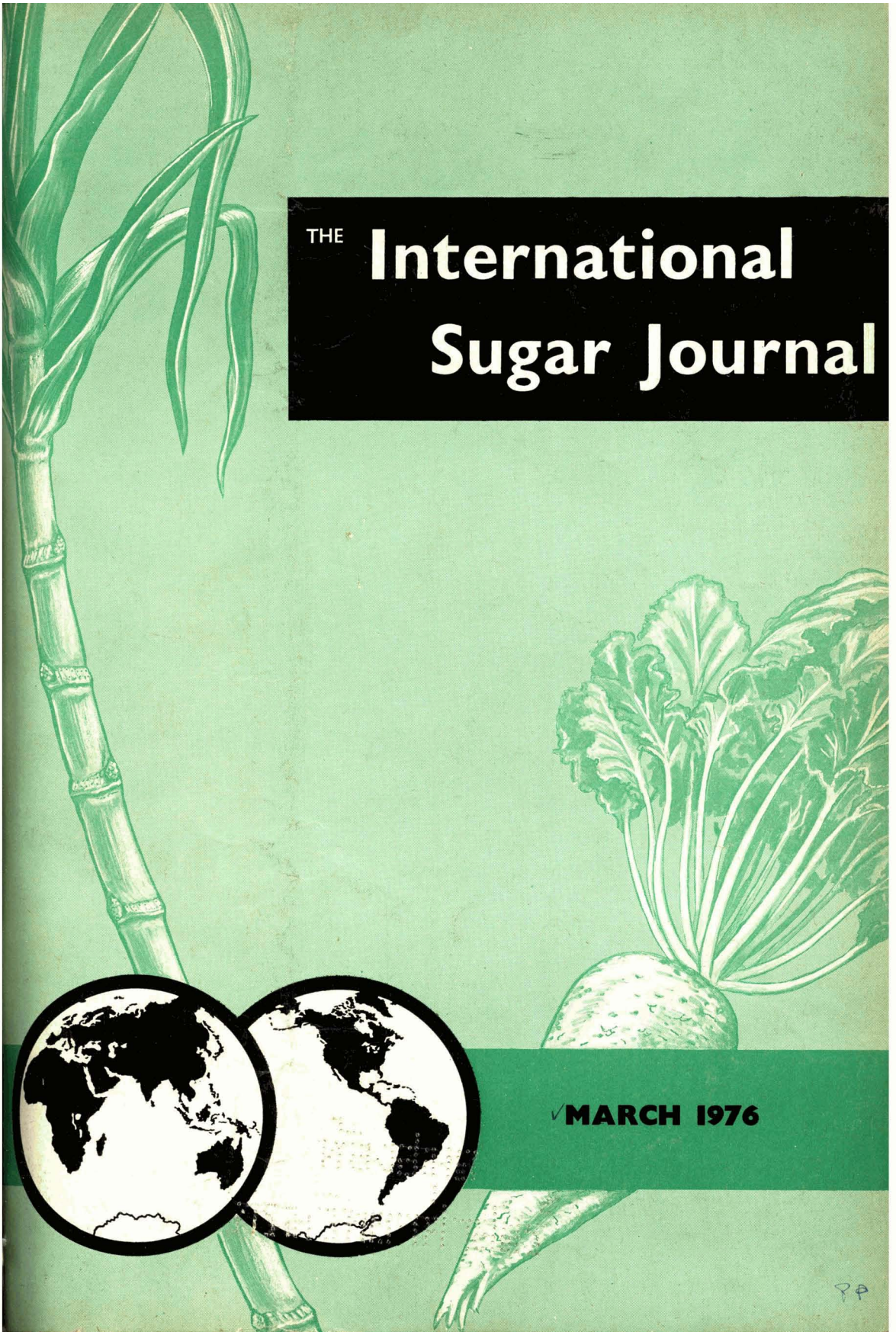
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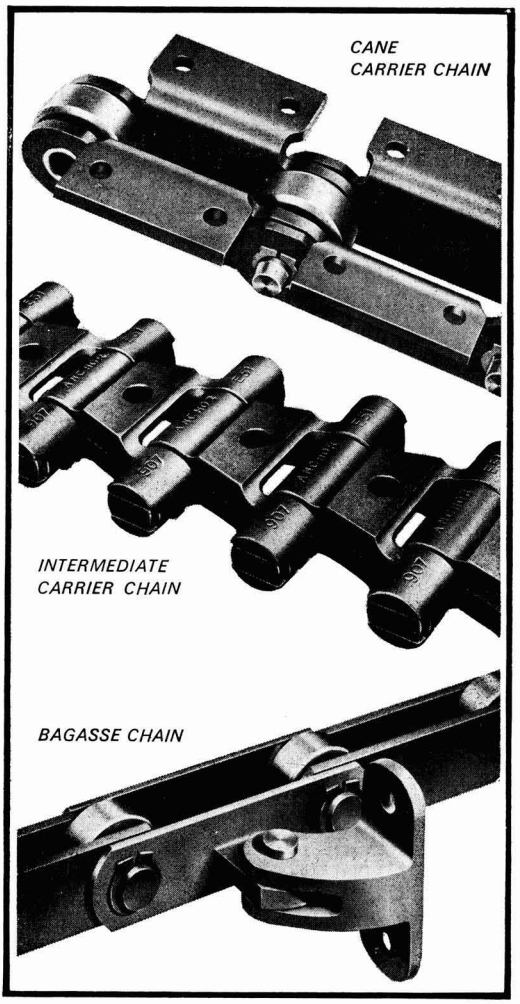

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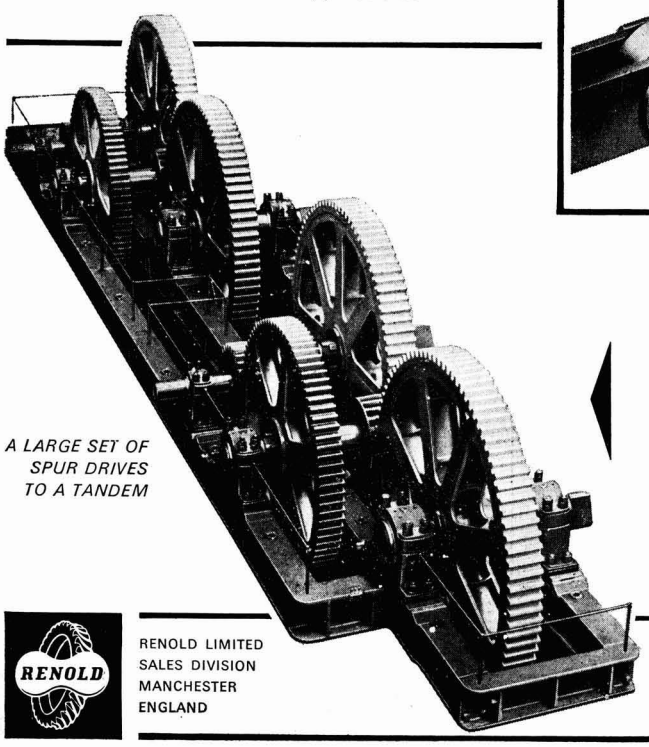

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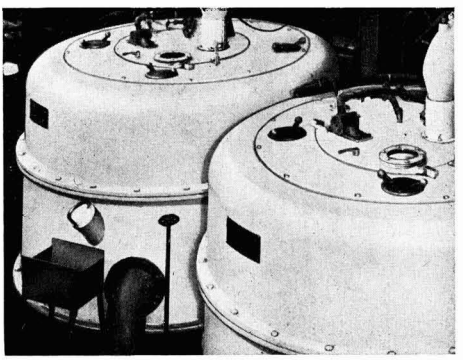

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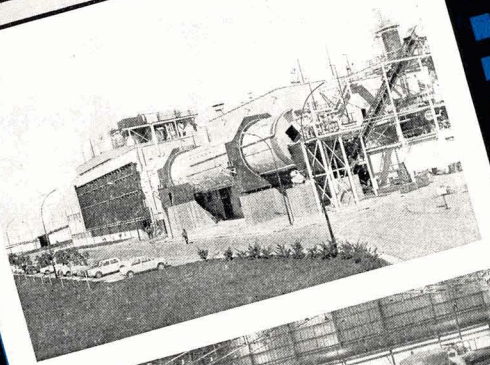

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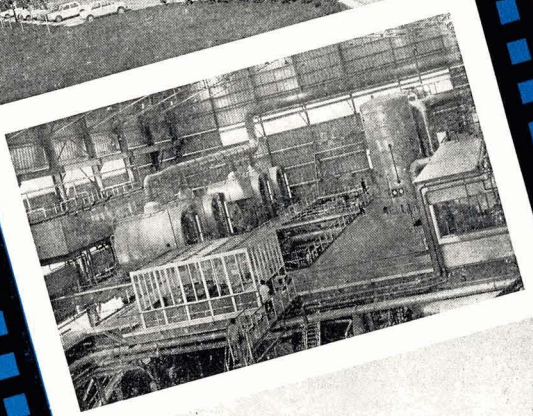

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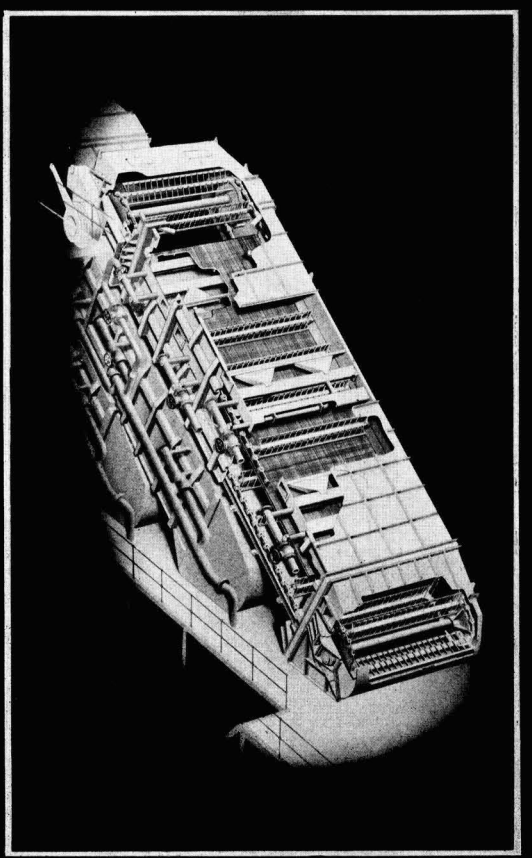

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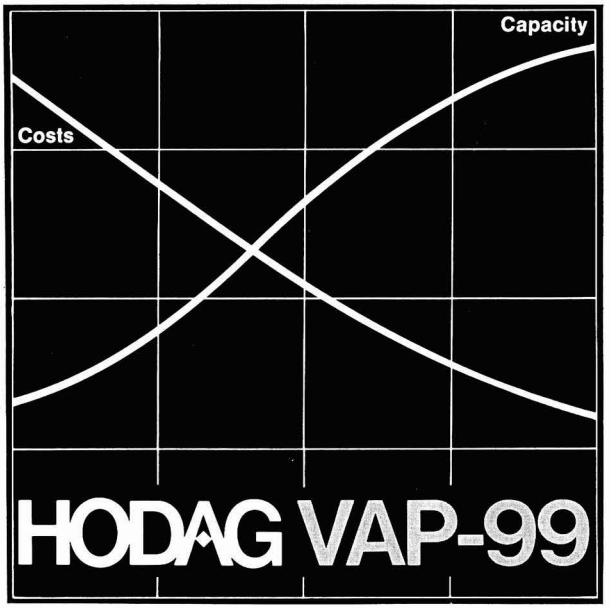

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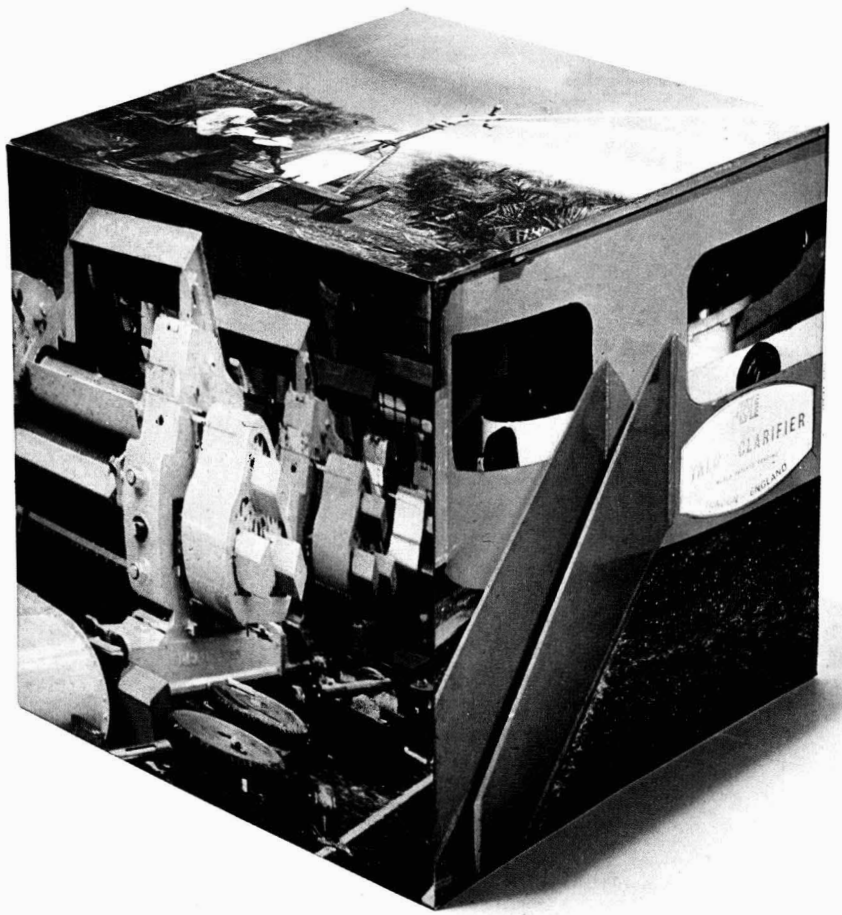

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March 1976

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Amidon de canne. 2ème partie. Composants d'amidon et leur spectres de complexes d'iode. E. WHAYMAN et A. L. WILLERSDORF. *p.* 67–68

L'affinité pour l'iode de l'amylose isolée de l'amidon de canne était virtuellement identique à celle de l'amylose de l'amidon de pomme de terre; les amylopectines de l'amidon de canne de deux variétés ont révélé des affinités pour l'iode très similaires et qui étaient très différentes de celle de l'amylopectine de l'amidon de pomme de terre. La teneur en amylose de l'amidon de canne a été mesurée par spectrophotométrie et était de 15%, contre 23% pour l'amidon de pomme de terre et on considère que ce dernier est un étalon non approprié pour la détermination de l'amidon de canne par une méthode de "valeur bleue" à moins d'appliquer des facteurs de correction.

* * *

La formation enzymatique de coloration dans les jus de betterave et de canne. 1ère partie. D. GROSS et J. COOMBS. *p.* 69–73

Après un bref aperçu des enzymes et de la formation enzymatique de coloration dans les extraits de plantes, avec mention particulière du rôle de la tyrosine comme substrat classique, on décrit des essais dans lesquels l'enzyme active de la betterave (phénoloxydase) a été isolée, ses propriétés moléculaires et sa spécificité de substrat étant detérminées à l'aide de tyrosine radioactive. On traite également de l'isolement de la phénoloxydase de la canne à sucre; on a trouvé que son substrat spécifique est l'acide chlorogénique. La formation enzymatique des colorants dans les jus de canne se fait par l'une de deux réactions: oxydation en présence d'acide chlorogénique d'un phénol secondaire qui n'est pas un substrat pour la phénoloxydase et réaction de quinone chlorogénique avec des acides aminés.

* * *

La chemie de la précipitation au phosphate de calcium en clarification de jus de canne. 3ème partie. J. GUERRA D. *p.* 73–75

L'auteur décrit des essais concernant la précipitation au phosphate de calcium en chaulage classique avec différentes valeurs initiales pour le rapport molaire calcium:phosphate, dans lesquels il est démontré que la teneur initiale en phosphate peut devenir tellement élévée par rapport au calcium initial que l'addition de chaux ne contribuera pas à sa précipitation à un degré élevé. L'emploi de saccharate de calcium au lieu de lait de chaux est brièvement mentionné et on discute de la nature du produit de réaction secondaire, l'hydroxyapatite, de sa précipitation et de l'adsorption de macromolécules du jus d'usine.

Zuckerrohrstärke. Teil II. Stärkekomponenten und ihre Jodkomplex-Spektra. E. WHAYMAN und A. L. WILLERSDORF. *S.* 67–68

Die Jodaffinität der aus Zuckerrohrstärke isolierten Amylose war prinzipiell derjenigen der Amylose aus Kartoffelstärke gleich; die Amylopektine der Stärke von zwei Zuckerrohrsorten wiesen einander sehr ähnliche Jodaffinitäten auf, die sich aber stark von der des Amylopektins aus Kartoffelstärke unterschieden. Der Amylosegehalt der Zuckerrohrstärke wurde spektrophotometrisch zu 15% gegenüber 23% bei der Kartoffelstärke ermittelt. Die letztere ist nach Ansicht der Verfasser als Standard für die Untersuchung von Zuckerrohrstärke nach der "Blauwert"-Methode nur geeignet, wenn Korrekturfaktoren benutzt werden.

* * *

Enzymatische Verfärbung von Rüben- und Rohrsäften. Teil I. D. GROSS und J. COOMBS. *S.* 69–73

Nach einem kurzen Ueberblick über Enzyme und enzymatische Verfärbung von Pflanzenextrakten mit dem ausdrücklichen Hinweis auf die Rolle des Tyrosins als klassisches Substrat beschreiben die Verfasser Versuche, bei denen sie das aktive Enzym in der Zuckerrübe (Phenoloxidase) isolierten und seine Moleküleigenschaften sowie die Substratspezifität mit Hilfe von radioaktivem Tyrosin untersuchten. Es wird ferner über die Isolierung von Phenoloxidase aus Zuckerrohr berichtet, für die als spezifisches Substrat die Chlorogensäure ermittelt wurde. Die enzymatische Bildung von Farbstoffen in Zuckerrohrsäften läuft nach einer der beiden folgenden Reaktionen ab: die Oxydation eines sekundären Phenols, das kein Substrat für die Phenoloxidase ist, in Gegenwart von Chlorogensäure sowie die Reaktion von Chlorogensäurechinon mit Aminosäuren.

* * *

Die Chemie der Calciumphosphatfällung bei der Reinigung von Zuckerrohrsäften. Teil III. J. GUERRA D. *S.* 73–75

Der Verfasser berichtet von Versuchen über die Calciumphosphatfällung bei der Standardkalkung mit verschiedenen Ausgangswerten für das Molverhältnis Calcium:Phosphat. Nach diesen Versuchen ist es möglich, dass der Anfangs-Phosphatgehalt gegenüber dem ursprünglich vorhandenen Calcium so hoch wird, das die Zugabe von Kalk nicht wesentlich zu seiner Fällung beiträgt. Die Verwendung von Calciumsaccharat an Stelle von Kalkmilch wird kurz erörtert, und die Natur des sekundären Reaktionsproduktes, des Hydroxyapatits, seine Fällung und die Adsorption von Makromolekülen aus Betriebssäften wird diskutiert.

Almidón de caña. Parte II. Componentes del almidón y los espectros de sus complejos con iodo. E. WHAYMAN y A. L. WILLERSDORF. *Pág.* 67–68

El afinidad para iodo del amilosa separada de almidón de caña fué casi idéntica con aquella de amilosa de almidón de patata; amilopectinas de almidón de caña de dos variedades demuestran afinidades para iodo muy semejante entre sí pero muy diferente de aquella de la amilopectina de almidón de patata. El contenido del amilosa en almidón de caña se estimó espectrofotometricamente como 15% comparado con 23% en almidón de patata y ésto no es considerado un patrón apropriado para el estimación de almidón de caña por un método de "número azul" sin aplicación de factores de corrección.

* * *

Formación enzimática de color en jugos de remolacha y de caña. Parte I. D. GROSS y J. COOMBS. *Pág.* 69–73

Después de un breve resumen sobre enzimas y formación enzimática de color en extractos vegetales, con mención especial del papel de tirosina como sustrato clásico, se describen experimentos para separar la enzima áctiva de remolacha de azúcar (fenoloxidasa) y para determinar sus propriedades moleculares y su especificidad como sustrato por uso de tirosina radioactiva. Se relata también la separación de fenoloxidasa de caña de azúcar; su sustrato específico se reveló como ácido clorogénico. Formación enzimática de materias colorantes en jugo de caña occurre por uno de dos reacciones: oxidación en la presencia de ácido clorogénico de un fenol secundario que no es sustrato para fenoloxidasa, y reacción de la quinona de ácido clorogénico con amino-ácidos.

* * *

La química de la precipitatión de fosfato de calcio en clarificación de jugo de caña. Parte III. J. GUERRA D. *Pág.* 73–75

El autor describe experimentos sobre la precipitación de fosfato de calcio en clarificación normal con diferentes valores de la relación molar calcio:fosfato, en que se demuestra que es posible que el contenido inicial de fosfato llegara a ser tan alto en relación al calcio inicial que adición de cal no contribuira a un alta proporción de su precipitación. El uso de sacarato de calcio en lugar de leche de cal se menciona brevemente, y se discuten la natura del produto secundario de la reacción—hidroxiápatito—su precipitación y su adsorción de macromoléculas del jugo en la fábrica.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII MARCH 1976 No. 927

Notes & Comments

World sugar production, 1975/76

F. O. Licht have recently published their second estimate of world sugar production for the crop year September 1975–August 1976[1] and this is reproduced elsewhere in this issue. The overall production figure is set no less than 2 million tons under the first estimate, approximately two-thirds of the reduction being found in the cane sugar figure and one-third in that for beet sugar. The new total still represents an increase of 3·2 million tons over the 1974/75 estimate or some 4%, to a total of 82,756,370 metric tons, raw value.

The cane sugar reduction is accounted for by the major adjustments to the estimates for Cuba (down 400,000 tons), Brazil (down 400,000 tons), Argentina (down 200,000 tons) and India (down 200,000 tons), all being the result of adverse weather conditions reported from these countries. The Cuban figure must remain tentative, however, because of the reluctance of the Cuban authorities to publish figures, although the crop has been stated to be larger than that of 1974/75 which is set at 5,500,000 tons.

The Australian crop is set 100,000 tons lower, owing to bad weather and that of South Africa is also not expected to reach the earlier anticipated level, being set 70,000 tons below the original forecast. All the other adjustments to cane sugar estimates are relatively minor.

A senior Soviet official recently quoted farm crop figures above the 1974 level and sugar beet was conspicuously absent; observers have concluded that there was a fall from the 1974 level and Licht have prudently reduced their estimate by 400,000 tons to 8,400,000 tons; they emphasize, however, that speculation on the level of USSR sugar production will continue until official figures are released.

* * *

UK beet area

British Sugar Corporation have announced a record beet area for this year of 510,000 acres (206,400 ha) compared with 488,000 acres under beet in 1975, which was also a record. (It is stressed that the actual area drilled in 1976 will be somewhat lower than the total area available.) Growers offering the same area as in 1975 and those offering more have been accepted by the BSC for the same contracted tonnage as last year, while new growers have been offered a nominal 2 metric tons per ha. All or most of the beet will attract the full "A" quota price (about £19.00 a metric ton, basis 16% sugar content, including all allowances), since total sugar production is unlikely to exceed the "A" quota ceiling of 1,040,000 metric tons unless yields are exceptionally good. White sugar production in 1975 was under 650,000 tons, which was more than 15% below the latest 1975 estimate from the BSC. Mr. JOHN BECKETT, Chief Executive of BSC, is reported[2] as saying that they were very disappointed. "We are going to be marginally ahead of 1974, but not very much. This is nearly the second worst yield in 25 years."

* * *

The Australian sugar industry

According to the Annual Report for 1974-75 of Commercial and Industrial Development in Brisbane, the Queensland sugar industry is expected to spend well in excess of $A 200,000,000 in expansion of its 30 sugar factories and in building new bulk terminals (including associated port development) during the period 1975–77[3]. Examples of this expansion include: a $A 1,500,000 programme at Nambour factory, covering installation of a new boiler and ancillary equipment plus additions and replacements to the mills and process stations as well as improvements in the cane transport systems; a $A 40,000,000 programme at Inkerman, Pioneer and Plane Creek factories, including an additional mill train, increased evaporator capacity, a boiler of 180,000 kg.hr^{-1} steam capacity, a bagasse handling plant and cane transport rolling stock at Inkerman and boilers and equipment to increase the crushing capacity at the other two factories; a $A 25,000,000 programme for the Victoria, Macknade, Goondi and Hambledon factories of CSR Ltd. for increase in the hourly crushing rates, with a further $A 18,000,000 intended for normal replacement purposes up to 1979. During 1974–75, $A 11,250,000 was spent on new equipment at Kalamia, Pleystowe and Invicta factories, $A 2,500,000 at Maryborough (including $A 2,200,000 spent on a bagasse handling plant with ancillary equipment, and $A 300,000 on a boiler), and $A 500,000 at Rocky Point (including a new boiler and bagasse handling plant, renovations to the crushing plant, a new vacuum pan and cane railway work). A $A 1,800,000 programme has also been instituted at Bingera and Fairymead factories to increase their crushing rates by about 20% in order to cope with the additional cane supply from the Gin Gin area resulting from the closure of the local factory, while other money has been spent on cane transport improvements.

[1] *International Sugar Rpt.*, 1975, **107**, (35), 1–4.
[2] *The Times*, 26th January 1976.
[3] *See also I.S.J.*, 1976, **78**, 64.

It has been pointed out[1] that in the 1975/76 cane season, the Australian sugar industry will earn its second highest income on record, estimated at more than $A 590,000,000. At least two-thirds of production is covered by long-term sales contracts, several of which would be above the present world market prices, so that the fall in the world price has not really affected Australian sugar.

Latest crop forecasts[2] show a worsening situation in central and north Queensland as a result of heavy rains and floods. At the end of November, the amount available for harvesting was still estimated at 21,413,000 tons. The sugar content is very low, almost down to the 1973 level which was the worst for 15 years, and 7½ tons of cane are needed to yield 1 ton of 94 n.t. sugar. Estimated sugar production is put at 2,858,000 tons, but wet weather has been causing frequent interruptions to harvesting, so that in northern areas up to 340,000 tons of cane would have to remain unharvested for each week of harvesting lost. In some areas the c.c.s. is so low that harvesting of the cane seems unlikely.

* * *

Mauritius sugar crop 1975[3]

Final data indicate that the 21 sugar factories on the island crushed 4,248,145 long tons of cane in the season which lasted from 27th June to 23rd December. Yields averaged 21·5 tons per ha compared with 29·7 tons. ha^{-1} in 1974. Sugar production was 460,882 tons, a 32·8% reduction on the previous crop. Average sugar extraction was 10·85 % cane, and sugar production per acre was 2·34 tons as against 3·47 tons in 1974. All of these figures are the lowest since 1960, when Cyclone Carol severely damaged the cane crop, and are largely a result of considerable crop damage caused by Cyclone Gervaise in February 1975 and Cyclone Ines in March 1975.

* * *

Paris white sugar market[4]

Trading in sugar on the Paris Terminal Market resumed on 26th January after a lapse of almost 14 months. The business of the Caisse de Liquidation has now been transferred to a new organization, the Banque Centrale de Compensation, which has a capital of Fr. 12,000,000 and is owned by a group of leading French banks. This will henceforth be the organization charged with the financial execution and liquidation of operations on the Paris Terminal Markets under the Bourse de Commerce. A new series of regulations has recently been published which defines the position of the Bourse de Commerce and the Compagnie des Commissionaires. Trading will probably take time to develop since dealers will wish to digest the effect of the new arrangements.

It is pointed out[5] that the closure of the white sugar market has hurt French beet growers and sugar refiners, who have been deprived of their arbitrage facilities on future crop prospects. Their money has provided much of the financial backing for the market to re-open, it is stated, while support has also come from London sugar dealers, who normally account for at least 25% of the total business. The London market members are not participating directly in the new market clearing bank, as they were originally invited to do, but pressure from London and the possibility that a substitute market might one day develop there have been major forces in getting the Paris market back into business.

* * *

Tate & Lyle Ltd. report 1975

Of Group profits of £52,600,000 before tax, 14% was contributed by UK refining activities, 8% by overseas refining operations (represented by Redpath Industries Ltd. in Canada and Rhodesia Sugar Refineries Ltd.) and 9% by raw sugar manufacture (including local refining) in Belize, Jamaica, South Africa and Zambia. In his statement, the Chairman says: "The uncertainties surrounding raw sugar supply are being resolved, but the reduced tonnage that we can import under the Lomé Convention and the reduced amount of beet raw sugar from the British Sugar Corporation means that the rationalization of the industry, which we have forecast before, is now imminent . . . We are successfully negotiating long-term contracts with the ACP cane-producing countries, but much has still to be done, notably securing a margin and a structure comparable to that of the beet industry . . . It is our intention to provide security of supply and price based upon the long-term contracts with the ACP producers. We regard it as vital to ensure that the UK is not as vulnerable as in the past to beet crop failures, and a secure supply of cane sugar as an alternative source is increasingly important".

References are made in the report to activities of other Group members, including Tate & Lyle Engineering, whose "Talo" process has been introduced in a further 12 factories; it is expected that more than 3½ million tons of refined sugar will be produced by this process in 1976. During 1975 a pilot plant was launched for the production of 1000 tons per annum of a surfactant made from sugar for use in detergent manufacture. The company is working towards full-scale commercial production.

On the question of the re-opening of the Paris white sugar market, the Chairman does not consider "that the solution, long overdue, is completely satisfactory or equitable. However, (we) finally took the line that it would be better to clear up the mess so that all knew where they stood rather than to take the various parties involved to court. However, the Company would like to express its gratitude to all those who have made a positive contribution to reaching a settlement".

On 31st October 1975 the Nigerian Government decreed a severe cut in the controlled price of cube sugar which is a major part of Tate & Lyle marketing in that country. Stocks of cube sugar in the company's warehouses in Nigeria and large shipments awaiting discharge were affected; the resultant losses mean that Tate & Lyle (Nigeria) Ltd., which is 40% owned by the Nigerian public, will operate in "an unsatisfactory profit position".

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[1] *Queensland Newsletter*, 14th January, 1976.
[2] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (1), 18.
[3] *Mauritius Sugar News Bull.*, 1975, (12).
[4] C. Czarnikow Ltd., *Sugar Review*, 1976, (1268), 13–14.
[5] *Economist*, 24th January 1976.

Cane starch

Part II. Starch components and their iodine complex spectra

By E. WHAYMAN and A. L. WILLERSDORF
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INTRODUCTION

IN Part I[1], it was found that cane starches from a number of different districts and varieties were identical as judged by their potentiometric iodine affinity. The amylose content was estimated to be 14% but the standards used were commercial samples of corn amylose and amylopectin obtained from Nutritional Biochemicals Co.

The standards should, of course, have been from cane, so it was decided to fractionate cane starch and examine the linear and branched components.

EXPERIMENTAL

Fractionation

Fat-free cane starch from N:Co 310 and Q 58 varieties was fractionated with 1-butanol by the method described by WHISTLER[2]. The amylose complex was re-precipitated twice, and the soluble branched fraction treated once more with 1-butanol. Both fractions were precipitated from warm aqueous solution with ethanol before redissolving and freeze-drying. The moisture content of the freeze-dried fractions was then determined by drying sub-samples overnight in a vacuum oven at 40°C over P_2O_5. The same procedure was adopted in fractionating BDH laboratory reagent-grade potato starch.

Iodine complex spectra

The calculated weights of freeze-dried materials corresponding to 10 mg dry weight were dispersed with glass stirring rods in 5 cm³ of N KOH. After standing at 5°C for one hour the mixtures were mixed for a further hour with the stirring rod. The solutions were then neutralized to pH 7·0 ± 0·1 with roughly 0·1N HCl, then transferred to 100 cm³ standard flasks and made to the mark with distilled water. A 10-cm³ aliquot of the stock starch solutions (equivalent to 1 mg) were then transferred to 50-cm³ standard flasks with 5 cm³ of 2% sodium hydrogen tartrate and 10 cm³ of a solution containing 0·2 mg.cm⁻³ of iodine and 0·2 mg.cm⁻³ potassium iodide. After making to the mark the flasks were gently shaken, allowed to stand for 15 minutes then run against freshly prepared buffer-iodide blanks over the range 430–830 nm in a Perkin-Elmer model 402 double-beam scanning spectrophotometer.

To estimate amylose contents, solutions containing a range of linear fraction percentage were prepared by pipetting suitable ratios of amylose and amylopectin stock solutions (totalling 10 cm³) into 50-cm³ standard flasks. The other reagents were then added as before. Blanks were prepared from identical solutions of freeze-dried whole cane or potato starches, and scans carried out over the same wavelength range.

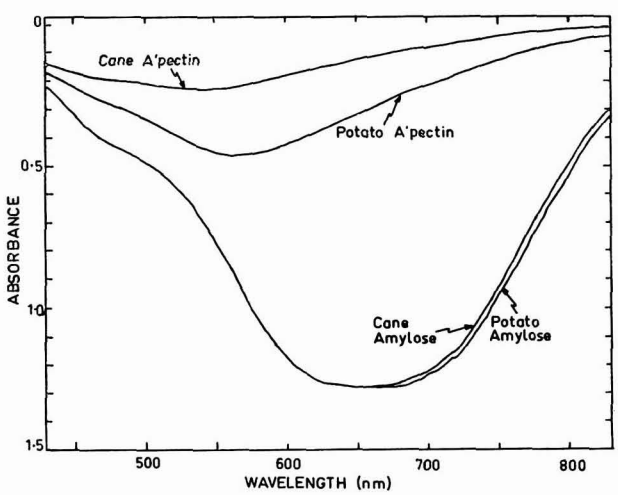

Fig. 1. Iodine complex spectra of fractions from potato starch and Q 58 and N: Co 310 cane starches

Iodine affinities

The iodine affinities of the cane amylose and amylopectin were determined by the potentiometric titration technique described previously in Part I.

RESULTS

The measured iodine affinities of the Q 58 and N:Co 310 amyloses were very similar to the results reported earlier[1] for corn amylose in Part I. The amylopectins, as expected, exhibited very low iodine affinities around 0·4.

The iodine complex spectra for the cane starch and potato fractions are shown in Fig. 1 and for the whole starches in Fig. 2. It can be seen that the amylose spectra are virtually identical, regardless of origin. The two cane amylopectins are very similar but differ markedly from the potato amylopectin in that much less colour is developed with iodine. This was visually evident during preparation of the solutions, there being no hint of blue or purple in the brownish cane amylopectin-iodine complex.

The comparisons of the prepared range of amylose-amylopectin ratio solutions with the corresponding whole starches are shown in Fig. 3. The horizontal

[1] STEVENSON & WHAYMAN: *I.S.J.*, 1976, **78**, 44–46.
[2] "Starch-Chemistry and Technology", Vol. I (Academic Press, London), 1965, p. 339.

blanks shown are for whole starch *vs.* whole starch. The amylose content of the whole starches can be estimated from the deviation of the prepared mixtures from the blank. The Q 58 and N:Co 310 samples apparently contain 15% linear fraction, and the BDH potato starch 23%.

Discussion

It is to be expected that the amylose spectra are virtually identical, as the fractionation method is specific for linear molecules. The only variation expected would be in chain length. This is reported to change the position of the absorption maximum[3] but no marked differences are evident in this work.

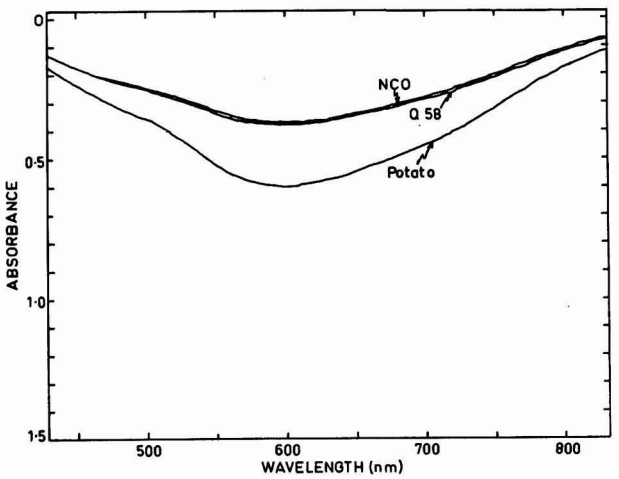

Fig. 2. Iodine complex spectra of whole cane and potato starches

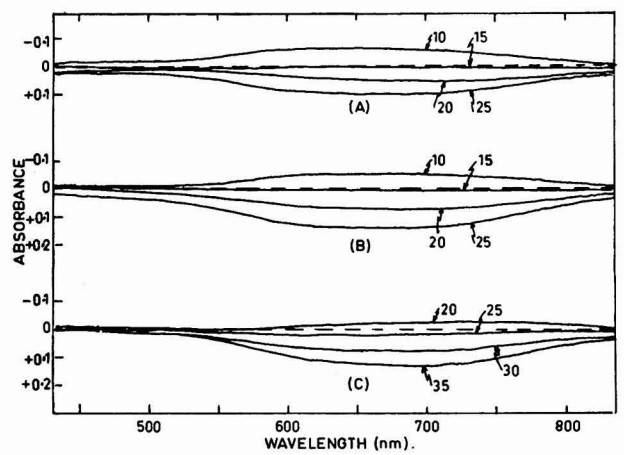

Fig. 3. Deviation of iodine complex spectra of whole starches from prepared mixtures of differing amylose percentages. (A) N:Co 310; (B) Q 58; (C) BDH Potato starch

(Broken lines represent blanks—whole starch *vs:* whole starch)

The very marked difference between the spectra of cane and potato amylopectins is most interesting. The extremely broad maximum and low general absorption over the wavelength range suggest that there is very little complex formation with iodine. This is thought to be due to the presence of much shorter linear sections between branch points than those reported for potato amylopectin of about 25 glucose units[4]. Work on the structure of cane amylopectin is in fact currently in progress at this Institute, and very preliminary results suggest a structure intermediate between the very highly branched glycogen, and potato amylopectin[5].

The estimated amylose contents of the cane and potato starch confirm that, unless correction factors are applied, potato starch is an unsuitable standard for estimation of total cane starch by any "blue value" method. The correction factor can be readily determined if a small sample of whole cane starch is available, but this is only of value in determining the total starch content of cane or mixed juice. Once through the clarification stage of raw sugar manufacture, the composition of the starch is unknown, as preferential loss of a component may occur.

There have been attempts reported in the literature to determine the composition of starch in raw sugar, but the separation of actual starch from the other polysaccharides presents a very severe problem. Figures quoted for South Africa raws[6] are almost certainly in error owing to the separation technique employed in which starch was recovered by precipitation as the iodine complex. From the results in this work the extremely low affinity of cane amylopectin for iodine would be expected to lead to strong preferential recovery of linear or lightly branched fractions and consequently highly erroneous amylose to amylopectin ratios.

Summary

Cane starch was fractionated by the butanol complex technique. The linear A fraction or "amylose" was found to give essentially identical iodine complex spectra to those of the A fractions from corn or potato starches. The branched fraction, however, yielded very different spectra from those of corn or potato "amylopectins" and is thought to be much more highly branched. The amylose content of cane starch was estimated spectrophotometrically to be 15% compared with 23% for potato starch.

[3] Baldwin *et al.: J. Amer. Chem. Soc.*, 1944, **66**, 111.

[4] Baird *et al.: Carbohydrate Research*, 1973, **27**, 464–467.

[5] Blake & Littlemore: Unpublished work in progress.

[6] *Ann. Rpt. Sugar Milling Research Inst.*, 1969, 6–7.

Enzymic colour formation in beet and cane juices

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Paper presented to the 15th General Assembly, C.I.T.S., 1975.

PART I

INTRODUCTION

ENZYMIC browning caused by tyrosinase in mushroom tissue and plant extracts was discovered by BERTRAND[1] in 1895. However it was many years before modern analytical methods and techniques of enzymology made it possible to investigate the reaction mechanisms responsible for the colour formation. The important role played by phenolic compounds both in enzymic and non-enzymic browning reactions could thus be established, and the polyphenol oxidases (the specific enzymes that help to catalyse the relevant reactions) characterized.

There is a certain confusion in the literature about the name and identity of the enzyme, variously and apparently indiscriminately also referred to as *o*-diphenol oxidase, tyrosinase, phenol oxidase or briefly, phenolase. The recommended name and Enzyme Commission (EC) number is *o*-diphenol:O_2 oxidoreductase (EC 1.10.3.1).

Polyphenol oxidases may be defined so as to include all enzymes capable of oxidizing phenolic compounds to produce *o*-quinones (catecholase) and of introducing a second hydroxyl group into a monophenol (cresolase). Many of them contain both cresolase and catecholase activities, but some are specific for *o*-dihydroxyphenols only.

Of the phenolic compounds occurring in plants, the more complex are the flavonoids (catechins), flavonols and cinnamic acid derivatives such as chlorogenic acid and caffeic acid whilst, among the simple phenols, catechol and tyrosine are of major interest.

Tyrosine, both a mono-hydroxyphenol and an amino-acid, is present in sugar beet. This compound is the classic substrate for enzymic oxidation by tyrosinase, leading by way of L-3,4-dihydroxyphenylalanine (DOPA) and DOPA-quinone finally to the formation of dark-brown or black pigments (melanins).

A comprehensive review article entitled "Food Browning as a Polyphenol Reaction" has been written by MATHEW & PARPIA[2], surveying the existing literature up to 1970 and indicating the widespread importance of the reaction to the food and agricultural industries.

Naturally, the beet sugar industry has been concerned for a long time with the elucidation of the reaction mechanism and basic chemistry of colour formation and its possible inhibition. For instance, at the 12th CITS General Assembly in Paris in 1963, HENRY *et al.*[3] reported the results of an extensive investigation of colour formation in diffusion juices and its possible inhibition. This dealt with enzymic and non-enzymic colour formation involving phenolic compounds. Another publication the following year by LAZAR & HENRY[4] dealt with the development of colour in cossettes by enzymic action. Results indicated the presence of a "dopaoxidase" in the tissues. This comprised the combined activities of a tyrosinase (cresolase) with a relatively heat-resistant polyphenol oxidase. LIPETS & OLEINIK[5] reported quite recently experiments dealing with the possible prevention of enzymic colour formation by complexing tyrosine and DOPA with aluminium ions.

Whilst considerable information is available concerning beet products, much less work has been carried out using cane. The information on the presence and concentration of phenolic compounds is still sketchy and contradictory, although latterly increasing[6]. Thus Stevens[7] could not detect a single phenol in cane juice, although he found ferulic acid in filter mud and several compounds, including ferulic acid and possibly caffeic acid, in leaf extracts. In contrast, chlorogenic and caffeic acids were found to be major phenolic constituents in sugar cane by GROSS & COOMBS[8] and their presence in cane juice has been confirmed by FARBER & CARPENTER[9].

As far as relevant enzymes are concerned, ALEXANDER[10] has reported the isolation of a polyphenol oxidase (tyrosinase) from cane meristem tissue. This has a sharp optimum activity at pH 7·5 and is capable of oxidizing a variety of phenols such as tyrosine, catechol, DOPA, pyrogallol, *p*-cresol and hydroquinone. In more recent studies[11,12] it has been shown that the specific substrate for this enzyme from cane is chlorogenic acid.

We have attempted to isolate the active enzyme from sugar beet and determine its molecular properties and substrate specificity, using radioactive tyrosine. Results are compared with those of similar studies on the enzyme purified from sugar cane. In both cases, understanding of the reaction mechanisms involved would help in devising effective methods of inhibiting or minimizing the formation of unwanted colour during extraction and refining of sugar.

METHODS AND MATERIALS

Phenol oxidase activity was determined polarographically, measuring enzyme-catalysed oxygen con-

[1] *Compt. Rend.*, 1895, **121**, 166; *ibid.*, 1896, **122**, 1215.
[2] "Advances in Food Research", Vol. 19. (Academic Press, New York and London) 1971, pp. 75–145.
[3] *Proc. 12th Gen. Ass. C.I.T.S.*, 1963, 54; *Sucr. Belge*, 1963–64, **83**, 185, 225.
[4] *Ind. Alim. Agric.*, 1964, **81**, 655.
[5] *Izv. Vuzov, Pishch. Tekhnol.*, 1972, (6), 119; *S.I.A.*, 1973, **35**, Abs. 73-948
[6] CARPENTER *et al.*: *I.S.J.*, 1975, **77**, 9.
[7] *ibid.*, 1959, **61**, 199.
[8] *ibid.*, 1971, **73**, 100.
[9] *ibid.*, 99.
[10] *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 113.
[11] BALDRY *et al.*: *Planta* (Berlin), 1970, **94**, 107.
[12] COOMBS *et al.*: *Phytochemistry*, 1974, **13**, 2703.

sumption, using a Clark-type oxygen electrode in a "Perspex" water-jacketed (25°C) cell (Rank Brothers, Cambridge, England). The electrodes were separated from the magnetically stirred reaction mixture by a PTFE membrane. The current measured, when a polarizing potential of 600 mV is applied to the electrode, is directly proportional to the O_2 concentration.

The apparent Michaelis constant (K_m) values were calculated by least squares analysis of data obtained, using the double reciprocal (Lineweaver-Burk) form of the Michaelis-Menten equation.

Phenolic compounds were determined by streaking samples on a borate buffer (0·05M, pH 9·2)-impregnated sheet of paper (Whatman 3MM) and separating them by high-voltage electrophoresis[13]. The sheet was then photographed under U.V. light and reversed photographically so that phenolic compounds appeared dark. It was scanned by means of a densitometer (Chromoscan) and the values obtained related to calibration curves established with standard compounds.

Proteins were resolved by polyacrylamide gel electrophoresis, using 9% gels. Phenol oxidase activity was detected by incubating the gel strips after electrophoresis in a solution of 5 mM DOPA and 5mM chlorogenic acid at pH 7·0 in MOPS buffer [3 (N-morpholino) propane sulphonic acid] at 30°C for 30 min, or in 80% alcohol.

Labelled [U ^{14}C] tyrosine was obtained from the Radiochemical Centre, Amersham, Bucks., England.

Results

Phenol oxidase from sugar beet

Certain problems had to be overcome arising from the low protein and high sucrose content of beet as well as from effects of phenol oxidation products on the enzyme during extraction. However, the following extraction procedure yielded 60 mg of protein with tyrosinase activity from 6 kg of beet tissue.

The beet was cut into blocks, then sliced into three volumes of acetone at −30°C and left overnight. The acetone was then discarded and the tissue homogenized in three volumes of fresh acetone at −30°C. The acetone was discarded again and the cold beet pulp, which was now free from low-molecular weight phenols, amino-acids and sugars, allowed to warm up to 3°C. It was then homogenized in two litres of ice-cold water and filtered through muslin. The cellular debris was discarded. Three litres of acetone at −30°C were added to the supernatant and left overnight in the cold room. A dark-grey precipitate was obtained by centrifugation in a bench centrifuge and homogenized in about 100 cm³ of 0·01 M phosphate buffer of pH 6·8. The insoluble material was removed by centrifugation in a bench centrifuge, 10 cm³ of 10% Ca acetate was then added and the solution frozen and thawed. The resulting precipitate of calcium salts of non-protein contaminants was removed by centrifugation at 62,000 *g*.

The supernatant was freeze-dried, the resultant powder taken up in water and insoluble calcium salts removed by centrifugation at 62,000 *g*. The supernatant was passed through a large column of "Sephadex G-25" and placed in dialysis tubing, which was then packed on the outside with solid $(NH_4)_2SO_4$ and left overnight. The resulting protein precipitate was taken up in water, centrifuged at 62,000 *g*, dialysed against water and freeze-dried to give 60 mg of protein powder. The molecular weight was determined by gel filtration, using a "Sephadex G-200" column calibrated with proteins of known molecular weights[14], and found to be about 200,000.

Using an oxygen electrode, it was established that the enzyme preparation had both cresolase and catecholase activity, i.e. it was capable of both hydroxylating tyrosine and oxidizing the *o*-diphenol product (DOPA) to the *o*-quinone. The apparent Michaelis constant (K_m) value for DOPA as substrate was determined as 2·0 mM.

Although the specificity of the beet phenol oxidase for tyrosine and DOPA can be determined by means of an oxygen electrode, there are several oxygen-consuming reactions involved which complicate the measurement. The activity has therefore been investigated using radioactive tyrosine as a substrate and separating the products of the reaction on a column of "Sephadex G-15". The three amino-acids of interest, i.e. phenylalanine, tyrosine and DOPA are separated by adsorption effects whilst the final oxidation products, being of higher molecular weights, are separated by the gel-exclusion effect. Since the latter products are coloured, they may be detected by passing the eluate from the column through a spectrophotometric flow cell. Changes in distribution of radioactivity can be monitored by liquid scintillation counting of fraction samples off the column. Fig. 1 shows the changes in optical absorption at 420 nm and in radioactivity of reaction products of the original radioactive tyrosine. Products of reaction were sampled after 10 min and 24 hr.

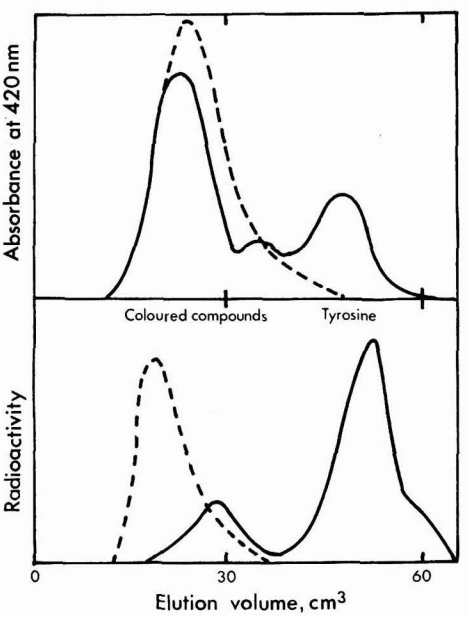

Fig. 1. Colour formation from radioactive tyrosine as an effect of beet phenol oxidase (tyrosinase). After 10 min (———), after 24 hr (– – – –)

[13] Gross: *J. Chromatog.*, 1961, **5**, 194; *I.S.J.*, 1967, **69**, 323, 360.
[14] Andrews: *Biochem. J.*, 1965, **96**, 595.

After 10 min, a certain part of radioactivity had been incorporated in DOPA and another part in a coloured low-molecular weight polymer. After 24 hr, all the radioactivity had been incorporated in a coloured high-molecular weight polymeric substance.

The formation of enzymic colorants in beet juice

It is well known that the formation of colorants in beet juice is dependent on one reaction, i.e. the oxidation of an *o*-diphenol to the corresponding *o*-diquinone. In this case the substrate is DOPA. However it is not clear whether this compound is present in the beet before slicing and extraction or whether it is derived from another amino-acid such as tyrosine or phenylalanine. The following experiment was therefore carried out.

Portions of beet removed from the crown, the skin and the centre were extracted in hot ethanol. This was used to prevent any action of enzymes on phenols during extraction. The extracts were taken to dryness *in vacuo*, redissolved in water and submitted to analysis for amino-acids on a Technicon "Auto Analyzer". No DOPA could be detected, but high concentrations of tyrosine were found; these ranged from 138·5 μmoles per 100 g of tissue in the crown to 80 μmoles in the skin and 49·5 μmoles in the centre of the root.

The results indicated that the colour formation must be based on the initial hydroxylation of tyrosine to DOPA. This will be oxidized to DOPA-chrome and then form melanins by some complex reactions. It is interesting to note that aqueous solutions of DOPA can undergo a spontaneous, non-enzymic auto-oxidation in air to give melanins.

Phenol oxidase from sugar cane

The application of standard isolation methods proved unsatisfactory. Difficulties arose from the rapid precipitation of all protein, including the enzymes, by phenolic oxidation products. Use of thiols in the isolation medium, $(NH_4)_2SO_4$ precipitation or the preparation of acetone powders led either to irreversible loss of activity or to the formation of an insoluble enzyme. The following procedure[12] was finally devised.

Approximately 50 g of leaf or stem tissue was blended under nitrogen for 3 min in 0·05M HEPES (N-2-hydroxyethyl piperazine-N′-2 ethane sulphonic acid) buffer solution of pH 7·5 (100 cm³) at 4°C, filtered through muslin and particulate matter removed by centrifugation at 62,000 *g* for 30 min. The supernatant was rapidly freeze-dried. The dried powder was dissolved in water (30 cm³), clarified by centrifugation and passed through a column of "Sephadex G-25" (superfine), pre-equilibrated with 0·05M HEPES buffer. The totally-excluded volume was collected and passed through a "Sephadex G-200" column pre-equilibrated with HEPES buffer and calibrated with proteins of known molecular weights. This made the determination of the M.W. of the isolated enzyme a fairly simple procedure[14]. The "Sephadex G-25" treatment removed low-molecular weight phenolic compounds and, in the case of stem extracts, the sucrose as well. In addition, a large proportion of the brown colour was adsorbed and thus removed. "Sephadex G-50" removed practically all the residual coloration.

Fractions from the "Sephadex G-200" column were assayed for phenol oxidase activity polarographically, using chlorogenic acid as a substrate. Two peaks of activity were recorded. Contents of tubes corresponding to these fractions were bulked, freeze-dried and stored in a deep-freezer. The two fractions have been termed PPO-I (M.W. = 130,000) and PPO-II (M.W. = 32,000). Control samples showed 60–70% of total activity in PPO-1.

A broad pH optimum between 4·5 and 7·5 was found for both forms of the enzyme. Both forms were denatured fairly rapidly at 55°C.

Samples of the leaf and stem phenol oxidase preparations were examined by polyacrylamide gel electrophoresis. Gels were loaded with 40 μl samples containing about 1 mg protein in 2 cm³. After separation, the gel strip was developed in a solution containing 1·5 cm³ of 5 mM chlorogenic acid and 1·5 cm³ of 5 mM DOPA in 10 cm³ of 80% ethanol. Dark bands developed in the regions of *o*-diphenol oxidase activity. Protein was detected by staining with Xylene Brilliant Cyanin G. The results are shown in Fig. 2. PPO-I remained near the top (origin) of the gel, whilst PPO-II migrated almost to the bottom. With leaf preparations, a single band corresponding to the protein band was observed; with stem preparations, a brown protein band migrated ahead of the colourless PPO-II band. Such preparations were slightly coloured and could have contained an impurity, caused by a fraction of the protein having been complexed with phenol-oxidation products; they also had an additional absorption band between 300 and 340 nm.

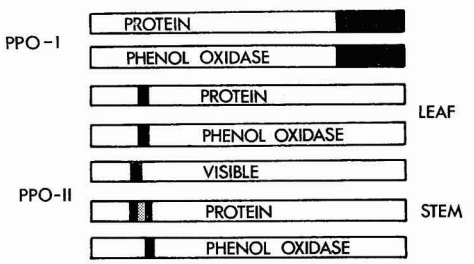

Fig. 2. Schematic drawing of separations by polyacrylamide gel electrophoresis of polyphenol oxidases isolated from leaf and stem tissue of sugar cane

Highly purified enzyme preparations gave a single band of protein which coincided with phenol oxidase activity. Aqueous solutions were colourless with a single absorption maximum at 280 nm.

The molecular and enzymic properties of the two forms of enzyme are summarized in Table I.

Table I. Properties of polyphenol oxidase from sugar cane

Fraction	*PPO-I*	*PPO-II*
M.W.	130,000	32,000
Specific activity (μ moles O_2 per mg protein per min)	5·7	1,500
pH optimum	4·5–7·5	4·5–7·5
$t_{\frac{1}{2}}$ (55°C)	1·6	3·0
K_m (mM) for:		
Chlorogenic acid	2·4	1·1
Caffeic acid	6·0	8·7
3,4-dihydroxyphenylalanine (DOPA)	10·1	45·0
V_{max} (Relative) for:		
Chlorogenic acid	1·00	1·00
Caffeic acid	0·39	0·32
3,4-dihydroxyphenylalanine (DOPA)	0·11	0·15

The values of V_{max} with various substrates are reported relative to chlorogenic acid. A number of

other phenols were also investigated. Catechol and pyrogallol supported low rates of O_2-consumption. However, protocatechuic and gallic acids, vanillin, *p*-coumaric acid, tyrosine, cinnamic acid and phenylalanine had no effect.

When the enzyme preparations were aged and the buffer strength increased to 0·1 M, or 8 M urea included in the buffer, the activity present in PPO-I was recovered in PPO-II.

The results very strongly suggest that the cane polyphenol oxidase consists of sub-units each of a molecular weight of 32,000, which are normally aggregated to form a tetramer of a molecular weight of 130,000.

Formation of enzymic colorants in cane juice

Although the nature of the colorants formed in cane juice differs from that in beet juice, they have one reaction in common, namely the oxidation of an *o*-diphenol to the corresponding *o*-diquinone. In cane juice this phenol is chlorogenic acid. Two

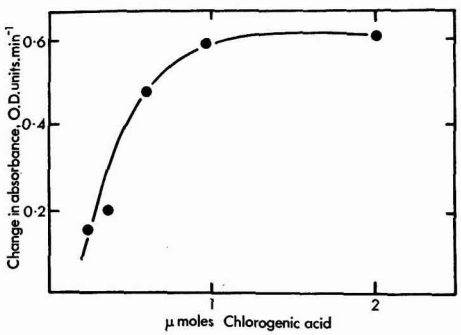

Fig. 3. Effect of concentration of chlorogenic acid on the rate of increase in absorbance at 420 nm in reaction mixtures containing chlorogenic acid, 1 μ mole of DOPA and purified polyphenol oxidase PPO-II

possible routes of colour formation have been investigated in sugar cane extracts. The first route involves the oxidation of a secondary phenol which itself is not a substrate for phenol oxidase; the second involves the reaction with amino-acids or amino-groups of proteins.

The first type of reaction can be recognised by an enhancement of O_2 consumption on addition of a second phenol in the presence of chlorogenic acid. Results are shown in Table II.

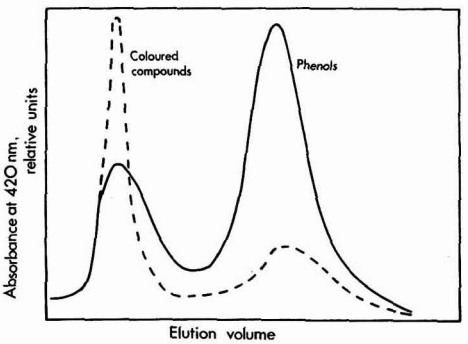

Fig. 4. Separation on "Sephadex G-25" column of reaction products of mixture of chlorogenic acid, amino-acids and cane polyphenol oxidase. Chlorogenic acid plus amino-acid mixture (– – –), control (———)

Table II. Effects of phenolic compounds on oxygen consumption by chlorogenic acid

*Compound added** (1·0 *mM*)	*Relative rate*	*% Chlorogenic acid oxidized*
Control †	1·0	89
Coumaric acid	1·0	74
Purpurogallin	1·0	86
Caffeic acid	1·4	57
Catechol	1·4	58
Pyrogallol	1·6	29
DOPA	1·8	13

* To 0·1 *mM* chlorogenic acid
† No added phenol

The products of such reactions were separated by high-voltage paper electrophoresis and the amount of chlorogenic acid oxidized determined. It was found that in the control sample most of the chlorogenic acid had been used up. When other phenols had been added, the consumption of chlorogenic acid was markedly reduced. These results suggest that a primary enzyme-catalysed oxidation of chlorogenic acid is followed by a chemical reduction of the resulting *o*-diquinone by the secondary *o*-diphenol. The secondary quinone will then polymerize to form colour. In the case of DOPA in combination with chlorogenic acid, the rate of formation of colour is spectacularly rapid. As shown in Fig. 3, concentrations of chlorogenic acid of less than 1 μmole.cm^{-3} will promote a reaction generating colour at a rate of over 0·5 O.D. units.min^{-1}.

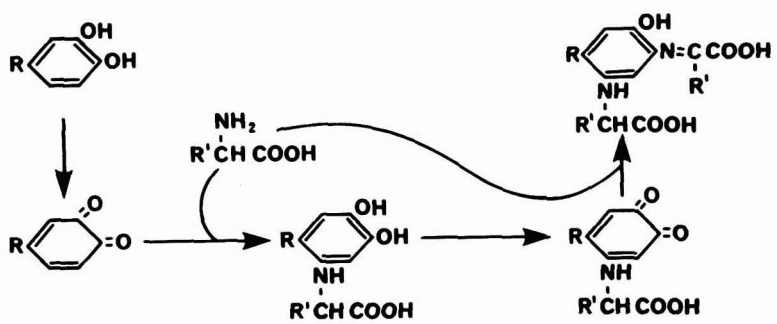

Fig. 5. Probable mechanism of colour formation in reactions in the presence of amino-acids or proteins

The second type of reaction, i.e. of the chlorogenic quinone with amino-acids, has been examined, using "Sephadex G-25" columns to separate the coloured reaction products from the substrate. On elution with water, followed by 0·1M NaOH or 0·1M NH_4OH, two peaks of absorbance at 420 nm were observed The first peak, close to the exclusion volume, comprised the coloured compounds, and the second peak contained the simple phenols and amino-acids. Typical results are shown in Fig. 4. In both, control and sample with added amino-acids, two peaks are present. However the height of the coloured peak was considerably increased by the presence of amino-acids. The possible reaction mechanism is shown in Fig. 5. The complex phenol-amino-acid compounds would then polymerize and yield dark-brown to black melanins. A similar mechanism may apply in the presence of proteins with suitable reactive amino-acid groups and/or SH groups. Amines also react with *o*-quinones to give quinoimines, and so do indoles. When the 3-position is free, indoles condense with quinones to produce intensely coloured indolyl quinones.

(*To be continued*)

The chemistry of calcium phosphate precipitation in cane juice clarification

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PART III

Should it be definitely shown that co-precipitation of substituents is enhanced if the calcium concentration of the liquid phase is made smaller, it may prove beneficial to aim for balance at $R_{juice} = 1·6$ to $1·5$ or possibly less; this may induce removal of magnesium, manganese, iron (II), etc. to the order of 0·15–0·25 total moles per mole of precipitated phosphate.

It should be noted that balancing at $R_{juice} = R$, followed by addition of NaOH, determines a unique curve of dissolved calcium and its unique partner curve of dissolved phosphate as functions of pH. Therefore, if different juices are all brought to balance at $R_{juice} = R$, then after bringing with NaOH to a common final pH value, they will all show equal contents of calcium and equal contents of phosphate. This may significantly improve the uniformity of subsequent manufacturing operations. Fig. 12 shows the course of treatment of a juice to which lime is first added to achieve balance followed by addition of NaOH to adjust pH.

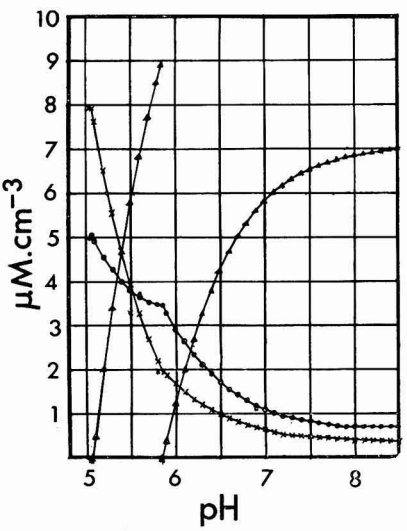

Fig. 12. ⊙ = $[Ca^{2+}]$; × = $[\Sigma PO_4]$;
△ = $\Delta Ca(OH)_2$ — pH 5–5·8; ΔNa — pH 5·8–8·5

Precipitation of calcium phosphate in standard liming

Figs. 13–15 show the courses of liming with $Ca(OH)_2$ of juices with different initial values of R_{juice} ranging from 0·531 to 0·250. They indicate that the calcium content of limed juices steadily decreases with R_{juice} (or decreases as initial phosphate content increases) to the extent that juice of Fig. 14 ought rightly to be described as "balanced for alkalization with lime", as it has quite low contents of both calcium and phosphate at final pH. Fig. 15 shows that it is possible for initial phosphate content to become so high in relation to initial calcium as to preclude the possibility of precipitating it to very low values by addition of lime within a reasonable compass of pH [compare with *Case* (*d*) above]; this condition may also be brought about in factory practice by injudicious addition of phosphate.

Juices with identical values of $R_{juice} = (Ca^{2+})_i/(\Sigma PO_4)_i$ but with different values of the quantities which enter to define this ratio may show quite different responses to standard liming.

Calcium saccharate versus *milk-of-lime*

The lime treatment experiments described in the Experimental Section were made with calcium saccharate solution instead of milk-of-lime in order better to control the amounts of base added. The basic assumptions laid down in the section concerned with the development of theory and calculations imply that calcium hydroxide is being considered throughout as a typical strong base, entirely dissociated in solution according to the equation

$$Ca(OH)^2 \rightarrow Ca^{2+} + 2\,OH^-.$$

The quite satisfactory agreement of theory with experiment found in this work indirectly supports this assumption. In spite of this, several special replicate runs (not here reported) were conducted using regular milk-of-lime instead of saccharate solution; results were identical within the precision of the analytical procedures.

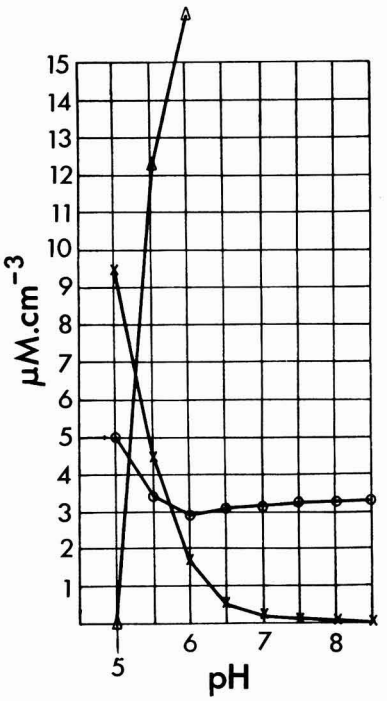

Fig. 13. ○ = [Ca^{2+}]; × = [ΣPO_4]; △ = $\Delta Ca(OH)_2$

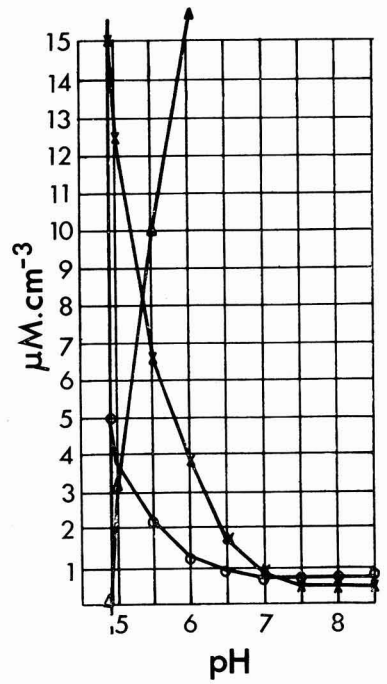

Fig. 14. ○ = [Ca^{2+}]; × = [ΣPO_4]; △ = $\Delta Ca(OH)_2$

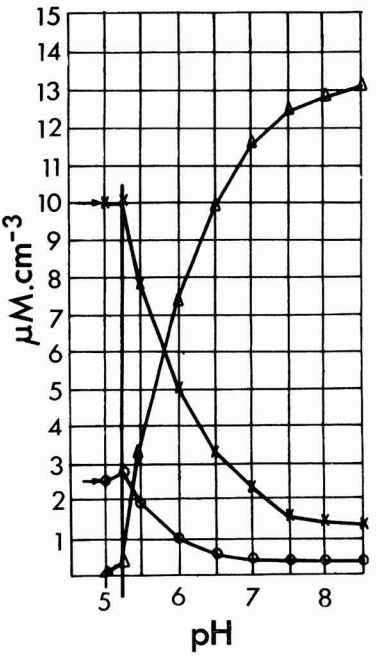

Fig. 15. ○ = [Ca^{2+}]; × = [ΣPO_4]; △ = $\Delta Ca(OH)_2$

Nature of secondary reaction product

KRAUSKOPF[26] summarizes the chemistry of calcium phosphate in some situations of geological importance as follows: "When a solution of Ca^{2+} is added to a phosphate solution, the immediate precipitate is $Ca_3(PO_4)_2$ or $CaHPO_4$, depending on the pH. . . . The chemistry of calcium phosphate is complicated by the ability of this substance to react with other materials in solution to form a still more insoluble compound called apatite. . . . Properly speaking, apatite is not a single compound or mineral but a group of closely similar substances whose relations are still not altogether clear. . . . Another simple apatite is hydroxyapatite, $Ca_5(PO_4)_3OH$. . . . Many other substitutions are possible in the apatite structure: Cl for part of the F and OH, CO_3 and SO_4 for PO_4, and cations like Sr, Y, Mn for Ca. . . ."

". . . Experimentally, apatite has been formed in a variety of ways: by slow direct precipitation with careful control of pH and concentrations; by slow reaction of solution with freshly precipitated calcium phosphate. . . ." This book gives $K_{PS} = 2{\cdot}51 \times 10^{-7}$. *Note:* Calcium to phosphate molar ratio of apatite equals 1·667.

HIDI[27] mentions detection by X-ray methods of hydroxyapatite in calcium phosphate precipitates from sugar solutions. BERNARDI[28] describes preparation of Tiselius' hydroxyapatite, (HA); this involves prior precipitation of $CaHPO_4$, $2H_2O$ (brushite) from aqueous medium followed by conversion, also in aqueous medium, into *crystalline* HA. DEER *et al.*[29], reviewing the apatite family of rock-forming minerals,

[26] "Introduction to Geochemistry", 1967.
[27] *Proc. 13th Congr. ISSCT*, 1968, 1736–1743.
[28] "Methods in Enzymology', Vol. 22, pp. 325–339.
[29] "Rock-forming minerals", Vol. 5, 1962.

report that hydroxyapatite is most readily obtained from solutions of calcium salts with the addition of ammoniacal phosphate solutions.

Precipitation of hydroxyapatite by addition of NaOH to balanced seeded synthetic juice

Calcium phosphate was precipitated at room temperature from balanced synthetic juice (R_{juice} = 1·667) by slow addition, with stirring, of 0·2N NaOH in amount required to bring about incipient precipitation; the two-phase mixture was kept well stirred for 10 minutes; NaOH was next added slowly and the pH further raised to 8·5; stirring was continued for 10 minutes. Parallel experiments were thus conducted on plain juice and on juice seeded with ten parts by weight of very fine crystals of HA per million parts by weight of juice. The precipitate from the seeded juice showed an X-ray diffraction pattern identical with that of the seed crystals; the other precipitate showed an entirely different pattern not as yet identified. Precipitates differed greatly as to settling speed and final (one hour) settled volume; texture of settled precipitates was also different.

Note: KOIKE & HAMADA[30] describe preparation of calcium phosphate *gel* for column chromatography of proteins. The product is unusable because of poor flow characteristics unless mixed with a suitable filter aid, such as "Super-Cel" or cellulose.

Adsorption of factory juice macromolecules on HA

BERNARDI[28] and BERNARDI & KAWASAKI[31] report chromatography of proteins on HA columns; these workers advance a fairly specific mechanism to account for the strong adsorption of some protein macromolecules and related materials, dispersed in dilute, nearly neutral (0·001 M, pH 6·8) alkali phosphate, on HA crystals, and their elution or redispersion by the action of higher concentrations of also nearly neutral alkali phosphate (phosphate gradient). They also show that proteins, after more or less complete disruption or denaturation by chemical means or by heat, are less completely and strongly fixated on HA: the fixated fraction may be eluted or redispersed by lower phosphate concentrations.

Following this up, factory juice was first passed through a "Sephadex" column to effect separation of macromolecular material from juice electrolytes. The macromolecular fraction was next run through a column loaded with HA; column washing then followed with 0·001 M alkali phosphate buffer of pH 6·8. Examination of the wash liquid failed to show dissolved protein material. Elution of adsorbed protein material followed on feeding to the column a phosphate gradient of pH 6·8. Experiments were carried out at room temperature.

Note: Prior separation on "Sephadex" is required to by-pass calcium, which would add on to HA crystals (secondary reaction mechanism) and cause column stoppage.

This suggests that an adsorption process similar to the one advanced by BERNARDI *et al.* may also be found to operate if crystalline HA is made to form by balanced, careful precipitation within a protein dispersion itself while pH is raised toward neutrality and dissolved phosphate concentration is thereby brought down to such a low value as not to interfere with adsorption on the solid. The implications of this suggestion with regard to removal of some protein materials in juice clarification by liming are obvious. A similar adsorption process may perhaps be found to operate with regard to other juice components (pectins, sugar phosphates, phospholipids, etc.) which would seem to fulfill the requirements of the assumed operating mechanism.

Applicability of model juice theory to industrial practice

The classical laws and principles of chemical reactions and equilibria for dilute solutions account for and describe quite satisfactorily the peculiarities of the CaO-P_2O_5-H_2O system as manifested in highly simplified synthetic juices. This supports the expectation that the same clear-cut, powerful means may be found to account to a good extent for the peculiarities of more realistic model juice systems with a greater number of relatively simple, rather well defined inorganic constituents (magnesium, aluminium, possibly silicon, perhaps iron); this may turn out to be a question of mere complication by dint of number rather than a problem of real complexity. Some of the simpler organic juice components may also lose ground before the same laws and principles.

It appears, too, that some deductions drawn from such description of highly simplified juice also evidence a good measure of agreement with some aspects of factory practice and experience. This supports the expectation that other deductions which imply change of outlook and revision of procedure will successfully carry through when subjected to the test of practical application.

Matters stand differently, to be sure, with regard to regular macromolecular dispersed juice components and other materials, extraneous or not, commonly classed together as colloids; here no equally clear-cut, polished tools are available as yet to inquiry. It seems, though, that progress over this rough terrain may perhaps be made easier by trying to remove from the field some of the lesser impediments.

Acknowledgments

Thanks are due to EMILIO RODRÍGUEZ ALVAREZ for his invaluable help in setting up the computer programme and to Professors ARTURO AMARAL and ROBERTO DE ARMAS for helpful discussions. Professors AMARAL and MIGUEL BRUNET put at our disposal chemical analysis and computing facilities; thanks are due to them and to all personnel of the Cane Nutrition Laboratory and the Systems Analysis and Computation Center of the University of Havana who helped with the work.

Thanks are also due to Professor DONALD F. CLARK, University of British Columbia, Canada, for his kind, prompt and disinterested help in providing needed literature; to SILIO LÓPEZ (Chemistry School, University of Havana) for the X-ray diffraction work, to PEDRO VALDÉS and CARLOS W. RODRÍGUEZ (Cane Nutrition Laboratory, University of Havana) for the chromatographic experiments, and to ROLANDO SANTANA, of this laboratory, for help in HA preparation and seeding experiments.

Patent has been applied for the "balanced" treatment of cane juices and for the seeding of cane juices in the process of clarification by liming.

[30] "Methods in Enzymology", Vol. 22, p. 339.
[31] *Biochimica et Biophysica Acta*, 1968, **160**, 301–310.

Sugar cane agriculture

Weeds in Louisiana. L. L. LAUDEN. *Sugar Bull.*, 1975, **53,** (15), 4.—Three weeds proving troublesome in Louisiana cane fields are briefly mentioned. They are mule weed, golden rod and Raoul grass. The first two can be controlled with a combination of "Silvex" and 2,4-D, while incorporation of "Treflan" in the soil has proved effective against Raoul grass, which has shown itself to be more harmful than Johnson grass in reducing cane yields.

* * *

C.P.65-357 plant cane weak. H. ROBICHAUX. *Sugar Bull.*, 1975, **53,** (15), 11.—While this cane variety has given good ratoon crops, as a plant cane it has shown itself to be susceptible to frost occurring in March. The author suggests that perhaps, in view of the outstanding result achieved in plant cane tests with the same variety planted in September, it would be better to alter the planting time.

* * *

A comparison of replanting methods in ratoon cane fields. F. Y. HSIA. *Rpt. Taiwan Sugar Research Inst.*, 1974, (65), 1–8.—Comparison of four methods of replanting in gaps between ratoons with respect to cane performance and yield showed that the best was replanting with seedlings brought on in soil-filled polyethylene bags, followed by replanting with nursery bed seedlings and replanting with top cuttings. In all three cases, replanting was carried out after ratoon germination. Replanting with top cuttings immediately after off-barring was the least suitable method. However, from the economics viewpoint, replanting with nursery bed seedlings was the best method.

* * *

Study of irrigation efficiencies and furrow lengths on clay cane fields. Y. T. FANG, Y. H. CHANG and D. Z. HWANG. *Rpt. Taiwan Sugar Research Inst.*, 1974, (65), 9-15.—Irrigation trials were conducted on heavy soil with four furrow lengths (100, 150, 200 and 270 m) and five stream sizes. No difference in maximum distribution efficiencies was found, and it is suggested that a furrow length of 300 m be adopted to meet the needs of mechanization and labour requirements. A simple equation is presented for calculation of the appropriate stream size for a given furrow length.

* * *

Studies on a chemical extraction method for soil zinc. M. M. KAO and T. C. JUANG. *Rpt. Taiwan Sugar Research Inst.*, 1974, (65), 17–30.—Of nine extractants used to assess the zinc content of sixteen representative cane soils in pot tests in order to relate zinc content to cane growth, the best was found to be O·1N HCl. Investigation of the effects of the extraction period and extractant:soil ratio showed that increase in both factors increased the amount of zinc extracted, particularly from alkaline soils. Increase in the temperature and concentration of the extractant also increased zinc extraction. Optimum conditions were an extractant: soil ratio of 10:1, a period of 3 hours and a temperature of 25°C (room temperature).

* * *

The effective rainfall on sandy cane fields in the Taiwan Western Plain. H. CHU, M. S. CHYOU and C. N. LIN. *Rpt. Taiwan Sugar Research Inst.*, 1974, (65), 31–46. Test pots and an artificial rain simulator were set up for experimental work. Field measurements and soil moisture changes at different depths yielded relationships between natural precipitation and the corresponding effective rainfall. From these and analysis of the rainfall pattern, tables have been drawn up of monthly and annual effective rainfall for different cane regions in different seasons in Taiwan.

* * *

Sex pheromone of the grey borer. I. Trapping cage and attracting materials. W. Y. CHENG. *Rpt. Taiwan Sugar Research Inst.*, 1974, (65), 47–53.—Virgin female moths of the grey borer, *Eucosma schistaceana,* were trapped after being attracted by male moths. Filter paper soaked in extract of female abdominal tips ground in dichloromethane attracted males on the first night but not on the second, while some males were attracted by mated females on the second night but not on the first.

* *

Cane breeding in Réunion. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1974, 1–28.—Details are given of hybridization and selection work, and selected varieties are described. Results are tabulated of varietal trials.

* * *

Cane diseases in Réunion. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1974, 30–33.—While outbreaks of gummosis, leaf scald, smut, yellow spot, rust and pokkah boeng have been insignificant, one important disease which has reappeared after a very long absence is red rot caused by *Cephalosporium sacchari.* Symptoms are given of this disease as well as the damage it causes to cane and possible means of control.

* * *

Weed control in Réunion. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1974, 34–46.—Information is given on new pre- and post-emergence herbicides tested and of the weeds against which they have been particularly successful. Descriptions are given of four major weeds which are especially harmful or could become so: *Paspalidium geminatum, Artemesia vulgaris, Rottboellia exaltata* and *Paspalum dilatatum.* The first three were successfully controlled only by application of "Roundup", while no herbicide has yet been found to control *P. dilatatum* effectively.

Mechanical harvesting in Réunion. ANON. *Rpt. Centre d'Essai de Rechercher et de Formation* (La Bretagne), 1974, 47–55.—Mechanical harvesting was carried out in Réunion in 1974 for the first time. Three machines were involved in cutting 15,000 metric tons of cane (about 0·7% of the total grown); they were a Massey-Ferguson MF 102 and a Don Mizzi 741 chopper-type and a McConnel whole-stalk harvester. The operation of each machine is described and their merits and demerits considered as well as the relative costs of mechanical and manual cutting and loading.

* * *

Cane burning and mechanical harvesting. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1974, 56–72.—The behaviour of two cane varieties (R 541 and R 526) has been studied in an investigation of burning and mechanical harvesting. Results indicated that burning has no adverse effect on the cane provided it is harvested the same day, while mechanical harvesting does increase the quantity of extraneous matter accompanying the cane into the factory. To overcome this, it is recommended to ensure good rock removal and thus provide for efficient harvester operation as close to the soil level as possible, while cane varieties should be grown which are more suitable for mechanical harvesting, e.g. those which allow the trash to fall easily to the ground and which do not have a tendency to lodge.

* * *

Varietal trials in Réunion. ANON. *Rpt. Centre d'Essai de Recherche et de Formation* (La Bretagne), 1974, 73–184.—Results of cane varietal trials in various locations on the island are tabulated.

* * *

Behaviour of variety NA 63-90 in comparison with commercial varieties. R. FERNÁNDEZ DE U. *Bol. Est. Exp. Eg. Agropec. Famaillá* (Argentina), 1975, 21 pp. Trials have been made in Argentina by various experiment stations in which NA 63-90 has been compared with other varieties to assess its suitability as an early-maturing cane for growing with the object of extending the season and so increasing the cane crop which can be processed by the existing factories and thereby avoiding the need to invest large sums in new factories. The trials show that the variety matures sufficiently early to allow harvesting a month before the usual start to the season and provides a cane yield slightly higher than the earliest cultivated variety with an extra recoverable yield of 16 kg of sugar per ton.

* * *

Response of sugar cane varieties of different ages to two doses of nitrogen. R. FERNÁNDEZ DE U. and J. FAADE E. *Bol. Est. Exp. Eg. Agropec. Famaillá* (Argentina), 1975, 26 pp.—Four very different cane varieties were grown as plant cane and ratoons in two different locations in order to assess their response to two different levels of nitrogen, applied as urea. No variety responded to either level as plant cane but responded as ratoons, the response increasing with age and varying from 3·1% with 90 kg N per hectare to 22·8% with 60 kg.

* * *

Natural infection test for sugar cane mosaic virus. S. MATSUOKA and A. K. DODSON. *Brasil Açuc.*, 1975, **85,** 234–238.—Natural spread of mosaic to cane varieties from an infected one planted every fourth row in a block of 5-metre rows was assessed as a means of determining the reaction of commercial, breeding and new promising varieties to the virus. The varieties were given preliminary ratings six months after planting, using control varieties of known rating, and those for 24 varieties tested are tabulated.

* * *

Ideal number of leaves for foliar diagnosis in sugar cane (ratoon). J. O. FILHO and H. DE CAMPOS. *Brasil Açuc.*, 1975, **85,** 239–245.—Trials were made in which 2, 5, 10, 15 and 20 leaves per hectare, taken from different stalks, were used for foliar diagnosis of nutrient status, chemical analyses being made of the central 20-cm portion of each +3 leaf without midrib. It was concluded from the results that two leaves per hectare were sufficient for N, P and K determination.

* * *

Effects on the soil of mechanical cultivation and of levels of fertilization applied to sugar cane ratoons. A. A. CASAGRANDE, O. P. GODOY and P. C. CORSINI. *Brasil Açuc.*, 1975, **85,** 246–265.—Comparisons were made of soils which had been given three levels of N–P–K fertilizer and treated by subsoiling to 40–50 cm depth, disc cultivated to 10 cm and ploughed to 10–15 cm. After harvesting the ratoon crop, samples of soil were examined for physical and hydraulic characteristics; for all fertilizer levels, subsoiling increased total porosity to a depth of 27 cm and decreased bulk density to 36 cm and water availability to 36–45 cm. Hydraulic conductivity was excellent but higher than standard values for soil water retention. Discing, at all fertilizer levels, reduced bulk density to a depth of 9 cm compared with ploughing but both gave excellent values for hydraulic conductivity.

* * *

Contours protect threatened soils. J. D. VEURMAN. *Producers' Rev.*, 1975, **65,** (4), 94–95.—In advocating the use of contouring to conserve soil, the author cites the experiences of cane farmers from various parts of the Mackay district of Queensland who have found that contouring not only controls soil erosion, but also permits higher cane yields, more even maturing and better ratooning. The higher cane yields have been attributed to a more even moisture distribution and retention of fertilizer. It is pointed out that soil loss through erosion may continue for years without being obvious.

* * *

An introduction to the Malaysian sugar industry. K. Y. LI. *Taiwan Sugar*, 1975, **22,** 58–65.—Details are given of four major cane projects in Malaysia, of which three involve an area of more than 80,000 acres. The agricultural practices are described and information is given on cane research activities at the Malaysia Agricultural Research and Development Institute in Alor Star, Kedah.

* * *

Transfer of toxin susceptibility to plant protoplasts via the helminthosporoside-binding protein of sugar cane. G. A. STROBEL and K. D. HAPNER. *Biochem. Biophys. Research Comm.*, 1975, **63,** 1151–1156.—Leaf cell protoplasts of the tobacco plant and toxin-resistant sugar cane effectively adsorbed the toxin-binding protein derived from membranes of susceptible cane[1], whereupon the protoplasts became susceptible to the helminthosporoside and took up raffinose. Tobacco

[1] *I.S.J.*, 1975, 77, 335, 365.

protoplasts were treated with ^{14}C-binding protein, ruptured and fractionated on a sucrose density gradient column. A peak of radioactivity was associated with the enriched plasma membrane fraction. These results support the hypothesis that the binding protein is the primary recognition site governing susceptibility of cane to helminthosporoside and hence to eye spot.

* * *

The new fertilizer advisory service (of the Bureau of Sugar Experiment Stations). A. V. RUDD. *Cane Growers' Quarterly Bull.*, 1975, **39**, 4–5.—The most important physical factors affecting cane response to fertilizers and the reasons for varying requirements of the nutrients are discussed for N, P and K on the basis of a series of soil calibration trials initiated in 1969 as part of the BSES fertilizer advisory service.

* * *

N. I. J. STEWART. *Cane Growers' Quarterly Bull.*, 1975, **39**, 6–7.—In a study of nitrogen fertilizer, the author describes the various forms in which it is available to cane growers and discusses the most suitable type to use, time of application and optimum quantity.

* * *

New fertilizer mixtures for cane growers. A. W. FORD. *Cane Growers' Quarterly Bull.*, 1975, **39**, 8.—The P:K ratios found to be most suitable under certain conditions in Queensland are given. The values, found by the BSES in calibration trials, have been recommended to fertilizer manufacturers and it is expected that mixtures available to cane growers will approximate to these.

* * *

Fiji increases at Bundaberg—altered plough-out policies. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1975, **39**, 9–10.—In an effort to contain Fiji disease, which is particularly rampant in N:Co 310 cane, all farmers having infected cane had to plough-out 20% of their 1974 gross assignment at the end of the 1975 harvest and will not be permitted to replant with N:Co 310 until autumn 1976, although replanting with another variety in spring 1975 was allowed. The author is of the opinion that the situation will deteriorate further in 1976, since control of the disease is impossible while N:Co 310 remains on the list of approved varieties.

* * *

The search for rat control. R. E. KERKWYK. *Cane Growers' Quarterly Bull.*, 1975, **39**, 11.—A brief description is given of the procedure adopted in testing rat poisons for use in Queensland cane fields. Two species mainly responsible for cane damage are *Rattus conatus* and *Melomys littoralis*.

* * *

Recent and future development of the Tully Sugar Experiment Station. C. R. NALDER. *Cane Growers' Quarterly Bull.*, 1975, **39**, 12.—Information is given on the establishment of this experiment station, work on which started in 1969 with the clearing of eight hectares for planting with cane the following year. The eventual area available for experimental work will be about 40 ha.

* * *

Orange freckle again. W. A. WEBB and N. CLARKE. *Cane Growers' Quarterly Bull.*, 1975, **39**, 13–14. Reasons for the outbreak of this disease in Queensland in 1974 are suggested, including the extensive planting of Q 90 cane which is one of the most susceptible to orange freckle. Heavy losses were caused on some farms in 1975. A number of recommended ways of minimizing the effects of the disease are listed, but it is stressed that these suggestions are only tentative and will not eliminate orange freckle. While use of large quantities of potash increases incidence, lime or filter cake, well worked into the soil before planting, helps check infection.

* * *

Poor soil management—costs tonnes. P. R. DOWNS. *Cane Growers' Quarterly Bull.*, 1975, **39**, 15–16.—The importance of good soil structure for optimum cane growth and means of obtaining it are discussed.

* * *

New land? Plan now—or pay later! A. I. LINEDALE. *Cane Growers' Quarterly Bull.*, 1975, **39**, 21–23.—The importance of planning the layout of new cane land so as to avoid problems which could occur in later years is discussed and factors requiring attention are examined, including the row length in relation to harvesting and drainage, soil erosion control, access and transport, irrigation, and the need for new land to tie in with existing farm designs and features.

* * *

Three-point linkage—quick-hitch system. C. R. HENKEL. *Cane Growers' Quarterly Bull.*, 1975, **39**, 24–25.—Illustrations are reproduced which demonstrate the ease with which implements can be attached to and detached from a tractor by means of a quick-hitch three-point linkage.

* * *

Farm levels at Bundaberg. J. F. REIMERS. *Cane Growers' Quarterly Bull.*, 1975, **39**, 26–27.—An outline is given of levelling work carried out on cane farms in the Bundaberg district of Queensland for purposes of flood irrigation and drainage.

* * *

Para grass—view from two sides of the fence. J. A. CURRIE. *Cane Growers' Quarterly Bull.*, 1975, **39**, 28–29.—Para (panicum) grass—*Brachiaria mutica*—makes excellent pasture, but is also one of the worst weeds in cane fields of northern Queensland. Advice is given on the best means of control in cane fields while recommended measures to obtain para grass pasture are also described.

* * *

"Caveat emptor!"—let the buyer beware. J. F. USHER. *Cane Growers' Quarterly Bull.*, 1975, **39**, 30.—The author warns of the need to ensure that second-hand cane equipment is thoroughly clean when purchased, so that weeds, pests and diseases are not transmitted from one area to another.

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River Improvemen Trusts—an asset to the industry. E. F. COPLEY. *Cane Growers' Quarterly Bull.*, 1975, **39**, 31–34.—The work undertaken in Australia by River Improvement Trusts set up under legislation passed in 1940 is described, with details given of work completed and planned in a specific area of Queensland in 1975. The activities are aimed at maintaining rivers free of obstructions, preventing erosion of banks, increasing flow rates, preventing flooding of land by tidal waters, and inhibiting salt intrusion into the course of a river.

The spur-throated locust—a threat to the Burdekin? C. W. CHARDON. *Cane Growers' Quarterly Bull.*, 1975, **39**, 35–36.—Although not regarded as a major cane pest, the spur-throated locust can cause severe losses locally. A large influx of the pest into the Burdekin district of Queensland occurred in late 1974. The life cycle is described and details given of possible control methods. With the aim of preventing or alleviating damage caused by locusts, the Plague Grasshopper Destruction Act 1973-1974 was passed, under which local committees are set up wherever plague grasshopper areas are declared. The function of these committees is explained.

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A mechanism of disease resistance in plants. G. A. STROBEL. *Scientific American*, 1975, **232**, (1), 80–88. The toxin-binding protein in eye spot-susceptible cane and its interaction with potassium-magnesium-ATPase[1] are described with the aid of diagrams and micrographs.

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Effect of plant age and time of harvest on yield of six sugar cane varieties grown in contrasting environments. I. Plant cane crop. R. JULIEN, G. F. SOOPRAMANIEN and G. DELAVOUET. *Rev. Agric. Sucr. Maurice*, 1974, **53**, 138–148.—Trials were conducted with six varieties of cane harvested at 60, 64 and 68 weeks in July, September and November at five different locations representing different climatic zones in Mauritius. Variety, time of harvest and age at harvest all significantly affected the fresh cane weight in all environments, but time of harvest was found to be the dominant factor. Yields were generally lower the later was the harvest, while differences in yield between July and November were mainly due to environmental factors, although varietal differences occurred. The effects of age on yield varied; a marked variety-environment interaction was detected, but all varieties showed lowest yield at 60 weeks. Recoverable sugar content increased from early to late harvest, the increase from early to mid-season harvest being generally more pronounced than from mid-season to late harvest, but again the rate of increase depended on the variety, while environment also affected the sugar content. Age did not have a significant effect on sugar content in cane harvested early or at mid-season. Sugar yield was markedly affected by an interaction between date of harvest and environment.

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Efficacy of fungicide "Benomyl" ("Benlate") for treatment of sugar cane setts. C. RICAUD, J. C. AUTREY, S. SULLIVAN and P. FERRÉ. *Rev. Agric. Sucr. Maurice*, 1974, **53**, 198–205.—Field and greenhouse tests on sett treatment with "Benomyl" to combat pineapple disease are reported. When cold dipping of the setts followed treatment at 52°C for 20 minutes in a hot bath containing 30 g of fungicide per 100 litres, "Benomyl" was slightly more effective than "Aretan" and "Agallol" organo-mercurial compounds (as well as being cheaper and safer). Germination and shoot height of the treated setts were greater after treatment than in the untreated controls.

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Latest on techniques for mechanical harvesting; smut disease; and release of new varieties. G. THOMPSON. *S. African Sugar J.*, 1975, **59**, 223–224.—Reference is made to developments in mechanical harvesting, with mention of a subsidy scheme project in Eastern Transvaal (one of three areas where conventional harvesters are to be used), development of harvesting equipment at the Mount Edgecombe Experiment Station (the "Gobbler" harvester and "Sasex" cane cutter), and preparation of land at La Mercy for testing combined mechanical harvesting and soil conservation procedures. A new mechanical harvester is also being developed by a Mr. BELL which has shown promise on hillside plantations. The problem of smut in N:Co 310 planted in northern, irrigated areas of the South African cane belt is briefly discussed. The same variety elsewhere in South Africa has remained free of the disease. N:Co 376 cane, relatively resistant to smut, seems to be succumbing to the disease in areas where infected N:Co 310 is grown. Three new varieties chosen for pre-release propagation are mentioned: J 59/3, Co 1001 and N 64/38.

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Balance of the first sugar cane season 1974. ANON. *Sucr. Maghrébine*, 1974, (15), 17–19.—The first cane season in Morocco, involving a total of 10,628 metric tons of cane harvested from 278 ha, is reported.

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Sugar cane ripeners in Hawaii—1973. L. G. NICKELL and D. T. TAKAHASHI. *Sugar News* (Philippines), 1975, **51**, 88–93.—See *I.S.J.*, 1975, **77**, 145.

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Cane materials handling—1973. C. W. HART. *Sugar News* (Philippines), 1975, **51**, 94–96.—See *I.S.J.*, 1975, **77**, 144.

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Effects of weed competition on nitrogen fertilization of sugar cane. E. A. CERRIZUELA, R. A. AREVALO and A. A. SOLDATI. *Rev. Agron. Noroeste Argentino*, 1974, **11**, 179–191.—Trials were carried out over three crops using five varieties in plots which were weed-free and weed-infested, to discover the effects of placement of fertilizer on the uncovered stools and on both sides of the covered row by comparison with no fertilization. Results showed that weed competition effects were the same for each variety and were increased by N fertilization, efficiency of which was halved by the presence of weeds. Control of weeds seems to be more important than N fertilization. Placement of the fertilizer showed no differential effects.

* * *

Extraction of nutrients by sugar cane. F. A. FOGLIATA. *La Ind. Azuc.*, 1975, **81**, (944), 26–29.—From cane weight and analysis, the amounts of N, P_2O_5, K_2O, CaO and MgO removed from the soil were measured for an 18-month plant cane crop and a 12-month ratoon crop, each using two varieties. The variations in extraction are recorded and the great importance of nitrogen demonstrated. While the soil used for the trials provides adequate amounts of the other elements, N fertilization is necessary since natural fixation does not provide sufficient nitrogen for the cane in the time available.

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A chopper-harvester system for sugar cane. H. T. E. SMITH. *Management Study* (Mananga Agricultural Management Centre, Swaziland), 1975, (1), 27 pp. An integrated cane harvesting system using chopper-

[1] *I.S.J.*, 1975, **77**, 335, 365.

harvesters is examined in general terms, the subject being divided into: operation of the harvester, cane transport (both infield and field-to-factory) and reception at the factory yard. The importance of buffer stocks of cane is stressed as a means of avoiding factory or harvester stoppages where there is inadequacy of cane at the factory or excessive cane build-up caused by factory stoppages. A continuous flow of chopped cane should be the aim, since deterioration starts shortly after cutting; the maximum desirable period between cutting and milling has to be decided on the basis of local conditions, but a figure of 12 hours is considered unpractical because of the difficulties and costs of handling and control of operations. Harvester output and maximum forward speed, particularly as a function of harvester design and crop yield, are discussed and a formula derived for calculation of cutting rate. The use of transport bins is considered of advantage, and various methods for their transfer from field trailer and for emptying at the factory are examined. Bin size and numbers required are considered as well as other factors involved in their use.

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Drip irrigation scheduling at Hawaiian Commercial & Sugar Company. J. M. SAKUMA. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 24–29.—The drip irrigation scheduling method used by the author's company is based on the use of climatic data (pan evaporation and rainfall) and soil moisture storage data as well as irrigation applications to determine the moisture status in the field. Thus, water applied in irrigation plus rainfall are added to the limit of the soil moisture storage capacity and the pan evaporation figure subtracted to give a water balance. The system is briefly explained and typical data are presented.

* * *

Flat culture techniques and possible applications for drip irrigated fields. M. O. ISHERWOOD. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 30–31.—Advantages of growing cane on flat land are considered in relation to normal agronomic practices.

* * *

General status of drip irrigation. W. GIBSON. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 32–34.—Various aspects of drip irrigation, as used on some 15,000 acres of cane land in Hawaii, are discussed and solutions to a number of earlier problems described.

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D8K and D9H designed to meet environmental goals. R. L. KROLAK. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 41–49.—Measures used by the manufacturers to reduce the sound level in operation of D8K and D9H track-type tractors are described, and briefer mention made of safety devices incorporated in the machines.

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The Soil Conservation Service and drip irrigation. M. C. TULANG and J. W. BEDISH. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 35–40.—The Soil Conservation Service in Hawaii has as its primary objective the provision of technical assistance to land users in carrying out effective conservation programmes. The introduction of drip irrigation has raised the need to modify erosion control measures, since the system obviates the need for furrows which do provide some erosion control. The SCS's approach to the problem is explained and a list presented of erosion control practices applicable to cane fields. Mathematical expressions are presented for calculation of soil loss with and without contouring.

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Chemical treatment and filtration for drip irrigation. B. MCELHOE and W. GIBSON. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 50–52.—Chlorine added to irrigation water at the rate of 10 ppm free chlorine every day for 20 minutes has proved the most effective method of preventing plugging of drip irrigation tubing, while copper sulphate (used at the same rate) is almost as good, although other chemicals tested have proved less effective. The use of sand filters for water treatment has been found to be effective when soil particles measure 30–100 microns (typical for much of the surface water in Hawaii). However, where the particles are much smaller they cannot be easily removed by this means, so that the use of the chlorine treatment has been widely adopted. Screening and vigorous flushing will also minimize plugging.

* * *

Harvesting systems 5 years from today. R. B. V. TOLEDO. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 53–54.—The system envisaged for use by the Laupahoehoe Sugar Co. by 1980 will include a Toft DR564 chopper-harvester, the Foremost/Stubenberg cane buggy for infield transport and a pushrake for inaccessible places. Cane will be transported in 10-ton bins. In the more distant future, the author considers that the pushrake will be replaced by a pick-up-chopper-cleaner type of harvester.

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Effect of cane trash mulching and filter cake incorporation on sugar cane. H. H. HAGIHARA. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 55–59.—Trash mulching has been found to reduce soil and cane nitrogen but has increased cane yield at 12 months and K, Si, Zn and Mn uptake, compared with cane grown on unmulched land. Filter cake applied to soil at a typical rate of 20 tons per acre has increased cane yield markedly compared with untreated cane, while half the amount increased yield only slightly. Its use also increased soil phosphate, potash, calcium and magnesium, but reduced the N content. A typical filter cake analysis shows the quantities of these nutrients (including N, which is present only to a very small degree) in filter cake.

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Ploughing—why no permanent solution? N. ROZEFF. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 60–62. Some of the possible advantages (which require investigation) of reduced tillage are discussed. It is pointed out that such a system under Hawaiian conditions would imply leaving the cane field in a compacted state with only finely prepared strips for germination and growth, although this could lead to lower soil losses by erosion and removal by harvesting equipment, reduced fertilizer leaching and increased soil moisture in the root zone plus better utilization of fertilizers, improved weed control, etc. The question of reduced labour requirements and machine usage for tillage also arises.

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Technical and political aspects of using sewage effluent on sugar cane. E. Y. HIRATA. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 63–67.—Preliminary investigations on the use of domestic sewage for cane irrigation have shown promise, but one major problem is the low nitrate N uptake, which could lead to excessive levels in the ground water and ultimately in potable water supplies. Where drip irrigation is used, the sewage would require treatment to prevent clogging of the pipes, and a further degree of treatment would be needed to reduce virus activity.

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Hydrostatic drive equipment in the sugar cane industry. J. R. MARSHALL. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 68–73.—Advantages of hydrostatic drives, in which the pump has a variable displacement in contrast to hydraulic drives in which the pump displacement is fixed and the motor is controlled by mainstream valving, are discussed and the mechanical, fluid flow and control aspects of their operation are explained.

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Slow-release fertilizer—experimental results from Puna Sugar Co. and Lihue Plantation Co. R. S. UCHIDA, J. B. THOMSON and C. J. YOUNG. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 74–79.—While sulphur-coated slow-release urea tended to increase cane sugar yield compared with normal urea, a number of cost factors require consideration in deciding the overall benefits of the slow-release fertilizer. In particular, although analysis of the urea will depend on the make used, a typical example was that of the TVA sulphur-coated urea, which had a 30–35% N content compared with 46% N in normal commercial urea. In view of this, a greater amount would be required to give the same rate of N application as with normal urea, and the increased bulk would add to the costs of application. On the other hand, leaching and volatilization are reduced by use of slow-release fertilizers.

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Residues of herbicides and growth regulators in sugar cane from using radioactive labelled chemicals. H. W. HILTON, N. S. NOMURA, S. S. KAMEDA and W. L. YAUGER. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 80–84.—Work conducted at the HSPA Experiment Station on determination of the properties and fate of chemicals added to cane roots (in a hydroponic nutrient solution) or to foliage of growing cane is reviewed. The herbicides and ripeners involved had all been labelled with ^{14}C, and details of retention on the leaves and translocation of the residues are tabulated.

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Field studies with sugar cane ripeners in Hawaii—1974. L. G. NICKELL and D. T. TAKAHASHI. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 85–90.—A survey is presented of cane ripeners and preliminary results of field studies are briefly mentioned in certain cases.

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Seed farm concept at Ka'u Sugar Company Inc. I. YONEMITSU. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 91–93.—Information is given on the system used to produce sufficient seed cane to meet half of the company's requirements. The cane is grown on 450–500 acres and is ready for harvesting at 6–9 months. The problems of scheduling, made more difficult by the growing of only four varieties, are discussed. Despite these problems, the system is considered worthwhile for reasons which are listed.

Seed farm at Kekaha. S. INAZU. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 94–97.—The scheme used by Kekaha Sugar Co. to grow seed cane is described, with particular mention of the operation of a Massey-Ferguson seed cutter, which cuts about 0·75 tons of seed billets in 5½ minutes. Overall costs of seed cane production are discussed.

* * *

Present and future seed cutting and handling programmes. R. D. SOLLARS. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 98–101.—Important factors considered in the setting up of a centralized seed cane scheme by the author's company are discussed, and results are given of an incentive scheme for hand cutting seed cane lengths of 12–16 inches.

* * *

A project evaluation process with risk analysis. J. F. WILLIS. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 102–107.—Risk analysis is explained in which assessment of the probabilities of a cane crop failure, a severe drought or normal weather with heavy and with light fertilization is used as an example. The monetary effects are also assessed for each factor.

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The transition from crawlers to four-wheel-drive tractors. L. M. HUMMEL. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 108–113.—Reasons for the changeover from track-type to 4-wheel-drive tractors in farming in the US are discussed by a representative of the International Harvester Co.

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A mechanical memory device as used to time replanted seed on replanters. D. THOMPSON. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 114–116.—A description and illustration are given of a mechanical memory device which is designed to act as time control on a cane planter.

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Entomological parasite-host records from Mauritius. J. R. WILLIAMS. *Occ. Paper, Mauritius Sugar Ind. Research Inst.*, 1974, (28), 33 pp.—Alphabetical lists are given of parasites and their hosts, and of hosts and their parasites; a bibliography is given, and parasite and host indexes to the entries in the first two lists are included.

* * *

Improved practices for sugar cane cultivation in Rajasthan. ANON. *Cane Grower's Bull.*, 1975, **2**, (1), 12–15.—Details are given of cane agriculture in Rajasthan, with information also supplied on the agro-climatic conditions in the four cane-growing regions.

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The Sugar Cane Research Station, Anakapalle, Vishakhapatnam District, Andhra Pradesh. ANON. *Cane Grower's Bull.*, 1975, **2**, (1), 16–19.—Work carried out at this research station, established as an agricultural research station in 1913, is described. The total area of the station is 42·75 ha.

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Epidemic of *Pyrilla* on sugar cane. ANON. *Cane Grower's Bull.*, 1975, **2**, (1), 20.—A heavy incidence of *Pyrilla* on cane in Uttar Pradesh, Haryana and Bihar and the control measures adopted are reported. The pest migrated to the cane from wheat when the latter crop was harvested. "Endrin" or BHC gave good results, both aerial and ground spraying being used.

Sugar beet agriculture

The destruction of wild beet. A. VIGOUREUX and R. VANSTALLEN. *Le Betteravier*, 1975, **9**, (88), 8–9.—The chief characteristic of wild beet is its propensity to early bolting. Means of controlling this "weed" are described. For inter-row control, hoeing is recommended. Within rows of planted beet, there are three possibilities; manual uprooting, chemical spraying of the flower stalks, or cutting of the stalks[1]. Illustrations show the various types of mechanical control and the stages of growth and bolting of wild beet.

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Deficiency diseases. R. VANSTALLEN. *Le Betteravier*, 1975, **9**, (88), 10.—The symptoms and control of deficiencies in magnesium, boron and manganese in beet are described. It is stated that it is better to prevent the condition than cure it. The factor most responsible for restriction of plant growth is considered to be excessive soil acidity, and soil analysis will permit early remedy of this by liming, which will have little effect after emergence. With regard to magnesium deficiency, the author warns against mistaking the symptoms for those of beet yellows.

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Some aspects of sugar cane or sugar beet growing in Morocco. G. SCHMIDT. *Zeitsch. Zuckerind.*, 1975, **100**, 348–350.—The advantages and disadvantages of beet growing in comparison with cane are considered with respect to conditions in Morocco, where recently cane has been grown for sugar extraction in addition to the well-established growing of beet. Aspects discussed include irrigation, soil type and land availability, climate and economic viewpoints.

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Improving beet handling. M. MAWBY. *British Sugar Beet Rev.*, 1975, **43**, 87.—The question of optimum siting of beet clamps for ease of loading onto road trucks is discussed with particular reference to the employment of haulage contractors by beet farmers. While the time taken to load the beet and turn the vehicle around is economically important, another important factor considered is the amount of soil loaded; for minimum dirt tare it is advisable to build the clamp on the hardest, driest area available and to ensure that the cleaner-loader operates efficiently in unrestricted space clear of any obstructions.

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The underleaf spray technique in commercial practice. A. S. KENNEDY. *British Sugar Beet Rev.*, 1975, **43**, 95. Underleaf spraying of weeds with "Betanal" in June gave as good control in a 2-acre test area as did hand weeding on another 3 acres. Where no underleaf spraying was used, weeds were much in evidence on the trial site by early September. Little benefit was gained by adding a residual herbicide to "Betanal". "Pyramin" applied as a pre-emergence herbicide had little effect on weed growth, although beet emergence was good.

Cost-sharing group invests in a weedcutter. D. CHARLESWORTH. *British Sugar Beet Rev.*, 1975, **43**, 97, 102.—The author describes how three farmers in Norfolk have invested in a weedcutter [the Ramsey "Weed Beta" developed by the British Sugar Corporation and Ramsey (Hunts) Engineering Ltd.] to eliminate bolters and later-developing weeds. Easily handling 3–4 acres an hour, the machine is normally used twice per crop—once during August and then just before harvesting in September.

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Trials of commercial varieties of sugar beet. L. A. WILLEY and S. F. H. MCCULLAGH. *British Sugar Beet Rev.*, 1975, **43**, 100–102.—Beet varietal trial results are tabulated for the three years 1972–74. It is pointed out that only about one in ten of the numerous varieties assessed performed sufficiently well under UK conditions to justify their recommendation. The current official list drawn up by the National Institute of Agricultural Botany contains four multigerm and six monogerm varieties. The final elimination of multigerm varieties in favour of monogerm beet, which are better as regards sugar yield, resistance to bolting and disease tolerance, is thought to be close at hand.

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The fight against weeds. II. A. FLEURY. *Hautes Etudes Betterav. Agric.*, 1975, **7**, (30), 38–47.—Means of combating weeds (other than chemical control) are discussed in this general article on the subject, and the advantages and disadvantages of chemical control are stated.

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Results of comparative sugar beet varietal trials in Belgium from 1972 to 1974. N. ROUSSEL, R. VANSTALLEN and W. ROELANTS. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1975, **43**, (1), 1–48.—Details are given of varietal trials at six locations in 1974, and results are compared with those obtained in 1973 and 1972 for the same varieties; comparison is also made between varieties for each of the three years.

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Dispersal of *Phoma betae* in sugar beet storage yards. W. M. BUGBEE. *Plant Disease Reporter*, 1975, **59**, 396–397.—Although it had previously been found that *Phoma betae* (an important sugar beet storage rot pathogen as well as leaf spot pathogen in a later phase) survived perennially in beet yard soils in the Red River Valley, recent investigations showed that wind dispersal of soil-borne inoculum of the pathogen did not occur during piling, but *P. betae* was found in extraneous matter falling from the boom of the piler as it traversed the face of the pile. Since it has been found that *P. betae* can survive at least 26 months in the soil, a 4-year crop rotation is recommended as well as seed treatment with fungicide.

[1] *I.S.J.*, 1975, 77, 374.

(Beet) Sugar campaign balance 1974. I. Agricultural report of the 1974 campaign: meteorological and climatic observations. ANON. *Sucr. Maghrébine*, 1974, (15), 5–16.—Agricultural aspects of the 1973/74 beet campaign in Morocco are reported.

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Post-emergence herbicides for effective weed control in sugar beets. W. F. MEGGITT. *Sugar Beet J.*, 1975, **38,** (3), 2–4.—Various herbicides are mentioned in a general discussion of post-emergence weed control. Guidance is given on how and when to apply such herbicides. While environmental factors, particularly temperature (which should be 60–80°F for best results), are important for post-emergence weed control, timing is critical; if delays occur as a result of inclement weather, weeds may become too big for effective control. Moreover, while pre- and post-emergence treatment effectively controls annual weeds, perennial weeds require control at another stage or year in the crop rotation, since herbicides which can control hardy perennial weeds will also kill beet.

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Let's not forget the cultivator. C. KESTER and F. KIRK. *Sugar Beet J.*, 1975, **38,** (3), 5.—Advice is given on beet field cultivation and its aims—early cultivation to break the soil crust and aerate, and second and third cultivations to aerate the soil and prevent growth of weeds which have escaped pre- and post-emergence spraying.

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Insects in 1975: known and unknown. R. F. RUPPEL. *Sugar Beet J.*, 1975, **38,** (3), 6–7.—Insects mentioned include white grubs, wireworms, cutworms, flea beetles and spinach leaf miners. Where and when to expect them and means of control are discussed. Regular checking of fields for all pests, whether known or unknown, is essential. The author refers to the unpredictability of pests and mentions new pests which have become serious in Michigan during recent years.

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From seeds to seed crop. R. C. ZIELKE. *Sugar Beet J.*, 1975, **38,** (3), 7–9.—The author explains the methods used to produce beet seed in the USA, where beets planted in late summer in a mild climate are allowed to overwinter and grow seed stalks in the next spring. While only a few areas in the country provide the conditions necessary for seed production, many locations have been found along the western coast and in temperate mountain valleys which are highly suitable.

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Package of practices for sugar beet cultivation in Rajasthan. D. S. OBEROI and R. SINGH. *Cane Grower's Bull.*, 1975, **2,** (1), 3–4, 15.—Information is given on beet agricultural practices in the Sriganganagar district of Rajasthan, India.

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Package of practices for growing sugar beet in Punjab. R. S. KANWAR, D. S. DEOL and J. S. SANDHU. *Cane Grower's Bull.*, 1975, **2,** (1), 5–6, 15.—The earlier report from Jullundur[1] is expanded to include the major beet pests and diseases encountered plus possible control measures. At present, no commercial beet growing is carried on in the state.

Effect of spacing on sugar beet seed production. S. S. SAINI, P. P. SHARMA and K. B. RASTOGI. *Cane Grower's Bull.*, 1975, **2,** (1), 7–9.—Trials in 1967–69 are reported, in which seedlings of the same beet variety were planted at intervals of 30, 60 or 90 cm with inter-row spacings of 30, 60 or 90 cm. Results showed that the smallest inter-beet and inter-row spacing gave significantly higher beet seed yields than did greater spacings, while other factors (number of days required for the beet to flower, number of shoots developed per root, primary axis length and seed weight) were unaffected by spacing.

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Effect of foliar application of micro-nutrients on sugar beet in West Bengal. R. C. SAMUI and S. K. MUKHOPADHYAY. *Cane Grower's Bull.*, 1975, **2,** (1), 10–11. The effect of boron and molybdenum foliar application was determined by experiment. The nutrients were applied 45 days after sowing, and a normal N-P-K fertilization programme was followed. While boron, applied as 0·5, 1·0 and 1·5% borax solution, gave lower beet and sugar yields than did the control (sprayed with water) and gave a higher sucrose recovery % only in the case of the 1·5% solution, 0·1% sodium molybdate solution gave a significantly higher beet and sugar yield and sucrose recovery % than the control, although the other concentrations had little effect.

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Factors affecting sugar beet quality and storage properties. M. MARTENS. *Cukoripar*, 1975, **28,** 81–85. Factors affecting beet quality and storage properties are briefly examined, including: sowing time; chemical control of diseases, pests and weeds; irregular beet spacing; topping height; transport; and treatment with chemicals to reduce fungal diseases, leaf growth and respiration in storage. The effects are illustrated by graphs in some cases.

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The effect of chemical treatment on sugar beet yield and quality. B. DEBRECZENI and K. KOVÁCS. *Cukoripar*, 1975, **28,** 85–88.—Experiments conducted in 1974 by the Dept. of Agricultural Chemicals at Gödöllo in Hungary are reported, in which 3:3:4 mixtures of $N:P_2O_5:K_2O$ were applied at the rate of 150, 300, 600 and 900 kg per ha with and without chemical weed control. Whereas increase in the amount of fertilizer applied was accompanied by a fall in the beet sugar content and a rise in the proportions of organic and inorganic substances which adversely affect quality, it was found that adequate weed control enabled 300 and 600 kg of the fertilizer mixture to give a sufficiently greater yield to balance the drop in sugar content.

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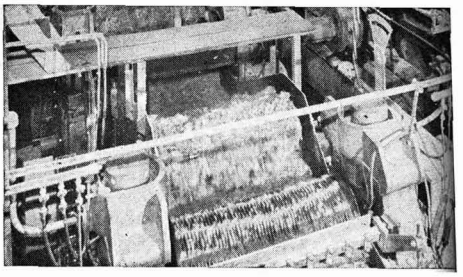
Do you still have acid soils? Think of liming them. R. VANSTALLEN. *Le Betteravier*, 1975, **9,** (89), 7. The importance of liming acid soil is indicated for fields in the same region of Belgium where the soil pH is 7·2–7·8 and 6·0–6·6. The higher soil pH is shown to be accompanied by a greater beet yield and sugar content than in the fields of lower pH. The cheapest form of lime is sugar factory waste lime, and the economics are worked out, including the value of the N, P, K and Mg also contained in it.

[1] KANWAR: *I.S.J.*, 1974, **76,** 113.

Cane sugar manufacture



A non-diaphragm slurry pump. D. R. PADDOCK and P. B. QUINAN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 181–184.—Mention is made of the fact that some sugar factories in Queensland have stopped using diaphragm-type slurry pumps for transferring primary mud from the well of each clarifier compartment to the mud box; reasons for this include the short life of the diaphragms and their high seasonal replacement cost as well as the adverse effects on the clarified juice when a diaphragm ruptures. The authors explain how this type of pump may be modified to eliminate the diaphragm, simultaneously increasing the pump capacity and considerably reducing maintenance of the non-return valves and air control system. Operation of modified pumps at Condong and Goondi has been virtually trouble-free. Costs of the modification are briefly discussed.

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Simplified multi-effect evaporator calculations. P. G. WRIGHT. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 185–193.—Simplified expressions are given for calculation of multiple-effect evaporator steam requirements and heat transfer in the case of evaporator arrangements typical for Queensland. Sample calculations are presented.

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Automatic control of an evaporation station. C. D. CLARKE and M. WEBBER. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 195–201.—Information is given on the automatic control of juice evaporation rate, level and Brix in the quadruple-effect evaporator (made up of seven vessels) at Farleigh, with mention of related process controls and equipment. The operating procedures are described and control charts reproduced, indicating the high efficiency of the systems.

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Nucleation in sugar boiling. R. J. BATTERHAM, T. E. NORGATE, F. SWEETT and R. N. TAYLOR. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 211–219.—Experiments with a computer-controlled laboratory crystallizer, which permitted accurate control of supersaturation even at high crystal contents, were conducted at temperatures in the range 38–79°C, a stirrer speed of 0–750 rpm, seed crystal sizes of 190–780 μ, crystal contents of 0–50% and a true purity of 0·55–1·0. A microscope on the side of the pan allowed nuclei as small as 10 μ to be detected directly without the need to withdraw samples. Impure solutions were prepared by mixing a final molasses of 1·58 reducing sugars:ash ratio with pure sucrose solutions. Results, in the form of graphs and tables, show the effects of the different variables on the nucleation boundary and nucleation rates; they indicate that working supersaturations may be highest when boiling is carried out at low crystal contents, at low purities or with small crystals. Nucleation rates displayed a simple exponential dependence on supersaturation and a second-order dependence on crystal content which suggests a collision breeding mechanism (as indicated by an initial sharp fall in supersaturation with increase in stirrer speed followed by a gradual and slight rise in supersaturation with further increase in stirrer speed).

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Continuous boiling of low-grade massecuites. R. J. STEINDL, K. F. MILLER, R. BROADFOOT and J. E. SELDON. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 221–228.—Tests conducted up to 1974 on continuous boiling in Queensland are summarized and further trials reported. Preliminary conclusions include: (a) the *C*-magma produced was comparable to that produced in batch pans and cured in continuous centrifugals; (b) the production rate was equivalent to that of a batch pan of similar volume; (c) only a minimum of supervision would be necessary for stable boiling control with provision of relatively simple control loops; and (d) the use of internal baffles in the final two of six cells in the test arrangement gave a closer approximation to plug flow through the system than would be expected from two perfectly mixed cells in series and would narrow the product size distribution from a given number of cells.

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Mechanical circulation in low-grade pans. P. W. GOODENOUGH and M. R. PLAYER. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 229–233. Trials at Victoria, where the low-grade pan station comprises one pan for graining and two pans (one provided with a stirrer) for further handling of the massecuite, were aimed at determining the effects of mechanical circulation. Results indicated that, while there were considerable advantages in mechanical stirring when the steam supply was poor and the material being boiled was of a refractory nature, many of the claims made for forced circulation were exaggerated and adequately high crystallization rates could be achieved in well-designed natural circulation pans.

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Performance charts for continuous pans. R. BROADFOOT and E. T. WHITE. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 235–244.—For prediction of continuous vacuum pan performance or for the design of a suitable pan to give a required performance, a method is described in which the steady-state model of a well-mixed vessel fed with massecuite and molasses or syrup at constant rates is solved graphically. The model assumes no formation of false grain, a crystal growth rate which is independent of crystal size, no change in crystal shape with growth, and a crystal size distribution in accordance with the findings of WRIGHT & WHITE[1].

[1] *I.S.J.*, 1970, **72**, 89.

A modified pan boiling technique. P. W. COLLINS. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 245–248.—Results are reported of experiments in which a Foxboro Model 40 adjustable-span "Pneumaticset" was used to control pan boiling on the basis of a decrease in the conductivity feed control set-point with increase in the massecuite height (the system incorporates two adjustable limit stops which force the conductivity set-point to remain within certain limits). Comparison with normal boiling practices showed that the gradual reduction in massecuite conductivity during the later stages of boiling-on resulted in shorter cycle times and improvements in exhaustion and sugar quality.

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Contactless conductivity measurement in massecuite. S. R. REICHARD and T. L. VIDLER. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 249–253. A contactless conductivity electrode for use in vacuum pans is described and the principle of its operation explained. Tests with two such electrodes showed that they functioned faultlessly, except for a broken wire in each case, and that no resetting was necessary throughout the season. More uniform readings were obtained than from conventional conductivity control systems over a short period, although reasons for this are not known. Changes in the circuitry would be necessary before the electrode could be applied to other materials such as syrup, molasses, mud, remelt liquor, etc.

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The sugar recovery problem. R. J. BATTERHAM. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 255–262.—The operation of low-grade stations is examined with the aim of establishing reasons for limited sugar recovery and means of improving it. While it is thought that impurities affect crystallization in such a complex way that no simple solution to the problem is likely, there is the possibility of using crushed sugar as seed material, and the advantages of this are discussed. Processes for increasing recovery which are relatively new are briefly described: ion exchange, ion exclusion, reverse osmosis and ultrafiltration, use of organic solvents and active carbon, and electrodialysis.

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The motion of crystals leaving a continuous (centrifugal. R. J. SWINDELLS and E. T. WHITE. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 283–291.—As part of a programme concerned with improving continuous centrifugal performance, the authors have made a study of the prediction of the motion of a crystal across the annular gap between the basket and casing. A computer programme has been written to solve the equations involved in calculating the trajectories as a function of basket speed, basket and casing diameters, the air velocity profile and temperature, and crystal size, shape and drag coefficient. The ability of the computer programme to predict crystal trajectories is demonstrated by three examples: (1) where there is no windage in the casing, (2) where there is natural windage, and (3) where air patterns are imposed. These show that while impact velocities can be reduced by increasing the diameter of the casing, the diameter required appears to be too great for practical purposes. A more suitable means of reducing impact and crystal breakage is creation of a wind profile against the crystal movement, although other factors need to be considered, e.g. the possible fouling of air flow ducts by the crystals, the carry-over of fines, and the need to maintain a pressure balance between the sugar and molasses chambers.

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The selection of the Babinda boiler. K. J. NIX. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 293–300.—Details are given of a Babcock & Wilcox bi-drum boiler with bagasse furnace which, at 46% bagasse moisture content, has a maximum steam rate of 220,000 kg.hr^{-1}, although the boiler can operate at varying generation pressures and efficiencies in the range 58–68% of rated capacity at a bagasse moisture content of 50%, and is adaptable to increases in crushing rates.

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Computer modelling of boilers. J. M. STEWARD and W. B. CRAWFORD. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 301–309.—As a contribution to the simulation of a complete cane sugar factory[1], a model has been designed of a boiler in order to determine the steam output from a given quantity of bagasse with variations in e.g. bagasse moisture content and excess air. Full details are given of the programme.

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Dewatering of fly-ash from bagasse-fired boilers. G. M. SAWYER and R. N. CULLEN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 311–317.—Pilot plant tests are reported in which fly-ash slurry was dewatered in a settling tank with ash removal by scraper conveyor, a subsider from which concentrated slurry was withdrawn, and a horizontal filter. While the efficiencies of the three pieces of equipment were in the ascending order in which they are given above, addition of flocculant considerably improved the efficiency of the subsider, raising it above that of the filter, which was not affected by flocculant addition. On the other hand, flocculant addition was not practical in the case of the settling tank. The cake from the filter was sufficiently dry to be readily handled in an ash hopper, and the dewatering process at low vacuum was rapid, giving a filtrate sufficiently clean to be directly recycled.

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Centrifuge performance in the treatment of cane mud. P. N. STEWART, A. G. NOBLE and G. A. BROTHERTON. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 319–329.—Details are given of tests on the use of solid-bowl centrifuges for treatment of cane mud. While the centrifuge was easy to operate and maintain, its capital costs were high and its overall performance, at a maximum mud solids retention of 80–85% under the most favourable operating conditions, was not as good as that of well-operated rotary filters, so that in its present form the machine is not a practical alternative to the filter.

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Enzymic hydrolysis of dextran in mills. P. HIDI and R. STAKER. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 331–344.—Laboratory and factory investigations on dextran removal from cane juice, syrup and molasses by means of dextranase, showed that maximum results can be obtained provided a

[1] *I.S.J.*, 1975, **77**, 364.

sufficient quantity of the enzyme is used, thereby considerably improving sugar crystal shape and molasses exhaustion. However, limitations are imposed by temperature, pH and Brix; on the other hand, since high dextran levels cause prolonged reductions in the milling rate, the use of dextranase may be justified, but it is emphasized that the best method for controlling dextran is before the cane reaches the mill.

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Clarification of juice from the varieties My 55-14 and Ja 60-5. P. M. FABREGAT and L. GOMEZ R. *ATAC*, 1975, **34**, (2), 36–41.—Clarification is subject to factors which may be controlled in the factory or laboratory (method of liming, temperature, etc.) but also to others which are not controllable (cane variety, agricultural and climatic conditions, age at harvest, etc.). Experiments were made to determine the effect of some of the latter by clarification under constant process conditions. Sedimentation curves showed variety My 55-14 to have better clarification qualities than Ja 60-5, reaching final mud volume quicker. Juice from My 55-14 clarified better as the season progresses, but it yielded both heavy and light floccules, the latter remaining in suspension. With the same N fertilization, higher P fertilization improved clarification of the cane juice while, with the same P level, sedimentation was worse with lower N and K fertilization.

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The application of steam turbines to energy recovery in industrial plants. S. V. WILDMAN and T. J. GOLDSMITH. *APE Engineering*, 1975, (19), 24–27.—The use of steam turbines to produce mechanical or electrical power as well as process steam (from steam raised by burning waste combustible material or from waste heat) is discussed generally. Reference is made to the heat steam produced by bagasse burning in a cane sugar factory; it is pointed out that if the power:heat ratio increases or other uses are found for surplus bagasse, turbine output in terms of steam can be improved by increasing the inlet steam temperature and pressure. The effect of different inlet steam conditions on steam consumption by typical single- and multi-stage turbines is indicated, and normal overall efficiencies of various types of turbines are given. Problems associated with steam turbine use for energy recovery systems are discussed.

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VCF method to calculate sugar yield. G. ARCENEAUX. *Sugar J.*, 1975, **37**, (10), 23–28.—The varietal correction factor (VCF) empirical method developed in Louisiana some 40 years ago to calculate the adjustment in cane milling performance for cane varietal differences is explained. Its essential features include use of a reference variety on a continuing basis and determination, as decisive factors, of normal juice extraction % cane and a sucrose reduction factor. An 80-lb sample is processed as in factory milling with uniform maceration, the above-mentioned factors found and the ratio of indicated recoverable sugar from a given variety to that of the reference variety established—this ratio is the VCF. Adjustments derived by this means have been found to be more realistic than adjustments based on differences in the fibre contents, and experimental errors are usually 1–1·5%.

Waste fuel drying and the energy crisis. E. W. KERR. *Sugar J.*, 1975, **37**, (10), 40–47.—See *I.S.J.*, 1911, **13**, 603–608.

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Steel turnplates in use at Enterprise mill. R. VAN WIJK. *Sugar J.*, 1975, **37**, (10), 53.—Details are given of a cast steel turnplate, the teeth of which were cut by a welding torch piloted by an electronic eye following a pencil-drawn pattern. Two such turnplates were made at the author's sugar factory for Nos. 1 and 5 mills instead of manufactured turnplates which would have been subject to a long delivery delay. The advantage of cast steel turnplates is the greater quantity of cane which can be crushed (340,000 tons compared with 220,000 tons using cast iron turnplates).

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A case of poor performance of an evaporator unit. S. SRINIVESEN. *Indian Sugar*, 1975, **24**, 941–944, 959. See SRINIVASAN: *I.S.J.*, 1975, **77**, 376.

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Present state and future prospects of the Philippines sugar industry. J. C. DACANAY. *Sucr. Franç.*, 1975, **116**, 283–287.—A brief survey is presented of the Philippines sugar industry and of future plans, which include expansion into North Luzon.

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DDS automatic pan boiling controls. J. P. MERLE. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 117–122. Details are given of the DDS automatic control system installed on a low-grade pan at the Honokaa Sugar Co. which has operated flawlessly for 3 months since start-up, although no performance data are given.

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Solid-bowl centrifuging of cane mud at Mossman mill. S. C. GRIMLEY and R. A. ALLAWAY. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 123–129.—A further account is given of the use of a "Mercobowl 16L" centrifuge to treat clarifier mud. (See also STEWART *et al: I.S.J.*, 1975, **77**, 86; 1976, **78**, 85; HUNWICK: *ibid.*, 1975, **77**, 86.)

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Continuous grinding at Honokaa Sugar Company: its effect on plant and people. B. G. ROSS. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 130–137.—Operation of the Honokaa factory on a continuous basis (with four shifts a day each day of the week) over a period of 261 days was necessary when another factory owned by the company was closed, so that cane from two areas had to be processed in the one factory. The effects on the machines and their operators are discussed, and future prospects briefly mentioned. In 1974 the factory was expected to operate for 242 days to produce 70,000 tons of sugar.

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More chain per dollar. R. W. EBLY. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 162–172.—Conveyor chain selection, wear and corrosion are discussed by a representative of Rexnord Inc. and recommendations are given on ways to achieve maximum chain and sprocket life.

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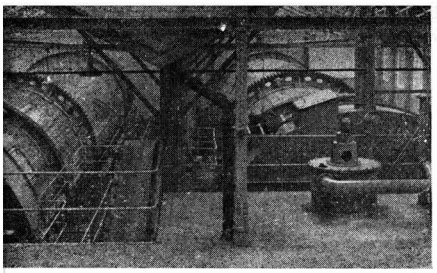
Computerization of factory operations at Mossman mill. S. C. GRIMLEY and R. A. ALLAWAY. *Rpts.* 1974 *Meeting Hawaiian Sugar Tech.*, 173–187.—See ALLAWAY: *I.S.J.*, 1975, **77**, 55.



Beet sugar manufacture

Increasing sugar yield in the beet sugar industry. YU. D. GOLOVNYAK, M. Z. KHELEMSKII, A. YA. ZAGORUL'KO and L. G. BELOSTOTSKII. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23**, 3–18.—Factors examined in relation to beet sugar yield include beet quality, reception and storage; improvements in all three factors will contribute to a rise in sugar recovery, it is stated. Other means of increasing efficiency on the raw material side are examined, including the maintenance of weekly charts showing the quantities of beet harvested and supplied to the factory and daily charts showing the amount of beet lifted per hour. Also mentioned is the need for more modern equipment in Soviet factories to increase the degree of pulp pressing. On the processing side, improvement in control of diffusion, carbonatation and juice flow is also called for.

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Use of chemical preparations for beet preservation in storage. M. Z. KHELEMSKII, M. L. PEL'TS and I. R. SAPOZHNIKOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23**, 30–48.—Investigations are reported in some detail and references made to results quoted in the literature on chemical treatment of stored beet to combat rotting and sprouting. While both maleic hydrazide and polyphenols (particularly pyrocatechol and hydroquinone) were effective in reducing losses due to the two above-mentioned factors, pseudoallicins (antibiotics) did not stop sprouting and are, in any case, only available on a limited scale.

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Production of cossettes from beet of varying quality. V. N. SHCHEGOLEV, V. N. NECHITAILO, E. V. LITVINOV and N. V. POGORELOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23**, 56–71.—Means of improving cossette quality as a contribution to greater diffusion efficiency are discussed, covering both beet slicer construction and operation.

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The use of anti-foaming agents for normalization of diffuser operation and their requirements. V. N. BORZDAYA, A. K. BURYMA, V. E. SKRIPLEV and V. G. YARMILKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23**, 72–76.—A brief survey is presented of means used in the USSR and elsewhere to combat foam formation in diffusers, including specially formulated surface-active agents and more general products such as soap stock, vegetable oils and animal fats.

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Undetermined sucrose losses in diffusion. A. K. BURYMA, N. A. SYCHEVSKII and V. G. YARMILKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar Prom.*, 1974, **23**, 77–93.—The unkown losses were determined in BMA and DDS diffusers during four campaigns. The results are discussed and factors governing the losses examined. Empirical expressions are presented for their calculation as a function of diffusion parameters and beet processing quality. It is shown that one of the most important variables is diffusion residence time.

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Pan circulators and controls. J. P. ABBOTT and J. E. A. RICH. *Sugar J.*, 1975, **37**, (11), 8–13.—Types of massecuite stirrers installed in white sugar pans of Holly Sugar Corporation factories are described with the aid of diagrams, and graphs are presented showing the benefits of their use as regards pan yields.

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Recent advances in ion exchange techniques and apparatus design. K. W. R. SCHOENROCK. *Sugar J.*, 1975, **37**, (12), 16–19.—Fixed-bed counter-current ion exchange systems are discussed in brief and a diagram presented showing the basic components of the Amalgamated Sugar Co. two-unit system. Installed at Nampa factory for replacement of potassium and sodium ions in intermediate green syrup with magnesium ions from a sulphonic-type cation exchange resin, the system has proved more efficient than a fixed-bed co-current one in a number of ways. The advantages and disadvantages of the counter-current scheme are discussed.

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First carbonatation end-point control. J. F. T. OLDFIELD, N. W. BROUGHTON and M. SHORE. *Sucr. Belge*, 1975, **94**, 247–253.—See *I.S.J.*, 1975, **77**, 88.

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Syrup preparation. S. BOUČEK and V. VALTER. *Listy Cukr.*, 1975, **91**, 80–82.—A simple syrup Brix control system based on dilution with thin juice is described which is installed before the pan supply tank. Mean error (from 70 readings) was $\pm 1{\cdot}4$°Bx. An automatic temperature control for the syrup in the supply tank is also described; this has been found to maintain temperature within ± 3°C of the required value.

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New type of milk-of-lime dosing device. Z. SOMORA. *Listy Cukr.*, 1975, **91**, 83–90.—Details are given of a patented dosing means based on a system of weir-troughs, each of which is provided with a servo-motor linked to a central flow measuring element and which feeds the milk-of-lime at constant rate to a distributor, which is also described.

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More on the A1-PDS-20 diffuser. A. S. DERZHAVETS, A. I. STERLIKOV, A. M. GROISMAN and M. A. ZYUKIN. *Sakhar. Prom.*, 1975, (4), 22–23.—Despite a number of drawbacks, the A1-PDS-20 4-scroll diffuser is considered promising. At a throughput of 2000 metric tons per day and a draft of 120%, pulp losses have amounted to 0·35–0·40%. The diffuser has six compartments, and the four scrolls are arranged in

two parallel lines in series, so that the tail sections rotate at a higher speed than the head sections. This arrangement prevents cossette blockages.

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Thick juice storage and processing at Mironovskii sugar factory during the 1972/73 campaign. T. P. KHVALKOVSKII *et al. Sakhar. Prom.*, 1975, (4), 23–28.—During 120 days' storage in a tank at temperatures ranging from —13 to +40°C, 2235 tons of thick juice underwent marked changes in colour content (a 50% average increase), more than doubled its melanoidin content and showed a marked increase in coloured alkaline decomposition products. However, reducing sugars fell by 11%, while no yeasts occurred and mould and thermophile counts were low. For 30 days, the juice had a temperature below zero, although the minimum was —6°C. Processing by a 3-massecuite scheme yielded 0·33% (on beet) less white sugar than was obtained by direct processing without storage. The higher losses were made up of 0·01% in storage plus other losses considered unavoidable in two-stage processing, including a 0·13% increase in molasses loss. The quality of the white sugar was better than the standard specification. Some recommendations are given on treatment of the juice before, during and after storage so as to avoid excessive losses.

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A new dust separator for white sugar dryer/coolers. A. F. ZABORSIN *et al. Sakhar. Prom.*, 1975, (4), 32–37. Details are given of a dust separator comprising a horizontal followed by a vertical Venturi tube in which high gas turbulence creates a high degree of dispersion of the spray liquid (2nd carbonatation juice, water or steam). The droplets are trapped by a conventional device installed below the vertical tube.

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Experience in operation of a sugar factory with a reduced quantity of effluent. V. A. BUROV, I. P. BERESTNEV, V. N. BAZLOV and N. I. YANVAREV. *Sakhar. Prom.*, 1975, (4), 37–40.—The systems introduced at Dergachskii sugar factory for treatment and recycling of flume-wash water and for sweetening-off filter cake are described.

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Operation of vacuum filters with a moving filter cloth at Korenovskii sugar factory. N. G. LILA and B. I. EIBOZHENKO. *Sakhar. Prom.*, 1975, (4), 46–47. Modifications to the vacuum filters at this factory have enabled them to be operated as belt filters. The operation and component parts are explained.

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A vacuum filter with moving filter cloth. V. NOSIKOVA. *Sakhar. Prom.*, 1975, (4), 47–49.—The B-40 vacuum filters at Ertil'skii sugar factory have been modified to permit their operation as belt filters. Full details are given.

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Improvement in 1st carbonatation juice filtration. A. S. OKOLOT and M. S. KOZLO. *Sakhar. Prom.*, 1975, (4), 49–50.—Improvement in the settling rate and filtration of 1st carbonatation juice at the authors' factory has been achieved by installing a second 1st carbonatation vessel provided with an internal circulation tank having a serrated top. Recirculating juice is pumped up through this tank and overflows into the main vessel. The initial juice comes from the preceding 1st carbonatation vessel, in which it is only partially gassed, the final alkalinity being obtained in the second vessel. From the first vessel, a high proportion of the juice is recycled to preliming. Comparative results are tabulated.

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Trends in the designing of sugar factories. L. I. NEMIROVSKII. *Sakhar. Prom.*, 1975, (4), 51–56.—The major steps in Soviet sugar factory planning are outlined and basic trends up to the year 1990 are briefly set out.

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Proposals of Ukrgiprosakhprom (Ukrainian State Planning Office for the Sugar Industry) for the designing of new sugar factories. V. E. POPOV. *Sakhar. Prom.*, 1975, (4), 57–61.—Guidelines are given for the designing of beet sugar factories in relation to processes and the requisite equipment.

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Types of railheads for beet reception. I. B. SOMOROV. *Sakhar. Prom.*, 1975, (4), 61–64.—The layout and equipment of railheads for the reception of beet are discussed and two versions of a general scheme presented for handling 100,000 tons of beet annually.

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Use of ultrasonics for scale prevention in evaporators. I. M. FEDOTKIN *et al. Sakhar. Prom.*, 1975, (4), 64–67. Further tests on the use of magneto-striction oscillators are reported, in which scale formation in 2nd and 3rd evaporator effects has been reduced and heat conduction increased.

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Present state and future prospects of the sugar industry in Poland. W. GORALCZYK. *Sucr. Franç.*, 1975, **116**, 287–290.—A general survey of the Polish sugar industry is presented with brief mention of the 1974/75 campaign. It is planned to increase the beet area to 600,000 ha by 1980, and several new factories having a daily beet slice of 6000 metric tons are projected. Between 1980 and 1985 small, unprofitable factories will be closed.

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Mechanical cleaning of beet flumes. V. LOCHMAN. *Listy Cukr.*, 1975, **91**, 115–117.—Details and illustrations are given of a grab, as used for ballast handling, which is operated from a 4-wheeled vehicle to remove sediment from beet flumes when they are not in use.

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Massecuite crystallization with surface-active additives. YA. G. ROPOTENKO *et al. Sakhar. Prom.*, 1975, (5), 9–12.—Laboratory and factory-scale tests are reported in which the effects of various surfactants on the crystallization rate of *A*- and *C*-massecuite were determined. All five additives tested increased the rate compared with the untreated control, but the most effective was acetoglyceryl monostearate produced by 50% acetylation of the monoglyceride, while the least effective was sunflower oil. The effects on massecuite Brix and purity varied.

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White sugar drying by pulse-flow fluidization with air. A. F. ZABORSIN *et al. Sakhar. Prom.*, 1975, (5), 15–18. Experiments are reported in which white sugar was dried by hot air generated at an average flow rate of 1·46 m.sec^{-1} and an interval of 0·5–1·0 Hz. The

pulsed flow was brought about by a rotary choke valve placed after the heater, to which air was fed from two fans. Results are expressed in graph form, showing the mass transfer coefficient and rate of pressure change across the grid supporting the sugar as a function of frequency of air flow and height of the sugar layer. These showed that the process is highly effective in drying sugar of high moisture content at low power output.

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Industrial water economy and reduction of waste water at Moldavian sugar factories. P. S. MAKSIMUK. *Sakhar. Prom.*, 1975, (5), 18–22.—Details are given of measures adopted at sugar factories in the Moldavian SSR to reduce water consumption and quantity of effluent. The article is accompanied by a diagram showing the layout of a factory and its relevant water supply scheme.

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Deionization of liquid syrup by electrodialysis. P. P. ZAGORODNYI, L. D. BOBROVNIK and I. M. FEDOTKIN. *Sakhar. Prom.*, 1975, (5), 22–24.—Investigations of electrodialysis involved use of syrup from a 2nd evaporator effect; its Brix (30–35°) was that at which factory products have maximum conductance. From the tests, conducted in a 21-cell dialyser having membranes of 450 cm^2 surface area, an equation was derived for calculation of dialyser length and membrane surface area to meet given requirements.

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Investigation of the aeration and micro-climate of sugar factories. A. A. CHERNYI and V. D. PETRASH. *Sakhar. Prom.*, 1975, (5), 28–30.—Details are tabulated of the temperature in the vicinities of process equipment at three Soviet sugar factories. The tables also show the amount of heat liberated to the surrounding air as well as the temperature gradients per m of building height during September at an ambient temperature of 16·8–20·7°C. The aim is to establish bases for a suitable ventilation scheme in factories.

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Electro-flotation means of treating flume-wash water. A. N. KRIVCHUN, P. S. TSYGANKOV, YU. F. TSYUKALO and I. S. CHERKAS. *Sakhar. Prom.*, 1975, (5), 32–34. A laboratory electro-flotation system is described which has been used in tests on treatment of flume-wash water. The waste water was treated with HCl and then fed to the top of a column housing, approximately halfway down, a series of soluble aluminium anodes and, towards the bottom, a stainless steel grid acting as a cathode and, below it, a number of insoluble graphite anodes. The system of electro-flotation operates on the principle of dissolution of the soluble anode metal with formation of hydroxides; these adsorb the bacteria, colloids and solid particles in the waste water and float to the top of the column under the effect of hydrogen bubbles. The graphite in the test system acted as a support for oxidation of the chloride ions to free chlorine which dissolved in the water and oxidized many of the soluble organic substances, simultaneously sterilizing the waste water. At a throughput of 3·2–4·8 m^3 per square metre per hour, the COD and BOD_5 were reduced by 68·6% and 63·5% from an initial value of 4752 and 3623 mg O_2 per litre, respectively, while the suspended impurities content was reduced by 97·6% and the bacterial population fell from $1·4 \times 10^8$ to $3·2 \times 10^3$ per cm^3. Maximum efficiency was achieved at a final pH of 5·5 compared with 6·4. For a factory having a daily slice of 3000 metric tons of beet, it is calculated that 330–420 m^3 of flume-wash water (38–48% of the total) could be treated in an hour, using a system having a total surface area of 100 m^2 and a height of 1·3–1·5 m; the energy consumption would be about 100 kWh.

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A barometric leg for condensate drainage with automatically-controlled hydraulic resistance. V. N. GOROKH, A. I. KHOMENKO and B. I. KRAMARENKO. *Sakhar. Prom.*, 1975, (5), 59–62.—A condensate sealing leg is described which is provided with automatic control of the diaphragm valve so as to maintain pressure at the steam chamber exit and regulate the quantity of condensate withdrawn.

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Microbiological methods in the evaluation of diffuser biocides. K. A. OSWEILER and G. H. SISLER. *Zeitsch. Zuckerind.*, 1975, **100**, 346–348.—Details are given of three techniques for measuring microbial activity in diffusion juice, viz. the plate count method, determination of viable cells by staining and counting, and use of oxidation-reduction indicators such as resazurin.

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The effect of basic geometric parameters on power consumption in a disc-type crystallizer. A. I. GROMKOVSKII, V. M. FURSOV and V. E. APASOV. *Izv. Vuzov, Pishch. Tekh.*, 1975, (2), 110–113.—A scale model of a disc-type crystallizer was used in a study of the power consumption as a function of viscosity, distance between the discs and length of the mixer paddles. A highly viscous molasses solution was used as material, and the speed of rotation of the shaft varied. From the results, equations have been derived for calculation of power consumption; a nomogram demonstrates the linearity of the power consumption-Reynolds' number relationship.

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Nomograms for calculation of sugar extraction from beet cossettes. V. M. LYSYANSKII, A. I. FEL'DMAN, A. A. LIPETS, O. V. STRATIENKO and A. O. SOLYANIK. *Izv. Vuzov, Pishch. Tekh.*, 1975, (2), 140–142.—Nomograms are reproduced which permit calculation of a number of variables occurring in counter-current beet diffusion. Worked examples are presented showing how to use the nomograms.

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A new method of treating beet knives. A. D. BAGLYUK. *Sakhar. Prom.*, 1975, (6), 13–15.—Details are given of a method for beet knife treatment with kubonite grinding discs, and results are compared with those obtained by hand grinding.

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Determination of the work power consumed by crystallizers. A. I. GROMKOVSKII, V. M. FURSOV and V. E. APASOV. *Sakhar. Prom.*, 1975, (6), 25–27.—The power consumed by crystallizers provided with spiral and disc-type cooling elements was examined. Operation of scale models showed that the power consumption could be divided between that required for mixing and that expended in overcoming the friction acting on the journals and bearings. Empirical equations have been derived.

Experience in the use of radio-isotope devices in the sugar industry. K. A. NEKRASOV. *Sakhar. Prom.*, 1975, (6), 43–47.—Information is given on radio-isotope systems used in Soviet sugar factories for such tasks as level detection and control, and automatic counting of bags of sugar.

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An improved arrangement for charging lime kilns. K. N. SAVCHUK. *Sakhar. Prom.*, 1975, (6), 50–54. A lime kiln charging device is described which has three distribution baffle plates instead of the normal one. The arrangement replaces a previous system which has proved faulty for various reasons, which are listed. Comparison is made of kiln performances where one and three baffles are used.

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Use of peracetic acid for disinfection in sugar manufacture. J. HERČÍK and V. DACHOVSKY. *Listy Cukr.*, 1975, **91**, 126–132.—Laboratory and factory tests are reported in which "Persteril" (peracetic acid) was used as disinfectant. In one factory, a 0·5% solution was used to treat recycled press water, while a 1% solution was used for diffusion (the amounts added are given); in another factory, peracetic acid was combined with formalin to give complete sterilization in diffusion.

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20 years of the sugar industry in Israel. L. ROSENBERG. *Zeitsch. Zuckerind.*, 1975, **100**, 389–391.—A survey is presented of the Israel beet sugar industry which incorporates two sugar factories (Afula in the north and Kiryat-Gat in the south) and which was deliberately shrunk (even to the level at which closure of Afula factory was suggested) when the world sugar price was low. Now that the price has risen, it is planned to increase the beet area to 6000 ha (as it was 10 years ago) and to raise sugar production eventually to more than 50,000 tons by expanding the existing factories and erecting another.

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The effect of physico-chemical pretreatment of raw juice on subsequent purification. V. PREY, H. ANDRES and T. DIETMAIER. *Zeitsch. Zuckerind.*, 1975, **100**, 392–394.—See *I.S.J.*, 1976, **78**, 55.

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Fully-automatic knife treatment—development and factory application. R. HIES. *Zeitsch. Zuckerind.*, 1975, **100**, 395–400.—Developments in the field of beet knife grinding are described and information given on automatic equipment manufactured by H. Putsch & Comp.

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(Beet) Sugar campaign balance 1974. II. Technical report. ANON. *Sucr. Maghrébine*, 1975, (16), 5–17. The processing of nearly 2 million metric tons of beet to raw sugar at the eight sugar factories in Morocco in 1973/74 is reported.

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Low-grade crystallizer work in the sugar factory. J. GENOTELLE. *Sucr. Maghrébine*, 1975, (16), 18–23. See *I.S.J.*, 1974, **76**, 269.

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Treatment of diffusion water with sulphur dioxide by means of a rotary kiln gas ejector. K. WAGNEROWSKI, C. DABROWSKI, S. MURAWSKI and R. ODER. *Gaz. Cukr.*, 1975, **83**, 86–90, 113–116.—Means of diffusion water treatment with SO_2 are discussed and details given of laboratory tests on the use of a gas ejector. A description is given of a factory scheme incorporating a rotary kiln and an ejector as well as automatic pH control. Benefits of the system are listed.

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Effect of limed flume water on the overall sugar factory effluent. K. SKALSKI. *Gaz. Cukr.*, 1975, **83**, 118–120. Investigations have shown that treatment of flume water with milk-of-lime[1] does not cause any marked changes in the pH of the overall factory effluent, while the treatment in itself has a number of advantages, particularly where recycling of treated water is carried out.

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Supplying the evaporator station with softened water. F. NOWAK. *Gaz. Cukr.*, 1975, **83**, 125–126.—Where there is a deficiency of thin juice as a result of shortfalls in beet deliveries, the evaporator can be fed with a sufficiency of condensate to make up the difference (provided the deficiency is short-lived). Where there is a lack of condensate, it has been found expedient to make up the deficiency with water softened by ion exchange resin. A diagram is presented of the layout of such a scheme.

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The sugar industry and environmental protection. A. SZABÓ. *Cukoripar*, 1975, **28**, 94–97.—The literature on prevention of environmental pollution (covering air, water and soil protection, noise abatement and waste utilization) is reviewed, including both general aspects and the role of the sugar industry.

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Diffusion water. K. MAGYAR. *Cukoripar*, 1975, **28**, 55–59, 105–110.—The effects of water pH, ammonia content and hardness on raw juice properties are examined. Of the three factors, pH is shown to be the most influential; increase in its value is accompanied by a considerable increase in juice colloid content and a reduction in its filtration and settling rates. Methods of acidifying diffusion water were investigated, and the results tabulated. These show that demineralization with a cation exchange resin was better than the other methods as regards the three factors mentioned above, while addition of SO_2 was almost as good as regards colloid content and filtration rate and better in terms of settling rate. Addition of CO_2, H_2SO_4 and HCl had effects on the colloid content which fell in the order in which the additives are given.

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Increasing the durability and reliability of centrifugal beet slicers. YU. F. TSYUKALO, V. T. RUD', L. V. KOTLYAR and N. B. IL'CHENKO. *Sakhar. Prom.*, 1975, (7), 42–43.—Rapid wear of beet slicer parts at the author's factory was followed by replacement of mild steel with stainless steel for face plates, case bands and hold-down straps. A slicer modified in this way operated throughout the 1974/75 campaign, while an unaltered machine stopped after 80 days.

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The sugar beet in the Soviet Union. J. MORAGHAN. *Sugar y Azúcar*, 1975, **70**, (8), 34–35.—The beet sugar industry of the USSR is outlined.

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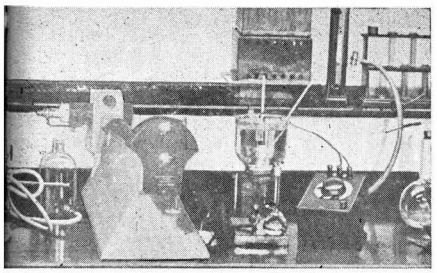
[1] *I.S.J.*, 1974, **76**, 26.



Laboratory methods & Chemical reports

Investigation of the behaviour of various colorant groups in crystallization. V. PREY and H. WESNER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The effect of various groups of browning products on the colour of sugar solutions boiled in a laboratory system was investigated. Alkaline decomposition products remained mostly in the mother-liquor and were mainly adsorbed on the surface of the sugar crystals, having only slight tendency to incorporation within the crystal. Melanoidins are incorporated in the crystals to a degree which is dependent on the amino-component, but also have a rather noticeable tendency to be deposited on the crystal surface. They are the major contributors of colour to sugar. Caramels mainly attach themselves to the surface of the crystal; although present only in small quantities, they contribute much to the colour of the solution. Washing was found to improve the colour if this was due to alkaline decomposition products and caramels, but not if melanoidins were present.

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Application of enzymatic determination of sucrose in the sugar industry during the 1974/75 campaign. P. DEVILLERS, R. DETAVERNIER and J. ROGER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—An automatic method for enzymatic determination of sucrose is described in which the sucrose is hydrolysed by β-fructosidase, and the resultant glucose oxidized by glucose oxidase, giving rise to a coloured reactant, the colour of which is measured spectrophotometrically at 340 nm. Accuracy is about 0·05% of the sucrose present. For loss determination, the method is more accurate than polarimetry, and for drawing up a balance it is more reliable, needing only 2 analyses per week.

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Properties of colorants produced by the degradation of reducing sugars. J. C. WILLIAMS. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Fractions of a Maillard colorant essentially homogeneous with respect to net charge were separated by chromatography on a column of anion exchange cellulose and their average molecular weights determined by gel permeation chromatography on "Sephadex G 50" using 8 molar urea solution as eluant. Comparison of the results with M.W. measurements of the methyl esters of the same colorants by vapour pressure osmometry showed that the colorant molecules in solutions of low ionic strength have an extended rod-like configuration similar to that of polyethylene glycols. Increase in the ionic strength of the solutions by addition of salts led to a contraction of the molecules to a random coil configuration similar to that of dextrans. Molecular weight increased with net charge of the fractions, and both molecular size and net charge were found to play an important role in the removal of colorants by resins—molecular size relative to the porosity of a resin determines the accessibility of adsorptive sites to colorant molecules, while net charge dictates how firmly an adsorbed molecule is held and how easily it can be displaced by ash or by other colorant molecules (self-elution).

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Interaction of potassium and sodium salts with sucrose and their role in the formation of molasses. N. P. SILINA. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—See *I.S.J.*, 1974, **76**, 187, 217.

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Non-sugars affecting sucrose habit modifications. G. MANTOVANI, C. A. ACCORSI and G. VACCARI. *Paper presented to the 15th Gen. Assembly CITS*, 1975. Single sucrose crystals were grown at 25°C in aqueous solution at 1·10 supersaturation in the presence of dextrans of differing molecular weight (in the range 60,000–275,000) as well as in cane raw sugar solution of varying origin. Increase in *c*-axis elongation was found with increase in molecular weight and dextran concentration, but the effect was not so marked that needle-shaped crystals were formed. A synergistic effect possibly involving dextrans and other impurities was apparent on the crystals grown from the raw sugar solutions. While a relationship between the polymeric structure of dextran with a high percentage of 1–6 links and sucrose habit modification is probable, no mechanism could be established.

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Correlation between visual and quantitative methods for floc in refined beet sugar. J. R. JOHNSON. *Sugar J.*, 1974, **37**, (7), 21–25.—Correlation is established between the Spreckels visual method of determining saponin or floc in refined beet sugar solution and the Liebermann method which is based on development of fluorescent colour when the floc (dissolved in glacial acetic acid) reacts with conc. sulphuric acid. It is shown that there is risk of saponin not forming floc when its content is lower than 2 ppm, so that either method could give erroneous results. Full details are given of the Liebermann method, and hints given on how to avoid errors.

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Macro and micro nutrient content of millable Florida sugar cane. H. J. ANDREIS. *Sugar J.*, 1975, **37**, (8), 10–12.—The quantities of N, P, K, Ca, Mg, S, Fe, Cu, Mn, Zn and B removed from the soil together with cane during two seasons were determined from stalk and trash samples obtained at two sugar factories. The values are tabulated for the four cane varieties involved; these showed varietal differences, although the average amount of P, K and Ca removed per ton of millable cane was the same for both areas. An experiment, established in 1960, to determine how many cane crops could be grown on the same peaty soil before the occurrence of a micronutrient deficiency in the soil, showed that 11 crops yielded approxi-

mately the same weight of cane and sugar per acre, and that the soil, of 87% organic matter content of pH 5·8 and receiving given quantities of nutrients only at planting, showed no deficiency of any micro-nutrient.

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New method to determine moisture and fibre in cane. A. L. FORS. *Sugar J.*, 1975, **37**, (9), 11–13.—The procedure developed at Compañía Industrial Azucarera S.A. in Mexico for determination of fibre and of moisture in section 8–10 of cane samples involves the use of a carpenter's saw for preparation of the sample, while a hand pressure strainer is used to obtain juice for Brix determination. The method used for preparation and determination is outlined with the help of illustrations.

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An evaluation of the hypoiodite oxidation method for the estimation of glucose and its application to the analysis of the glucose:fructose ratio in sugar cane molasses and honey. S. BOSE, L. SINGH and S. MUKHERJEE. *Indian Sugar*, 1975, **24**, 861–864.—The modified Luff-Schoorl method for estimating reducing sugars is described and its application to molasses analysis discussed.

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Bagasse moisture in infra-red reflectance. B. PARTRIDGE and S. R. REICHARD. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 153–156.—A Pier infra-red reflectance moisture meter, which operates on the principle of differences in the amount of light energy absorbed by water according to the wavelength, was tested to establish whether such an instrument could be used for bagasse moisture determination. Comparison was made between the instrument reading (the ratio between the reflected energy in the 1·93 and 1·70 μm wave bands) and the moisture content as found by oven drying. Evaluation of 350 readings taken on 35 samples showed that, at an accuracy of $\pm$ 7·1% and a correlation coefficient of 0·73, the instrument was not suitable for use with bagasse. It is suggested that much of the water is trapped in the fibres and is not sensed by the instrument's rays.

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The significance of ash. L. K. KIRBY. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 263–269.—The increase in ash content and decrease in reducing sugars content in cane juice, sugar and molasses since the mid-1940 period in Queensland are discussed as is the rise in expected molasses purity. The author briefly indicates a number of agricultural factors which may have contributed to the problem.

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Field performance tests on automatic sugar polarimeters. P. C. IVIN, L. A. PASTEGA and L. RIDDEL. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 207–210.—Tests with three automatic polarimeters were conducted at three factory laboratories. Results, which are reported, indicated that the Bendix 700 was much slower in operation than the other two and suffered from defects in the electronic circuitry; the Schmidt & Haensch "Saccharomat IV" operated without any problems, although it was slower than the third instrument, a Kernchen "Sucromat", which gave pol readings averaging 0·02°S lower than the "Saccharomat IV" but operated most satisfactorily. All three instruments permitted more rapid and efficient pol determination with greater reproducibility than did a manual instrument.

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Possibilities for automatic raw sugar pol control. J. H. KING. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 271–281.—Tests using a reflectance meter as described earlier[1] were conducted at Mulgrave factory with the aim of controlling raw sugar pol. Good correlation was established between pol and reflectance, and automatic control of raw sugar pol by molasses addition was found to be a practical alternative to the normal system of pol control, so that further investigations are considered justified.

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The study of physico-chemical factors for grading gur from sugar cane varieties in Punjab. B. SINGH, K. SAREEN and H. L. SHARMA. *Indian Sugar*, 1975, **24**, 947–949.—The colour, pol content, purity, reducing sugars content, moisture and ash content of gur from 12 cane varieties grown in Punjab are tabulated and discussed.

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Storageability characteristics of sugar beet varieties. J. HOBBIS and L. BATTERMAN. *Sugar J.*, 1975, **37**, (12), 32–35.—Details are given of the procedures used at the Rocky Ford research laboratory of American Crystal Sugar Co. to evaluate the storage properties of beet varieties as well as the effects of certain agronomic factors, e.g. use of N fertilizers and growth regulators, on beet storage. Amino-N is determined by a modification of the Stanek-Pavlas method; sodium and potassium are measured spectrophotometrically; raffinose, kestose, dextrose, levulose and levan are determined by paper chromatography, and sucrose by gas-liquid chromatography. The total of the five compounds found by paper chromatography is used to calculate their effect on polarization measurement and a "corrected sugar" value obtained. A "total impurity value" (similar in concept to the Carruthers-Oldfield "impurity index" but omitting sucrose) is obtained and from this is calculated thin juice purity as $\frac{100 \text{ corrected sugar}}{\text{corrected sugar} + \text{total impurities}}$ Comparison between a number of calculated values and experimental results of laboratory phosphatation of juice from cossettes obtained from one of the company's sugar factories (the laboratory process simulating the factory process) shows very close agreement.

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Genetic viewpoints of molasses formation. V. A. GOLYBIN, S. Z. IVANOV and V. G. CHERNIKINA. *Sakhar. Prom.*, 1975, (5), 13–14.—The role played by reducing sugars in molasses formation is discussed from the viewpoint of their origin, viz. occurrence in the raw material and formation as a result of sucrose inversion. The melassigenic effect is enhanced by further sucrose decomposition to reducing sugars which themselves are subject to degradation during processing. Moreover, the newly-formed reducing sugars have a solubilizing effect on sucrose, thereby still further increasing the losses. Melassigenic coefficients have been calculated for reducing sugars

[1] MILLER & TAYLOR: *I.S.J.*, 1975, 77, 93.

based on the secondary decomposition of sucrose and for the reducing sugar alkaline degradation products containing Ca, K and Na, respectively. Such calculations will, it is stated, permit a more precise evaluation of unknown losses.

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Fractionation and investigation of colorants formed during processing of cane raw sugar. I. F. BUGAENKO. *Sakhar. Prom.*, 1975, (5), 25–27.—Colorants formed during refining of cane raw sugar were fractionated by passing dilute molasses solution through a DEAE-cellulose column after centrifuging for 15 minutes at 5000 rpm. The column was eluted with ammonium chloride and with sodium diphosphate and caustic soda, both in varying concentrations. The six fractions obtained (one light brown, three yellow and two dark brown) were weighed and analysed for C, H, O and N. Their infra-red spectra were also measured, and are discussed in some detail. The greatest part of the colouring matter was composed of melanoidins mostly formed as a result of reducing sugar degradation under the effects of heat and alkali.

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Determination of the residual quantity of certain organo-phosphorus pesticides in sugar. A. Z. USMENTSEVA, A. YA. ZAGORUL'KO and M. A. KLISENKO. *Sakhar. Prom.*, 1975, (5), 52–55.—Details are given of a thin-layer chromatographic method for determining four residual organo-phosphorus compounds in sugar. Details are given of suitable extractant, adsorbent and solvent for each compound as well as the spot colour and R_f value.

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Investigation of the behaviour of various colorant groups in crystallization. V. PREY and H. WESNER. *Zeitsch. Zuckerind.*, 1975, **100**, 341–346.—See *I.S.J.*, 1976, **78**, 60.

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Application of enzymatic determination of sucrose in the sugar industry during the 1974/75 campaign. P. DEVILLERS, R. DETAVERNIER and J. ROGER. *Sucr. Franç.*, 1975, **116**, 299–307.—See *I.S.J.*, 1976, **78**, 91.

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The theory of sugar crystallization. V. M. KHARIN. *Izv. Vuzov, Pishch. Tekh.*, 1975, (2), 129–136.—While Stokes' law applies to mass transfer between solution and individual freely-falling spherical crystals where the proportion of the total volume of solution occupied by the crystals is small, under normal boiling conditions the proportion of massecuite occupied by crystals is high. The author examines the boiling process mathematically and develops equations for calculation of the mass transfer coefficient and mass transfer motive force, in which the effect of constraint, i.e. small inter-crystal distance and lack of freedom of movement, is taken into consideration.

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Measurement of the flow rate of sugar solutions in vertical tubes by probeless methods. V. P. KLOCHKOV, V. P. IVANOV and V. M. ZEMLYANSKII. *Izv. Vuzov, Pishch. Tekh.*, 1975, (2), 137–139.—Details are given of a scheme for measurement of velocity distribution across a vertical tube which is based on the Doppler effect, whereby the radiation frequency of a laser beam alters under the effect of optical heterogeneity in the solution. Profiles are reproduced, showing the differences in velocity between the centre of the tube and near the wall. Water and sugar solution were used as test materials, the sugar solution concentration being 16% and 30%.

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Influence of aging and turbidity on refractometer Brix of final molasses. P. MELLET. *S. African Sugar J.*, 1975, **59**, 215–221.—Reasons for discrepancies in the refractometric Brix values of final molasses were investigated. While storage for up to seven weeks caused only very slight change in Brix and pH, irrespective of temperature (2°C, room temperature or 45°C), increase in Brix occurred with increase in the pore size of filter paper through which the molasses solution was passed before measurement. Comparison of Brix measurements after use of Whatman No. 42 paper with those obtained after centrifuging showed close agreement. Confirmation of the suitability of this filter paper was obtained by comparing the measured Brix of 13 samples from different factories with that obtained after centrifuging for 15 minutes at 14,600 and 27,000 *g*; the average difference was $\pm 0{\cdot}50$°Bx, which compares favourably with differences usually found between results for different filter papers.

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The determination of sugar surface moisture. F. SCHNEIDER, A. EMMERICH and U. TICMANIS. *Zucker*, 1975, **28**, 349–356.—Comparison of the modified Karl Fischer method described earlier (for total moisture determination)[1] with the method using methanol as solvent showed that for surface moisture determination the former method, using formamide, took much longer because of the relatively high viscosity of the test solution, while use of a lower concentration coupled with extrapolation gave values which varied according to reaction conditions. The methanol method gave values which were independent of quantitative relations as well as reaction conditions. A rapid method has been developed in which 100 cm³ dried methanol and 2 g powdered sugar (or preferably 100 cm³ sugar-saturated, dewatered methanol and 1 g dried powdered sugar) are heated to 25°C and titrated with the Karl Fischer solution until a drop (of about 0·015 cm³) is needed only after 6–12 minutes to cause the potentiometer needle to move from 0 to 50 mV. Sugar (20 g) is then added and the solution titrated dropwise at constant stirring speed for 22 minutes, whereby the needle will oscillate about 50 mV. The moisture content is then calculated as $\frac{C.V_{kz}}{10E_z}$, where C = measuring solution titre (mg water per cm³), V_{kz} = corrected amount of measuring solution used (cm³) and E_z = weight of sugar (g). The mean value from a number of measurements is recommended in order to eliminate errors due to the mode of operation, e.g. stirring rate. Results have been obtained which agree with those of the more precise method within experimental error.

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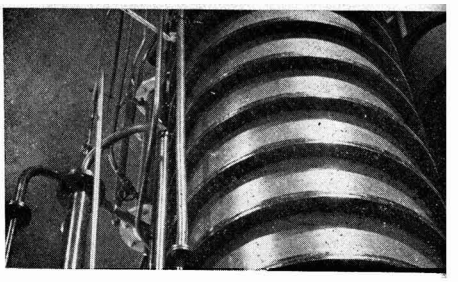
The effect of potassium and sodium carbonate and sulphite on sucrose solubility. S. Z. IVANOV, I. P. OROBINSKII, R. I. TYULYAKOVA and A. P. BOLDYREV. *Sakhar. Prom.*, 1975, (6), 20–21.—The effect of K and Na carbonate and sulphite concentration on sucrose solubility was investigated at 20, 30 and 40°C and the results plotted on a graph.

[1] *I.S.J.*, 1972, **74**, 120.

By-products



The chemical composition and nutritional value of yeast. L. VANOSSI. *Ind. Alimentari*, 1975, **14,** 93–97.—Yeast constituents and their quantities are surveyed and the nutritional and therapeutic value of specific yeasts, including *Saccharomyces cerevisiae* cultured on molasses, discussed.

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Physical properties of bagasse particle board. R. HESCH. *Sugar y Azúcar*, 1975, **70,** (5), 23–24.—A comparative study of the physical properties of particle board made from pine/spruce, poplar and beech woods and bagasse has shown that bagasse can compete with the best woods (from conifers) as regards strength and swelling under the influence of humidity, while it is superior to wood from broad-leaved varieties of trees. Moreover, bagasse consumes less resin, permits board of the same strength to be manufactured at lower densities, and allows thicknesses of up to 50 mm and densities as low as 300 $kg.m^{-3}$ for housing purposes, unlike wood.

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Sugar cane by-products as crop boosters. R. P. HUMBERT. *World Farming*, 1975, **17,** (1), 18–19.—Central Motzorongo in Mexico had the problem of disposing of 7000 tons of filter cake per cane crop as well as bagasse. Treatment with "Cofuna S.B." (obtained from Cie. Française des Fumures Naturelles, Paris) turned the filter cake-bagasse mixture into a black humus in 4 months. Field trials showed that application of 1 ton of the compost per ha yielded 104 tons of cane per ha compared with 78 $tons.ha^{-1}$ in untreated control plots, while 3 tons of the compost per ha yielded only 101 $tons.ha^{-1}$. Yield increases were achieved on different soils, although actual yield data were not obtained for more than one plot. About 350 tons of the compost have been applied in the area serving the factory and commercial usage of "Cofuna S.B." is under way in other parts of Mexico, while tests are being undertaken in other Latin-American countries, Swaziland and Malaysia.

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Dissolving pulp from bagasse. L. GUTIÉRREZ, I. CEPERO and R. BAMBANASTE. *ATAC*, 1975, **34,** (I), 38–47.—An account is given of the equipment and process used in pilot plant investigations of dissolving pulp manufacture from bagasse, together with discussion on depithing, prehydrolysis, etc. The studies have led to the conclusion that it is best to employ a sulphate prehydrolysis (especially where bagasse has a high hemicellulose content); that better pulp quality is obtained with two-stage depithing and a Ritter treatment during storage; that the alkaline cooking and bleaching should be subsequent processes in order to reduce the degree of depolymerization in the finished pulp and so maintain high filtrability and reactivity; and that bagasse yields a dissolving pulp suitable for rayon manufacture except that its filtrability reaches only 60% of that obtained from coniferous wood.

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Liquid additive for fattening of cattle. T. K. ALIMOV. *Vest. Sel'skokhozyaistv. Nauki*, 1974, (7), 74–77; through *S.I.A.*, 1975, **37,** Abs. 75–636.—A liquid feed supplement recommended for use in fattening young bulls consists of 83·6% molasses, 8% urea, 6% $(NH_4)_2HPO_4$, 1% $Na_2SO_4,7H_2O$, 1·4% of a special enzyme preparation, and traces of vitamins and antibiotics. When daily rations based on 45 kg acid pulp included 1·2 kg of this supplement in place of 1 kg molasses, the digestibilities of all the principal nutrients increased, average daily weight gain increased by 60 g, feed conversion improved from 7·7 to 7·2 kg/kg, and cost/kg liveweight decreased by 8%.

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Preliminary note on the use of molasses in the feeding of growing pigs. B. M. BAUSTAD. *East African Agricultural Forestry J.*, 1973, **29,** (2), 203; through *S.I.A.*, 1975, **37,** Abs. 75–637.—Eighteen pigs were fed from 25 kg to 100 kg liveweight on diets containing 0, 20 or 39 weight % (cane) molasses. Weight gains were highest in the groups receiving molasses, but the 39% molasses group had the poorest feed conversion efficiency. Energy consumption per kg carcass gain was best in the 20% molasses group.

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On the delignification of rice straw and sugar cane bagasse. Y. FAHMY, T. M. SALEH and O. M. ABDEL HAFEZ. *Egypt. J. Chem.*, 1972, **15,** 591–599; through *S.I.A.*, 1975, **37,** Abs. 75–663.—A bagasse containing 19% lignin, 2·5% ash and 21% hemicellulose was treated with varying NaOH concentrations. Temperature had little effect on lignin dissolution. The lignin content decreased in the pulp for 1½ hours, then increased for the remainder of the cooking time. The steady increase in the lignin content may mean that the redeposition of lignin is irreversible in bagasse pulping. On infrared spectroscopic examination the bagasse showed a band of ester carbonyl at 1697 cm^{-1} and a very strong lignin band at 1730 cm^{-1} which is thought to represent an ester carbonyl of the lignin-uronide type.

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Improvement in the quality of ethyl alcohol. ANON. *Taiwan Sugar*, 1975, **22,** 6–13.—Steam was found to be the main source of ammonia, traces of which were found in the ethyl alcohol produced at Hualien sugar factory, making the product unsuitable for wine making. Modifications made to the distillation process, whereby the problem was overcome, are described and analytical data tabulated for the various process stages and final product.

World sugar production estimates 1975/76[1]

BEET SUGAR	1975/76	1974/75	1973/74
EUROPE	(metric tons, raw value)		
Belgium/Luxembourg	717,000	620,000	797,000
Denmark	451,000	424,000	376,000
France	3,350,000	3,013,000	3,240,000
Germany, West	2,610,000	2,492,714	2,509,566
Holland	928,000	795,100	850,589
Ireland	204,000	148,598	196,101
Italy	1,415,000	1,034,000	1,156,000
United Kingdom	740,000	613,864	1,068,778
Total EEC	*10,395,000*	*9,141,276*	*10,194,034*
Austria	511,000	402,660	371,096
Finland	89,000	84,231	82,789
Greece	313,000	191,114	161,927
Spain	867,000	584,184	805,126
Sweden	289,000	312,000	270,000
Switzerland	67,000	73,873	79,531
Turkey	1,022,000	852,182	752,330
Yugoslavia	522,000	571,000	468,751
Total West Europe	*14,043,000*	*12,212,519*	*13,185,584*
Albania	18,000	16,000	19,000
Bulgaria	218,000	200,000	240,000
Czechoslovakia	780,000	750,000	730,000
Germany, East	700,000	670,000	560,000
Hungary	410,000	345,692	326,022
Poland	1,830,000	1,588,900	1,817,114
Rumania	450,000	620,000	580,000
USSR	8,400,000	8,000,000	9,750,000
Total East Europe	*12,806,000*	*12,190,592*	*14,022,136*
Total Europe	26,849,000	24,403,111	27,207,720
OTHER CONTINENTS			
Afghanistan	10,000	9,000	8,259
Algeria	15,000	14,100	3,400
Azores	7,000	7,000	6,500
Canada	119,000	103,500	119,300
Chile	330,000	224,897	129,432
China	980,000	950,000	900,000
Iran	590,000	585,000	570,000
Iraq	9,500	9,000	10,000
Israel	30,000	28,000	13,300
Japan	245,000	286,170	408,889
Lebanon	5,000	7,940	11,584
Morocco	262,000	272,830	226,875
Pakistan	22,000	24,717	9,800
Syria	18,000	18,000	18,432
Tunisia	9,000	6,330	5,100
United States	3,450,000	2,767,000	2,899,457
Uruguay	94,600	84,650	57,203
Total Other Continents	6,196,100	5,398,134	5,397,531
TOTAL BEET SUGAR	33,045,100	29,801,245	32,605,251
CANE SUGAR			
EUROPE			
Spain	30,000	29,800	29,377
NORTH & CENTRAL AMERICA			
Belize	66,000	83,600	91,028
Costa Rica	190,000	177,990	164,020
Cuba	5,400,000	5,500,000	6,044,000
Dominican Republic	1,100,000	1,170,000	1,194,104
Guadeloupe	92,000	87,500	97,471
Guatemala	450,000	382,370	325,358
Haiti	72,000	73,039	68,503
Honduras	82,000	77,111	80,640
Martinique	15,000	10,889	10,512
Mexico	2,800,000	2,900,000	2,837,372
Nicaragua	245,000	195,727	160,400
Panama	148,000	134,065	108,860
Puerto Rico	303,000	274,896	260,607
El Salvador	270,000	253,000	232,227
USA—Mainland	1,508,000	1,325,034	1,288,626
Hawaii	1,000,000	1,001,538	944,151
West Indies—Barbados	103,000	99,944	111,807
Jamaica	360,000	392,500	382,390
St. Kitts	25,000	25,100	27,897
Trinidad	229,000	167,587	192,298
Total N. & C. America	14,458,000	14,331,890	14,622,271
SOUTH AMERICA			
Argentina	1,300,000	1,532,136	1,641,837
Bolivia	210,000	166,964	188,613
Brazil	6,560,000	7,230,000	6,933,354
Colombia	1,043,000	980,200	897,300
Ecuador	300,000	283,085	283,493
Guyana	380,000	344,177	344,615
Paraguay	56,600	78,214	76,278
Peru	1,005,000	970,000	1,020,816
Surinam	9,000	8,000	7,910
Uruguay	24,700	22,655	23,047
Venezuela	588,000	548,000	586,777
Total South America	11,476,300	12,163,431	12,004,040
AFRICA			
Angola	40,000	80,000	85,000
Cameroun	31,000	29,000	21,400
Congo (Brazzaville)	55,000	28,866	37,492
Egypt	640,000	581,994	611,000
Ethiopia	150,000	142,933	134,072
Ghana	18,000	12,607	8,784
Kenya	195,000	186,667	176,854
Madeira	1,900	2,606	2,778
Malagasy Republic	123,000	122,984	106,700
Malawi	69,000	53,347	52,000
Mali	10,000	10,000	10,000
Mauritius	460,000	737,966	760,782
Morocco	4,070	0	0
Mozambique	210,000	300,000	265,546
Nigeria	40,000	38,660	30,277
Réunion	240,000	227,949	239,210
Rhodesia	260,000	250,000	248,000
Somalia	40,000	39,000	35,000
South Africa	1,975,000	2,005,000	1,831,575
Sudan	189,000	142,946	134,413
Swaziland	205,000	197,319	172,651
Tanzania	136,000	114,909	117,889
Uganda	40,000	48,800	60,310
Zaire	68,000	64,000	63,000
Zambia	84,000	64,550	58,000
Total Africa	5,283,970	5,482,103	5,262,733
ASIA			
Bangladesh	112,000	111,162	99,793
Burma	75,000	72,000	70,000
China	2,800,000	2,600,000	2,550,000
India, excl. khandsari	5,200,000	5,375,000	4,375,000
Indonesia	1,227,000	1,084,414	936,628
Iran	85,000	83,000	98,300
Iraq	13,000	6,250	12,000
Japan	229,000	192,450	247,000
Malaysia	70,000	50,000	16,000
Nepal	7,000	6,768	8,778
Pakistan	566,000	525,896	612,273
Philippines	2,730,000	2,471,304	2,534,584
Sri Lanka	29,000	18,257	21,650
Taiwan	835,000	751,094	892,066
Thailand	1,300,000	1,162,109	926,312
Total Asia	15,278,000	14,509,704	13,400,384
OCEANIA			
Australia	2,900,000	2,921,000	2,593,000
Fiji	285,000	281,000	319,000
Total Oceania	3,185,000	3,202,000	2,912,000
TOTAL CANE SUGAR	49,711,270	49,718,928	48,230,805
TOTAL BEET SUGAR	33,045,100	29,801,245	32,605,251
TOTAL SUGAR PRODUCTION	82,756,370	79,520,173	80,836,056

[1] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (36), 1–4.

Brevities

Barbados sugar situation[1].—Insufficient rainfall during the last few years, a shortage of labour willing to work in the fields, inadequate agricultural techniques and extensive cane burning are factors which have contributed to a reduction in sugar production from an average of 172,000 long tons, tel quel, in 1950–68 to 96,899 tons in 1975, while the 1976 crop is expected to be only 90,000 tons. However, current plans call for an increase in output to a level of 140,000 tons per annum by 1977 through an early return to green cane harvesting, increased mechanization and the continued replacement of other crops by cane on marginal land.

* * *

West Bengal sugar development[2].—The Government of West Bengal set up the West Bengal Sugar Industries Development Corporation in 1973 to acquire and renovate the Ahmedpur factory of the former National Sugar Mills which had closed in 1964. A trial crushing season was achieved in 1974 and the Corporation now has plans for further development of sugar cane cultivation in the state and possible erection of sugar factories in the Murshidabad, Midnapore and Malda districts.

* * *

Yugoslavia beet crop[3].—Official Yugoslavian statistics indicate a beet production of 4,220,000 metric tons from 108,000 ha (compared with 4,300,000 tons grown on 104,000 ha in 1974), i.e. a beet yield of 39·1 tons per ha compared with 41·2 tons.ha^{-1} in the previous year. Sugar production was 490,000 metric tons, raw value, compared with 571,000 tons in 1974. The Government plans to make Yugoslavia self-sufficient in sugar by 1985, and to this end plans to erect four new sugar factories and reconstruct six of the 13 existing factories.

* * *

Mexican sugar exports[4].—A sharp fall in exports of sugar from Mexico is indicated. The figure fell from 607,000 tons in 1973 to 427,000 tons in 1974, while estimated exports for 1975 were 206,000 tons. Reasons for the decline are given as: only a marginal increase in production, high domestic requirements, high production costs, labour problems and low world market quotations. However, the main cause seems to be an average increase in domestic consumption of 19·4% per year while production has increased only by about 10% per year during the period 1971–75.

* * *

Thailand sugar situation[5].—The Internal Trade Dept. of the Ministry of Commerce has prescribed new regulations governing the domestic and foreign trade in sugar. The Department will cease handling the sugar trade but will be responsible for its price control, so that while producers will have a free hand in future sugar trade, they will have to sell their white sugar for domestic consumption at the prescribed price; this has been raised because of a sharp increase in the price to be paid to the growers for cane in the 1975/76 season and to allow a reserve of 50,000 tons of white sugar to be maintained as a safeguard against shortages on the home market. Moreover, the Thailand Government will collect a 100% premium on export sugar where the price per ton exceeds a given level, but a subsidy will be provided on all white sugar sold domestically up to the quantity normally consumed (480,000 tons) to compensate producers for the losses sustained. Cane production in 1975/76 is expected to reach 16,550,000 metric tons, yielding 1,250,000 tons of sugar, of which 770,000 tons of raw sugar will be available for export. It is believed that sugar manufacturers will have a free hand in the export trade.

* * *

US food additive regulations and "Taloflote".—Tate & Lyle Ltd. have successfully petitioned the US Food & Drugs Administration for an amendment to the food additive regulations, whereby the use of acrylamide-acrylic acid resin (marketed as "Taloflote") as a flocculant in clarification of beet and cane juice is extended to include beet and cane sugar liquor treatment; the concentration of the flocculant is not to exceed 10 ppm (on weight of liquor). The amendment now permits the use of "Taloflote" in US refineries.

* * *

New French sugar factory possibility[6].—The construction of a sugar factory at Forges d'Aunis near La Rochelle (in Charente Maritime département) is being considered. The area under beet (12,000 ha) would be sufficient to supply a factory having a daily slice of 6000 tons of beet.

International Society of Sugar Cane Technologists

16th Congress 1977—Brazil

On pp. 29-30 of our January issue we published names and addresses of the Regional Vice-Chairmen. In the meantime, we have been notified of changes in the details for India and Puerto Rico. These should now read:

INDIA

Mr. S. K. Somaiya,
c/o Godavari Sugar Mills Ltd.,
Fazalbhoy Building,
Mahatma Gandhi Road,
Bombay.

PUERTO RICO

Mr. Joselo Sánchez Dergán,
c/o Sugar Corporation of Puerto Rico,
P.O. Box 9745,
Santurce 00908.

Guatemala sugar exports[7]

	1974	1973	1972
	(*metric tons, raw value*)		
Algeria	0	6,298	0
Canada	5,054	0	0
Egypt	9,243	0	0
Finland	7,620	0	10,693
France	0	0	11,835
Morocco	0	0	10,217
Portugal	9,098	0	0
UK	31,396	34,497	0
USA	81,479	61,878	70,116
USSR	0	27,517	0
Total	143,890	130,190	102,861

Chile sugar imports[8]

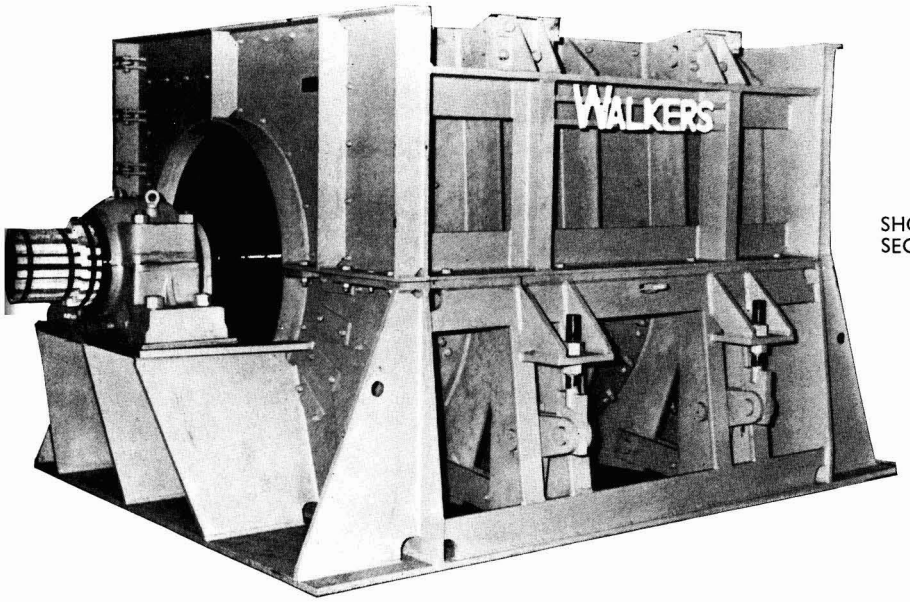
	1974	1973	1972
	(*metric tons, raw value*)		
Australia	0	18,669	0
Argentina	43,072	57,547	0
Bolivia	7,394	30,000	0
Brazil	72,200	32,435	23,800
Colombia	35,837	0	20,900
Cuba	0	146,391	172,900
Dominican Republic	15,372	0	0
Peru	0	5,000	14,900
Other countries	0	6,522	0
Total	173,875	296,564	232,500

Peru sugar exports[9].—Peru exported 422,000 tons of sugar in 1975, compared with 460,000 tons in 1974, while only about 400,000 tons is expected to be exported in 1976. The decline in exports is mainly a result of increased domestic consumption. Carry-over stocks at the end of 1975 were about 50,000–55,000 tons, of which 25,000 tons were intended for the home market.

* * *

New Nigerian sugar factory planned[10].—Of the 175,000 tons of sugar consumed annually in Nigeria, 80% has to be imported; since consumption is expected to double over the next 10 years, the Nigerian Government plans to increase production, and among measures to this end is the construction of a new factory at Lafiagi, 300 km north-east of Lagos. The factory, to be built by an Indian concern, is planned for an annual production of 60,000 tons of sugar.

[1] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (1), 17.
[2] Kar & Ray: *Sugar News* (India), 1975, **7**, (5), 8.
[3] *Zeitsch. Zuckerind.*, 1976, **101**, 44.
[4] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (2), 11.
[5] *Standard Chartered Review*, 1976, (Jan.), 31.
[6] *Zeitsch. Zuckerind.*, 1976, **101**, 43.
[7] *I.S.O. Stat. Bull.*, 1975, **34**, (12), 50.
[8] *ibid.*, 27.
[9] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (2), 11.
[10] *Zeitsch. Zuckerind.*, 1976, **101**, 45.



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SECTOR ADJUSTMENT

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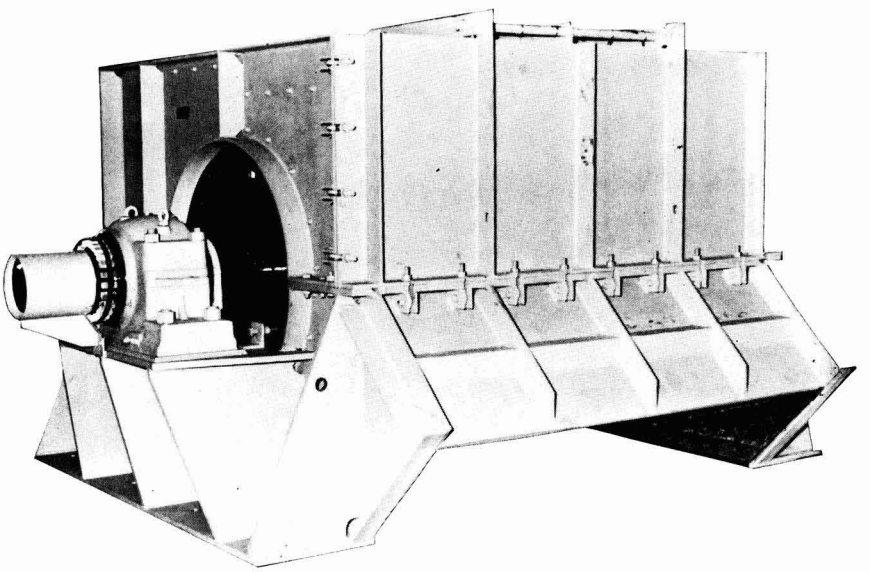
SHREDDED CANE EXIT



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