million tons of 1963, which has been the lowest figure since the Cuban revolution.

Meanwhile the plan of spring cane plantings had nearly been completed in June with only 12,000 hectares of a total of 180,000 ha remaining to be sown. President DORTICOS said that the next harvest will start in October and that there will be an abundance of cane. It is to be Cuba's strategy from now on to produce steadily good harvests rather than one great harvest.

* * *

The UK, the EEC and sugar supplies.

During the debate on legislation necessary for the entry of the UK into the EEC, as affecting sugar, the Minister of Agriculture, Fisheries and Food reaffirmed that the Government was committed to ensuring that arrangements to be made by the Community after 1974 will meet in full the assurances given to the developing members of the Commonwealth Sugar Agreement. He also referred to Australian supplies to the enlarged Community after 1974 and mentioned that Protocol No. 16 of the European Communities Bill specifically covers the possibility of disruptions to world trade such as would occur if Australia were to be abruptly excluded from the UK market after many years of a large guaranteed market; this would place a strain on the International Sugar Agreement.

Mr. PRIOR pointed out that, in the British Government's view, this measure clearly applied to Australia and that clearly action should be taken under the protocol to phase-out Australia's supplies to Great Britain after 1974.

* * *

ICUMSA 16th session

By kind invitation of Mr. O. BOZOK, Chairman of the Turkish National Committee of ICUMSA, and Türkiye Seker Fabrikalari A.S., the 16th Session of ICUMSA (International Commission for Uniform Methods of Sugar Analysis) will be held in Turkey in 1974. The meeting will begin on Monday 3rd June and finish on the 8th June. Further details including information on possible visits to places of historic interest will be announced in this Journal or may be obtained from the General Secretary of ICUMSA, P.O. Box 35, Wharf Road, Peterborough, PE2 9PU England.

Sierra Leone sugar imports, 1971[3].—In 1971 sugar imports into Sierra Leone totalled 23,177 long tons, tel quel, compared with 28,475 tons in 1970. Principal suppliers were France (4818 tons), the USSR (4447 tons), Belgium (3980 tons), the UK (2725 tons) and East Germany (2254 tons).

* * *

Colombia sugar expansion[4].—According to a US Dept. of Agriculture report, sugar production in Colombia is to be increased to a record level of 840,000 metric tons in 1972/73. This will permit a 37% increase in sugar exports to 250,000 tons; in 1971/72 exports included 49,442 tons to the United States and 132,470 tons to the world market. Further expansion of sugar production is expected in the coming years.

[1] *Public Ledger*, 1st July 1972.
[2] *Public Ledger*, 24th June, 8th July 1972; C. Czarnikow Ltd., *Sugar Review*, 1972, (1082), 118.
[3] C. Czarnikow Ltd., *Sugar Review*, 1972, (1066), 47.
[4] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (14), 8.

The evolution of a new-look South African raw sugar

By J. B. ALEXANDER
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Paper presented to the 14th Congress, I.S.S.C.T., 1971

Introduction

THE position in which polarization is the sole factor taken into account when raw sugar is priced is slowly, but surely, changing. The raw sugar producer no longer finds it prudent merely to ship the maximum weight of raw sugar he is able to separate from molasses. The sugar delivered to the refiner should be tailored as far as possible to the customer's requirements.

It is not necessary to have to visit a great number of refineries to realise that each has its own particular requirements in respect of raw sugar. These requirements are often difficult to evaluate and may relate to any of the following: (a) customs duties and taxes; (b) sugar receiving and handling equipment; (c) prevailing weather conditions; (d) type and capacity of raw sugar storage; (e) type of refining process and equipment available; (f) types of products manufactured by the refinery; and (g) beliefs of the purchaser or users of the raw sugar.

It is my intention to consider the general requirements of refiners and groups of refiners in conjunction with the steps which have been taken in South Africa to meet these requirements. An indication of the success achieved is given by a comparison of the properties of sugar previously produced with those of the new type South African sugar.

Steps taken to improve crystal quality

Raw sugar properties have been conveniently divided into those of the crystal (affined) sugar and the whole sugar (crystal plus syrup film surrounding the crystal). As the crystal accounts for the major portion of raw sugars, it is not surprising that most attention was previously focused on finding ways and means of improving crystal quality. The partial remelt system[1] has found increasing use in the production of raw sugar in South African factories. The fundamentals of this boiling scheme are: (a) the double curing and remelting of all *C*-sugar; (b) the use of *B*-sugar to make magma for footings of all *A*-massecuites; and (c) return of *C*-sugar and excess magma remeltings for up-grading syrup.

The main advantages of the remelt system in respect of raw sugar are: (1) the production of a standard product consisting of large *A*-sugar crystals only; and (2) the double curing and remelting of the lowest purity sugars ensures that a large percentage of the impurities associated with *B*- and *C*-sugars is kept out of circulation and that the improved purity of *A*-massecuite results in fewer impurities in *A*-sugar crystals.

The chief disadvantages of the partial remelt system were found to be: (1) It produced *A*-massecuites containing larger crystals in lower viscosity mother liquor; as a result small variations in the massecuite, brought about during boiling, were found to have an unusually large effect on purging characteristics; this was especially noticeable when producing low polarizing sugars and caused difficulties in controlling polarization and safety factor. (2) Although there was a noticeable reduction in starch content of the sugars produced by the partial remelt system, the level was still considerably above that of sugars from many other countries; refiners still experienced difficulty in their filter stations when processing this sugar.

Coating sugar with final molasses

In order to overcome the difficulty of producing an *A*-sugar of constant polarization (approximately 97·7°) and safety factor, it was decided to cure and steam-wash the crystal from *A*-massecuites virtually free of all mother liquor and, after drying, to recoat the crystal with final molasses to the desired polarization. This was achieved by blending the washed *A*-sugar with a controlled amount of final molasses, using a scroll conveyor with an angle of incline of about 20°. The use of final molasses and not *A*- or B-molasses was dictated by the requirement that the safety factor be less than 0·25. The ratio of water to pol-reducing activity of other liquors in a normal raw sugar factory was found to be too high and the use of dryers on low pol sugar was found to be fraught with difficulties.

The position was reached where a large-grained sugar with satisfactory crystal purity and safety factor was being produced. The problem of starch, however, remained, and this was soon to be joined to other problems new to the South African sugar technologist. Although low pol sugars gave no handling difficulties in South Africa, when they arrived at their destination, considerable difficulties were experienced on many occasions in discharging ships or handling the sugar in and out of storage. The handling difficulties became acute in cold dry weather, and although the situation was alleviated by increasing the safety factor to a value of about 0·28 (in South Africa), this did not solve the problem of stickiness in low pol sugars.

Increase in colour of raw sugar on storage made itself felt in 1968 when a large tonnage of low pol sugar had to be held in the Durban sugar terminal for up to a year before export. It was found that some sugar had more than doubled in colour owing to deterioration taking place in the surface film surrounding the sugar crystal. There were also indications of

[1] VAN HENGEL: *S. African Sugar J.*, 1962, **46**, 587–595.

an abnormal fall in polarization which could not be attributed to the action of micro-organisms, as the safety factor of the sugar was within the prescribed limit and there was no significant increase in reducing sugars.

Starch removal

Although initial tests[2] using a centrifuge to remove starch from mixed juice at Umzimkulu appeared promising, later tests carried out by the Sugar Milling Research Institute at Melville with a machine specially designed to minimize sand erosion within the bowl were disappointing. Only at low throughputs was starch removal from the mixed juice really effective.

The use of malt enzymes by BOYES[3] at Tongaat was found to be uneconomical. A number of factories have used the natural enzyme process based on the findings of NICHOLSON and HORSLEY[4] both on its own and in conjunction with other starch removal processes. The main disadvantage of the natural enzyme process has been found to be the varying amounts of starch and sucrose-hydrolysing enzymes present in mixed juice. On occasion this makes it virtually impossible to achieve the adequate removal of starch in a controlled manner without appreciable losses of sucrose through inversion by invertase naturally present in the juice.

Vacuum clarification based on the RABE process[5,6,7] was introduced at a number of Natal factories in the late 1960's and was responsible for the production of a considerable tonnage of raw sugar of low starch content. Control of the vacuum flotation was found in practice to be sensitive to variation in both juice flow and juice quality. These difficulties, coupled with the high cost of chemicals required, led to the abandonment of the RABE process for starch removal in South Africa.

In 1926 HADDON[8] used a heat-stable enzyme for reducing the starch content of juices from the cane variety Uba. Although the exact course of the enzyme, which he named Ubase, is not certain, the description of conditions given in his patent[9] makes it clear that this was the first use of a bacterial enzyme for the reduction of starch in sugar cane juices. With the advent of commercial bacterial amylases at competitive prices, their use in the sugar industry received considerable study. Some of the findings were reported by BRUIJN and JENNINGS[10] and by SMITH[11]. Most factories in South Africa now make use of bacterial enzymes during raw sugar production, and the most popular point of application is between the last two vessels of the evaporator. Because the enzymes used are virtually invertase-free the method used has the advantage of efficient enzyme utilization without any associated sucrose loss.

Improvements in coating material

Having produced a sugar with a crystal of high purity, low starch content, and good grain size, it remained only to change the characteristics of the sugar coating material in order to eliminate difficulties of colour formation, poor handling, and low refinery yield associated with the high ash % non-sucrose of the molasses coating. Customs' requirements in most countries importing raw sugar stipulate a maximum polarization. It follows that the raw sugar producer should attempt to produce a sugar with the minimum required amount of pol-reducing impurities, which should, however, also be those most desired by the refiner. This would mean replacing objectionable impurities such as ash, colour, and gums, with others less melassigenic, less troublesome in process and—if possible—having an enhancing value in respect of refinery products or by-products. The impurity chosen to fit this rôle was reducing sugar, and it was decided to use high-test molasses in place of final molasses as a coating material. High-test molasses is produced by hydrolysing approximately 60% of the sucrose in raw syrup and concentrating to 82% solids (Table I). This unique method of manufacturing raw sugar has been patented.

Table I. Typical analysis of sugar components

	Very high pol sugar	*Final molasses*	*High-test molasses*
Polarization (S°)	99·5	35·0	8·0
Moisture (%)	0·10	18·5	18·0
Sulphated ash (%)	0·12	15·0	2·8
Reducing sugar (%)	0·09	14·5	55·0
Starch (mg/kg)	100	1500	1500
Gums (mg/kg)	800	28000	8000
Colour (a_c^*, 560 nm)	0·20	30	5·0

The most convenient means of demonstrating the effect of coating a very high pol sugar with high-test molasses instead of final molasses is to consider typical examples as in Tables II and III, where the same basic (VHP) sugar has been coated to equivalent polarizations with both final molasses and high-test molasses. The results of replacing final molasses with high-test molasses as a coating material are as follows: (1) the amount of coating material is reduced by approximately 30%, thus ensuring that 0·36 and 0·85% more VHP sugar (i.e. crystal) is included in the final coated sugar for high and low pol sugars, respectively; (2) the amount of water included in the sugar is reduced by more than 20%; (3) the sulphated ash content of high pol sugar is reduced by 53% and that of low pol sugar by 68%; (4) the reducing sugar content of coated sugars is increased by some 200–300%; (5) the content of gums in the sugars is reduced by 24 and 40% for high and low pol sugars, respectively; (6) the colour contained in the total sugar shows a marked reduction to 42 and 29% of the value of molasses-coated sugar for high and low pol sugars, respectively; (7) although the safety factors show an improvement, in line with the reduction of sugar moisture, this is of doubtful significance and illustrates

[2] ALEXANDER: *ibid.*, 1958, **42**, 579–583.
[3] *Proc. 32nd Congr. S. African Sugar Tech. Assoc.*, 1958, 37–43.
[4] *I.S.J.*, 1958, **60**, 260–263.
[5] ANON: *S. African Sugar J.*, 1966, **50**, 628–633.
[6] RABE: *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 42–45.
[7] ARCHIBALD: *Proc. 42nd Congr. S. African Sugar Tech. Assoc.*, 1968, 39–44.
[8] *S. African Sugar J.*, 1920, **10**, 629–631.
[9] HADDON: South African Patent No. 1176/27, (1927).
[10] *Proc. 42nd Congr. S. African Sugar Tech. Assoc.*, 1968, 45–52.
[11] *Proc. 44th Congr. S. African Sugar Tech. Assoc.*, 1970, 88–93.

the unreliable nature of safety factor in measuring the concentration of the crystal coating of a raw sugar; and (8) rendement, the figure accepted by many refiners as giving an indication of the recoverable refined sugar, shows significant improvements of 0·4 and 1·0% for low and high pol sugar, respectively.

Other characteristics of high-test coated sugar as opposed to those coated with final molasses which are not illustrated in Tables II and III are: (a) the humectant effect of the increased reducing sugar content reduces the stickiness problem and tendency to cake; (b) affination is easier owing to the reduced viscosity and the reduced quantity of the film coating; and (c) a reduced amount of refinery molasses is produced with a high reducing sugar:ash ratio and low colour.

Table II. Comparison of high pol sugars (98·7°) produced by coating with final molasses and high-test molasses

	1.24% *final molasses*			0·88% *high-test molasses*			
	VHP sugar contribution	*Molasses contribution*	*Total sugar (A)*	*VHP sugar contribution*	*HT molasses contribution*	*Total sugar (B)*	*B — A (%)*
Polarization (S°)	98·27	0·43	98·70	98·62	0·07	98·69	100
Moisture (%)	0·10	0·23	0·33	0·10	0·16	0·26	78
Sulphated ash (%)	0·12	0·19	0·31	0·12	0·02	0·14	47
Reducing sugars (%)	0·09	0·18	0·27	0·09	0·48	0·57	210
Starch (mg/kg)	99	19	117	99	13	112	96
Gums (mg/kg)	790	350	1140	790	70	860	76
Colour (a_c^* 560 nm)	0·20	0·37	0·57	0·20	0·04	0·24	42
Safety Factor			0·25			0·20	80
Rendement (pol–4·5 ash–r.s.)			97·06			97·47	100·4

Table III. Comparison of low pol sugars (97·7°) produced by coating with final molasses and high-test molasses

	2·79% *final molasses*			1·96% *high-test molasses*			
	VHP sugar contribution	*Molasses contribution*	*Total sugar (C)*	*VHP sugar contribution*	*HT molasses contribution*	*Total sugar (D)*	*D — C (%)*
Polarization (S°)	96·72	0·98	97·70	97·55	0·16	97·71	100
Moisture (%)	0·10	0·52	0·62	0·10	0·35	0·45	74
Sulphated Ash (%	0·12	0·42	0·54	0·12	0·05	0·17	32
Reducing sugars (%	0·09	0·40	0·49	0·09	1·08	1·17	290
Starch (mg/kg)	97	42	139	98	29	127	91
Gums (mg/kg)	780	780	1560	780	160	940	60
Colour (a_c^* 560 nm)	0·19	0·84	1·03	0·20	0·10	0·30	29
Safety factor			0·27			0·20	74
Rendement (pol–4·5 ash–r.s.)			94·80			95·76	101·0

Table IV. Comparison of export raw sugar made by described techniques and some previously produced high pol sugars

	Ave. of 3 latest shipments (1970)	*Ave.* 1957–1958 *season production*
Polarization (S°)	98·69	98·41
Moisture (%)	0·25	0·51
Safety factor	0·19	0·30
Reducing sugars (%)	0·61	0·32
Sulphated ash (%)	0·14	0·40
Reducing sugar:ash ratio	4·4	0·80
Rendement	97·45	96·29
Specific grain size (mm)	0·69	0·58
Gums (mg/kg)	600	—
Starch (mg/kg)	120	450
Filtrability (% C.S.R.)	54	24
Colour (a_s^*, 560 nm)	0·08	0·24

Table V. Comparison of export raw sugar made by described techniques and some previously produced low pol sugars.

	Ave. of 4 latest shipments (1970)	*Ave.* 1962–1963 *season production*
Polarization (S°)	97·69	97·25
Moisture (%)	0·46	0·59
Safety factor	0·20	0·22
Reducing sugars (%)	1·16	0·81
Sulphated ash (%)	0·19	0·60
Reducing sugar:ash ratio	6·1	1·35
Suspended matter (%)	0·015	0·027
Rendement	95·68	93·74
Specific grain size (mm)	0·69	0·79
Gums (mg/kg)	670	1060
Starch (mg/kg)	120	250
Filtrability (% CSR)	56	41

Centralized coating

The decision to coat all very high pol sugar at the Durban sugar terminal instead of at individual mills was made just before the change to coating with high-test molasses. The main advantages of coating at a central point just prior to loading raw sugar for shipment are: reduction in deterioration during storage (particularly in respect of colour), less variation in the quality of the coated product, and the economic benefits of handling a single type of sugar in storage. The versatility which the whole system gives to export sales is, of course, also in important consideration.

Practical disadvantages are a dust problem with some VHP sugars and a greater tendency for uncoated VHP sugars to cake in storage. To these must be added the capital cost of additional equipment required, together with the cost of both high-test molasses and the additional crystal contained in the coated sugar.

Summary

The paper describes steps which have been taken to improve and standardize the quality of raw sugars in South Africa and yet to allow the export of both

low and high polarizing sugars from the same storage and supply point. The main contributors to the improvement of quality discussed in this paper are: (1) the partial remelt system; (2) the process of recoating high purity *A*-sugars with final molasses to the desired pol; (3) the reduction of starch in sugars by use of bacterial enzymes added to the raw syrup; and (4) the production and storage of very high pol sugars which are coated with high-test molasses to the desired polarization immediately before being loaded for export from a central storage point. Details of the improvements in sugar quality achieved by using high-test molasses instead of final molasses as a coating are given. Also included are analyses of the most recent sugar shipments made using this improved technique compared with some previous sugars.

Sucrose solubility data treated by a digital computer procedure

By L. BIASINI, C. A. ACCORSI and G. MANTOVANI*

THE variation of the solubility of sucrose as a function of the amount of non-sucrose present in solution has been the subject of much study. WAGNEROWSKI *et al.*[1], working with the data obtained by WIKLUND[2], expressed the saturation coefficient *C*, i.e. the ratio of sucrose solubilities in the pure and impure solutions, both in terms of sucrose:water ratios, in a linear relationship with the non-sucrose: water ratio *A*, viz.

$$C = mA + b \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

This is illustrated as the broken line in Fig. 1.

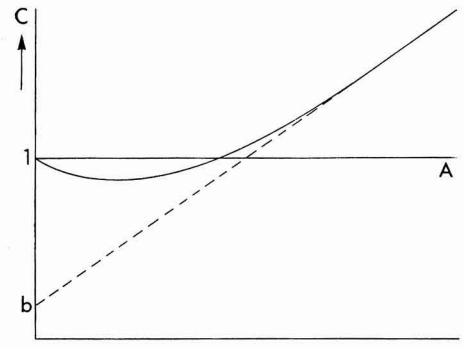

Fig. 1

However, in less impure solutions, this linear relationship is not valid and the locus of the relationship describes a curve returning to the level of $C = 1$ when $A = 0$, as is shown by the solid line in Fig. 1. The difference between the solid and broken lines has a value of $(1 - b)$ at $A = 0$ and diminishes rapidly as *A* increases (Fig. 2). VAVRINECZ[3] evaluated this difference as an exponential term, so producing a corrected equation

$$C = mA + b + (1 - b)e^{-cA} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

This type of equation may be applied independently of the value of *A* both to technical solutions, as may be deduced from the data of SCHNEIDER, EMMERICH and KIATSRICHART[4] and VAVRINECZ, ACCORSI and MANTOVANI[5], and to synthetically prepared solutions[6].

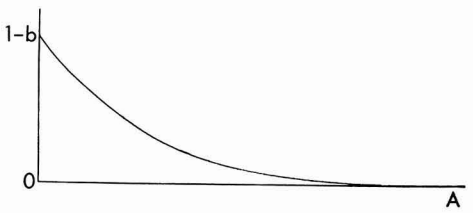

Fig. 2

The equation has three parameters (*m*, *b* and *c*) and VAVRINECZ devised a method for their calculation. A number of measurements of *C* are made at relatively low purity, corresponding to the straight section of the graph. These are plotted and the line extended to the ordinate where $A = 0$; *m* may be calculated from the slope of the line and *b* from the value of the ordinate at the intercept. From these, values of $(mA + b)$ may be calculated for low values of *A* and the differences obtained between these calculated values and measured values of *C* for the same purities. From equation (2), the difference $D = C - (mA + b) = (1 - b)e^{-cA}$ so that, knowing *D*, *b* and *A*, we may calculate *c*.

* The authors are, respectively, Director of the Calculation Laboratory of the Mathematical Institute, Assistant of the Chemical Institute, and Director of the Serafino Cevasco Sugar School, University of Ferrara, Italy.

[1] *Gaz. Cukr.*, 1961, **63**, 262; *Zeitsch. Zuckerind.*, 1962, **87**, 664.
[2] *Socker Handl.* II, 1946, 65.
[3] *Zeitsch. Zuckerind.*, 1965, **90**, 70.
[4] *Proc. 14th Gen. Assembly C.I.T.S.*, 1971, 467–486.
[5] *Zeitsch. Zuckerind.*, 1971, **96**, 380.
[6] SCHUKOV: *Zeitsch. Zuckerind.*, 1900, **50**, 291; RAO and GUPTA: *J. Ind. Chem. Soc.*, 1940, **3**, 49; WISE and NICHOLSON: *I.S.J.*, 1956, **58**, 329; KELLY: "Principles of Sugar Technology", Vol. II. Ed. P. HONIG (Elsevier, Amsterdam) 1959, p. 67; MANTOVANI and FAGIOLI: *Gaz. Cukr.*, 1964, **72**, 278.

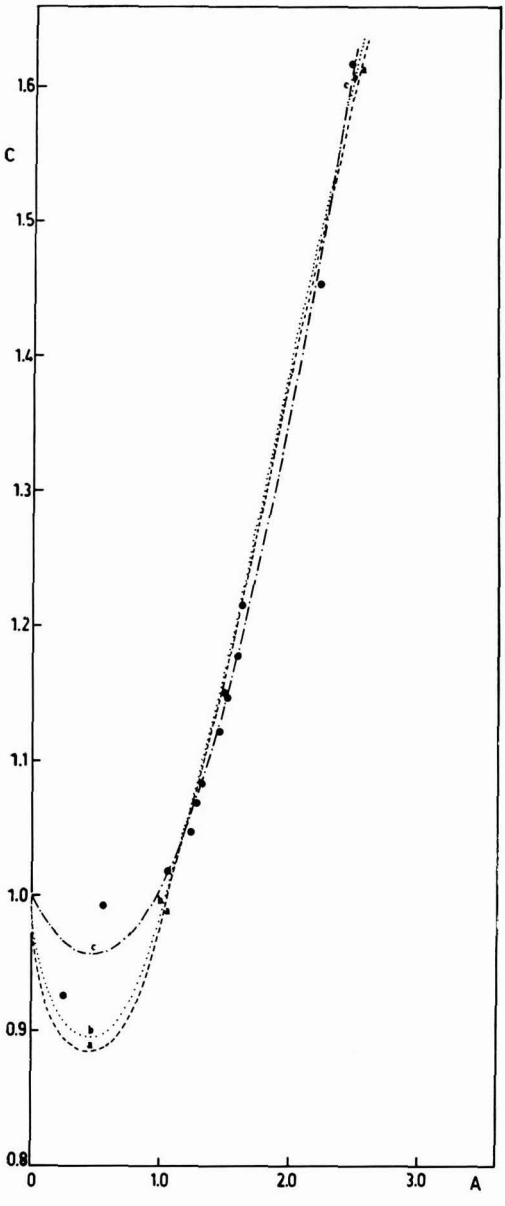

Fig. 3. Relative closeness to experimental data of the calculated figures obtained using different parameters.

Experimental data related to Tables 1 and 2:
(a) calculated by $m = 0{\cdot}452$, $b = 0{\cdot}475$, $c = 2{\cdot}13$ (after VAVRINECZ)
(b) calculated by $m = 0{\cdot}4779$, $b = 0{\cdot}4244$, $c = 1{\cdot}846$ (systematic investigation)
(c) calculated by $m = 1{\cdot}441$, $b = -5{\cdot}015$, $c = 0{\cdot}272$ (systematic investigation)

The parameters of equation (2) are very interesting because they are connected with modifications to the structure of the aqueous sucrose solutions caused by the presence of other constituents[7,8]. Consequently, their calculation from experimental data is very important. We agree that, as a first approximation, the method proposed by VAVRINECZ may be adopted and, in any particular case, can be very satisfactory if used by someone who understands well the phenomena studied.

However, we have attempted to obtain further results on a basis of treatment of the experimental data in the following manner:

(*a*) by adopting a systematic procedure for evaluating the parameters m and b as a first step; this is to say, by seeking the most suitable range where the curve may be approximated to a straight line;

(*b*) by setting up a digital computer programme for the systematic analysis of a range of variation of the parameters, knowing some approximate initial values. This procedure minimizes the quantity

$$Q\,(m,b,c_{m,b}) = \sum_{i=1}^{N} \left\{ C_i - [mA_i + b + (1-b)e^{-cA_i}] \right\}^2 \quad \ldots\ldots(3)$$

which is a function of the three variables m, b and c. In this case, other methods of the iterative type[9], alternative to the systematic analysis of the parameters, are appreciably less economical. In this way, we can determine, by means of a non-linear regression, the value $c_{m,b}$ which corresponds to each of the values assumed by the pair m and b. The initial values of the parameters m and b can be obtained *a priori* by an exploratory study, for instance by the initial steps of the VAVRINECZ method[3]; the final values chosen for m, b and c will be those which minimize the quantity Q.

(*c*) by investigating the reliability of available results with the aim of establishing the limits resulting from the adoption of an equation such as equation(2).

We have applied the procedure of systematic analysis to measurements of sucrose solubility in molasses with constant proportions of cationic equivalents but with different compositions in respect of the percentages of the cations K^+, Na^+, Mg^{++} and Ca^{++}. Variation in the relative proportions was obtained by the use of ion exchange, following experimental techniques described elsewhere[5,10].

Examination of the experimental data has allowed us to make the following observations:

(1) In general there is an appreciable improvement from the initial values of the parameters; not only do they change remarkably but also the sum of the squares of the differences decreases considerably.

[7] MANTOVANI and INDELLI: *I.S.J.*, 1966, **68**, 104.
[8] SCHNEIDER *et al.*: *Zucker*, 1963, **16**, 465; SCHNEIDER: *Ind. Sacc. Ital.*, 1964, **57**, 225.
[9] MALINVAUD: "Statistical Methods of Econometrics" (North Holland, Amsterdam) 1970.
[10] PIECK, HOUSSIAU and VANDEWIJER: *Proc. 13th Gen. Assembly C.I.T.S.*, 1967, 191.

From Tables I and II it will be seen that the initial values $m = 0{\cdot}452$, $b = 0{\cdot}475$, $c = 2{\cdot}13$, giving a Q value of 0·0184, after examination by the computer technique, are modified first to $m = 0{\cdot}478$, $b = 0{\cdot}424$, $c = 1{\cdot}85$ giving a Q value of 0·0169 and by further elaboration to $m = 1{\cdot}441$, $b = -5{\cdot}015$, $c = 0{\cdot}272$, giving a Q value of 0·0044. This behaviour is illustrated in Fig. 3.

Table I. Elaboration of experimental data of Vavrinecz *et al.*[5] concerning sucrose solubility tests at 40°C in molasses with cationic composition: K = 98·10%; Na = 0·23%; Ca = 1·37%; Mg = 0·30%. Calculation of the average quadratic deviation for the parameters m, b, c obtained through the direct procedure[3].

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}452$, $b = 0{\cdot}475$, $c = 2{\cdot}13$
0·25	0·9260	0·8954
0·55	0·9930	0·8861
1·05	1·0190	1·0057
1·19	1·0510	1·0545
1·22	1·0440	1·0655
1·28	1·0690	1·0879
1·29	1·0830	1·0917
1·45	1·1210	1·1543
1·48	1·1510	1·1664
1·49	1·1470	1·1705
1·59	1·1770	1·2114
1·62	1·2150	1·2239
2·22	1·4530	1·4813
2·45	1·6180	1·5861

Average quadratic difference between experimental and calculated data, $Q = 0{\cdot}01843$

Table II. Elaboration of the experimental data quoted in Table I according to the systematic investigation procedure.

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}47796$, $b = 0{\cdot}42440$, $c = 1{\cdot}846$	$C_{exper.} - C_{calculated}$
0·25	0·9260	0·9060	0·02004
0·55	0·9930	0·8956	0·09736
1·05	1·0190	1·0091	0·00988
1·19	1·0510	1·0572	—0·00617
1·22	1·0440	1·0681	—0·02406
1·28	1·0690	1·0904	—0·02139
1·29	1·0830	1·0942	—0·01118
1·45	1·1210	1·1570	—0·03605
1·48	1·1510	1·1693	—0·01825
1·49	1·1470	1·1733	—0·02635
1·59	1·1770	1·2149	—0·03794
1·62	1·2150	1·2276	—0·01263
2·22	1·4530	1·4932	—0·04020
2·45	1·6180	1·6026	0·01540

Average $Q = 0{\cdot}016917$

Table III. Elaboration of experimental data of Vavrinecz *et al.*[5] concerning sucrose solubility tests at 40°C in molasses with cationic composition: Ca = 79·38%; K = 20·09%; Na = 0·48%; Mg = 0·05%. Calculation of the average quadratic deviation for the parameters m, b, c obtained through the direct procedure[3].

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}247$, $b = 0{\cdot}480$, $c = 1{\cdot}33$
0·44	0·9050	0·8789
0·65	0·8940	0·8597
0·79	0·8700	0·8570
1·01	0·8710	0·8649
1·37	0·8770	0·9023
1·87	0·9410	0·9853
2·74	1·1560	1·1708

Average $Q = 0{\cdot}00489$

(2) We may judge the reliability and accuracy of the results obtained since large variations in the parameters may result in only small variations in the sum of the squares of the differences; when this occurs reliability is poor. Tables III and IV indicate this; while the Q value changes from 0·0489 to 0·0484 the parameters change from $m = 0{\cdot}247$, $b = 0{\cdot}480$, $c = 1{\cdot}33$ to $m = 0{\cdot}208$, $b = 0{\cdot}576$, $c = 1{\cdot}55$.

Table IV. Elaboration of the experimental data quoted in Table III according to the systematic investigation procedure.

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}20805$, $b = 0{\cdot}57649$, $c = 1{\cdot}553$	$C_{exper.} - C_{calculated}$
0·44	0·9050	0·8824	0·02261
0·65	0·8940	0·8661	0·02790
0·79	0·8700	0·8651	0·00495
1·01	0·8710	0·8746	—0·00359
1·37	0·8770	0·9118	—0·03484
1·87	0·9410	0·9889	—0·04792
2·74	1·1560	1·1529	0·00305

Average $Q = 0{\cdot}004838$

(3) The speed of the computer treatment and the convenience of utilization of the data allow us to make calculations easily in any series of tests. Tables V, VI, VII and VIII show the results of computer calculations for molasses with increasing amounts of Mg and decreasing amounts of K and Na at 50°,

Table V. Elaboration of the experimental data of Pieck *et al.*[10] concerning sucrose solubility tests in molasses with cationic composition: K = 81·2%; Na = 14·3%; Ca = 4·5%; Mg = 0%.

$t = 50°C$

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}30934$; $b = 0{\cdot}68360$; $c = 1{\cdot}47$	$C_{exper.} - C_{calculated}$
0·00	1·0000	1·0000	0·00000
0·14	0·9962	0·9845	0·01166
0·27	0·9809	0·9800	0·00090
0·52	1·0000	0·9920	0·00805
0·80	1·0458	1·0289	0·01694
1·07	1·0802	1·0804	—0·00019
1·54	1·1756	1·1930	—0·01739
2·12	1·3206	1·3535	—0·03289
2·67	1·4924	1·5158	—0·02342
3·03	1·6412	1·6246	0·01660

Average $Q = 0{\cdot}002692$

$t = 60°C$

A	*C experimental*	*C calculated on a basis of* $m = 0{\cdot}33253$; $b = 0{\cdot}60783$; $c = 1{\cdot}161$	$C_{exper.} - C_{calculated}$
0·00	1·0000	1·0000	0·00000
0·13	0·9966	0·9883	0·00831
0·27	0·9897	0·9843	0·00544
0·50	1·0000	0·9936	0·00643
0·78	1·0377	1·0258	0·01193
1·04	1·0753	1·0709	0·00439
1·53	1·1712	1·1830	—0·01178
2·07	1·3322	1·3316	0·00057
2·66	1·4966	1·5102	—0·01363
3·14	1·6438	1·6622	—0·01841
3·66	1·8288	1·8305	—0·00168

Average $Q = 0{\cdot}000953$

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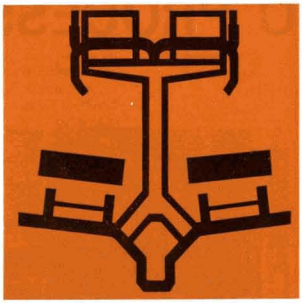

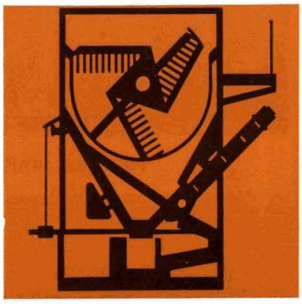

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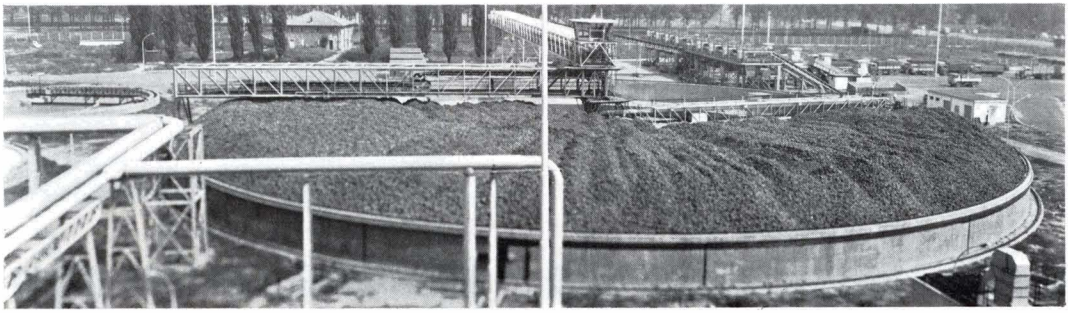

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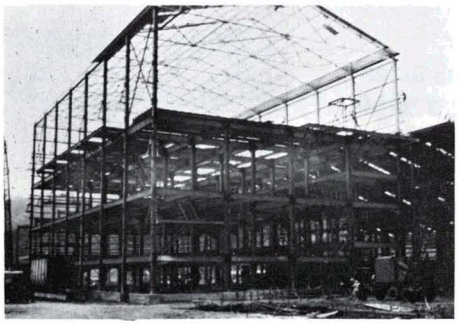

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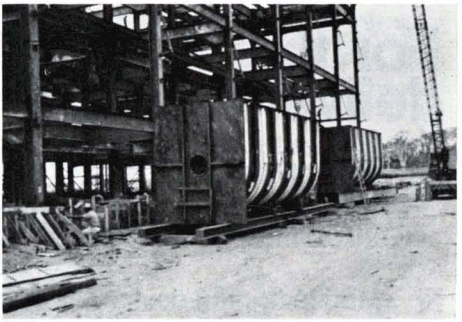

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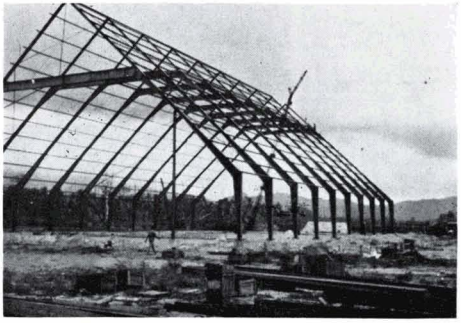

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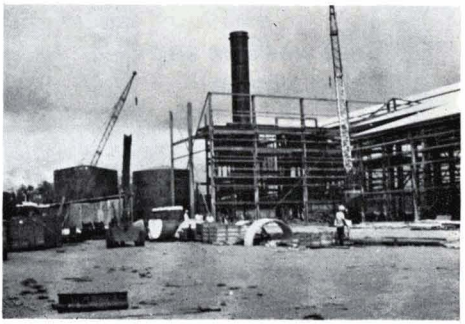

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$t = 70°C$		C calculated on a basis of $m = 0{\cdot}32783$; $b = 0{\cdot}56331$; $c = 1{\cdot}025$	
0·00	1·0000	1·0000	0·00000
0·27	0·9818	0·9829	—0·00114
0·52	1·0030	0·9901	0·01295
0·79	1·0364	1·0166	0·01979
1·04	1·0697	1·0546	0·01506
1·54	1·1727	1·1582	0·01445
2·11	1·2848	1·3053	—0·02045
2·60	1·4242	1·4461	—0·02186
2·66	1·4364	1·4639	—0·02751
3·09	1·5758	1·5947	—0·01889
3·48	1·7030	1·7165	—0·01348
4·05	1·8939	1·8979	—0·00398
4·95	2·1848	2·1888	—0·00399

Average $Q = 0{\cdot}003210$

60° and 70°C, respectively. Fig. 4 summarizes graphically the results obtained, emphasizing the influence of temperature on the saturation function, an influence often neglected by many authors.

Finally it is important to observe that, by means of the laborious treatment, we can emphasize very significant cases such as those shown in Figs. 5a, b and c, all concerned with the experimental data quoted in Table I but drawn for wide variations in the parameters m, b and c. We may see that large

Table VI. Elaboration of the experimental data quoted in Table V, with molasses of cationic composition: K = 40·3%; Na = 9·2%; Mg = 50·5%.

$t = 50°C$ A	C experimental	C calculated on a basis of $m = 0{\cdot}14028$; $b = 0{\cdot}71936$; $c = 1{\cdot}167$	$C_{exper.} - C_{calculated}$
0·13	0·9848	0·9787	0·00606
0·26	0·9733	0·9630	0·01027
0·55	0·9542	0·9442	0·00997
0·80	0·9466	0·9419	0·00468
1·06	0·9542	0·9495	0·00468
1·54	0·9733	0·9819	—0·00862
2·09	1·0305	1·0370	—0·00654
2·52	1·0687	1·0877	—0·01900
3·06	1·1603	1·1565	0·00378
3·36	1·1832	1·1963	—0·01307

Average $Q = 0{\cdot}000941$

$t = 60°C$		C calculated on a basis of $m = 0{\cdot}12666$; $b = 0{\cdot}77008$; $c = 1{\cdot}170$	
0·14	0·9897	0·9830	0·00670
0·27	0·9692	0·9719	—0·00272
0·56	0·9692	0·9604	0·00878
0·80	0·9692	0·9616	0·00762
1·07	0·9726	0·9714	0·00125
1·56	1·0034	1·0047	—0·00133
2·14	1·0514	1·0599	—0·00853
2·56	1·0959	1·1058	—0·00992
3·17	1·1678	1·1772	—0·00941
3·61	1·2295	1·2307	—0·00117

Average $Q = 0{\cdot}000446$

$t = 70°C$		C calculated on a basis of $m = 0{\cdot}10072$; $b = 0{\cdot}84693$; $c = 1{\cdot}634$	
0·14	0·9848	0·9828	0·00199
0·29	0·9758	0·9715	0·00435
0·56	0·9697	0·9647	0·00505
0·81	0·9727	0·9693	0·00343
1·08	0·9788	0·9822	—0·00342
1·60	1·0091	1·0193	—0·01020
2·10	1·0545	1·0634	—0·00890
2·55	1·1091	1·1061	0·00295
3·06	1·1545	1·1562	—0·00167
3·62	1·2121	1·2120	0·00014
4·12	1·2606	1·2621	—0·00149

Average $Q = 0{\cdot}000267$

Table VII. Elaboration of the experimental data as quoted in Tables V and VI with molasses of cationic composition: K = 19·1%; Na = 8·8%; Mg = 72·1%.

$t = 50°C$ A	C experimental	C calculated on a basis of $m = 0{\cdot}05657$; $b = 0{\cdot}78743$; $c = 1{\cdot}380$	$C_{exper.} - C_{calculated}$
0·13	0·9771	0·9724	0·00465
0·27	0·9618	0·9492	0·01264
0·53	0·9351	0·9197	0·01538
0·80	0·9008	0·9032	—0·00237
1·06	0·8969	0·8966	0·00027
1·59	0·8931	0·9011	—0·00798
2·11	0·8893	0·9184	—0·02906
2·58	0·9198	0·9394	—0·01963
3·00	0·9695	0·9605	0·00897
3·30	0·9771	0·9763	0·00075

Average $Q = 0{\cdot}001797$

$t = 60°C$		C calculated on a basis of $m = 0{\cdot}06594$; $b = 0{\cdot}75777$; $c = 1{\cdot}006$	
0·14	0·9795	0·9774	0·00209
0·28	0·9623	0·9590	0·00330
0·53	0·9486	0·9348	0·01376
0·81	0·9281	0·9184	0·00969
1·07	0·9144	0·9109	0·00352
1·58	0·9075	0·9114	—0·00388
2·11	0·9212	0·9259	—0·00471
2·59	0·9315	0·9465	—0·01496
3·18	0·9623	0·9774	—0·01506
3·95	1·0205	1·0228	—0·00231

Average $Q = 0{\cdot}000795$

$t = 70°C$		C calculated on a basis of $m = 0{\cdot}07540$; $b = 0{\cdot}74686$; $c = 0{\cdot}964$	
0·13	0·9758	0·9800	—0·00419
0·27	0·9545	0·9624	—0·00775
0·51	0·9455	0·9402	0·00535
0·82	0·9318	0·9235	0·00827
1·08	0·9242	0·9177	0·00652
1·56	0·9242	0·9208	0·00343
2·12	0·9454	0·9395	0·00588
2·60	0·9636	0·9636	0·00004
3·15	0·9727	0·9965	—0·02383
3·57	1·0030	1·0242	—0·02116
3·93	1·0303	1·0489	—0·01862
4·74	1·1212	1·1069	0·01430

Average $Q = 0{\cdot}001830$

Table VIII. Elaboration of the experimental data as quoted in Tables V, VI and VII with molasses of cationic composition: K = 4·8%; Na = 1·8%; Mg = 93·4%.

$t = 50°C$

A	*C experimental*	*C calculated on a basis of* $m = -0.02141$; $b = 0.84106$; $c = 1.419$	$C_{exper.} - C_{calculated}$
0·13	0·9656	0·9704	—0·00484
0·27	0·9542	0·9436	0·01057
0·53	0·9084	0·9046	0·00377
0·81	0·8855	0·8741	0·01143
1·05	0·8511	0·8544	—0·00330
1·59	0·8130	0·8237	—0·01067
2·05	0·7863	0·8058	—0·01955
2·61	0·7901	0·7891	0·00099

Average $Q = 0.000786$

$t = 60°C$

		C calculated on a basis of $m = -0.01731$; $b = 0.85998$; $c = 1.416$	
0·14	0·9692	0·9724	—0·00320
0·27	0·9555	0·9508	0·00465
0·56	0·9178	0·9137	0·00414
0·80	0·8973	0·8912	0·00605
1·06	0·8767	0·8725	0·01415
1·58	0·8322	0·8476	—0·01538
2·05	0·8253	0·8322	—0·00688
2·57	0·8151	0·8192	—0·00407

Average $Q = 0.000403$

$t = 70°C$

		C calculated on a basis of $m = 0.01201$; $b = 0.82666$; $c = 1.160$	
0·13	0·9636	0·9773	—0·01371
0·28	0·9455	0·9553	—0·00981
0·54	0·9364	0·9258	0·01058
0·82	0·9183	0·9035	0·01471
1·06	0·8909	0·8901	0·00080
1·63	0·8727	0·8724	0·00027
2·10	0·8636	0·8671	—0·00347
2·58	0·8515	0·8664	—0·01486
3·17	0·8424	0·8691	—0·02673
3·70	0·8879	0·8735	0·01441

Average $Q = 0.001768$

variations in the parameters cause only small variations in the curve and thus in the Q value which is to be minimized.

The application of such a refined calculation procedure to the cases examined above may seem to be excessive in view of the notable influence of the analytical technique on the experimental data, where the error is about 2%. However, the possibility of using more precise measurement techniques and the general accordance of sucrose solubility data for technical and synthetically prepared solutions with such an equation as (2) support the application of the best methods for solution of this problem.

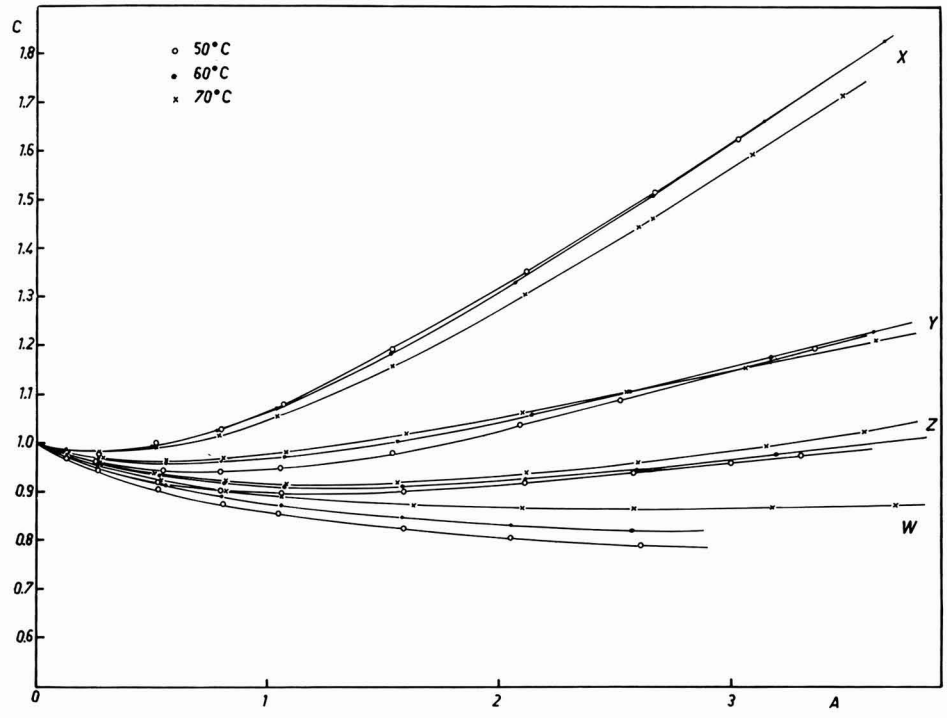

Fig. 4

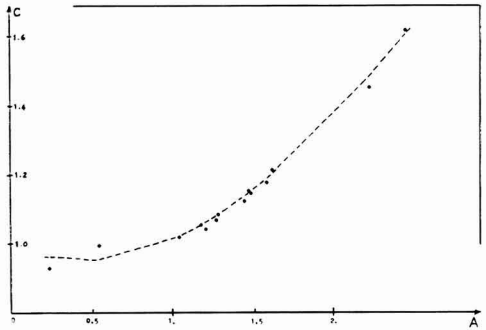

Fig. 5a. Curve drawn for equation (2) using parameters m = 0·907, b = —1·29, c = 0·5, calculated from the experimental data of Table I

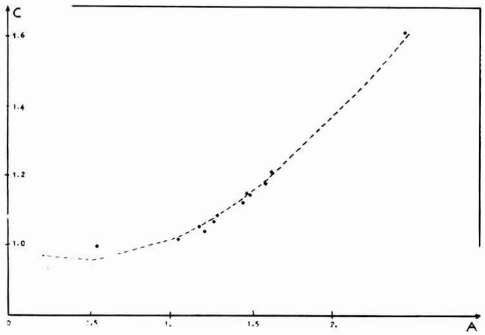

Fig. 5b. Curve drawn for equation (2) using parameters m = 1·023, b = —1·97, c = 0·419, calculated from the experimental data of Table I

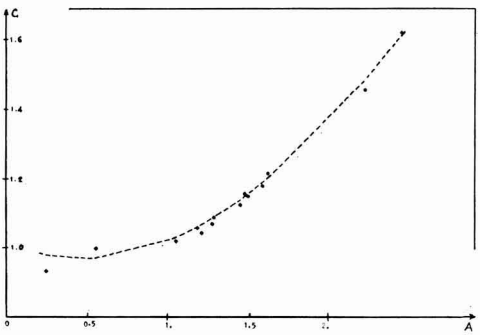

Fig. 5c. Curve drawn for equation (2) using parameters m = 1·441, b = —5·015, c = 0·272, calculated from the experimental data of Table I

In future work it is proposed to examine the significance of the variations in the values of m, b and c with changes in non-sucrose and temperature. It is necessary to proceed with caution in this, however, in view of the need to ensure the reliability and validity of the m, b and c values which must be obtained by rigorous selection of the appropriate experimental methods.

Summary

The authors have applied a procedure of systematic analysis to sucrose solubility data. This treatment of experimental data affords advantages and improvements by comparison with the simple use of the equation of VAVRINECZ.

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

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

PART II

Studies in the visible region

Sugar colours having absorption peaks at or near 420 nm have been reported by a large number of workers including the authors. Studies made in these laboratories have generally employed the Unicam spectrophotometer both for colour measurements as well as in kinetic studies on caramel formation. The nature of curves obtained at different concentrations in case of raw sugars, gur and molasses are given in Figs. 7, 9, 11. Though the general nature of the absorption curves remains more or less similar for all coloured products it may be seen that at lower concentration the curves hardly showed any peak. As the concentration increased, however, the peak became better defined.

The position of maximum absorption was found to depend on the concentration of the sugar and therefore of the colouring matter. In the case of raw sugar, for example, no peak was visible at 10° and 20°Brix, but appeared at 410 nm with a 30°Brix solution. This peak shifted to 415, 420 and 430 nm as the concentration increased from 40° to 60°Brix. It has been shown by the authors[8] that in the case of caramel also, the position of maximum absorption shifted to higher wavelengths from 400 to 460 nm with increase in concentration. This shift in the position of maximum absorption has not been reported earlier but was found universal for gur and molasses and appeared characteristic of the sugar colours.

Another significant observation made in these studies was the non-obedience to Beer's law (see

Figs. 8, 10, 12). This wide divergence from the obedience to Beer's law was found to be universal. Even a standardized curve which may correlate the optical density with the concentration of the sugar was not feasible. It is important that, for any standardized method of measurement, the colour intensity at the particular wavelength which is the position of maximum absorption should vary either linearly or in a definite fashion which could correlate the instrument reading with the concentration in the calibration curve. It can therefore be stated that such measurements are not suitable for the determination of the colour index of sugars.

The interference by light scattering on the colour measurements was quite pronounced in Unicam spectrophotometric readings. Attempts were made to examine the interference of scattering, i.e. by subtracting twice the attenuancy index at 720 nm from that at 420 nm. The range of wavelength available on the Unicam instrument was from 400 to 700 nm only, so that the values at 700 nm were subtracted instead of those at 720 nm; however, measurements at 700 and 720 nm were not expected to be very different because of the nearly horizontal nature of the spectral curves at these wavelengths.

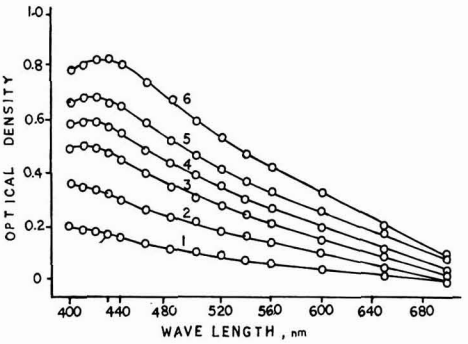

Fig. 7. Spectra of raw sugars at different Brix (Unicam spectrophotometer). Curve 1—10°Bx, 2—20°Bx, 3—30°Bx, 4—40°Bx, 5—50°Bx, 6—60°Bx.

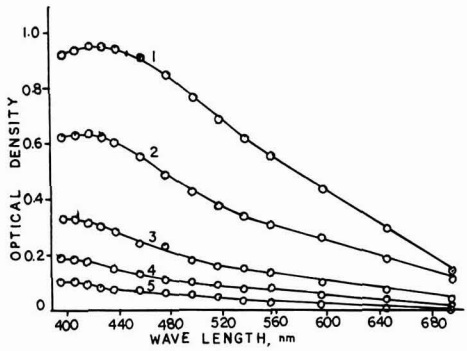

Fig. 8. Spectra of gur at different concentrations (Unicam spectrophotometer). Curve 1—10%, 2—5%, 3—2%, 4—1%, 5—0·5%.

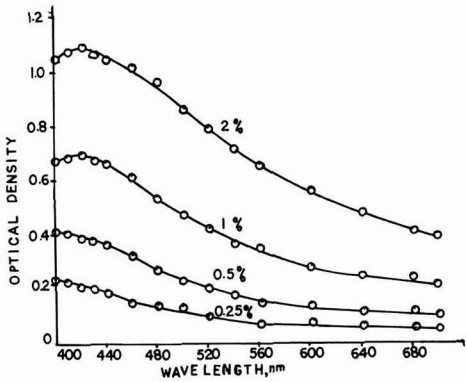

Fig. 9. Spectra of molasses at various concentrations

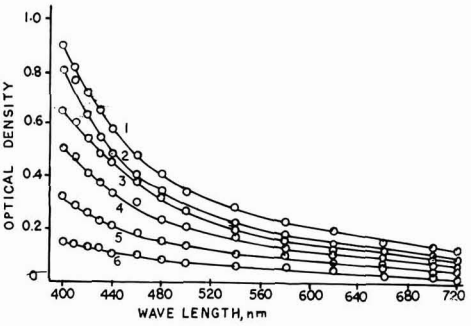

Fig. 10. Spectra of deteriorated sugar of various concentrations (Beckman DU spectrophotometer). Curve 1—60°Bx, 2—50°Bx, 3—40°Bx, 4—30°Bx, 5—20°Bx, 6—10°Bx.

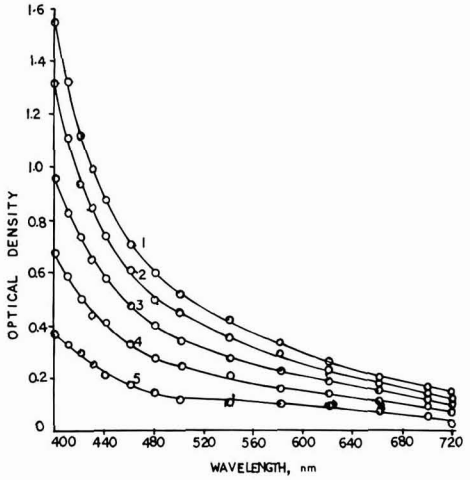

Fig. 11. Spectra of raw sugars at different concentrations (Beckman DU spectrophotometer). Curve 1—50°Bx, 2—40°Bx, 3—30°Bx, 4—20°Bx, 5—10°Bx.

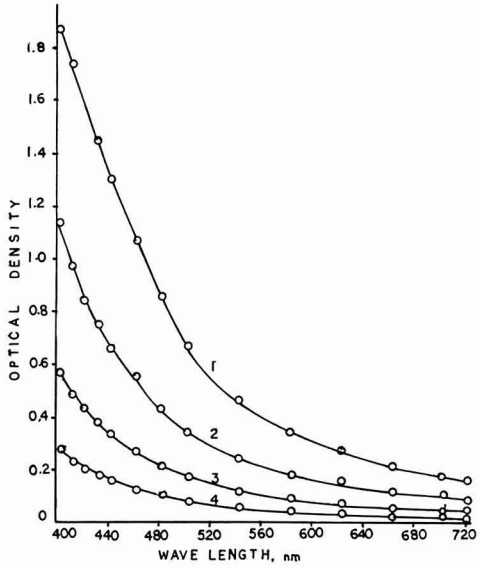

Fig. 12. Spectra of gur at different concentrations (Beckman DU spectrophotometer). Curve 1—4%, 2—2%, 4—0·5%.

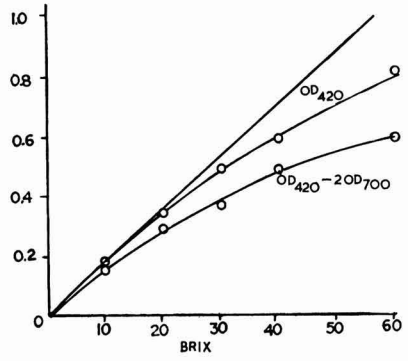

Fig. 13. Non-obedience to Beer's law of raw sugar spectra measured with Unicam spectrophotometer at different Brix

An examination of the nature of the curves again showed that Beer's law was not obeyed even with this correction, i.e. the colour index would vary if the initial concentration of the sugar employed was different. Thus it may be seen that values of (OD_{420} — 2 OD_{700}) for the same sugar at 30°Brix and 60°Brix were 0·36 and 0·60, whereas the values should have doubled if the optical density (OD) at unit concentration were to be evaluated as required in the colour index equation for calculating the attenuancy index. Similar observations were made for gur as well as molasses. It must therefore be concluded that the equation given for the determination of the colour index is not valid.

Interesting results in the visible region of the spectrum were obtained with all sugar house products, on making the measurements using a Beckman DU spectrophotometer. It may be seen from Figs. 13, 15 and 17 that under no circumstances could any peak be obtained, either in the deteriorated sugar, raw sugar or gur. Though the results for only single samples are given, this was found to be the typical behaviour and characteristic of the colour present. The absorption values decreased with increasing wavelength and there appears no justification for making any observation at any particular wavelength, since Beer's law was found to be invariably obeyed at 400 nm, 420 nm, 490 nm and 550 nm. In addition there appears to be no need of subtracting twice the OD at 720 nm, the latter being hardly 5–10% of the value at 400 nm. A comparison of Figs. 1–3 with

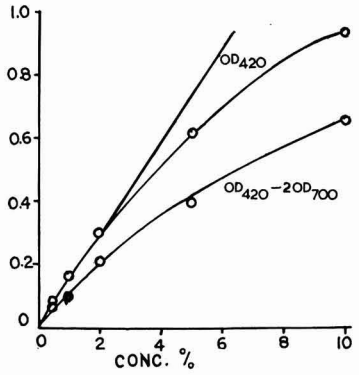

Fig. 14. Non-obedience to Beer's law of gur spectra measured with Unicam spectrophotometer at different concentrations

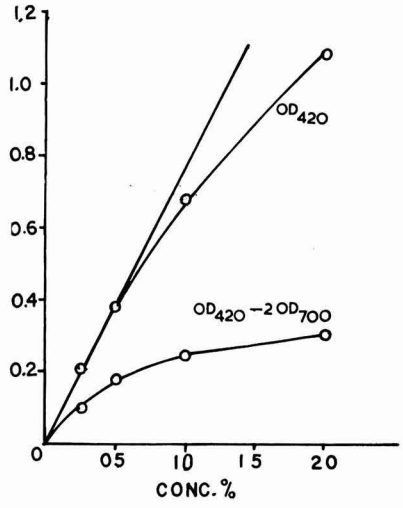

Fig. 15. Non-obedience to Beer's law of molasses spectra with change in concentration

Figs. 13, 15 and 17 will show that the value of OD at 720 nm is negligible by comparison with the values at 270 nm, since colour measurements at 400 nm are a small fraction of those at 720 nm. The influence of scattering would therefore be completely eliminated by measurement at 270 nm. Other spectrophotometers have not been examined but any one giving results akin to the Beckman could equally be used. It is, however, felt that similar studies may be necessary before specifying any other spectrophotometer.

ACKNOWLEDGEMENT

The authors' thanks are due to Shri S. C. GUPTA, Director, and Dr. N. A. RAMAIAH, Professor of Physical Chemistry, National Sugar Institute, Kanpur, for their keen interest in the work.

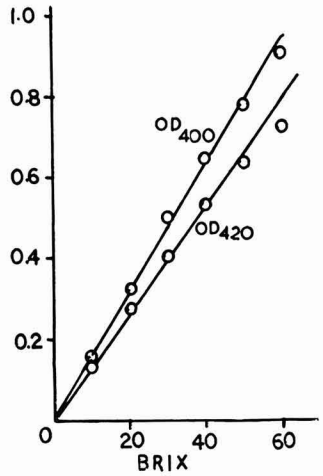

Fig. 16. Obedience to Beer's law of spectra of deteriorated sugars with change in Brix (measurements made with Beckman DU spectrophotometer)

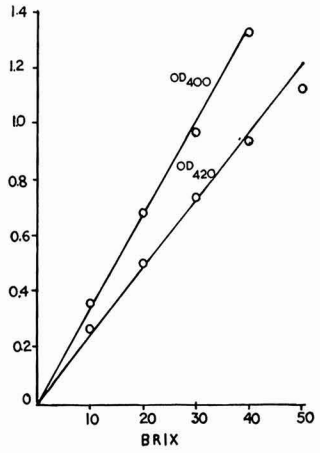

Fig. 17. Obedience to Beer's law of spectra of raw sugars at different Brix (measurements made with Beckman DU spectrophotometer)

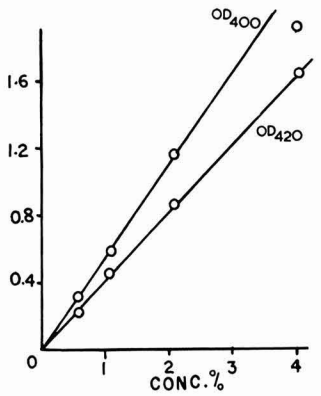

Fig. 18. Obedience to Beer's law of spectra of gur at different concentrations (measurements made with Beckman DU spectrophotometer)

SUMMARY

The procedure laid down for evaluation of the colour of commercial sugars by ICUMSA involving measurement at 420 nm and 720 nm appeared arbitrary since no coloured sugar showed any absorption maxima at these wavelengths. The positions of maximum absorption of a series of deteriorated sugars—originally direct consumption white sugars that had developed colour on storage—raw sugars, gur (jaggery), molasses and the colour eluted from cane juices with the help of ion-exchange resins were investigated in the ultra-violet and visible regions using a Beckman DU spectrophotometer and in the visible region using a Unicam instrument in order to evaluate their inherent colour characteristics. The spectrophotometric curves showed only one peak with a maximum at 270 to 280 nm or a tendency for a peak in this region. Obedience to Beer's law was invariably found at the peak wavelengths since the optical density increased with concentration of the sugar under examination in all cases. No absorption peak could be found in the visible region covered by the Beckman instrument. Obedience to Beer's law was observed only at lower concentrations and not at the concentration recommended by the ICUMSA.

The reported absorption peak at or near 420 nm was observed using the Unicam spectrophotometer. With all types of sugars the position of the peak, however, shifted from 410 nm to 460 nm with an increase in the amount of colouring matter present. Non-obedience to Beer's law was a general characteristic feature, and the wide divergence from a linear relation between optical density and sugar concentration prevents any calculation of the sugar from the colour index.

The measurement of colour at 270–280 nm, as suggested, would hardly be affected by light scattering due to the turbidity of the solutions since such interference would be negligible at the low concentrations recommended.

Sugar cane agriculture

Mercury fungicide registrations to end—"Benlate" use to begin. H. W. HILTON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 73.—Because of the toxicity and pollution hazards of mercury recently brought to light (notably in Japan) "Benlate" will be substituted for mercury fungicides in dealing with pineapple disease of sugar cane (*Ceratocystis paradoxa*). The use of "Benlate" is discussed.

* * *

Studies on pineapple disease. R. S. BYTHER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 75–78.—This disease is discussed at some length. It can be serious in Hawaii. Apart from infecting seed pieces it is a cause of stalk rot with Hawaii's 2-year crop cycle.

* * *

Effects of ethylene on root growth. R. S. BYTHER and P. H. MOORE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 78–79.—Illustrations are given of the effect of ethylene on cane roots, showing root hair and secondary root stimulation, while normal root development was inhibited.

* * *

Black rot in Hawaii. R. S. BYTHER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 80–81. Black rot disease of sugar cane, due to the fungus *Ceratocystis adiposa*, was isolated in 1970 from a diseased cutting from a field at Hamakua Mill Company. Symptoms of the disease closely resemble those of pineapple disease. The disease may be controlled by cold-dipping in either phenylmercuric acetate (PMA) or "Benlate". It is not expected to cause serious economic losses.

* * *

Varietal testing against ratoon stunting disease. C. A. WISMER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 83–84.—Certain varieties believed to be tolerant to the disease are to be further tested.

* * *

Screening for brown spot disease. C. A. WISMER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 81.—In Hawaii brown spot disease of sugar cane has been recognised for at least 8 years. During this period only a few commercial clones have shown tolerance to the disease. A resistant variety, 54-5882, was used in crosses with two susceptible varieties. The progeny (802 seedlings) was screened by inoculating with the disease. Only a few seedlings showed any resistance to the disease. There was no correlation between results from inoculations of young plants in "flats" and more mature plants in the field.

* * *

Looking for borer resistant sugar cane varieties. V. C. CHANG, V. M. TANIMOTO, A. K. OTA, J. W. BEARDSLEY and S. LEACH. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 85–88.—The so-called beetle borer or New Guinea sugar cane weevil (*Rhabdoscelus obscurus*) is the worst insect pest in Hawaii. It accounts for a heavy yearly loss of sugar. For possible control, stress is laid on resistant varieties of sugar cane and the possibilities of biological control. These lines of research are discussed. The borer parasites introduced from New Guinea in 1968 are now considered to be different from those introduced in 1910. Reasons are given.

* * *

Tachinid parasite of borer fails to penetrate cane trash. J. W. BEARDSLEY and J. LEEPER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 88–89.—Experiments are reported which prove the correctness of the belief that poor biological control of borer grubs may be due to the refusal of the parasite to enter the layer of cane trash on the ground in order to get to the borers.

* * *

Adult tachinids depend on weeds for food. J. W. BEARDSLEY and J. LEEPER. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 89.– Observation has shown that borer parasites in Hawaii, adult tachinid flies, depend upon nectar and extra-floral glandular secretions from certain cane field weeds as sources of carbohydrate food. The main weeds are garden spurge (*Euphorbia hirta*), castor oil plant (*Ricinus communis*) and rattle pod (*Crotalaria saltiana*).

* * *

Flight behaviour and dispersal of the beetle borer. A. K. OTA and V. C. CHANG. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 90.—Experiments are reported which prove that the beetle borer can readily fly a distance of several hundred feet and migrate with ease from a mature infected cane field to a young uninfected cane field.

* * *

Zinc phosphide registered as a rodenticide. H. W. HILTON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 94–95.—On the 14th October 1970 zinc phosphide was registered as a rodenticide for

broadcast application in bait form on sugar cane fields in Hawaii. Initial field trials with broadcast applications of zinc phosphide-treated bait gave substantial reductions in stalk damage from rats where two or more applications were made. Pol ratio and mill data were very favourable, although core sampling did not show the same results.

* * *

Value of pre-baiting shown in cage tests. A. TESHIMA. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 101.—In a cage test conducted in connexion with field evaluations 108 rats (36 each of three species) were fed two, one or no pre-bait rounds of oats before being given thallium-poisoned oats. The results show the considerable value of pre-baiting with the unpoisoned bait material before poison bait is put down.

* * *

Interest continues in early post-emergence applications over cane. R. V. OSGOOD and H. W. HILTON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 106–108.—Many field screening tests have shown that adequate weed control—with only minor or temporary cane effects—can be obtained from "Ametryne" or "Diuron" applied as broadcast treatment over small emerged weeds and emerged cane. 2,4-D can be included where it is needed and where spray drift is not a problem. "Dalapon" will probably not be used in this way because the injury to sugar cane is quite severe and lasting.

* * *

Bay-94337 selected from herbicide screening. R. V. OSGOOD. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 108–110.—The herbicide Bay-94337 (a Chemagro product) has shown great promise as a herbicide with sugar cane. It is particularly active as a pre- and early post-treatment for Guinea grass (*Panicum maxicum*) considered to be a major weed species in sugar cane. Sugar cane tolerance is good, although certain varieties such as 53-263 are sensitive.

* * *

How much herbicide drifts from aircraft and how much reaches the ground. H. W. HILTON, W. H. ROBINSON and R. V. OSGOOD. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 111–113.—A project is reported designed to study drift from aircraft applying herbicide (notably "Ametryne") to sugar cane. It was found that applications were not uniform and that about 15–20% of total herbicide never reaches the ground.

* * *

Tolerance of sugar cane varieties to "Ametryne". R. V. OSGOOD. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 121.—"Ametryne" tolerance of 30 new varieties was tested. Only 4 were resistant, 9 were intermediate and 18 highly susceptible.

* * *

Mechanizing ditch spraying. R. V. OSGOOD. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 121.—Aircraft spraying of weeds in supply ditches and drains is reported as are experiments to ascertain the best herbicides and the most suitable concentrations to use.

* * *

Foam characteristics of surfactants and antifoam agents. H. W. HILTON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 121–122.—Foaming problems in filling aircraft spray tanks with herbicide sprays were investigated and various antifoam agents tried. Too much anti-foam can decrease the wetting properties of the solution.

* * *

One-eye seed pieces. ANON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 123.—Further experimental work on planting (and harvesting) one-eye seed pieces, is reported. Improved planting, including lower cost, is being sought through work presently being done. Mechanization for preparing and planting one-eye seed pieces promises substantial reductions in labour and material, as well as increased efficiency.

* * *

Coating and packaging for seed pieces. R. W. OSGOOD and H. W. HILTON. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 126.—Experiments have been made with several methods of protecting single-eye seed pieces from moisture loss, as they are more prone to drying out than the normal 3-eye seed pieces. Protection is by coating the cut ends or packaging in plastic film. Shoots and roots will penetrate polyethylene film of 1 mil (0·001 in) thickness, provided it is tightly shrunk round the seed piece.

* * *

The Burdekin—world's best sugar producer. ANON. *Australian Sugar J.*, 1971, **63**, 71–73.—The Burdekin Delta is regarded as one of the premier sugar producing regions of the world. The three mill areas in the district averaged over 7 tons of sugar per acre in 1969. While this may not equal the Hawaiian record where plantation cane is grown over a two-year period, the three delta mills have proved their superior productivity by putting out half a ton of sugar per acre per month.

* * *

Research into fertilizer leaching. N. J. KING. *Australian Sugar J.*, 1971, **63**, 73–74.—Lysimeter studies being used to measure water application to cane are also supplying information on the amount of nitrogen in water seepage. Present indications are that the downward leaching of nitrogen fertilizer in cane fields is neither raising the nitrogen content of underground water sources nor being a source of pollution of streams or ponds.

* * *

Efficiency the keynote of success in sugar. H. N. WHITAKER. *Australian Sugar J.*, 1971, **63**, 75–76.—At the Meringa Field Day the Vice President of the

Australian Sugar Producers' Association paid tribute to the work of the Bureau of Sugar Experiment Stations in cane breeding for high yields and in diseases and pest control.

* * *

Diseased cane. J. A. ROW. *Australian Sugar J.*, 1971, **63,** 76.—Concern is expressed at the increase in the incidence of yellow spot disease in some parts of Queensland. Apart from loss in cane production in the field the disease causes a loss of sugar content in the cane. It is disheartening that some of the best modern varieties, with so many good qualities, will succumb to the disease in a year which happens to be wet, cloudy and humid. Different strains of the disease are believed to exist.

* * *

Toft harvesters in Florida. ANON. *Australian Sugar J.*, 1971, **63,** 109.—The successful introduction of the Queensland-made Toft CH 364 "Robot" chopper harvester into Florida early in 1971 is recorded. The harvester cut 400 tons per day on several occasions, limitation being transport vehicles.

* * *

Froghopper infestation in the sugar cane fields of Piracicaba. G. M. AZZI and K. DODSON. *Brasil Açuc.*, 1971, **77,** 342–348.—The froghopper or "cigarrinha" pest (*Mahanarva fimbriolata* Stal) has long been known to exist in the State of São Paulo and is now recorded as doing serious damage to cane there. In this paper biology, symptoms, nature of damage and rate of infestation are discussed. Field observation reveals widespread damage to the pest by two parasites, the fungus *Metarrhizium anisopliae* and the fly *Salpingogaster nigra* which parasitizes the nymphs.

* * *

The struggle against froghopper or cigarrinha. P. GUAGLIUMI. *Brasil Açuc.*, 1971, **77,** 349–350.—The attempts at biological control of the pest with insect parasites and with a fungus, *Metarrhizium anisopliae*, are discussed.

* * *

A study of the behaviour of cane varieties. L. VELLOSO. *Brasil Açuc.*, 1971, **77,** 351–365.—Cane yields and varieties on a number of estates are reported; the estates concerned were: Boavista, Conceição, N.S. das Dores, Fazendinha, Floresta, do Goiabal, Guandu, Lagoa das Pedras, Palacete, Periquito da Quinta and São Luis. Average yields varied from 44·13 to 71·28 tons/ha.

* * *

Parts of Zululand flooded as 21 inches of rain falls in 24 hours. ANON. *S. African Sugar J.*, 1971, **55,** 274–275.—One of the heaviest storms to take place in the sugar areas of Natal and Zululand is described. Falls of intensity of up to 100 mm (4 inches) per hour occurred for periods of up to 2 hours on end. The damage caused to fields, roads and dams is described. Available records show that storms of this nature can be expected only once in about every 25 years.

* * *

One ton sugar = 24 man-hours. ANON. *S. African Sugar J.*, 1971, **55,** 295.—According to American figures dealing with sugar beet and sugar cane farms in the United States, it required 80 man-hours to produce a ton of sugar in 1946 as against 24 man-hours in 1969. The reasons for this are discussed, e.g. the use of specialized machines for planting, cultivating and harvesting, improved and simplified cultural practices, application of improved or new fertilizers, herbicides and pesticides and better production planning.

* * *

N.S.W. sugar production at record level. ANON. *Producers' Rev.*, 1971, **61,** (5), 3–4.—Sugar production in New South Wales for the 1970 season was an all-time record. The estimated final figure for the year was 146,877 tons of 94 N.T. sugar made from 1,158,577 tons of cane crushed. Seasonal conditions were generally good until the last few weeks of the season when rain caused losses to occur in each mill area.

* * *

Australian sugar industry is research conscious. K. L. SUTHERLAND. *Producers' Rev.*, 1967, **61,** (5), 13–14. The amount of money spent on sugar research in Australia during the last decade, although greatly increased, is often difficult to ascertain. The Colonial Sugar Refining Co. Ltd. spent about $800,000 in 1957 and $2 million in 1966, both figures about evenly split between milling and agricultural research.

* * *

Long term ratooning of cane. ANON. *Producers' Rev.*, 1971, **61,** (5), 25–27.—The conditions which allow many good ratoon crops following the plant crop are explained. The soil-compacting effect of modern heavy harvesting machinery may militate against long term ratooning. The case is quoted in North Queensland, on fertile soil, where the 8th ratoon yielded 33·6 tons of cane when the district average was 30·4 tons.

* * *

Marian season was record—but it had its problems. F. J. SOPER. *Producers' Rev.*, 1971, **61,** (5), 29–31. Early in the season in the Marian Mill area of Queensland over-dry conditions prevailed, alleviated by a sudden deluge when 30 inches of rain fell in almost so many hours. Soldier fly remained a pest of major importance and the area damaged by Frenchi grubs showed an increase. Rhyparida grubs were again active in the lower-lying wetter soils. Rat damage was greater than it had been for several years. Leaf scald was still present as was ratoon stunting disease on a few farms.

Proserpine crop was a tribute to area's productivity. A. HOLMES. *Producers' Rev.*, 1971, **61**, (5), 33–35. The Proserpine area was still able to harvest 581,315 tons of cane in 1970 despite the extreme wind and flood damage done by cyclone Ada early in the year. Prolific growth of grass prevented weed growth, and the dry winter assured good burns right from the start of the crushing, so that extraneous matter was not the problem expected. Flood-damaged country caused the greatest difficulty in harvesting.

* * *

King size weed problem. ANON. *Producers' Rev.*, 1971, **61**, (5), 35.—The best wet season in 14 years has given Queensland farmers a serious weed problem. Herbicides have largely replaced mechanical weeding, and the value of "Gramoxone" and its use by the cane grower are explained.

* * *

Leaf scald, hope in new variety. ANON. *Producers' Rev.*, 1971, **61**, (5), 37.—This serious sugar cane disease is spreading in parts of Queensland. A new experimental variety, 59-C-600, resistant to the disease, holds out some hope for growers. It measures up to the susceptible Q 63 which it is intended to replace and should be available for general distribution in 1972.

* * *

Tractor operators need defensive driving techniques too. J. HERBERT. *Producers' Rev.*, 1971, **61**, (5), 39. Fatalities from tractor accidents in Queensland numbered 23 in 1970, compared with 12 in 1969. During a 12-year period wheeled tractors were concerned in 158 out of 183 fatal accidents; in 53 of these (over a third) tractors overturned sideways, down embankments or into gutters, etc.; 29 were due to unsafe actions such as cranking in gear, standing between tractors, speeding, etc.; 19 through tractors rearing backwards; while in 12 instances passengers fell under tractor wheels. A list of 12 safety rules for tractor drivers is given.

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Richmond's biggest crop was satisfactorily produced. ANON. *Producers' Rev.*, 1971, **61**, (5), 49–50.—There is general satisfaction with the position of the industry in this area of New South Wales. Mechanical harvesting was well to the fore in 1970. Black beetles were present in very large numbers and caused considerable damage to newly emerged shoots. Owing to the prolonged dry spell rat populations were low. Growers are advised to maintain their baiting campaigns and keep headlands and waste areas clean.

* * *

Stop burning cane or else. . . . ANON. *S. African Sugar J.*, 1971, 317.—Reference is made to the Hawaiian sugar industry having been given an ultimatum by the State Health Department to end the burning of sugar cane within three years because of the danger of air pollution. The severe repercussions this ultimatum could have on the Hawaiian sugar industry are discussed. It is argued that urban areas are responsible for 82% of the air pollution.

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Sugar cane varieties. J. FRITZ. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1970, 13–14.—Trials with the following cane varieties are discussed: R 526, M 63/39, R 472, R 464, R 512 and S 17. The variety R 526 proved to be the best both in terms of yield and in sugar content.

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Fertilizer experiments. J. FRITZ. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1970, 15–43.—The results of N-P-K fertilizer trials in cane growing areas in different parts of the island are given, soils being classified in six groups. Results obtained were very similar to those of previous years.

* * *

Sugar cane diseases. B. RAT. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1970, 45–58.—Gummosis due to the bacterium *Xanthomonas vasculorum* again claimed most attention. More than one strain or form of the bacterium is now known to be present.

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Cane borer. J. ETIENNE. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1970, 59–73.—The fight against the cane borer, *Chilo sacchariphagus*, continued, notably in attempts to exercise biological control by using the tropical American parasite *Lixophaga diatraeae* and the Indonesian *Diatraeophaga striatalis*, both of which have been successfully bred in Réunion under artificial or laboratory conditions. The last mentioned has now been successfully bred on another host, *Galleria mellonella*, which should allow of a higher rate of multiplication.

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Sugar cane breeding work. ANON. *Rpt. Sta. d'Essai de la Bretagne* (Réunion), 1970, 1–14.—Owing to unfavourable weather conditions the flowering of breeding cane was not good and hybridization work was affected. Twenty-three combinations were made and 2570 seedlings obtained. Several varieties were used for the first time in breeding work. Lists are supplied of the seedlings established in nurseries. Details are given of the different stages of breeding work.

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Sugar cane diseases, present position. ANON. *Rpt. Sta. d'Essai de la Bretagne* (Réunion), 1970, 15–20. A list is given of varieties cultivated, arranged in four categories according to their degree of resistance to gummosis. The following are resistant varieties: R 533, R 541, R 543, M 31/45, S 17, R 469, R 447 and R 484. Leaf scald, which has been in Réunion for a number of years, is claiming attention. Areas where it has been recorded are indicated.

* * *

Cane variety selection work. ANON. *Rpt. Sta. d'Essai de la Bretagne* (Réunion), 1970, 21–66.—Selection work carried out at different centres is discussed.

Imported foreign varieties. ANON. *Rpt. Sta. d'Essai de la Bretagne* (Réunion), 1970, 75.—During 1970 16 Australian or "Q" varieties were imported but with the exception of Q 86 do not appear to have done well. Other varieties imported were Woden from South Africa, PH 53/3 and PH 53/33 from the Philippines and M 907/61 from Mauritius.

* * *

Good development of the sugar cane depends on the balanced use of suitable nutrients. R. P. HUMBERT. *La Ind. Azuc.*, 1971, **76,** 65–69.—Initial growth of cane plants requires nutrients which must be available in the soil since the quantities in the setts are limited. In addition to the three major elements, micronutrients are needed to permit maximum growth, while the nutrients must be in suitable proportions since an excess of one can even reduce growth if it is out of balance with the others. Cane tissue analysis is commonly used to assess the nutrient status and a table gives the amounts which indicate deficiency for various elements in different sections—leaf, internode, etc. Detailed attention is given to the requirements of N, P and K.

* * *

Fallow flooding cane fields. G. ARCENEAUX. *Sugar J.*, 1971, **34,** (2), 19–21.—This practice, which has existed in Guyana for nearly 150 years, and its beneficial effects, are discussed, especially in relation to weed control, and destruction of soil pests and disease-producing organisms. In Louisiana experimental evidence indicates that flooding over a period of 3 to 4 months will destroy rhizomes and devitalize all seeds of Johnson grass in the soil. Increasing the flood period to 6 or 7 months if necessary would be feasible in Louisiana without loss of any cropping time.

* * *

Are your cane slings safe? ANON. *S. African Sugar J.*, 1971, **55,** 349.—The importance of cane loading slings being always in a sound, safe condition is discussed and the regulations of the Factories, Machinery and Building Workers' Act which governs them cited. A steel washer or plate must be permanently fixed to a sling and stamped annually by a competent or qualified person at the time of the annual inspection.

* * *

Growers praised for unity of purpose in recent difficult years. I. G. B. SMEATON. *S. African Sugar J.*, 1971, **55,** 351–357.—Despite all the problems of the 1960's, including severe drought, the South African sugar industry did not stand still but looked ahead to see what plans were needed for the 1970–1980 period. The annual sugar crop fluctuates between 1·7 and 2·0 million short tons a year, as against a demand, exclusive of high test molasses, of about 1·75 million short tons a year between 1974 and 1977. A planning and development committee was appointed with three representatives each of the growing and milling sections to consider the widening of the production base, bearing in mind that it takes from two to three seasons to get results.

* * *

Sugar cane cleaning. J. E. CLAYTON. *Sugar y Azúcar*, 1971, **66,** (7), 12.—The progress so far made in the field cleaning of cane with the experimental work carried out by the US Department of Agriculture Experiment Station at Belle Glade, Florida, is described. The most successful cleaners for Florida cane have been those using series of cleaning rolls which pull the loose trash through the rolls while the mature cane pieces remain on top of the rolls. About 20 types of rolls have been tried in several arrangements and configurations. Some of the rolls will successfully pull immature tops or leaves through the rolls and break them from the mature cane piece. This requires short cane pieces and a thin flow of cane.

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Mexican efforts in the use of sweet sorghum as a supplement to the sugar cane crop. ANON. *Sugar y Azúcar*, 1971, **66,** (7), 21–23.—Promising trials with American varieties of sweet sorghum as sources of sugar in Mexico are described. Varieties grown were: Brawley, Rex, Sart and Tracy as well as local selections. The possible advantages of sorghum for sugar were considered to be its short growing season (about 120 days) and its harvest period being made to correspond with the off-season between sugar cane harvests. Disadvantages as well as advantages are discussed.

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Sugar cane freezes in Mexico. A. L. FORS. *Sugar y Azúcar*, 1971, **66,** (7), 26–28.—In some sugar cane areas of Mexico the cane may be subject to frost at times but it is not as severe as the freezing that can take place in Louisiana. Comparisons are made between the two countries in this respect. The most frequent freezes take place in the State of Jalisco, affecting cane for Ingenios Tala, San Francisco de Ameca and Tamazula.

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The formation of nurseries or seed cane areas. S. RUGAI and J. O. FILHO. *Brasil Açuc.*, 1971, **77,** 443–454.—The large total area under sugar cane in the State of São Paulo is referred to and the question of the availability of suitable varieties of cane discussed, especially in regard to time taken to reach maturity.

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The importance of phytosanitary measures in controlling sugar cane pests. J. A. RIBEMBOIM. *Brasil Açuc.*, 1971, **77,** 455–457.—Special attention is given to the leafhopper (cigarrinha) campaign in Pernambuco.

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Survey of sugar cane pests in Rajasthan. A. N. KALRA and S. KUMAR. *Indian Sugar*, 1971, **20,** 839–843. Some results are given of an extensive survey carried out in 1962–63 ,with tables of the pests, their parasites and predators, and locations.

Stalk borer, *Chilo auricilia* Ddgn.—a serious pest of sugar cane and the scope of its control. O. P. SINGH. *Indian Sugar*, 1971, **20**, 845–846.—The literature referring to this pest—one of the most destructive in north India—is surveyed and a programme for control by chemosterilization is outlined.

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Improvement in the practices for ratooning of sugar cane—a review. R. L. BHOJ. *Indian Sugar*, 1971, **20**, 847–853.—In India average yields of ratoon crops are often miserably low, through neglect or ignorance, and they are often infested with pests or disease, thereby serving as a source of infection for neighbouring plant crops. Work that has been done on the subject with a view to improvement is discussed under the following headings: frequency of ratooning, varietal behaviour, intercultural practices, manuring and irrigation, pests and diseases, cultural treatment of plant crops, and future lines of work.

* * *

Improving the efficiency of green manures: sugar cane production in the Gangetic Plain. G. N. MISRA. *Indian Sugar*, 1971, **21**, 19–22.—Results are given of experiments carried out at Shahjahanpur, including some on the desirability of applying phosphate to leguminous green manure crops. These are in tabular form. It is concluded that the efficiency of green manure could be improved by the application of superphosphate at the time of its sowing. Green manure crops could be grown as intercrops and thus avoid the loss of a season.

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Studies on the water requirements of sugar cane in V.C. tract of Mysore State. M. B. TIPPANNAVAR, M. G. REDDY and G. V. HAVANAGI. *Indian Sugar*, 1971, **21**, 23–26.—The experiments described were carried out on a sandy loam soil at the Sugarcane Research Station, Mandya. Two nitrogen levels (225 lb and 300 lb per acre) and two irrigation levels were used. The variety of cane was Co 419. The effect of the nitrogen and irrigation levels employed were not statistically significant.

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A new promising variety of sugar cane Co 678, for western Madhya Pradesh (Jaora Sugar Factory Zone). M. S. VAIDYA, S. SINGH and R. P. PANDEY. *Indian Sugar*, 1971, **21**, 27, 22.—This variety has proved superior to the two varieties at present mainly cultivated, i.e. Co 312 and Co 419. It is a hybrid between Co 603 and Co 301 and was raised at Coimbatore. A description of the variety is given.

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A review of TSC's land reclamation program. J. F. WILLIAMS. *Taiwan Sugar*, 1971, **18**, 85–90.—An account is given of how the Taiwan Sugar Corporation is increasing its cane land by acquiring marginal waste or very stony land and converting it into agricultural land for cane. With the reclamation programme started in 1966–67 some 4133 hectares of land have now been reclaimed and there are 1293 hectares remaining. The land consists of 5 main types: stony land, river beds, sloping land, saline land and tidal land. Some 12,000 hectares on the west coast are considered to be potentially reclaimable.

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Improvement and management of saline soils on TSC's sugar cane plantations. S. C. YEN. *Taiwan Sugar*, 1971, **18**, 91–101.—With the increasing value of land in Taiwan the Taiwan Sugar Corporation decided to embark on an improvement campaign of low production saline soils on its sugar estates. This represented about 7·8% of the cane planted areas owned by the Corporation. How this work is being carried out, at great expense, is described. It has involved the extensive development of water resources and drainage systems.

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Field days are growers' big opportunities. ANON. *Producers' Rev.*, 1971, **61**, (6), 5.—The Bureau of Sugar Experiment Stations in Australia arranges field days at different centres. Each year these well-organized functions provide cane growers with a wonderful opportunity to see the results of work being done on their behalf by officers of the Bureau, to ask questions about diseases, pests, nutrition, varieties and the thousand and one things that concern them. They meet friends and invariably go away much better informed than when they arrived. Those cane farmers who fail to attend Bureau Field Days thus miss a great deal.

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Tremendous value in Bureau regulations. G. WILSON. *Producers' Rev.*, 1971, **61**, (6), 9.—The great value of the quarantine regulations of the Australian Bureau of Sugar Experiment Stations in preventing the spread of disease from one area to another is discussed. The Bureau's regulations should be respected by every grower no matter how harsh such regulations may appear to be.

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Horses for courses (Special purpose canes). ANON. *Producers' Rev.*, 1971, **61**, (6), 17.—Cane growers, when discussing cane varieties, are apt to have noticed the bad features of the newer canes more than the good characteristics. When a particular variety of cane does not perform well it is very often because it has not been grown under the conditions for which it was bred or selected. For instance, if a cane intended for medium class soils is grown on rich land it may well lodge and give low c.c.s., while on poor land it fails to yield up to expectations. And so the criticisms begin.

* * *

A new trend in cane planting. ANON. *Producers' Rev.*, 1971, **61**, (6), 18.—The advanced cane planting methods employed in Australia are described. The latest trend is to employ a chopper-harvester to cut the cane setts. The plants so cut are fed into a crate

which, after dipping in a mercurial solution, is lifted mechanically onto a planter frame. The crate becomes the planter box.

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Yellow spot disease in North Queensland. B. T. EGAN. *Producers' Rev.*, 1971, **61,** (6), 21.—The history of this disease in northern Queensland is outlined. A severe epidemic took place in the wet 1971 season. In recent years some of the formerly resistant varieties became more susceptible to yellow spot. The varieties have not changed but the fungus causing the disease has. There now appear to be several strains of the fungus and the latest one can attack Q 83, Q 84, Q 89, Q 91 and "Cyclops" quite heavily. However, Q 57 and Q 78 remain resistant, while Q 82 and Q 90 have shown some moderate yellow spot but only in a few fields to date.

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Progress at Tully Experiment Station. ANON. *Producers' Rev.*, 1971, **61,** (6), 33.—Progress at this recently established sugar cane experiment station of 99 acres is described as very satisfactory. It is the station for the very wet belt. Seven months-old stalks, of the variety Q78 were 10 feet long and were expected to grow another 2 feet. At harvest time yield is expected to be 55 tons/acre.

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"Flashover" is a cane fire risk. ANON. *Producers' Rev.*, 1971, **61,** (6), 37.—"Flashover" is the occurrence of a short circuit through the air between wires of a transmission line. Under normal climatic conditions the air is of sufficiently high resistance to prevent leakage of electricity, but when hot gases and smoke from burning sugar cane rise between the wires the resistance may decrease so much that electricity can flow through the air in the form of a violent flash. When this happens the wires will be damaged, and power will be cut off automatically, with resulting inconvenience, possibly over a wide area. Suggestions are made to avoid "flashover", e.g. restricting cane burning under wires to before 6 a.m. or after 7 p.m.

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Fertilizer nutrients in streams not objectionable. N. J. KING. *Producers' Rev.*, 1971, **61,** (6), 57.—There is nothing inherently objectionable about the presence of some fertilizer nutrients in rivers or that part of the ocean into which the rivers flow. However, water pollution studies are to be undertaken by the Sugar Experiment Stations in areas such as the Burdekin to find out whether or nor the heavy use of nitrogenous fertilizer is having any effect on creek or river water. Some of the statements made in regard to pollution could well be misleading to farmers.

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Toft machines in Taiwan and South America. ANON. *Producers' Rev.*, 1971, **61,** (6), 59–60.—The successful operation of the Australian Toft J250 cane harvesting machine in Taiwan, in Venezuela and in the Dominican Republic is described. In Taiwan local drivers were trained to operate the machine by an expert from Australia who lived with the mill and field staff at the Nanchow Sugar Mill guest house, thereby gaining an excellent appreciation of local conditions.

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Excellent strike by setts from M-F 201. L. G. VALLANCE. *Australian Sugar J.*, 1971, **63,** 142–143. Experimental planting of setts prepared by a chopper harvester gave excellent germination after planting, indicating that there could not have been much damage to buds. The possibility of planting setts being prepared in this way on a large scale is discussed. The total amount of seed cane cut by hand every year in Australia is about 320,000 tons.

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Gainful employment of the harvester's tractor. ANON. *Australian Sugar J.*, 1971, **63,** 143–144.—In order to improve the utilization of a powerful Fiat 900 tractor, this expensive machine, which normally powers a Don Mizzi 740 cane harvester, is disconnected and used by its owner when the cane harvesting season is over for other purposes such as ploughing, preparation of land for planting, pasture improvement, etc. Disconnection involves about a day's work but could possibly be made simpler.

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A new Raigros harvester. ANON. *Australian Sugar J.*, 1971, **63,** 144–147.—In this new cane harvester the inventor has aimed at maximum removal of extraneous matter, an important matter in the cane industry at the present time. A description and photographs of the machine are given.

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Biological control of weeds. W. H. HASELER. *Producers' Rev.*, 1971, **61,** (7), 7–10.—Ideal biological control reduces the population of a weed to the point where it is still present but causes no economic loss; in this case there is sufficient food material for survival of the insect and sufficient insects to prevent uncontrolled weed growth. The biological control of weeds has been in operation in Queensland for some 60 years and is a growing science. Weeds concerned are lantana, noogoora burr, groundsel bush, Crofton weed and cacti. Details are given of the control projects under way. A brief description is given of the origin and function of the Alan Fletcher Research Station, set up within the Australian Dept. of Lands, which carries out research on biological control of weeds, as well as chemical, mechanical and ecological control studies. The author is Director of the Station.

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A date in sugar history. ANON. *Producers' Rev.*, 1971, **61,** (7), 17.—Reference is made to the Ormiston House restoration fund. Ormiston House, near Cleveland and about 20 miles from Brisbane, is where the Queensland sugar industry had its beginning, for it was there that Louis Hope grew cane in 1862 and in 1864 produced 3 tons of sugar with the aid of a small Glasgow-made mill.

Sugar beet agriculture

Effects of gamma irradiation on chromatin activity of sugar beet tissue. V. L. DUNHAM, B. C. JARVIS, J. H. CHERRY and C. T. DUDA. *Plant Physiology*, 1971, **47**, 771–774.—This paper reports an investigation undertaken to determine the effects of gamma irradiation on protein and nucleic acid synthesis during washing of storage tissue, i.e. sugar beet tubers.

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Prediction of the fertilizer needs of sugar beet grown on fen peat soils. A. P. DRAYCOTT and M. J. DURRANT. *J. Sci. Food Agric.*, 1971, **22**, 295–297.—Results are given of five experiments on the fertilizer requirements of sugar beet grown on fen soils, carried out from 1963 to 1969. On average the return obtained from the addition of major nutrients was small. But in some fields, depending on soil, fertilizer greatly increased sugar yields. Fields were grouped by soil analysis and the responses to fertilizer of sugar beet when grown on soils in the different groups was examined. Four classes of soil were recognized—light peat, peaty mineral, organic mineral and mineral. Most of the response to agricultural salt was by crops on soils with low concentrations of exchangeable sodium. Nearly 10% of the British sugar beet crop is grown on fen soils.

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Investigations on the metabolism of sugar beet during the growing period. I. Glutamine, glutamic acid, asparagine and aspartic acid. M. BURBA and M. KASTNING. *Zucker*, 1971, **24**, 386–396.—Sugar beet was tested at fortnightly intervals during the harvest period (end-July to mid-November) for glutamine, glutamic acid, asparagine and aspartic acid by means of enzymatic tests using five varieties of sugar beet. The asparagine content was nearly independent of the harvest date; glutamine reached its lowest concentration at the beginning of September; aspartic acid at the end of September and glutamic acid, the existence of which was confirmed in sugar beet, only by the middle of October. It is thought such determinations could be of value to the breeder of sugar beet under certain conditions.

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Investigations on the decomposition and the fungal flora of the root residues of sugar beets. H. SORAN. *Zucker*, 1971, **24**, 427–433.—An account is given of the decomposition of sugar beets left in the soil after harvest and of the fungus flora to be found associated with them. Decomposition of the sugar beets was found to be complete after ten months. The fungus spectrum altered with the passage of time. Fungi that had been isolated were tested on sugar beet seedlings. With species of *Pythium* and *Rhizoctonia* a heavy to medium infection took place and with *Phoma eupyrena* and *Alternaria* only a light one.

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Fertilizer guidelines for sugar beets. A. HUFFAKER, N. FIELDMAN and D. OLDEMEYER. *Sugar J.*, 1971, **34**, (1), 13–14.—The value of soil testing as a guide to fertilizing is discussed. Through the use of modern technology the nutrient needs of the sugar beet crop can be largely controlled and planned. Growers should keep accurate records of crop rotation. The need to take properly representative soil samples is emphasized. N, P and K are separately discussed.

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Mechanical adjustments for precision planting beets. B. HUGHES. *Sugar J.*, 1971, **34**, (1), 18.—A uniform beet stand is the aim of every beet farmer and this requires uniform, consistent planter operation. It must have the proper size seed-plate. Worn out seed-plates should be replaced and all the associated mechanism examined and overhauled in advance of the planting season. Other precautions that should be taken are outlined.

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Precision planting for mechanical thinning. B. DAY. *Sugar J.*, 1971, **34**, (1), 19.—The first essential is concerned with the seed planter. It is important to see that the seed-plate is the correct size for the kind of seed used. Thinning machines have no means of eliminating doubles and a single seed only must be dropped at any given spot. Seed cans or hoppers should be allowed to run low occasionally to make sure oversize seeds are not collecting in them, for they will prevent operation with the normal seed and cause gaps. Correct depth of planting and electronic thinning are discussed.

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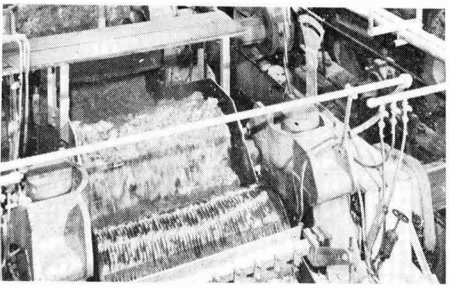
Field mechanization in Michigan sugar beets. ANON. *Sugar J.*, 1971, **34**, (1), 20–21.—Michigan is the fourth most important sugar beet producer in the United States, being ahead of 13 other states but behind California, Colorado and Idaho. In 1970 Michigan sugar beet growers made an incredibly rapid transition from using hand labour for thinning and hoeing to adopting space planting and chemical weed control. These changes, combined with favourable weather, led to a record sugar beet harvest. The area devoted to sugar beet may now exceed 84,000 acres.



Cane sugar manufacture

Influence of the cane juice purification process with active magnesium oxide on the technology of production of raw and refined sugar. O. ARGUDÍN. *Sugar News* (India), 1971, **3,** (2), 17–20.—See *I.S.J.*, 1970, **72,** 114.

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A modern sugar factory in the Philippines. A. GELLY. *Ind. Alim. Agric.*, 1971, **88,** 1063–1069.—Details and illustrations are given of equipment installed in the Fives Lille-Cail sugar factory erected near Santa Catalina, Negros Oriental, Philippines, for the Tolong Sugar Milling Co. The factory, which crushed the first cane in December 1970, has a daily capacity of 3000 tons of cane, expandable to 6000 t.c.d.

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Diffusion in sugar cane. M. OLAECHEA G. and J. DE LA BASTIDE. *Azúcar y Productividad* (Venezuela), 1971, (1), 30–46.—The principles and practice of sucrose extraction from cane by a diffusion process are discussed, with notes on the importance of preparation of the cane, extraction, and drying of the bagasse. Types of diffuser design are briefly described and details given of individual makes of diffuser, including the De Smet, BMA, DDS, Silver and "Saturne" units.

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What diffusion is. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1971, (257), 5–6.—The relationships between quantities of cane, water, bagasse and juice in a diffusion process are explained simply and illustrated by diagrams. Brief reference is made to the claim that the process is more correctly called lixiviation or percolation.

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The power factor. P. S. KHOKHAR. *Indian Sugar*, 1971, **21,** 71–74.—The author explains the significance of the power factor and how to increase it by means of a capacitor. Data are given for calculating the size of a capacitor for a given duty and recommended ratings for capacitors for use with induction motors are tabulated. The monetary savings possible by increasing the power factor are calculated.

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Some practical aspects of the manufacture of bold grains in the Indian sugar factories. D. R. PARASHAR. *Indian Sugar*, 1971, **21,** 161–167.—The advantages of larger grain sugar are discussed and data presented to show the better curing and storage properties of such sugar. It is shown that while there is need for greater evaporator capacity to handle low-grade sugar remelt of higher Brix than normal clear juice, the result will be less steam consumed by the vacuum pans and more boiling time available for the growing of larger grains. The question of suitable boiling scheme can only be answered by taking into account various factors governing pan boiling time and syrup concentration, although it is demonstrated that there is no direct relationship between grain size and massecuite quantity.

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Effect of deaeration of juices at various stages of processing or continuous passing of excess of oxygen or nitrogen during sulphitation process of clarification. T. P. SAKSENA, K. K. GUPTA, J. P. GUPTA and R. K. DIXIT. *Indian Sugar*, 1971, **21,** 195–198.—See *I.S.J.*, 1972, **74,** 148.

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The sugar economy of South Vietnam. N. PHUNG. *Sucr. Franç.*, 1971, **112,** 417–421.—A survey is presented of the cane sugar industry of South Vietnam with information on existing and planned sugar factories and refineries and plantations. Investment plans for the industry and its future prospects are discussed and tables given of data referring to cane and sugar.

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Third sugar silo (140,000 tons) to be built on terminal site. ANON. *S. African Sugar J.*, 1971, **55,** 454–455. Details are given of a third bulk sugar silo of 140,000 tons capacity to be erected alongside two existing silos at the Durban bulk sugar terminal in South Africa. It will be similar to the existing silos[1] with some improvements considered desirable in the light of experience. A 10,000-ton insulated circular silo is also to be built for storage of bagged refined sugar. Bagging will be carried out at the existing raw sugar bagging station at the terminal.

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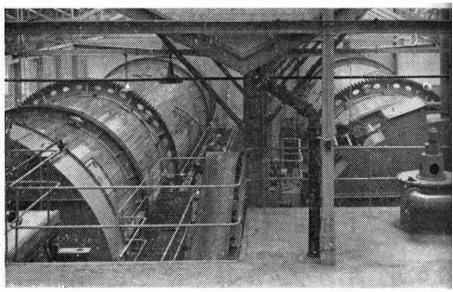
Darnall pan has many new features. A. VAN HENGEL. *S. African Sugar J.*, 1971, **55,** 481–485.—Details are given of a centre-flow calandria-type vacuum pan installed in Darnall sugar factory for *A*-massecuite (and occasionally *B*-massecuite) boiling. Designed and manufactured by members of the Huletts Group, the pan incorporates an internal condenser which is the subject of a patent. The nominal pan capacity is 50 tons of massecuite and its heating surface 285 m^2.

[1] *See also I.S.J.*, 1964, **66,** 156.

Beet sugar manufacture



The Goslawice juice purification system. K. KOPERA. *Gaz. Cukr.*, 1971, **79**, 129–134.—The carbonatation system introduced at Goslawice sugar factory (Poland) in 1967 involves adding lime (to make a total of 1·2% CaO on beet) in four doses: 0·20% in preliming, 0·40% in main liming, 0·50% in 1st carbonatation and 0·10% in 2nd carbonatation (where sodium carbonate is also added). Tabulated results for four campaigns during which the system has been used are compared with the two campaigns directly preceding its introduction; they indicate lower colour in thin and thick juice and white sugar, lower thick juice lime salts and slightly higher thick juice purity, but molasses yield and sugar content have also risen. Overall lime consumption is markedly reduced.

* * *

A screen for milk-of-lime purification. J. WOLAŃSKI and J. SOLTYSIAK. *Gaz. Cukr.*, 1971, **79**, 135–136, 151.—Details are given of an electrically-driven vibratory screen which has been used for some years in a number of Polish sugar factories to remove grit from milk-of-lime which it receives from the slaker above and passes on to one of two mixers.

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Application of the CEPI apparatus for evaporator protection in the sugar industry. D. SPANOVIC. *Gaz. Cukr.*, 1971, **79**, 143–146.—See *I.S.J.*, 1971, **73**, 118.

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Effect of temperature of heating on beet pulp quality. M. G. PARFENOPULO. *Izv. Vuzov., Pishch. Tekh.*, 1971, (2), 97–99.—From empirical equations is derived an expression for calculation of the time required to dry a layer of beet pulp in terms of the temperature of the furnace gases so that there is no deterioration caused by scorching.

* * *

Effect of the effective temperature difference in evaporators on the heat transfer coefficient. S. ZAGRODZKI and M. WACHOWICZ. *Zucker*, 1971, **24**, 471–477. Experiments with a special apparatus are described, in which 10–60°Bx sugar solutions were exposed to evaporation conditions and the various parameters measured. Results, given in tabular and graph form, indicate that the highest values of the heat transfer coefficient were obtained at a difference between solution boiling temperature and condensate temperature of 10°C, after which further increase in the temperature difference was accompanied by a fall in the coefficient. Hence, as high an effective temperature difference (up to 10°C) as possible is recommended for a 1st effect, where a high temperature in the steam chest will not adversely affect the juice quality, while the same amount of water can be evaporated but with a smaller heating surface. Because of the fall in the heat transfer coefficient with increase in concentration, remelt liquor should not be added to thin juice before evaporation.

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Limestone calcination for sugar factories. A. PASETTI. *Zucker*, 1971, **24**, 477–481.—See *I.S.J.*, 1971, **73**, 182.

* * *

The technological value of frozen beet. J. TRZEBIŃSKI. *Gaz. Cukr.*, 1971, **79**, 159–168.—The fall in processing quality of initially frozen beet which thaw during storage is discussed and immediate processing of such beet recommended. Data are tabulated showing the chemical composition of beet which have undergone putrefaction after thawing.

* * *

How to prevent losses during storage of sugar beet. A. FILUTOWICZ and S. KRASUCKI. *Gaz. Cukr.*, 1971, **79**, 169–172.—Marked deterioration occurs in beet which have been topped during harvest but left in the ground, particularly during warm, wet conditions. Of considerable significance for beet health during storage is ripeness, since unripe beet respire more and lose more sugar than do ripe beet. Different varieties react differently to prolonged storage, and those containing more sugar lose it more quickly. The authors consider it better to process the varieties of higher sugar content early in the campaign and leave the more fertile varieties until later.

* * *

Does the ionic composition of diffusion water affect the diffusion buffering system, the raw juice ionic composition and the pressing capacity of exhausted cossettes? H. SCHIWECK. *Zucker*, 1971, **24**, 523–537. Investigations have shown that the buffering capacity of diffusion water has little effect on the diffusion buffering system and that it is almost impossible to reduce the pH in diffusion by adding acids to the water. If the diffusion pH is lower than that of the press juice, it is a result of considerable acid formation from sugar by bacterial action, and the press water pH is thus a good indicator of the microbiological conditions in diffusion. While practically all the cations in diffusion water pass into the raw juice, provided they do not displace other cations bound to the pectins in the cossettes, they do not have any

noticeable effect on thin juice purity, while anions, 85–90% of which can pass from press water into raw juice after considerable pressing (giving only 20–25% pulp on beet), can exert considerable influence. Acidification of the water with HCl, H_2SO_4 or SO_2 will only aggravate the situation, since while there is an excess of alkali ions in thin juice, additional anions will form their corresponding alkali salts. Experiments, in which condensate was used as diffusion water after treatment with a weakly acid cation exchange resin in H^+ form to remove the ammonia, showed a marked reduction in the ash content of the water, juice and press-water, while the quantity of alkali ions remaining in the exhausted cossettes was increased. Moreover, the diffusion water obtained by this means was free of bacteria, while ZAGRODZKI *et al.* have found[1] that the colloid and pectin contents in raw juice were reduced by condensate ion exchange treatment. No relationship was found between exhausted cossette cations and pressing quality, which was found to be governed by pH and pulp press design and throughput. The question of reducing the pH of exhausted cossettes in order to raise pulp dry solids and by adding calcium chloride is also discussed.

* * *

Investigation of a method for determining the coefficient of processing performance and sugar yield. K. I. MUSOLIN. *Sakhar. Prom.*, 1971, **45**, (8), 15–17. Formulae are presented for calculation of the so-called "coefficient of processing performance", K_T, and beet sugar yield, z. They take the form $K_T = (1 - P_m/P_s)/(1 - 0{\cdot}01\ P_m)$, where P_m and P_s are molasses and syrup purities, respectively, and $z = K_T(D - L)$, where D is beet sugar content and L is sugar loss during processing. Possible applications of the formulae to evaluate beet varietal processing quality as well as factory performances are discussed, while a further formula is derived for calculation of molasses purity as a function of syrup purity. An earlier formula of KHVALKOVSKII is not recommended, for reasons given, for calculation of the extra sugar obtained by raising thin juice purity.

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Effect of cossette shape on performance characteristics of an S-17 diffuser. V. A. MASLIKOV and YU. G. BLEDNOV. *Sakhar. Prom.*, 1971, **45**, (8), 18–20. Experiments in which groove-shaped and flat cossettes were processed in an S-17 continuous beet diffuser showed the the latter shape had a number of advantages over the former, including lower juice draft and pulp losses.

* * *

The use of clarifiers. A. P. PONOMARENKO. *Sakhar. Prom.*, 1971, **45**, (8), 20–21.—Investigations at Lokhvitskii sugar factory showed that, in contrast to previous views in the USSR that 1st carbonatation juice clarifiers caused increased colour, the colour of intermediate products was in fact lower than at other factories not equipped with clarifiers, despite the fact that the beet quality was poorer at Lokhvitskii and a high temperature (130°C) was used in the 1st evaporator effect.

* * *

Investigation of electric drives for APN vertical automatic centrifugals. V. D. VASIL'EV, G. E. KOLOMIETS and I. G. LOKHONYA. *Sakhar. Prom.*, 1971, **45**, (8), 21–23.—Tests in which an A.C. 5-speed asynchonous drive was compared with a D.C. thyristor drive in operation of a Soviet APN fully-automatic centrifugal showed that the latter drive offered advantages over the former, particularly in the reduced power consumption resulting from "coasting" (centrifugalling with the motor switched off). The suitability of a control system based on non-contacting logical elements was demonstrated.

* * *

Effect of beet quality, storage methods and processing on undetermined sugar losses in diffusion. A. YA. ZAGORUL'KO, S. A. BOGDANOV and T. P. KHVALKOVSKII. *Sakhar. Prom.*, 1971, **45**, (8), 24–28.—The occurrence of real and apparent undetermined losses in beet diffusion is discussed, particular attention being focused on reducing matter accumulation and the action of beet invertase. Means of minimizing the losses are considered, involving beet quality, storage and diffusion.

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Modification of the scheme of operation of candle filters. A. M. BUNYAK and V. I. RADALOVSKII. *Sakhar. Prom.*, 1971, **45**, (8), 30–31.—Details are given of modifications to the automatic operation of candle filters at a Soviet sugar factory where a drop in the level of juice in the feed tank below that required to feed the filters and consequent recycling of filtrate has led to subsequent overfilling of the tank through delay in opening the feed valve, affecting the pressure in the filter and hence the kieselguhr precoat.

* * *

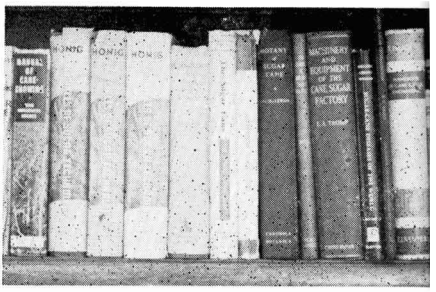
Improvement in the processing qualities of sugar beet in the Kazakh Republic—an urgent problem. E. A. VISHNEVSKII. *Sakhar. Prom.*, 1971, **45**, (8), 32–36. Reasons are given for the deterioration in beet quality in this Soviet republic, where raw juice purity in 1962/63 and 1966/67 averaged 85·4 and 81·3, respectively, compared with 85·8 in 1939/40. Improvements in beet agriculture are called for.

* * *

Gravity screens in the sugar industry. I. BOHAČENKO and M. STERZINGER. *Listy Cukr.*, 1971, **87**, 178–184. Full-scale trials of special hyperbolic screens designed for straining of press, flume and wash waters have shown that they are highly efficient in removing organic impurities and are recommended for pretreatment of water before clarification or hydrocyclone treatment. Preliminary results from tests on raw juice depulping are also reported.

[1] *I.S.J.*, 1967, **69**, 22.

New books



The analysis of molasses. (United Molasses Trading Co. Ltd., Bowater House East, 68 Knightsbridge, London SW1X 7LP, England.) 1971.

This work, produced in the form of thirteen sections and a collection of tables housed in a loose-leaf ring binder, has been introduced with the aim of providing a manual for commercial reference and for the working chemist. United Molasses, the principal international company concerned with molasses supply, has also endeavoured to introduce uniformity by restricting the methods used for each analytical procedure to those two which are of best reproducibility and widest general acceptance. The methods described have for the most part received recognition by ICUMSA and AOAC.

The first four sections deal with molasses composition, principles of molasses analysis, general laboratory notes, and preparation and standardization of Fehling's solution, after which the remaining sections cover determination of reducing sugars, sucrose, raffinose, unfermentable reducing matter (as invert equivalent), solids and Brix, sulphated ash, SO_2, gelling properties and viscosity. The subject matter is well presented and easily legible, and the work is obviously going to be of great value to anyone engaged in molasses analysis. Copies are obtainable from the Technical Services Dept. of UMTC at the address given above.

* * *

Problems of (the) Bangladesh sugar industry and their remedial measures. M. Y. Ali and A. B. Khan. 54 pp; 21·5 × 27·5 cm. (Atomic Energy Centre, Dacca, Bangladesh.) 1972.

The sugar industry of the former East Pakistan was based on the cultivation of 120,000 acres of cane land, intended to produce 1,800,000 tons of cane to be converted to 126,000 tons of sugar, during a crushing season of 120–130 days. In fact, the mills operated at only 42% of capacity in 1968/69, 60% in 1969/70 and 70% in 1970/71, owing to shortage of cane supplies around the mill zones. The present report has been prepared as a survey of the present state of the industry following the achievement of independence, and it gives an account of the formidable problems facing the Bangladesh Industrial Development Corporation now responsible for the sugar industry.

These stem largely from the lack of provision of cane development and extension facilities, and persistent need for "development" staff to spend their time in cane procurement for the mills. With adoption of varieties already known to be suitable and of higher yield, cane and sugar production could be greater, but even more the farmers need aid in fertilization, pest and disease control, irrigation and drainage, etc. Experience in other countries, particularly Taiwan, is drawn upon, and quotations made from surveys by sugar consultants in previous years. Recommendations are made from both technical and economic aspects, and it is proposed that the Sugar Division of the BIDC become a Sugar Corporation under the Ministry of Agriculture with responsibility for all aspects of cane growing and sugar manufacture, diversification and training, etc. The prospect of higher sugar consumption in the country requires consideration of expansion of the industry, emphasizing the need for radical reorganization to prevent the sugar industry from disappearance owing to replacement of cane by rice, wheat, tobacco and oil seed crops.

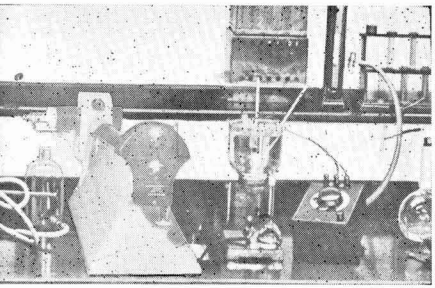
* * *

Sugar price movements in world and US domestic markets 1963-1970. (C. Czarnikow Ltd., Plantation House, Mincing Lane, London E.C.3.) 1971.

The latest copy of this 22 × 30-inch graph gives, as did its predecessors, a clear picture of the world and US domestic sugar prices using the Commonwealth Sugar Agreement Negotiated Price as a guideline. Although ending with December 1970 and therefore not reflecting the continuing increase in world prices throughout 1971, the graph nevertheless shows the general rising trend from operation of the International Sugar Agreement on 1st January 1969 and away from the extremely low prices of 1966–1968. The prices are given in US cents/lb and £/ton (before and after the 1967 sterling devaluation). The average world values during 1933–1970 are shown by a smaller graph in an inset panel, while factors having significant effect on the prices are noted in appropriate places on the larger graph. For anyone interested in the subject there can probably be no better acquisition than this graph, copies of which are obtainable from the company, one of the leading sugar brokers in the world, at the address given above.

Hawaii sugar production, 1971[1].—Final figures for sugar production in Hawaii show a total of 1,229,976 tons, 96° sugar. This is the third largest output in the past ten years.

[1] *Sugar y Azúcar*, 1972, **67**, (5), 40.



Laboratory methods & Chemical reports

The equilibrium relative humidity of raw sugar. K. F. MILLER and P. G. WRIGHT. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 83–88.—After discussing the significance of the relationship between equilibrium relative humidity (ERH) and the dilution indicator (DI) of a sugar, the authors describe work on ERH measurement. A method used by them, involving a Lambrecht Pernix hygrometer with modified hair element probe, gave results (expressed as a semi-log graph of ERH *vs.* DI) in close agreement with values obtained by TROTT[1] and the Sugar Research Institute (using closed-circuit systems and dew point apparatus) which were plotted on a second graph. Regression equations are given for both sets of results, that for the findings of TROTT and the SRI being considered the more suitable (ERH = 51·20 log DI — 15·00 with 95% confidence limits of ±7·5% RH). Although this equation should apply only to temperatures in the range 20–30°C and 97–99 pol, results of tests indicate that the ERH-DI relationship is independent of temperature up to 60°C and of pol below 99, although it may not apply to pol values greater than 99.

* * *

Micro-organisms in field and mill—a preliminary survey. D. BEVAN and J. BOND. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 137–143. A preliminary survey conducted by the Sugar Research Institute has revealed over 300 different micro-organisms in cane and sugar factory products. The findings are discussed under the headings of: green, burnt and chopped cane in the field, and prepared cane, cane mill, mixed juice and subsequent thermophile-infected products in the factory. Possible means of bacteriological control discussed include the use of bactericides and general mill hygiene.

* * *

The effects of varying percentage pol in open cells in prepared cane. L. A. PASTEGA. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 217–223. Tests to determine the effect of varying degrees of cane preparation on % pol in open cells involved drying 1000-g samples of chopped cane after fibrating for varying period of time with a hammer mill. The "mean particle thickness" of the dried material was calculated, after sieving the bagasse through screens of four different square apertures, as follows:

$$\frac{\text{sum of (\% of each fraction} \times \text{its thickness in mm)}}{100}.$$

A linear inverse relationship was found between mean particle thickness and % pol in open cells as determined by the SRI method[2]. Equally, an inverse relationship was found between particle thickness and extraction as well as a marked direct relationship between % pol in open cells and % pol extraction. However, in all cases differences were noted between the two varieties of cane involved, including the time required for the hammer mill to give the same pol in open cells. As the fineness of preparation increased, the differences in extraction between the two varieties decreased, although even at the same particle thicknesses, the % pol in open cells was higher in cane of one variety than in the other.

* * *

The influence of deteriorated cane on raw sugar filtrability. G. P. JAMES and J. M. CAMERON. *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 247–249.—From determinations of filtrability and of dextran content of 51 samples of sugar produced at the authors' sugar factory during some 6 weeks, it is concluded that cane deterioration, as expressed by dextran content, has a significantly reducing effect on raw sugar filtrability.

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Contribution to the knowledge of reducing substances in technical sugar juices. E. REINEFELD, K. M. BLIESENER, M. PALM and J. MÜLLER. *Zucker*, 1971, **24**, 420–426.—See *I.S.J.*, 1972, **74**, 88.

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Conversion of monosaccharides during acid hydrolysis of polysaccharides. R. BRETSCHNEIDER, I. BOHAČENKO, K. PATEROVÁ and B. KOPŘIVA. *Listy Cukr.*, 1971, **87**, 126–131.—Experiments were carried out to determine the effect of sulphuric acid on D-glucose, D-galactose, D-fructose, L-arabinose and D-xylose when carrying out acid hydrolysis of polysaccharides present in beet juice. At concentrations in the range 0·1–1N and 105°C decrease in the sugars content was caused almost exclusively by hydrolysis to furfural or 5-hydroxymethylfurfural. Limiting conditions were determined under which polysaccharide hydrolysis is accomplished at a fall in monosaccharide content no greater than 5%. For dextran and galactan, hydrolysis should be carried out with N sulphuric acid for 8 hr at most, for levan with 0·5N acid for 1 hr, and for araban and xylan with N acid for no more than 3 hr.

[1] *Proc. 14th Session ICUMSA*, 1966, 119, 120.
[2] HENDERSON: *I.S.J.*, 1971, **73**, 90.

Estimation of parameters of sugar granulometry. G. PIDOUX. *Sucr. Franç.*, 1971, **112**, 335–340.—By means of probability graphs and mathematical explanations, the author shows that the POWERS method of sieve analysis for sugar crystal evaluation requires modification in order to conform to all cases, and that four screen sizes should be used instead of just two.

* * *

Evaluation of viscometers for use in determining molasses viscosity. T. MORITSUGU and G. E. SLOANE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 132–133.—Experiments are reported which were carried out to find the cause of differences in readings given by an HSPA and two Brookfield viscometers, all three being of the rotating cylinder type. Because of their large cup radius:bob radius ratios, the two Brookfield instruments are classed as infinite-cup types for which calibration with a Newtonian liquid, as generally used for viscometers, is not valid, in contrast to the HSPA instruments, which had a much smaller ratio between cup and bob radii. Hence, an allowance for shear with the Brookfield instruments, where the conditions are quite different from those used in viscometer calibration, would, it is expected, reduce the readings to the value given by the HSPA viscometer.

* * *

A better procedure for analysing pol in molasses. T. MORITSUGU. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 135–136.—Modifications to the procedure, which has been adopted as a tentative method in Hawaii, involve (i) adding 0·9 g of basic lead acetate per 1% refractometric solids to the diluted solution after refractometric measurement, in contrast to the "as-needed" basis previously applied, and (ii) use of a 100-mm tube for saccharimeter readings as opposed to a 200-mm tube. At the recommended proportions of lead acetate, dilution at 1:5 and 1:9 had a negligible effect on the determination.

* * *

Burned *vs.* unburned cane—effect on refinability characteristics. J. C. TU. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 141–142.—Tests showed that juice and syrup from unburnt cane contained more methanol-insoluble and water-insoluble matter, gel, glucose polysaccharides and colour than did juice and syrup from burnt cane, which had lower viscosities and light-scattering intensities as well as better colour and filtrability. Differences in grain size (the sugar from the unburnt cane juice was coarser) had no effect on the refining properties.

* * *

Effect of grain size of colour and filtrability. T. MORITSUGU. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 142–143.—Tests have indicated a direct relationship between sugar grain size and colour, increase in colour per unit increase in grain size being greater for sugars of higher colour content. Filtrability decreases with increase in grain size, the extent of change being generally greater with poorer filtrabilities.

* * *

New analytical methods for use in refinability research. J. C. TU. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 143–145.—Three new methods have been developed for juice and syrup analysis in determining refining properties: (i) total amino-acid determination by adding ninhydrin to the sample and measuring the colour formed at 560 nm; (ii) hexose polysaccharides determination by precipitation with alcohol, thermal hydrolysis under acid conditions to hexoses, and measurement at 620 nm of the green colour formed by reaction between the hexoses and added anthrone; and (iii) dissolution in 5% KOH of the water-insoluble and 50% methanol-insoluble fractions in juice or syrup, followed by measurement of the viscosity of the resulting solution and comparison with the viscosity of 5% KOH solution. The difference is an approximate measure of the polysaccharide content, which represents the major high-molecular weight substances present.

* * *

Electronic calibrator for automatic saccharimeter. G. E. SLOANE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 145.—A modification of a method developed by the Thorn-Bendix Corporation involves passing D.C. of known intensity through the coils of the optical modulator unit of the saccharimeter. This causes rotation of the polarized light beam and a reading which should be equal to a previously determined value. Preliminary tests indicate the possibility of setting the calibrating current to within 1 part per thousand, which is adequate for instruments in factory use, although an accuracy of 1 part per five thousand may even be possible.

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Tests on an indicator for moisture content of bagasse. G. E. SLOANE. *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 146.—A Model 106 "Moisture Analyser" manufactured by Anacon Inc., of Ashland, Mass., USA, has been tested for bagasse moisture determination. The instrument sends an infra-red beam to the surface of the sample and measures and compares the intensity of the reflected beam at two wavelengths, corresponding to absorption by moisture and the absence of moisture. Samples of bagasse of known moisture content are then used for calibration. Distance of the sample from the instrument was found to affect readings.

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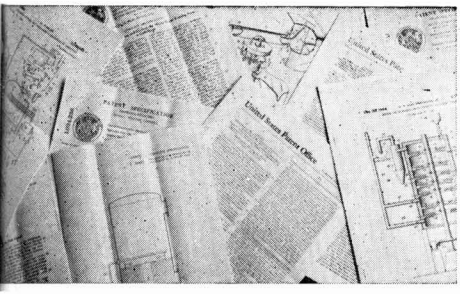
Crystallization capacity of syrup from different beet varieties. A. YU. GADZHIEV and I. P. OROBINSKII. *Sakhar. Prom.*, 1971, **45**, (7), 27–28.—In studies using syrups from three different Soviet beet varieties, the highest crystallization rate was observed in syrup (from R100 variety) containing considerably more reducing sugars than the syrups from the other two varieties, while the lowest crystallization rate occurred in syrup from RO6 which contained much more colloids than the other two syrups.



Patents

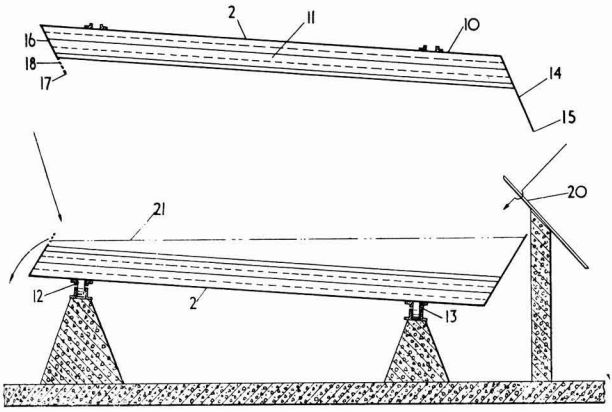
UNITED KINGDOM

Sugar production. TATE & LYLE REFINERIES LTD., of London E.C.3, England. **1,240,691.** 26th September 1968; 28th July 1971.—Solid particulate sugar is produced by drying droplets [produced by spraying (at 65–90°C) a sucrose-containing syrup (of at least 70°Bx and containing $\geq$ 10% invert and $\geq$ 4% ash) through a rotary atomizer into a drying chamber] (co-currently) in a moving airstream (at 80–260°C) having entrained within it seed particles (having a mean size of 10–150 microns). The seed particles are provided by recirculating a proportion of the previously obtained solid sugar.

* * *

Beet or cane diffuser. O. D'HOTMAN DE VILLIERS, of Durban, Natal, South Africa. **1,241,437.** 4th October 1968; 4th August 1971.

The drum 10 is mounted for rotation on rollers 12, 13, the former being higher than the latter so that the drum is tilted out of horizontal. The casing of the drum is closed at its lower end by an annular discoid plate 14 and at the higher end by a corresponding plate 16, the inner portion 18 being perforated in such a way that the perforations are at a lower level than the bottom of the aperture 15 on the lower end of the drum.



Within the drum are longitudinal baffles 11 which are corrugated and which raise and hold solid material (shredded cane) until it almost reaches the top of the drum, thereafter falling to a point along the drum nearer the lower end. At the lower end, the cane falls onto baffle 20 which takes it out of the drum. Water supplied at the lower end flows by gravity along the drum and overflows through the perforations in the end portion 18 of plate 16.

* * *

Method of agglomerating (sugar). W. J. MEGOWEN, of Carlisle, Mass., USA. **1,244,525.** 14th April 1969; 2nd September 1971.—Particles (of sugar) are agglomerated and broken in a first stage to produce agglomerated particles of a size not greater than a first pre-determined size. The fraction of the product comprising the larger particles, of a size in a pre-determined range with the first pre-determined size as its upper limit, is separated (by air classification) and subjected to a second agglomerating and breaking stage to produce twice-agglomerated particles not greater than a second pre-determined size. This is separated into three fractions; those particles in the first pre-determined size range, those in a second range (the larger particles), and those particles smaller than either the first or second range. The first of these fractions is recycled through the second stage and the last fraction recycled through the first stage (as are the smaller particles from the original first stage separation). The second fraction is subjected to a third agglomerating and breaking stage and separated into further fractions including one where the particles are in a third pre-determined size range, and smaller fractions which are recycled to appropriate previous stages.

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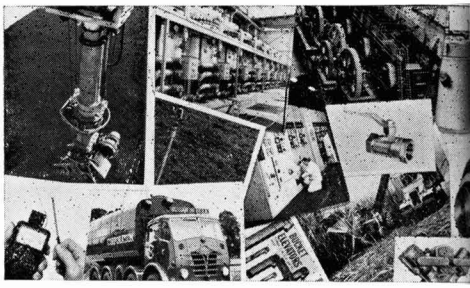
(Continuous) centrifugal. WESTERN STATES MACHINE CO., of Hamilton, Ohio, USA. **1,247,279.** 10th December 1969; 22nd September 1971.—See US Patent 3,490,947[1].

* * *

Soft sugar production. CANADA & DOMINION SUGAR CO. LTD., of Montreal, Quebec, Canada. **1,247,866.** 15th March 1968; 29th September 1971.—Onto a falling curtain of white sugar particles (of uniform size, less than 0·01 in) is atomized (at 1000–3000 psig pressure) an edible carrier liquid comprising (decolorized) sugar syrup [having a colour of 11,000 milliabsorbency units at 420 nm, containing 15–25% (18–22%) water, 15–40% invert sugar and 6–10% mineral salts, at a temperature sufficiently high to allow proper fluidity (45–85°C, 55–75°C)]. The rates of white sugar and/or syrup feed are so controlled that the sugar particles receive a coating of 0·1–1 micron.

[1] *I.S.J.*, 1971, **73**, 29.

Trade notices



Anti-foaming agent. Fabcon Inc., 33 Public Square, Cleveland, Ohio, USA.

"Sucrox" is a surface-active agent specifically developed as an anti-foaming agent for beet and cane molasses. Two years of field evaluation have shown that it will eliminate up to as much as 30% foam by volume in molasses tanks when used at the basic rate of 2 lb per 1000 tons of beet sliced. It is best dripped as an aqueous solution into the molasses being discharged from the low raw centrifugal. Apart from preventing foam, "Sucrox" will also improve molasses flow in and out of transport tankers.

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Steel belts. Sandvik Conveyor Ltd., Manor Way, Halesowen, Worcs., England.

The use of Sandvik steel belts for conveying has been extended to the application of the belt as a continuous moving band in drying and cooling. A new 18-page brochure describes clearly and concisely how Sandvik steel belts can thus be applied to all manner of products, including beet pulp, which can be cooled by passage on a perforated steel band over suction fans at the rate of 10 tons/hr. A separate leaflet (Case History 13/1) describes application of the same suction cooling system to beet pulp at the Karpalund sugar factory of the Swedish Sugar Corporation. The system used measures no more than 1·2 m wide and 8 m long (lack of space was one factor to contend with at Karpalund). The pulp on a 3·7-m stretch of the perforated steel belt is cooled from 70°C to 30°C while passing over fans and air ducts. Throughput is 8 tons/hr, and since installation in 1970 the continuous system has worked for 2000 hours without a stoppage.

* * *

Checkweigher. Driver Southall Ltd., Villa St., Hockley, Birmingham 19, England.

Driver Southall have introduced the 0215 "R" high-speed automatic checkweigher to replace a Mark II model first launched about 3 years ago. The new model operates on the same principle as the previous model but its performance is better with a 60% increase in average speed. One feature is the patented flexure weigh beam which has been re-designed to permit an increased operating speed while still maintaining an accuracy of $\pm$ 0·5 g. Packets weighing up to 6 lb can be accepted and rates of up to 250 packets per minute can be achieved.

PUBLICATIONS RECEIVED

POWER TRANSMISSION EQUIPMENT. Renold Ltd., Renold House, Wythenshawe, Manchester, M22 5WL England.

Recent brochures from the Renold Group, the largest organization in the world devoted exclusively to the manufacture and distribution of power transmission and mechanical handling equipment, describe the Renold torque limiter (designed primarily for use with chain drives and available in ten sizes covering maximum torque capacities from 50 to 1050 lb.ft to protect machinery against overloading, jams and shock loads), Crofts crown pin flexible couplings (available in 38 sizes for shafts up to 12 inches in diameter and with maximum power ratings ranging from 21 hp at 5800 rpm to 14,000 hp at 420 rpm), and Crofts shaft-mounted helical gear units capable of transmitting up to 59 hp at a maximum output speed of 425 rpm in gear ratios of 5:1, 15:1 and 20:1.

* * *

BELT CONVEYORS. Seeger Engineers Ltd., Progress Drive, Cannock, Staffs., WS11 3JE England.

Information on Seeger Engineers conveying equipment is contained in a number of brochures covering flat belt, gravity roller and screw conveyors as well as bucket elevators and pneumatic conveying equipment including rotary blowers. These and other conveyors available from the firm are obtainable in various widths and lengths. The range of belt conveyors is designed to give flexibility, and the full range of belt widths, type of belt and length of unit makes the conveyors attractive regarding both design and costs.

* * *

MOBILE BELT CONVEYORS. Rapistan Manufacturers Equipment Co. Ltd., Sutton Rd., Hull, Yorks., England.

A 4-page brochure describes "Rapistan" mobile belt conveyors, available in six models (light-, medium- and heavy-duty) and the "Floor-veyor Junior" models 401 and 451, the last two designed primarily for horizontal operation while the others can be used for sloping or horizontal operation. Available lengths, bed and belt widths depend on the model in question.

* * *

ROLLER CHAINS. Sedis, 102 rue Danton, 92 Levallois-Perret (Hauts-de-Seine), France; Sedis Co. Ltd., 9 Quarry Park Close, Moulton Park, Northampton, NN3 1QB England.

Sedis, a member of the Peugeot Group, is a company founded some 25 years ago for the manufacture of precision roller chain. The range of chains produced covers all known applications, and a 12-page brochure gives information on a number of such Sedis products.

Cane sugar machinery from Brazil.—M. Dedini S.A., cane sugar machinery manufacturers of Piracicaba, São Paulo, Brazil, are supplying a 12-roller milling tandem, complete with gears, turbo-reducers, conveyors and knives, to El Salvador. Roller length is 34 × 66 inches. A cane sugar factory designed and supplied by the Brazilian firm to Venezuela on a turn-key basis is at present under construction.

Taiwan sugar exports[1]

	1971	1970
	(*metric tons, raw value*)	
Refined sugar		
Hong Kong	992	323
Indonesia	13	0
Japan	2,180	3,110
Jordan	1,255	0
Laos	545	0
Malaysia	177	23
Vietnam, South	6,800	0
Other countries	886	682
	12,848	4,438
Raw sugar		
Cambodia	3,088	0
Indonesia	10,911	0
Japan	149,349	121,867
Korea, South	266,061	220,769
USA	77,902	78,515
Vietnam, South	20,586	0
Other countries	0	20
	527,897	421,171

Canada sugar imports 1971[2]

	1971	1970	1969
	(*long tons, tel quel*)		
Raw sugar			
Australia	271,048	265,235	215,489
Bahamas	—	—	4,505
Brazil	—	4,607	—
British Honduras	23,984	24,407	21,708
Colombia	—	—	6,398
Cuba	69,648	67,137	70,874
Dominican Republic	10,541	—	—
Fiji	77,072	61,500	74,289
India	72,478	57,976	—
Malaysia	—	—	10,341
Mauritius	103,078	161,237	199,886
South Africa	209,467	200,546	213,366
Swaziland	41,068	36,887	30,539
Uganda	—	11,551	11,478
USSR	—	20,098	—
West Indies and Guyana	6,099	22,830	72,587
	884,483	934,011	931,460
Refined sugar			
Holland	250	147	252
Norway	98	134	2
UK	37	462	70
USA	66	38	126
Other countries	3	—	178
	454	781	628

Bagasse paper and pulp project in Cuba[3].—The Council of Administration of the United Nations Development Programme has approved a $10,000,000-project in Cuba for establishing a pilot plant for the production of newsprint and dissolving pulp from bagasse. The UN will provide $3,000,000 and the Cuban Government $7,000,000. The F.A.O. and the U.N. Organization for Industrial Development will have charge of the execution of the programme in coordination with the Cuban authorities. The project will provide experience which will be of benefit to cane-growing developing countries and the results will be available to them.

Brevities

Indian sugar crop reduction[4].—The Indian Minister of Agriculture announced in May that 1971/72 sugar production would reach only 3,100,000 metric tons, compared with 3,740,000 tons in 1970/71, as a consequence of the reduced cane area and of unfavourable weather which included heavy rainfall in southern India and drought in northern districts. Sugar exports would probably reach only 100,000 tons in 1972, compared with 320,000 tons in 1971.

* * *

Bagasse pulp project for Australia[5].—Plans for a Queensland bagasse pulp plant were confirmed in Sydney on the 17th May by a representative of the W. R. Grace Company. As a result, one of the world's largest paper pulp plants may be established in Queensland at a cost of $A 72,000,000. Two sites in Mackay are being studied for the plant which would be the first in Australia to use bagasse as a raw material. When in full production the new plant will have a capacity of about 150,000 tons a year, representing about 16% of the total world output. There are indications that Japan would contract to buy about two-thirds of the plant's output, giving the Mackay operation an annual income of at least $A 30,000,000, The remaining output from the plant would also be exported to manufacturers of fine papers and cardboards. With an international shortage of short-fibre timbers emerging, W.R. Grace were confident of a sharp upturn in the demand for bleached bagasse pulp.

* * *

East Germany beet crop, 1971/72[6].—According to recently-published statistics, 4,500,000 metric tons of beet were processed in the 1971/72 campaign in East Germany. The beet yield was 24·3 tons/hectare and the crop area 210,850 hectares, compared with 32·0 tons/ha and 191,658 hectares in 1970/71.

* * *

Barbados sugar crop, 1971[7].—Sugar production in Barbados totalled 130,400 tons, 96° sugar, compared with 148,570 tons in 1970. Recovery was 8·8 tons cane per ton sugar, as against 9·1 tons in 1970, and the cane crop amounted to about 1,210,000 tons. The crop was about 10% below pre-crop estimates and suffered from cane fires, inadequate cane supplies to the factories, stale cane, and poor rainfall distribution in the wet season.

* * *

New US cane sugar refinery[8].—Tasty Baking Company of Philadelphia, Pa., has announced plans to build a 300 tons/day cane sugar refinery at Portsmouth, Virginia. Work is to begin promptly on the new facility, which will represent an investment of $9,000,000.

* * *

Canada beet sugar production 1971/72[9].—Sugar production in Canada during the 1971/72 campaign amounted to 134,680 long tons, compared with 97,218 tons in the previous campaign. The increase was largely due to increased yields in Alberta and Manitoba, the total beet area having been 81,096 acres, as against 68,722 acres in 1970/71.

[1] *Stat. Bull.* (I.S.O.), 1972, **31**, (4), 30.
[2] C. Czarnikow Ltd., *Sugar Review*, 1972, (1067), 53.
[3] *Cuba Economic News*, 1972, **8**, (56), 1.
[4] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (14), 8.
[5] *Queensland Newsletter*, 1st June 1972.
[6] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (15), 6.
[7] *The Cane Farmer*, 1972, **13**, 43–44.
[8] *Sugar y Azúcar*, 1972, **67**, (5), 41.
[9] C. Czarnikow Ltd., *Sugar Review*, 1972, (1075), 91.

Brevities

The late R. W. Mungomery.—The death occurred in March of R. W. MUNGOMERY who, at the time of his retirement in 1968, was Assistant Director of the Bureau of Sugar Experiment Stations. He joined the Bureau in 1925 as an entomologist and was subsequently appointed officer in charge of the Bundaberg experiment station. In 1945 he transferred to the Bureau's headquarters in Brisbane and took charge of Entomology and Pathology, being appointed Assistant Director in 1964. During his 43 years' service he carried out much research on control and eradication of cane pests and diseases, as has been recorded in our pages, while he was the co-author, with N. J. KING and C. G. HUGHES, of the Queensland "Manual of Cane Growing".

* * *

The late J. M. Saha.—The death occurred in January of J. M. SAHA, former Director of the National Sugar Institute, Kanpur, India, after a prolonged illness. He joined the Institute as Professor of Sugar Technology in 1948, becoming Director three years later. He retired in 1955 but remained a member of the Advisory Board and of other committees from time to time. He also served as Superintending Technologist of the Birla Group of sugar factories, instituting the Birla Sugar Research Laboratory at Hargaon, U.P. He made many contributions to the literature, as is evident from the frequent occurrence of his name in our indexes.

* * *

Czechoslovakia sugar beet crop, 1971/72[1].—The 1971 beet harvest in Czechoslovakia amounted to 5,880,000 metric tons, according to official statistics. This compares with 6,640,000 tons in 1970 and 8,000,000 tons in 1968. The average beet yield was only 31·14 tons/ha compared with 36·96 tons in 1970.

* * *

Mechanical harvesting in Barbados[2].—Three chopper-harvesters are to be used in Barbados during the 1972 crop on about 1000 acres of cane. Experiments started about 5 years ago when the Barbados Sugar Producers' Association were trying to determine the type of harvester best suited to the country's terrain. Experiments are continuing with a new type of harvester which has been developed to suit Barbados conditions and will harvest both green and burned cane. It was designed by Mr. C. HUDSON of the Sugar Technology Research Ltd. in Barbados and has been built by F. W. McConnel Ltd., of Ludlow, Shropshire, England.

* * *

Zambia sugar expansion[3].—Sugar production in Zambia in 1971 was 1415 metric tons higher than in 1970, as reported earlier[4] and the Zambia Sugar Co. Ltd.'s expansion programme has been speeded up so that it will give a 50% increase in raw sugar production in two years rather than three. Although the new refinery proposed at Nakambala Estate will mean an end to Zambia's having to import refined sugar, imports of raw sugar may still be necessary as demand for sugar has outstripped all expectations. Sales are presently estimated at 61,000 metric tons, marking a 17% increase over the figure for the year April 1970–March 1971, and are expected to rise to 67,000 metric tons in 1972/73, compared with an estimate of 45,800 tons in the Zambian sugar crop.

* * *

Hungary sugar situation[5].—Up to 1965 Hungary was self-sufficient in sugar and was even able to export sugar beyond her own requirements of 420,000 metric tons. Since then, however, imports have been necessary and reached 150,000 tons in 1971. Measures to encourage an increase of the sugar beet area have been unsuccessful, and yields have been 30% below expectations. In order to raise the reduced beet area to at least 100,000 hectares again, it has been decided to raise the purchase price of beets by 10 forints/100 kg and to pay an additional 5 forints/100 kg to those farms which increase their beet area during the coming four years by 10% compared with the 1971 area.

USSR sugar statistics, 1971[6]

	1971		1970	
Production		8,402,000*		8,848,000
Imports				
Cuba	1,535,709		3,003,290	
Hungary	0		827	
Poland	0		571	
		1,535,709		3,004,688
Exports				
Afghanistan	44,945		53,862	
Algeria	116,844		52,162	
Bahrein	0		4,143	
Bulgaria.....	94,297		160,696	
Ceylon	45,815		33,387	
Cyprus	6,521		3,327	
Egypt	9,705		10,792	
Finland	136,472		138,947	
Gambia	0		2,664	
Germany, East ..	75,239		160,944	
Ghana	16,638		39,045	
Guinea	1,087		5,435	
Hungary	76,377		12,098	
Indonesia	82,322		24,194	
Iran	66,377		59,400	
Iraq	168,262		177,050	
Italy	48,275		35,495	
Jordan	545		975	
Korea, North ..	12,825		33,364	
Kuwait	11,271		10,870	
Lebanon	30,265		24,388	
Libya	0		68,953	
Mali	6,691		22,034	
Malta	165		3,473	
Mongolia	19,391		17,986	
Nigeria	38,007		27,963	
Oman.....	0		2,999	
Qatar.....	0		543	
Saudi Arabia ..	10,632		30,962	
Sierra Leone ..	4,414		5,970	
Somalia	6,522		0	
Southern Yemen Republic	21,092		11,413	
Sudan	71,536		88,033	
Sweden	30,593		11,818	
Togo	1,332		816	
Trucial Oman ..	0		11,615	
United Kingdom	86,078		107,668	
Vietnam, North	16,239		1,078	
Yemen	33,648		49,079	
Yugoslavia	0		11,855	
Other countries	10,453		0	
		1,400,875		1,517,496
Net Imports		134,834		1,487,192
Consumption		10,350,000*		10,247,000

**Estimate*

Sugarcane Breeding Institute symposium.—A symposium is to be held during the 27th—30th September 1972 to celebrate the Diamond Jubilee of the Institute. Sessions will be devoted to breeding methods for obtaining canes of high yield and high sucrose content; breeding for resistance to diseases, pests, drought, frost, water-logging, salinity, etc.; the use of modern cytogenetics in cane breeding; application of breeding advances to producton; and breeding for desired technological characters in sugar cane. Persons wishing to attend the symposium either as an observer or as a contributor should inform the Director, Sugarcane Breeding Institute, Coimbatore 7, Tamil Nadu, India, as quickly as possible.

[1] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (13), 4.
[2] *The Daily Gleaner*, 20th January 1972.
[3] *Standard Bank Review*, May 1972, 20.
[4] *I.S.J.*, 1972, **74**, 63.
[5] F. O. Licht, *International Sugar Rpt.*, 1972, **104**, (13), 4.
[6] *I.S.O. Stat. Bull.*, 1972, **31**, (5), 106–107.

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