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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

La fractionation et caractérisation des composants colorés du sucre par des méthodes de séparation modernes. 1-ère partie. D. GROSS. p. 323–328

On a employé des méthodes variées à l'obtention de renseignements sur la composition des composants colorés dans des mélasses betteravières et de canne de sources variées. Les méthodes employées comprennent: l'électrophorèse à papier de haut voltage, la chromatographie à papier, l'électrochromatographie à deux dimensions (une combinaison des premières deux méthodes), la dialyse par des membranes, et la filtration avec des gels. On a employé l'échange d'ions pour l'isolation et la récupération de couleur. L'article est illustré des électrogrammes et chromatogrammes à papier obtenues sous des conditions variées.

* * *

Etudes sur la valeur pH dans la production du sucre. 2-ème partie. L'influence de dilution et concentration sur la valeur pH. D. P. KULKARNI, M. K. PATIL et K. C. VORA. p. 328–329

On a examiné les effets de la dilution sur la valeur pH de solutions sucrées, techniques, aussi que les influences combinées de la dilution et de l'augmentation de la température. On a trouvé que les valeurs pH de produits de hauts brix sont constamment plus basses que les valeurs obtenues après la dilution 1:1. On recommande l'adoption de la méthode employée dans des sucreries aux Hawaïï, c.-à-d. sans dilution, pour le mesurage des mélasses avec une concentration de solides réfractométriques jusqu'à 90%.

* * *

La détérioration de canne hachée, récoltée par machine. 1-ère partie. La dextrane, qui promet beaucoup comme indicateur quantitatif de la qualité de traitement de canne hachée. J. S. KENIRY, J. B. LEE et C. W. DAVIS. p. 330–333

On a examiné l'applicabilité des concentrations de l'acide lactique, de la gomme et de la dextrane dans des sirops et masses cuites comme indicateur de la qualité de canne hachée. On a établi une rélation quantitative entre la concentration de la dextrane dans certains produits et la performance de la sucrerie mesurée en fonction de la pureté des mélasses finales et l'allongement de cristaux, qui est un indicateur important de la qualité du sucre brut. Donc on considère que la dextrane promet beaucoup comme indicateur quantitatif de la qualité de canne hachée.

Die Fraktionierung und Charakterisierung von Zuckerfarbe durch moderne Trennmethoden. Teil I. D. GROSS. S. 323–328

Man hat verschiedene Methoden angewandt, um Informationen über die Zusammensetzung von Farbenkomponenten in Rüben- und Rohrmelasse verschiedener Quellen zu erhalten. Unter den Methoden sind: die Hochspannungspapierelektrophorese, die Papierchromatographie, die zweidimensionierte Elektrochromatographie (eine Kombination der ersten zwei Methoden), die Membrandialyse, und die Gelfiltration. Der Ionenaustausch wurde für die Trennung und Rückgewinnung von Farbe verwendet. Der Aufsatz ist mit Elektrogrammen und Papierchromatogrammen, die unter verschiedenen Verhältnissen erhalten wurden, illustriert.

* * *

Studien der pH-Werte in der Zuckererzeugung. Teil II. Die Wirkung von Verdünnung und Konzentration auf pH. D. P. KULKARNI, M. K. PATIL und K. C. VORA. S. 328–329

Die Wirkungen von Verdünnung auf den pH-Wert von technischen Zuckerprodukten wurden studiert, wie auch die kombinierten Wirkungen von Verdünnung und Temperaturerhöhung. Man hat gefunden, dass die pH-Werte von Produkten mit hohen Brix-Werten stetig nieder als die Werte von 1:1 verdünnten Produkten waren. Die Verfasser empfiehlt die in hawaiischen Zuckerfabriken für die pH-Messung von Melasse mit einer refraktometrischen Trockensubstanz von 90% angewandte Methode, d.h. ohne Verdünnung.

* * *

Die Verschlechterung von mechanisch geerntetem, kleingehacktem Rohr. Teil I. Dextran—ein vielversprechender, quantitativer Indikator der Bearbeitungsqualität von kleingehacktem Rohr. J. S. KENIRY, J. B. LEE und C. W. DAVIS. S. 330–333

Die Verfasser haben Versuche durchgeführt, um die Nutzbarkeit der Konzentrationen von Milchsäure, Gummisubstanzen und Dextran in Sirupen und Füllmassen als Indikator der Qualität von kleingehacktem Rohr zu bestimmen. Sie haben eine quantitative Beziehung zwischen der Konzentration von Dextran in einigen Produkten und der Fabrikleistungsfähigkeit gefunden. Die Fabrikleistungsfähigkeit wurde als Endmelasse-Reinheitskoeffizient und als Kristallverlängerung, die als wichtiger Rohzucker-qualitätsfaktor dient, ausgedrückt. Daher ist man der Meinung, dass Dextran vielversprechend als quantitativer Indikator der Qualität von kleingehacktem Rohr sei.

La fraccionación y caracterización del color de azúcar por métodos modernos de separación. Parte I. D. GROSS. pág. 323–328

Diferentes técnicas se han usado para obtener información sobre la composición de los componentes del color de melaza de remolacha y de caña de algunas fuentes. Los métodos incluyen electroforesis de alta tensión sobre papel, cromatografía á papel, electro-cromatografía en dos dimensiones (una combinación de los dos metodoes antecedentes), diálisis á través de un membrano, y filtración por partículas de "Separan" y "Bio-gel". Se emplea cambio de iones para isolar y recuperar color. El artículo se ilustra con electrogramas y cromatogramas á papel que se han obtenido en varias condiciones.

* * *

Estudios sobre pH en la fabricación de azúcar. Parte II. El efecto de dilución y concentración sobre pH. D. P. KULKARNI, M. K. PATIL y K. C. VORA. pág. 328–329

Se han examinado los effectos de dilución sobre el pH de productos técnicas de azúcar, así como los efectos de una combinación de dilución y crecimiento de temperatura. Los autores han hallado que los valores de pH de materiales de alto Brix fueron conformemente más bajo que los valores obtenido después de dilución 1:1. Recomiendan el adopción del procedimiento utilizado en las azucareras de Hawaii, á saber, sin dilución, para la medida de pH de melaza de hasta 90% concentración de solidos por refractómetro.

* * *

Deterioración de caña picada cosechada mecánicamente. Parte I. Dextrana—un cuantitativo indicador de promesa de la calidad para fabricación de caña picada. J. S. KENIRY, J. B. LEE y C. W. DAVIS. pág. 330–333

Se han conducido investigaciones sobre la utilidad de los análisises de acido láctico, goma y dextrana en meladuras y masas cocidas como guía á la calidad de caña picada. El nivel de dextrana en algunos materiales se relacionaba a la obra de la fábrica medido en términos de la pureza de melaza final y alargamiento de los cristales, que es un aspecto importante de la calidad de azúcar crudo. Por consecuencia, la dextrana se considera de promesa como un indicador cuantativo de la calidad de caña picada.

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Notes & Comments

Preparation for a new International Sugar Agreement.

As mentioned previously,[1] the Secretary-General of UNCTAD, Dr. PREBISCH, has called together a group of experts to meet in Geneva from 23rd October until early in November, whose task will be to prepare the way for the full Conference to be held in April with the object of establishing a new International Sugar Agreement. This it will do by indicating the outlines of the form in which a new Agreement might successfully be achieved.

Discussing the experts' task, C. Czarnikow Ltd.[2] write: "A necessary precursor to any decision on the proposed shape of a new Agreement must be the provision of accurate statistics and this will present the delegates with something of a problem. Figures indicating past performance are now reasonably easily obtainable in respect of almost every country in the world and it will not be difficult to establish the pattern of sugar movement during recent years. It is where forecasts of future trends of production and consumption are concerned that problems occur, however. Taking a spread of several years it can be seen that world consumption expands at an average rate of 4% per annum and, although there are factors which occur from time to time to change this pattern, they have so far tended to be of no more than one or two years' duration, after which the overall trend reasserts itself once more.

"Production, on the other hand, follows a much more complex growth curve. There is clearly a tendency towards expansion as a result of improving efficiencies in growing and processing techniques; this is small but important, although we would not care to quantify it. Major increases in production result from the establishment of new factories and finance for this is much more readily available at times of high prices. It follows, then, that production tends to rise rapidly after a period of high values on the world market. The third factor affecting production is, of course, the vagaries of the weather. Tremendous strides have been made in recent years to minimize the effects of drought and the development of new strains of beet and cane has done much to minimize losses due to adverse weather. Nevertheless, climatic conditions remain and will continue to remain of considerable significance to producers.

"These, then, are the factors affecting the pattern of supply and demand. Our own view is that consumption growth will be found during the next few years to remain close to the historical rate of 4%, although if values remain at around present depressed levels it may well exceed this figure. Production, on the other hand, is unlikely to show much expansion until improved price levels occur to provide the necessary financial boost. The rapid rise in output witnessed after the peak price levels of 1963 seems now to have come to an end and, in view of the consumption outlook, it appears probable that the heavy stocks, which in recent years have proved such a depressing market feature, will be substantially reduced.

"When drawing up estimates of production the expert group will have to take care to avoid two apparent pitfalls. The danger of examining the recent trend and then assuming that the line will be continued is an obvious one and it may confidently be assumed that delegates will not be misled in this way. A more difficult situation may arise, however, when delegates are asked to provide estimates of production in their own countries. There is likely to be in many cases a tendency to submit target figures which in the nature of things will probably not be realised. Handling this problem will require considerable delicacy on the part of the delegates, but it must be faced if there is to be any degree of reality about their figures and the decisions they take based upon them. Clearly, if a wide margin of production in excess of consumption is indicated by the group's figures many countries will feel that an Agreement cannot be contemplated in view of the substantial reduction of production which would be entailed in order to tailor output to the size of the market. On the other hand, if, notwithstanding this objection, an Agreement were reached on such an unsound basis and producers were induced to limit production, the recent problems of over-supply might shortly be replaced by the equally damaging ones of under-supply.

"There is general agreement that some form of export quotas must be adopted again if an Agreement

[1] *I.S.J.*, 1967, **69**, 289.

[2] *Sugar Review*, 1967, (835), 181–2.

is to be effective and it will have to be decided upon what basis they can be fixed. Many changes have occurred in the supply pattern since the breakdown of the previous Agreement and several producers have increased their market significance in the last few years. Quotas will probably bear a relationship to past performance, but it may be anticipated that preferential treatment will be accorded to the developing countries, particularly when considering the expected market growth in the future.

"Presumably some sort of mechanism will be proposed which will aim to keep prices within an acceptable range. In the past, when prices have moved outside the indicated range, rectification has been attempted by adjusting quotas. It is possible that this method will again be recommended although suggestions that the Agreement should contain provision for compulsory stock holdings which can be regulated in accordance with prevailing market conditions have also found favour in some quarters. It may also be worth considering whether a minimum indicated price level is really needed or, indeed desirable. In the past the floor of the price range was frequently cynically referred to as the effective market ceiling and in fact for a considerable period of time from 1954 to 1961, when the economic clauses of the ISA were in operation, this proved to be the case.

"The possibility of introducing buffer stocks as a method of adjusting sugar prices has often been considered in the past. Certainly they have proved to have some effect in controlling values in certain other commodities, but it has usually been argued that the diversity of sugar production and the physical size of the quantity which would need to be controlled if buffer stocks are to be effective would be sufficient to make this method unworkable. It might be worthwhile, however, to reconsider the possibilities on this occasion and, if it is felt impossible to introduce a full buffer scheme, to pursue various methods of incorporating stock holding arrangements with other methods of control."

* * *

Indian sugar policy.

Owing to severe drought production of sugar in India during the 1966/67 season has fallen sharply to less than 2·2 million metric tons compared with the previous year's record output of about 3,530,000 tons[1]. The working of the industry has been disrupted and forced unemployment has resulted. Monthly sugar releases for domestic consumption have been cut from 250,000 tons to about 157,000 tons and scarcity has raised prices to the consumer.

On the 16th August the Indian authorities announced measures to try to remedy this situation for 1967/68. As from 1st October the sugar factories are permitted to sell 40% of their production freely on the domestic market and the start of the next crop year has been brought forward to this date. The minimum prices for sugar cane have been increased for the 60% of production still to be controlled and duty on the sugar is reduced from the equivalent of £17·58 to £13·61 per metric ton. In addition, a rebate of 50% of the new duty will be allowed on all 1967/68 production which exceeds 80% of output during the 1966/67 crop, while the duty on khandsari is to remain unchanged at the equivalent of £10·21 per ton. The difference between factory sugar and khandsari is thus greatly reduced, although gur manufacturers have the advantage of no duty. The measures will help the sugar factories to compete more successfully with gur and khandsari manufacturers for supplies of cane.

The Indian sugar industry hopes that, as a result of the new sugar policy, production in 1967/68 will be increased to 2·5 million tons. However, the Food and Agriculture Minister thinks that production could reach 2·2 million tons against the 1·5–1·7 million tons expected for 1967/68 under the old policy.

India has arranged to ship her preferential commitments to the U.S., U.K. and Canada, amounting to some 220,000 tons and the authorities have decided that no imports are needed for the time being.

* * *

European beet sugar production, 1967/68.

F. O. Licht K.G. published their first estimates of European beet sugar production on the 22nd September, together with their fourth estimate of beet area in Europe[2]. The details of the sugar production estimates appear elsewhere in this issue but it might be mentioned that the total expected for both East and West Europe amounted to 24,443,000 tons, an increase of only 506,078 tons on the 1966/67 crop of 23,926,922 tons. It had been anticipated that Licht would indicate a much greater increase and the market responded to the estimates with a rise in values from £16·75 to £18·50; the higher level was not held, however, and fell to £17·75 but has since risen spasmodically to reach £20·00 at the time of writing.

As to the forecasts themselves, the beet tests in Western European countries and areas receive sufficient publicity that surprises among the estimates turned out to be rather mild; Licht anticipates 1,820,000 tons to be produced in France although bad weather conditions might make this difficult to achieve, while the West German crop may well be better than the 2,050,000 tons expected. As usual, great difficulty is presented by the East European countries ; little information on the progress of their crops is forthcoming, in contrast to the West, while the total production is greater, especially as the result of the inclusion of the giant U.S.S.R. production. Consequently great accuracy in the West European figures can be nullified by a smaller percentage error in the forecast for the East, due to lack of precise information.

[1] *Indian Sugar*, 1967, **17**, 317.
[2] *International Sugar Rpt.*, 1967, **99**, (27), 1–4.

The Fractionation and Characterization of Sugar Colour by Modern Separation Methods

By D. GROSS (Tate & Lyle Research Centre, Keston, Kent)

Paper presented to the 13th General Assembly of the Commission Internationale Technique de Sucrerie (C.I.T.S.), 1967

PART I

Introduction

THE chemical nature of colour in sugar products has been a challenge to the research chemist for a long time. Extensive studies of the problem in various laboratories over many years have so far failed to produce the relevant information on the chemical and physical properties of the individual compounds, or groups of compounds, constituting visible colour. It is generally agreed, however, that sugar colour consists of a highly complex mixture of components of very similar chemical structure, thus defying examination by conventional physical or analytical procedures.

Interest in this field has increased in recent years, thanks to the development of new physical separation methods. An absolute condition for progress in this field was to find a suitable technique for the separation of the complex mixtures into as many fractions as possible. It soon became clear that one technique alone was not sufficient and that several methods must be combined to provide the desired effectiveness. The application of modern physico-chemical techniques, such as chromatography, electrophoresis, ion exchange, adsorption, gel filtration and dialysis produced some interesting results in this laboratory, some of which were reported in an earlier paper[1].

Because of the high concentration of colouring matter present, molasses offers the most suitable material for such a study, as well as the possibility of detecting minor components. Since there are no known reagents producing a more intense colour on reaction with such components, except for certain phenolic compounds, the limits of detectability depend very much on the colour and concentration of the original components present. For sugar products of much lower colour content, such as raw and affined sugars, carbonatation liquor and fine wonechar decolorized) liquor, special enrichment methods have to be worked out, based on obsorption and concentration procedures. The difficluty here lies in the choice of suitable adsorbents and eluants, allowing a reasonably quantitative recovery without denaturation or alteration of the chemical structure of the components. High-voltage paper electrophoresis has already been found to be an extremely discriminating tool of high resolving power[1]. The technique has since been perfected so as to provide a convenient means of checking on changes that might have occurred during the various stages of the preparation of colour concentrate. Interesting information on the lability of some of the colour components and their transformation under the influence of organic solvents, heat treatment, irreversible adsorption and oxidative conditions was thus revealed.

Experimental

The high-voltage paper electrophoretic technique used was similar to that described before[1], but the introduction of better equipment[2] and accumulated practical experience led to certain improvements in performance, such as enhanced resolving power and higher reproducibility of results. The buffer solutions found most suitable were:

Buffer A: 0·05 M Na-borate of pH 9·2;
B: 0·75 M formic acid of pH 2·0;
C: 0·05 M citric acid adjusted with NH_4OH to pH 5·5.

Paper chromatography has been further investigated for the purpose of its application to some of the coloured components, particularly the cane pigments, and the following solvent systems were found to give reasonably good separations:

Solvent I: 2:1 acetone:water;
II: 4:1:5 *n*-butanol:acetic acid:water;
III: 7:1·5:1·5 ethanol:0·1M ammonium carbonate:conc. NH_4OH;
IV: 3:1 acetone:0·05M Na-borate, used with borate-impregnated paper.

Thin-layer chromatography, using silica gel, has shown so far no superiority over paper chromatography.

Membrane dialysis was performed, using mainly cellophane tubing ("Visking"). Molecules of a mol. weight larger than 10,000 will, in general, not pass this membrane.

Gel filtration was carried out, using "Sephadex" gels of various cross-linkages, such as G-75, G-50, G-25, G-15 and G-10, and of varying particle sizes, viz. coarse, medium and fine. "Sephadex" (Pharmacia A.B., Uppsala) is a cross-linked dextran, strongly hydrophilic and thus swelling considerably in water or electrolyte solution.

The gel, a three-dimensional network of carbohydrate chains, acts like a molecular sieve with

[1] GROSS: *Proc. 10th Congress C.I.T.S.*, 1957, 121; *I.S.J.*, 1957, **59**, 339.
[2] *idem., J. Chromatog.*, 1961, **5**, 194.

respect to molecules in solution. The degree of cross-linkage determines the pore size of the swollen gel and thus the size of the molecule allowed to penetrate the gel. By choosing the appropriate type of "Sephadex", components of a mixture can be separated according to their molecular size and some useful information gained on the range of molecular sizes involved.

Another material with molecular sieve properties used was "Bio-Gel P-6" (Calbiochem, Los Angeles). This is a porous polyacrylamide material, specially prepared for gel filtration, with an exclusion limit for molecules of a molecular weight greater than 4600. Another type, "Bio-Gel P-2", less porous, with an exclusion limit of 1600, proved more suitable.

Of several ion exchange resins investigated for isolation and recovery of colour, a cationic resin was found to have interesting properties[3], viz. "Zeo-Karb 225" (Permutit), 1% DVB, 14-52 mesh, used in the hydrogen form. The colour is best eluted with 0·1M NaOH. Although adsorption of colour from sugar solution is not quantitative, certain components can be usefully recovered in this way. An anionic ion exchange material also tried was DE11 (Whatman Chromedia), a modified cellulose powder, diethyl aminoethyl cellulose, with weakly-anionic exchange properties. Elution of colour is best carried out using 0·01M formic acid[4].

Results

High-Voltage Paper Electrophoresis

This technique proved extremely useful in providing qualitative and semi-quantitative information on the composition of colour in sugar products. It worked particularly well with low-purity products such as recovery house syrups and molasses, owing to the high concentration of colour present. Blackstraps from nearly all cane sugar producing countries were examined for regularities or differences in colour composition as exhibited by their electrophoretic patterns under standardized conditions, primarily at pH 9·2 in borate solution. It became apparent that, although the overall picture was often superficially similar, there were quite significant differences in composition and concentration between the individual samples.

The two main groups of components, viz. brown and yellow, were present to varying degrees (Fig. 1). The effect of certain treatment on the colour components could be followed by the electrophoretic patterns, as Fig. 2 illustrates. Carbonatation carried out with a rather larger than normal amount of lime led to formation of additional brown colour, without removing many of the yellow components, while phosphatation was effective in removing both brown

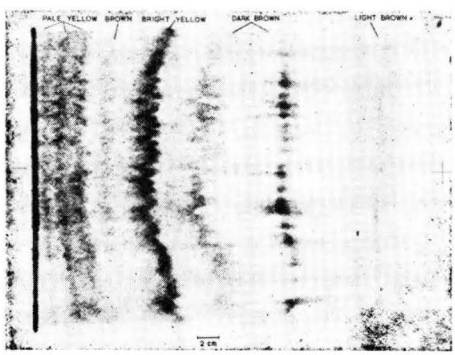

Fig. 1. Electrophoretic pattern (electrogram) of Jamaican molasses (blackstrap). Conditions: pH 9·2, Na-borate buffer (A), 70 V/cm, 55 min

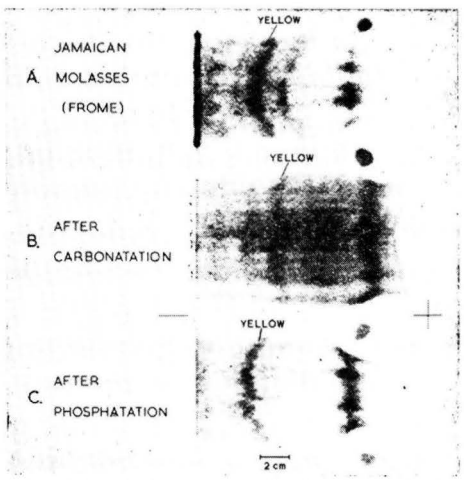

Fig. 2. Effect of carbonatation or phosphatation on Jamaican molasses. Electrophoretic conditions: pH 9·2, borate buffer, 80 V/cm, 30 min

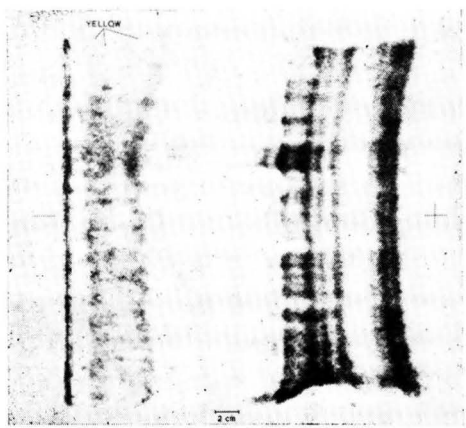

Fig. 3. Electrogram of Egyptian molasses. Conditions: pH 9·2, borate buffer, 60 V/cm, 120 min

[3] K. J. Parker (private communication).
[4] McDonald & Madacsi: *Proc.* 1966 *Tech. Session Cane Sugar Refining Research*, 136.

and yellow components. The fastest-moving brown colour was virtually unaffected. The spots adjacent to this band are picric acid markers of similar migration rate. Fig. 3 shows a particularly interesting resolution of colour in a sample of Egyptian molasses. Up to 15 bands, including several yellow bands, can be discerned on the original electrogram.

The fact that the best separations were achieved in borate buffer at pH 9·2, clearly indicated that even in the brown-coloured degradation products there were enough residual hydroxyl groups of the right structural position to form borate-complexes of suitable strength and variation in dissociation constants, thus providing the basis for a separation.

Later experiments were concerned with identifying, isolating and characterizing certain of the main coloured components. The yellow components, of which up to six could be recognised as separate bands of varying, well-defined migration rates, seem to be present only in cane sugar products. They are distinct in electrophoretic and chromatographic behaviour from the yellow components in beet sugar products. The view, previously expressed[1], that the yellow components are probably natural cane pigments belonging to the chemical family of flavonoid compounds, has been considerably strengthened by recent results. Their bright yellow colour under alkaline pH conditions, their fluorescence in colours varying from yellow to bluish-green in U.V. light, and their solubility behaviour in certain organic solvents and water, are indicative of this type of compound. The property of fluorescing in U.V. light is shared with other polyphenols, particularly those with a carbonyl group at position 4 of the heterocyclic ring. This fluorescence is frequently enhanced by formation of the corresponding phenolate anion by fuming with NH_3 or chelation with ethanolic $AlCl_3$. Of the various sprays available for the identification of typical orientations of hydroxyl groupings in flavonoids, 0·5% ferric chloride-potassium ferricyanide[5] containing a drop of $KMnO_4$ was found to give the Prussian blue reaction with some of the yellow compounds, possibly indicating *o*- and *p*-dihydroxy, *o*-trihydroxy and other easily oxidized phenols. This reaction was also given by a number of brown components both in cane and beet sugar products, including degradation products of hexoses. The lack of specificity rather limits the applicability of this otherwise very sensitive reagent. McLAREN[6] in his work on the isolation of yellow colour from refinery cane molasses, by extraction with organic solvents and alumina column chromatography, used the ferric chloride reaction to discriminate between the bright-yellow and brown polyphenolic compounds. While brown polyphenols developed a greenish-black colour, the yellow component formed a green colour with $FeCl_3$. From this and other tests he concluded that the isolated canary yellow colour consisted of flavonoids either in the aglycone or glycoside form. The colour isolated by entirely different methods in this laboratory fits in many respects the description given above and elsewhere[4,7]. The main difference lies in the fact that McLAREN was not able to separate further the yellow colour extract, whilst it can now be shown by this and McDONALD's[4] work that there are at least six components forming the bulk of the yellow colour in cane products. It is interesting to note that early Dutch workers[8] in Java reported on the isolation of a yellow cane pigment, "saccharetin", from cane juice, molasses or bagasse by extraction with NaOH and precipitation with lead acetate, describing it as closely related to flavones or flavanones. It seems very likely that this was the group of pigments now rediscovered and more closely examined by the help of modern techniques.

The isolation and characterization of the individual components, or groups of similar components, of brown colour proved a harder task for two main reasons: their instability on isolation, and liability to continued reactions during the extraction and necessary concentration stages. Zones that appeared homogeneous on the sheet of paper or in the column, produced new components with slightly different physical properties, once they were removed from their original medium. This makes the task of identification of specific bands quite difficult, since re-running of such isolated material often leads to a different and puzzling electrophoretic pattern, or to a complete loss of pattern. This contrasts quite strongly with the behaviour of the yellow pigments which act quite like homogeneous and stable compounds. Differences in the pattern between cane and beet molasses are demonstrated by Fig. 4.

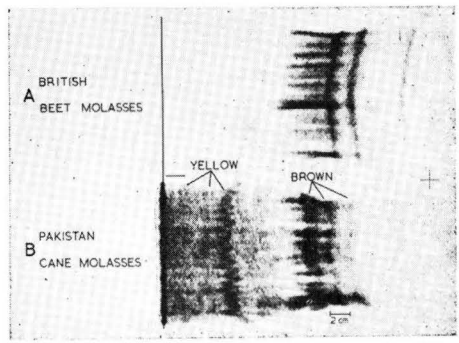

Fig. 4. Electrogram of beet and cane molasses. Conditions: pH 9·2, borate buffer, 80 V/cm, 60 min

To assist in the identification of brown colour fractions in some way, alkaline degradation products of both glucose and fructose were prepared under standardized conditions, viz. at a constant pH of 10·0, at 80°C and during 4 hr. The electrophoretic patterns

[5] KIRBY, KNOWLES & WHITE: *J. Soc. Leather Trades Chem.*, 1953, **37**, 283.
[6] *Proc. 8th Congr. Int. Ind. Agric.*, 1950, 18; *Abstr. Papers Amer. Chem. Soc.*, 1954, **126**, 21D.
[7] TU & ONNA: *Proc. 10th Congr. I.S.S.C.T.*, 1959, 291.
[8] HAZEWINKEL: *Archief Java Suikerind.*, 1907, **15**, (98), 243; STEUERWALD: *ibid.*, 1911, **19**, 1543.

of both products were similar, differing only in the proportions of some of the components. Fig. 5 shows a comparison of a sample of alkaline fructose degradation products with a sample of Australian molasses. It is evident that certain bands in the two patterns coincide, which may be considered a fairly good indication of the similarity of the chemical structure, if not identity. It, at least, points to the position in the pattern of molasses taken up by degradation products of hexoses.

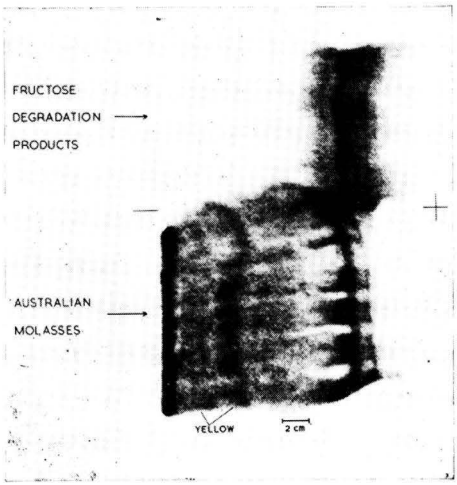

Fig. 5. Electrogram of Australian molasses and samples of alkaline fructose degradation products. Conditions: pH 9·2 borate buffer, 80 V/cm, 60 min

Paper Chromatography

Further work was done on improving solvent systems so as to be able to utilize better this convenient technique for the purpose of providing separation patterns based on a different physico-chemical principle. Solvent I proved particularly suitable for alkaline degradation products of hexoses, resolving the mixture into several well-defined bands, as Fig. 6

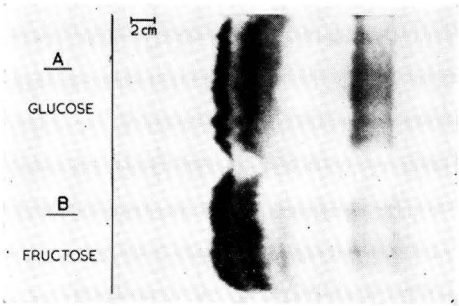

Fig. 6. Paper chromatogram of alkaline degradation products of hexoses. Solvent: acetone-water (2:1, by vol), 7 hr

llustrates. No prolonged attempt was made to establish the identity of individual bands, as extraction and concentration of bands caused the formation of new bands, an indication of the reactivity and potential susceptibility to rapid oxidation of the compounds involved. Further work is required to overcome this obstacle, by choosing conditions avoiding such complications. A comparison of cane and beet molasses (Fig. 7) clearly shows that solvent I is

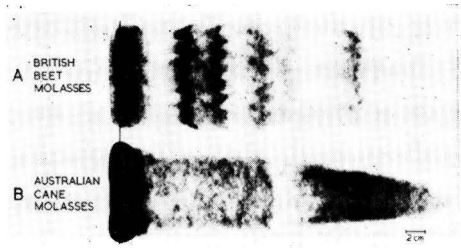

Fig. 7. Paper chromatogram of beet and cane molasses. Solvent: acetone-water (2:1, by vol), 7 hr

more suitable for beet molasses. However, it was found that solvent II gave an excellent resolution when used on cane molasses, not only for the yellow components, but separating also the brown colour into several discrete, well-spaced bands. Solvents III and IV were found useful for particular samples. The addition of borate causes formation of complexed colour compounds with changed R_f-values, adding a new physical property to the distribution mechanism.

Two-dimensional electrochromatography

The obvious approach in the search for enhanced resolving power was to combine the satisfactory electrophoretic method at pH 9·2 with the equally useful chromatographic procedure using solvent II, in the well-known two-dimensional technique. A suitable procedure evolved was to run the cane molasses sample first electrophoretically in buffer A for 120 min at 4 kV, dry the sheet and run it chromatographically at right angles in solvent II for 24 hr. Spraying the chromatogram sparingly with dilute NH_4OH or borate buffer reveals the well-separated yellow pigments. Compounds strongly fluorescing in U.V. light are well separated. So far, the procedure has not proved successful for brown colour, which seems to suffer significant denaturation when treated in this way, and streaks badly or becomes insoluble. However, the possibilites of two-dimensional techniques are far from exhausted and further work is warranted.

Electrophoresis at various pH values

It was previously found[1] that choosing pH conditions other than 9·2 in borate buffer could provide a certain amount of valuable information on the ionic nature of the compounds involved, although the patterns produced were not as detailed and interesting as at pH 9·2. Since the influence of the borate ion is

absent and no complex formation occurs, compounds can be studied in their free and natural ionic state. This means that the degree of dissociation displayed under chosen conditions will be a true characteristic of the free compounds and not of their borate complexes.

Further studies in this area, using improved procedures, have shown that the quality of patterns could be greatly improved and thus valuable information obtained, with regard to dissociation constant, strength of acid, iso-electric point, sign of charge, possible amphoteric nature and solubility. The pattern of a sample of Australian cane molasses run at pH 5·5 in buffer C (Fig. 8) reveals quite interesting features.

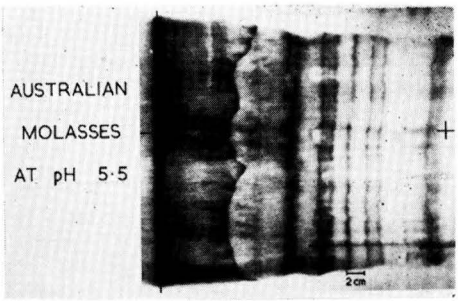

Fig. 8. Electrogram of Australian molasses at pH 5·5. Conditions: ammonium citrate buffer (C), 80 V/cm, 90 min

Under these conditions, acids of pK values up to 5 would be either partly or completely dissociated. Although it would appear that the mobility of the bulk of the colour shows a behaviour corresponding to that of rather weak acids, several well-resolved bands of fast-moving and highly-dissociated components are clearly revealed. The number of these acidic components and their ratio to the total visible colour vary from sample to sample, according to origin and process history of the molasses.

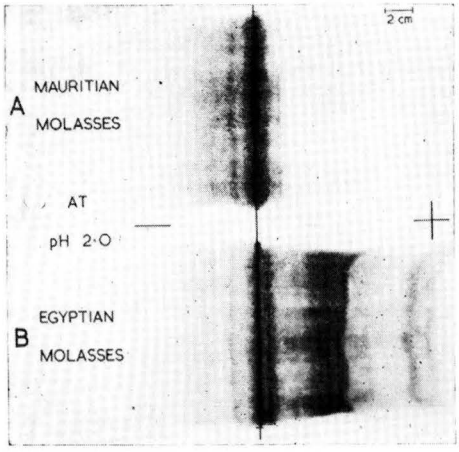

Fig. 9. Electrogram of cane molasses at pH 2·0. Conditions: formic acid buffer (B), 100 V/cm, 45 min

Experiments at pH 2·0, using buffer B, led to some interesting information, hitherto not available. Colour components of amphoteric character, the iso-electric points of which lay above pH 2·0, assumed a positive charge and migrated towards the cathode, whilst the bulk of the colour showed either no charge, i.e. suppressed dissociation, or was negatively charged. The latter indicated the ionic behaviour of fairly strong acids. Fig. 9 demonstrates the varying patterns at pH 2·0 of two cane molasses samples, run for comparison. The Mauritian molasses shows the presence of a much larger amount of cationic colour, whereas the Egyptian molasses contains a substantially larger amount of anionic components.

A spectacular migration of a wide range of cationic components is exhibited by a Jamaican molasses, as illustrated by Fig. 10. These brown bands of the

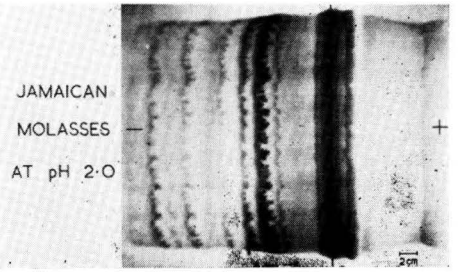

Fig. 10. Electrogram of Jamaican molasses at pH 2·0. Conditions: formic acid buffer (B), 100 V/cm, 60 min

typically wiggly shape could well be compounds of the melanoidin-type, incorporating varying numbers of amino-groups of the constituent amino-acids or peptides. Other interesting features discovered at pH 2·0 were yellow colour components migrating fast to the anode, i.e. strongly acidic, which were not identical with the yellow pigments separated at pH 9·2, because of their entirely different electrophoretic mobilities, absence of pH sensitivity and lack of fluorescence in U.V. light, or display of a quenching effect. Four such bands could be discovered in a cane molasses from West Pakistan. The bright yellow colour is liable to change to light brown or fade altogether after a few days' exposure to the atmosphere, presumably owing to rapid oxidation, as is the case of some phenolic compounds, such as the catechins.

Experiments in phosphate buffer of pH 7·3 (1·5 g NaH_2PO_4 and 3 g Na_2HPO_4 per litre) at 120 V/cm for 45 min produced good separations of yellow and light-brown components from the bulk of brown colour, the latter representing actual sugar degradation colour and streaking in a rather diffuse zone from origin to the first yellow band, but in which several

weak, fast migrating bands were discernible. This buffer proved useful for discriminating between non-ionic and anionic components of varying degrees of acidity. Again, it was established that the yellow components were not identical with the yellow pigments encountered in borate buffer, the mobilities of which at pH 5·5 and 7·3 are very low and indistinct from one another as revealed by fuming with NH_3. By running the same sample in a citrate buffer adjusted with NH_4OH to pH 9·2, two yellow bands could be discerned, the slower canary yellow and the faster a weak yellow. Their mobilities in relation to the brown bands were still very low, about 0·1–0·2. The higher and diverse mobilities in borate buffer are no doubt caused by the formation of complexes between the borate ion and the sugar moiety of the pigment.

Mobilities at pH 9·2 (borate)

Mobilities of the easily discernible bands in electrophoretic patterns at pH 9·2 were measured by calculating their migration rates in relation to that of picric acid under the same standardized conditions, allowing for electro-osmotic and hydrodynamic flow effects[1].

Table I. Relative migration rates of cane molasses colour components at pH 9·2 (borate)

Designation Y=yellow, B=brown	M_{Pic} = Migration rate of colour component: Migration rate of picrate
Y_1	0·16
Y_2	0·23
Y_3	0·30
Y_4	0·43
Y_5	0·54
Y_6	1·00
B_1	0·86
B_2	0·93
B_3	1·00
B_4	1·08
B_5	1·14
B_6	1·20
B_7	1·29
B_8	1·50

The establishment of the relative mobilities under conditions of greatest separability, particularly for the yellow components, should at least make it possible to discriminate between the components with closely similar properties and help to characterize them in some significant way so that results from different laboratories may be compared.

(To be continued)

Studies on pH in Sugar Manufacture

Part II. Effect of Dilution and Concentration on pH

By D. P. KULKARNI, M. K. PATIL and K. C. VORA
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Introduction

HIGH-density sugar house products such as all massecuites, *A*-heavy, *B*-heavy, *C*-light and final molasses are diluted for determination of pH. The actual hydrogen ion concentration of highly concentrated products appears to be complicated and for practical comparison 1:1 dilution is widely adopted.

HONIG[2] has shown that in general, dilution of technical sugar solutions results in rise of pH. In the initial stage of the sugar manufacturing process, we deal with thin juices containing 82 to 85% water while in the later stages, we handle products with 10 to 40% water content.

Procedure

The same techniques as used in Part I of this paper[3] were employed.

Results

Data presented in the tables throw light on the changes occurring in pH values of sugar house products on account of dilution and concentration.

It will be seen from Table I that pH decreases progressively with concentration in the evaporator. The fall in pH from clear juice to syrup, which varies from 0·45 to 0·60, is due partly to the removal of

[1] GROSS: *Chem. & Ind.*, 1959, 1219.
[2] Principles of Sugar Technology, Vol. II. (Elsevier, Amsterdam) 1959, p.p. 190, 192.
[3] *I.S.J.*, 1967, **69**, 297–301.

Table I. Change of pH with concentration in evaporator bodies

Clear juice	*1st body*	*2nd body*	*3rd body*	*4th body*	*Remarks*
6·90	6·60	6·50	6·35	6·30	
7·10	7·00	6·90	6·80	6·60	Raw sugar
7·05	7·00	7·00	6·90	6·60	White sugar
7·05	7·00	6·95	6·85	6·60	,,
7·30	7·25	7·20	7·05	6·95	Original material
7·30	7·25	7·20	7·10	7·05	Above material diluted to 15·8°Bx
7·40	7·35	7·20	7·10	7·05	Original material
7·40	7·35	7·20	7·10	7·05	Above material diluted to 15·8°Bx

ammonia and partly to the formation of organic acids. The authors found that evaporator condensates contained ammonia varying from 3·8 to 20 p.p.m. In order to eliminate the effect of dilution on pH, clear juice, syrup and juices from intermediate bodies were diluted to 15·8°Bx and analysed for pH. The pH drop from clear juice to syrup was found to be 0·25 and 0·35 in two experiments.

In the case of pan materials such as syrup and molasses, of Brix in the range of 60° to 85°, the pH increases with dilution as will be evident from data in Table II. The pH of undiluted molasses with Brix above 75° is lower than the pH found on standard 1:1 dilution by 0·2 to 0·45.

Table II. Effect of dilution on pH values of syrup and molasses

Material	*pH*		
	Undiluted	1:1 *dilution*	1:4 *dilution*
Syrup	6·40	6·80	7·00
A-heavy molasses	5·50	5·70	6·10
	6·35	6·70	6·95
	6·40	6·60	6·85
B-heavy molasses	5·70	6·10	6·30
	6·00	6·25	6·40
	6·20	6·40	6·55
	6·25	6·45	6·70
C-light molasses	5·50	5·80	6·00
	5·55	5·85	6·05
	5·65	5·70	5·95
	5·65	5·85	6·00
Final molasses	5·20	5·65	5·0
	5·40	5·65	5·95

Table III

Combined effect of temperature and dilution on pH values of syrup and molasses

Material	*Dilution*	*pH at 35°C*	*pH at 70°C*	*Change in pH*
Unsulphured syrup	undiluted	6·4	6·1	—0·3
	1:1	6·8	6·4	—0·4
	1:4	7·0	6·5	—0·5
A-heavy molasses	undiluted	5·5	5·3	—0·2
	1:1	5·7	5·5	—0·2
	1:4	6·1	5·6	—0·5
B-heavy molasses	undiluted	5·7	5·5	—0·2
	1:1	6·1	5·8	—0·3
	1:4	6·3	5·9	—0·4
C-light molasses	undiluted	5·5	5·3	—0·2
	1:1	5·8	5·4	—0·4
	1:4	6·0	5·6	—0·4

In Table III are illustrated the changes in pH values resulting from the combined influences of dilution and temperature on syrup and molasses. The standard method of measuring syrup pH requires no dilution, whereas for molasses 1:1 dilution is needed for comparison. Dilution raises the pH while a rise in temperature lowers it. In the case of syrup at high (1:4) dilution and room temperature (35°C) the pH exceeds that found in undiluted syrup at an elevated temperature (70°C) by 0·9. With molasses, however, the pH at 1:4 dilution and room temperature is 0·6 units higher than that found by standard 1:1 dilution and at the temperature of operation.

The same tendency is observed (Table IV) in the case of white sugar, raw sugar and molasses as with syrup and molasses. pH measured at high dilutions and room temperature would be completely misleading and the actual pH under working conditions would be lower by 0·4 to 0·6 than that observed at room temperature and with higher dilutions.

Discussion

Measurement of pH in highly concentrated solutions is a complex problem and it is not clear how far we get a correct idea about the real hydrogen ion concentration, e.g. in molasses, from our present methods of measurement. However, deviations from standard procedures in respect of dilutions would certainly lead to misleading results in the case of highly concentrated pan materials. It is interesting to note that the data on pH of undiluted high Brix (>75°) pan materials indicates a regularity in behaviour. The pH values of high Brix materials are consistently lower than those obtained by 1:1 dilution. The procedure recommended[4] for control of Hawaiian sugar factories, viz. that pH of molasses up to a concentration of about 90° refractometric solids should be determined without dilution, deserves to be considered for adoption in the light of the data presented.

Acknowledgement

Thanks are due to the management of Yeshwant S. S. Karkhana Ltd. for permission to publish this work.

Summary

The effects of dilution on the pH of technical sugar solutions have been examined, as have the combined effects of dilution and temperature increase.

[4] Official Methods of the Hawaiian Sugar Technologists for Control of Cane Sugar Factories, 1955, p. 69.

Table IV

Material	*Dilution*	*pH at 30°C*	*pH at 40°C*	*pH at 50°C*	*pH at 60°C*	*Change in pH between 30°C and 60°C*
White Sugar	60°Bx	5·8	5·7	5·6	5·5	—0·3
	40°Bx	5·9	5·8	5·7	5·6	—0·3
	30°Bx	6·2	6·0	5·9	5·8	—0·4
Raw Sugar	60°Bx	5·9	5·9	5·8	5·7	—0·2
	40°Bx	6·1	6·1	6·0	5·9	—0·2
	20°Bx	6·3	6·3	6·2	6·1	—0·2
Final Molasses	1:1	4·9	4·8	4·7	4·7	—0·2
	1:2	5·0	4·9	4·9	4·8	—0·2
	1:3	5·1	5·0	5·0	4·9	—0·2

Deterioration of Mechanically Harvested Chopped-up Cane

Part I. Dextran—A promising Quantitative Indicator of the Processing Quality of Chopped-up Cane

By J. S. KENIRY, J. B. LEE and C. W. DAVIS

(The Colonial Sugar Refining Co. Ltd., Sydney, New South Wales, Australia)

Introduction

SINCE the beginning of cane sugar manufacture, chemists have striven for additional means to predict, by analysis of material extracted from cane, the processing quality of the juice from that cane in the mill and subsequently in the various refineries; this applies particularly to deteriorated cane. The reliability of many compounds, or groups of compounds, as indicators of the processing quality of cane has been studied by several authors. For example, BRUIJN[1] has recently investigated volatile and non-volatile organic acids, alcohols, amino acids and polysaccharides, while IRVINE and FRILOUX[2], MCCALIP and HALL[3], and TANTAOUI[4] have also reported work on polysaccharides.

Until 1962, little work of this nature had been successfully conducted in Australia. This was understandable, not only because of the difficulty in finding a starting point, but possibly also because, in Australia, the processing difficulties associated with deteriorated cane were thought to occur less frequently and to be generally less severe than those described by overseas authors. The C.C.S. content—pol % cane minus half impurities % cane[5]—and purity of cane had been accepted as the principal indicators of the processing quality of manually-cut, whole-stalk cane.

In the early 1960's, the desire to overcome rising harvesting costs, together with an increasing labour shortage, precipitated the development of several types of mechanical harvester. One such harvester proved successful mechanically in the far northern cane fields. This machine, after topping and cutting the cane, chopped each whole stalk into billets. The billets, averaging ten to twelve inches in length, were loaded directly into a three- or four-ton mesh cane bin.

As this type of mechanical harvesting became more widespread, mill personnel recognised a disparity in processing quality between chopped cane and manually-cut, whole-stalk cane. For example, chopped cane that had been stored over the weekend shut-down period (harvested Friday and crushed the following Monday) was found to cause processing difficulties much greater than were normally experienced with similarly delayed whole-stalk cane. The chief symptoms arising from deteriorated chopped cane were slow-boiling process materials, elongated crystals and a retrogression in the exhaustibility of both high and low grade massecuites. The reduction in boiling rate, when coupled with poorer exhaustion in the high grade pans and lower purging efficiency of low grade massecuites, caused a serious decrease in the effective capacity of pan and centrifugal stations. There was also increased loss of sugar to final molasses. Furthermore, similar processing difficulties were subsequently experienced by the refineries when processing the corresponding raw sugars.

In the 1965 season some 80% of the cane at the C.S.R.'s two Herbert River Mills was mechanically harvested in a chopped-up condition. Processing difficulties at each mill were both consistent and severe, and the raws produced did not handle well in refineries. As a result of this severe experience, an investigation was designed to study quantitatively the deterioration of chopped cane and its effects on mill processing performance.

A prerequisite to the study of chopped cane deterioration *per se* was to find a more reliable indicator of the processing quality of cane; for it had been clearly shown that chopped cane, much more than whole stalk cane, could be of very poor processing quality and still retain an apparently high proportion of its original C.C.S. and purity. Throughout the 1966 season attempts were made at Victoria Mill to correlate factory processing performance, as measured by such indicators as final molasses purity and crystal elongation, with the level of gums, dextran and

[1] *I.S.J.*, 1966, **68**, 331–334.
[2] *Sugar y Azúcar*, 1965, **60**, (11), 58–59.
[3] *Proc. 6th Congr. I.S.S.C.T.*, 1938, 986–1004.
[4] *Sugar J.*, 1952, **15**, (6), 36–38.
[5] CLAYTON: *Proc. 10th Congr. I.S.S.C.T.*, 1959, 207.

lactic acid in various process materials. The results of this factory work are reported in the present paper. The results of an investigation into the rate of deterioration of chopped cane under different ambient conditions will be reported separately[6].

Experimental

The cane supply at Victoria is a one-year crop, and it is burnt before harvesting. It includes about 70% Pindar, 10% Q68 and 10% Q57. The mill process consists essentially of crushing, followed by lime defecation and evaporation to yield cane syrup, which is subsequently exhausted in vacuum pans using a 3-massecuite formula. Syrup and crystal are separated by single purging.

Cane syrup and final *C*-molasses were continuously sampled over corresponding periods of 16 to 24 hours. Syrup was analysed for gums, lactic acid and dextran, and final molasses for purity.

The crystal elongation and the concentration of gums, dextran and lactic acid in selected *A*, *B* and *C*-massecuites were also determined. Proof samples of the massecuites were taken from the vacuum pans just prior to dropping.

Analytical Methods

Brix (°Bx). was determined as total solids by absorbing the diluted (to about 30°Bx) product on strips of filter paper and drying at 96°–100°C for six hours.

Molasses Purity was expressed as sucrose (by Jackson and Gillis method II) % Brix.

Lactic Acid was determined by a modified Barker and Summerson[7] method. The analytical procedure consisted of a de-proteinating step (using sodium tungstate and sulphuric acid) followed by a copper sulphate—calcium hydroxide treatment that effectively removed interfering substances. Controlled hydrolysis with concentrated sulphuric acid converted lactic acid to acetaldehyde, the latter being estimated colorimetrically (570 mμ) as its complex formed, in the presence of cupric ions, with *p*-hydroxy diphenyl. Corrections were made for the over-estimating effect of the sucrose not removed by the purification step. Results are reported as % on Brix.

Gums were determined by a method similar to the "alcohol precipitation method" reported by Roberts and Friloux[8]. Process materials were diluted, prior to analysis, to a Brix dependent on their inorganic salt concentration. Solution densities ranged from 15°Bx for syrups and *A*-massecuites to 3–4°Bx for final molasses. The gums were precipitated from the diluted product by the addition of three volumes of ethanol. After centrifugation, the supernatant liquid was decanted and the gum pellet allowed to drain till dry. The dry pellet was dispersed in 80% ethanol and again separated by centrifugation and decantation. The alcohol-washed pellet was dissolved in distilled water and determined colorimetrically (490 mμ) as equivalent glucose by the phenol-sulphuric acid method. Results are expressed as % on Brix.

Dextran was determined by a method adapted from that of Nicholson and Horsley[9]. The method was standardized against a sample of dextran isolated from deteriorated cane. The dextran content of process materials was determined as follows. The product was diluted to a suitable Brix (see gums analysis). This solution was incubated[9] (commercial Biokleistase) to remove starch and then de-proteinated by the addition of trichloracetic acid. After filtering to remove insolubles, the dextran was determined as the haze[9] developed in 50% ethanol. Results are reported as % on Brix.

Crystal elongation was determined from a photograph (×40 magnification) of the massecuite. Each photograph contained about 30 crystals. The length (*l*) and breadth (*b*) of each crystal in the photograph was measured to the nearest millimetre. Then

$$\text{elongation, for } n \text{ crystals} = \frac{l_1 + l_2 + l_3 + \ldots l_n}{b_1 + b_2 + b_3 + \ldots b_n}$$

It is relevant to note that for massecuites that were classed as excellent from the point of view of grain regularity, the calculated elongation was in the range 1·0 to 1·2.

Results

The 1966 season crop in the Herbert River district was of generally good quality, and weather conditions were favourable for the harvesting operation. Apart from a few weeks at the start and end of the season, the weather was dry and cool and was therefore conducive to minimal deterioration of the cane between cutting and crushing. Furthermore, in the 1966 season, the organization of harvesting and transport at the Company's mills effected substantial reductions in the burning-to-cutting and the cutting-to-crushing delays for chopped cane. The combined effects of these factors resulted in a significant reduction, compared with previous seasons, in both the frequency and severity of processing difficulties. However, in the latter part of the season, when hot

Table I

Final molasses purity (y)	*Concentration (% Bx) in syrup of:* *Gums* (x_1)	*Dextran* (x_2)	*Lactic acid* (x_3)
40·9	0·53	0·022	0·106
40·1	0·48	0·010	0·051
41·8	0·66	0·053	0·060
41·1	0·55	0·033	0·060
40·3	0·50	0·020	0·040
39·9	0·46	0·002	0·046
40·1	0·45	0·005	0·040
40·6	0·51	0·008	0·055
40·6	0·54	0·018	0·055
40·0	0·58	0·015	0·050
40·2	0·57	0·027	0·050
40·8	0·55	0·015	0·040
40·2	0·54	0·007	0·046
41·1	0·53	0·014	0·067
44·8	1·04	0·150	0·115
43·0	0·70	0·100	0·090

[6] Keniry, Lee and Davis: *I.S.J.*, 1967, **69**, in press.
[7] *J. Biol. Chem.*, 1941, **138**, 535.
[8] *Sugar y Azúcar*, 1965, **60**, (11), 66–67.
[9] *J. Agric. Food Chem.*, 1959, **7**, (9), 640–643.

(mean ambient temperature 78–82°F), humid weather resulted in a marked increase in the rate of deterioration of all cane, Victoria Mill experienced substantial and prolonged variations in the processing quality of cane Over a four-week period during this latter part of the season, the following experimental data were collected.

Table I shows the purity of the final molasses related to the levels of gums, dextran and lactic acid in 16 samples of cane syrup. It is relevant that, over the period studied, the exhaustibility of fresh cane, as measured by RS/Ash ratio, did not vary appreciably.

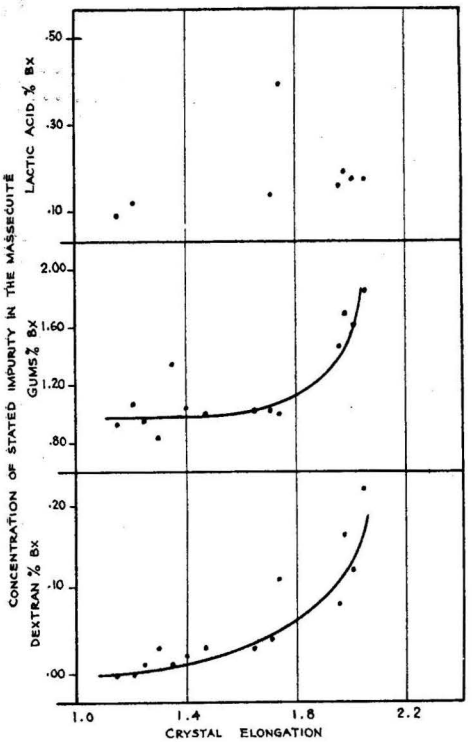

Fig. 1. Victoria Mill *A*-massecuites, 1966 season. Relationship between crystal elongation and gum, lactic acid and dextran concentrations

A multiple regression analysis of the data in Table I yielded the equation:

$y = 39{\cdot}079 + 1{\cdot}0709x_1 + 24{\cdot}091x_2 + 8{\cdot}619x_3 \ldots .(1)$, with the t-statistic for each variable: gums (x_1), $t_{12} = 0{\cdot}539$; dextran (x_2), $t_{12} = 3{\cdot}216$; lactic acid (x_3), $t_{12} = 1{\cdot}522$. Therefore the correlation between final molasses purity and dextran concentration is very significant (99% level) while those for gums and lactic acid concentrations are not significant.

An F-test significant at the 99% level indicates that the overall regression is a good fit (R^2 value = 0·95).

Figs. 1, 2 and 3 show the data relating crystal elongation in *A*, *B* and *C*-massecuite with the level in these massecuites of gums, dextran and lactic acid.

It should be stressed that syrup derived from fresh cane always contained gums and lactic acid but, in our experience, not dextran.

Discussion

Over the period studied, the level of gums, dextran or lactic acid in process materials—and by inference, their levels in cane—would have served as a qualitative indicator of the processing quality. Since these data were collected at Victoria Mill, where chopped cane comprised 80–85% of the supply, these conclusions must be considered to apply to chopped cane. Whether the same conclusions would apply for whole-stalk cane is, as yet, unknown.

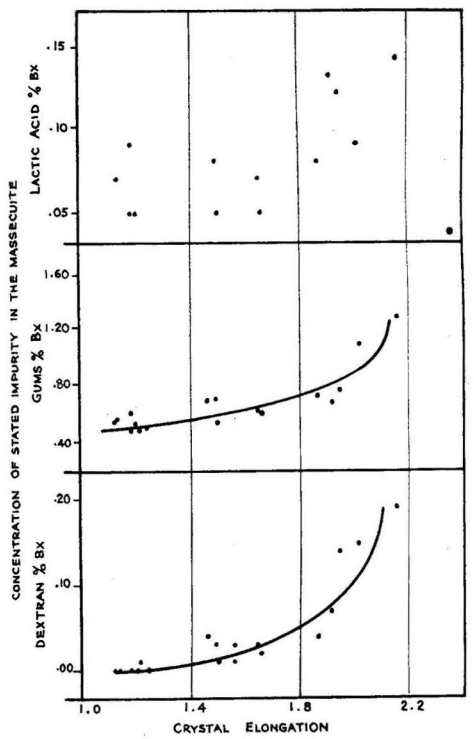

Fig. 2. Victoria Mill *B*-massecuites, 1966 season. Relationship between crystal elongation and gum, lactic acid and dextran concentrations

Lactic acid was suitably only for correlations such as: high lactic acid concentrations (0·10–0·15%

Bx in syrup) were generally associated with poor processing quality and *vice versa*. From a measured increase in the lactic acid content of cane syrup, it was not possible to predict by how much, if at all, the mill's processing performance would retrogress.

The use of gums as an indicator of the processing quality of cane has been described by other investigators[2,3,4]. Gums and dextran have similar properties. Dextran consists of the polysaccharide material precipitated from a starch-free and protein-free

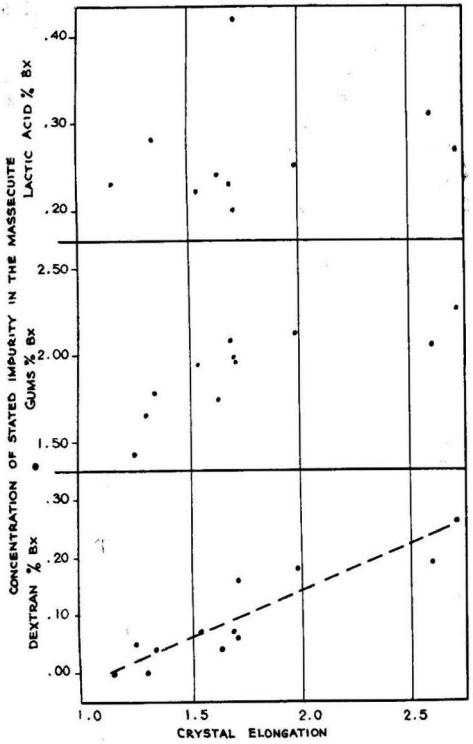

Fig. 3. Victoria Mill *C*-massecuites, 1966 season. Relationship between crystal elongation and gum, lactic acid and dextran concentrations

solution by 50% ethanol. Gums are those substances that are precipitated by 75% ethanol and that give a coloration with the phenol-sulphuric acid test. Gums therefore include dextran, other polysaccharides and, except in unheated cane juice, starch. There may also be some interference from protein.

With respect to the relative merits of gums and dextran as indicators of the processing quality of chopped cane, the results clearly show that, in the period studied, dextran was the better indicator. The content of dextran in massecuites gave a more reliable and more sensitive indication of the crystal elongation, particularly in the region of low elongation. The foregoing statistical analysis shows conclusively the superiority of dextran as an indicator of exhaustibility.

Bearing in mind the importance of developing a simple and rapid means of classifying cane, either in the field or in the mill yard, as of standard or sub-standard processing quality, we believe dextran has at least three distinct advantages over lactic acid or gums. These advantages would be in addition to our expectation that dextran will prove to be the most precise indicator of processing quality.

Firstly, cane syrup derived from fresh cane in the 1966 season contained no dextran and therefore was not subject to variations within the mill area and, within our limited experience, to variations among mill areas. By contrast, syrup derived from fresh cane contained a variable amount of gums and lactic acid. The range was, for gums, from 0·5 to 0·6% Bx in early June, through 0·3 to 0·4% Bx in September–October, to 0·4 to 0·5% Bx in November–December; and, for lactic acid, from 0·04% Bx early in the season to 0·06 to 0·07% Bx at the end of the season. The use of dextran as an indicator of cane quality would obviate the need to employ a sliding scale for the value of the indicator that corresponded to fresh cane.

Secondly, the dextran assay of cane juice[9] can be carried out in less than half an hour, whereas the time involved in a gums determination is at least two hours.

Thirdly, the results reported previously in this paper, and those to be reported in Part II[6], suggest that the first occurrence of dextran in chopped cane corresponded with the instant at which the juice from that cane would first have had a noticeably deleterious effect on the mill processing performance. It may therefore be possible to devise a test for dextran in juice whereby the classification of chopped cane as standard or sub-standard would be on the basis of no haze, or haze, respectively, by the dextran assay.

Summary

Difficulties in the milling and refining processes coincided with the introduction of wide-scale chopper harvesting in North Queensland. The usefulness of lactic acid, gums and dextran as indicators of the processing quality of chopped cane has been investigated at the Company's Victoria Mill. Over a four-week period at the end of the 1966 season, the level of dextran in certain mill process materials was quantitatively related to the mill processing performance, as measured by final molasses purity and an important aspect (crystal elongation) of raw sugar quality.

The application of dextran as a quantitative indicator of the processing quality of chopped cane has considerable promise.

Sugar cane agriculture

The influence of urea on the germination of sugar cane setts. R. A. AREVALO. *Rev. Agronomica Noroeste Argentino*, 1966, **5**, 155–164.—Various factors may be responsible for poor germination of sugar cane such as the nature of the soil, its microflora, insects and diseases. It was thought the presence of anti-oxidants, including urea, might counteract the putrefactive agencies. Urea was used in different concentrations, 15%, 25% and 35% but had little noticeable effect.

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The preservation of seed cane. M. A. SCARSI and D. M. MORIN. *Rev. Agronomica Noroeste Argentino*, 1966, **5**, (1–2), 165–173.—In the province of Tucumán in Argentina the planting of sugar cane is only carried out during certain months for climatic reasons and it is sometimes necessary to fill gaps where germination has been poor. Preliminary experiments to test the best methods of storing seed cane are here reported. Storage underground was superior to normal storage (by 10%).

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Trials for new cut-load harvester. ANON. *Australian Sugar J.*, 1966, **58**, 461–463.—A description is given of a new cut-load harvester ("Canegrowers' Champion"), manufactured in Bundaberg, Queensland, and developed for the farmer or small grower wishing to harvest his own cane. It weights only 20 cwt, is compact and able to manoeuvre on headlands without cutting the end stools. It is attached by a three point mounting to any tractor of the 45 h.p. range. Hydraulics tapped from the tractor's hydraulic system are used for the base cutter and topping adjustments. Other components are driven mechanically from the tractor. It should suit a grower with a harvesting allotment as low as 15 tons of cane a day.

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Factors affecting herbicide usage in sugar cane with special reference to soil applied herbicides. E. ROCHECOUSTE. *Sugar News*, 1966, **42**, 502–506.—The general principles involved in applying soil herbicides to sugar cane are discussed, under various headings—soil type, rainfall, temperature, soil micro-organisms, crop tolerance, varietal response, weed population, etc. In view of the rapid development taking place in this brance of agricultural science, it is considered that a sound knowledge of the principles involved is necessary in order to reap the maximum benefit.

Sugar cane crop reduction through borer damage at Nuñorco (Tucumán). V. C. MARTEAU. *Dept. Agrotécnico Ingenio Nuñorco, Monteros, Tucumán*, 1966, (4), 7 pp.—The severity of damage to cane by the borer *Diatraea saccharalis* in Tucumán is discussed. Results of counts of damaged and undamaged stalks over a period of four years on two different estates are given. The beneficial results from the introduction of the parasite *Lixophaga diatraeae* are discussed.

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Effect of treatment of seed cane on susceptibility of sugar cane to mosaic virus. N. ZUMMO. *Phytopathology*, 1967, **57**, (1), 83–85.—Heat treatment of sugar cane for control of ratoon stunting disease has become standard practice in Louisiana. Sugar cane plants grown from heat-treated seed cane were more susceptible to sugar cane mosaic virus (SCMV) than those from comparable non-treated seed cane when inoculated mechanically in the greenhouse. This effect was not carried over in the first progeny (ratoon) crop. Progeny cane was comparable to non-treated cane in susceptibility, but retreating progeny cane made it again more susceptible to infection. Mosaic symptoms developed earlier in plants grown from heat-treated seed cane than in those from non-treated seed cane. Presence or absence of ratoon stunting disease virus had no apparent effect on susceptibility to SCMV. Viruliferous ambrosia aphids released among test plants showed no feeding preference for plants of any treatment, but a higher percentage of plants grown from heat-treated seed cane became infected with SCMV.

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Observations on the biology of *Bactra* (*Nannobactra*) *minima minima* Meyrick **and the damage caused by it to nut-grass,** *Cyperus rotundus* **L.** T. SANKARAN and D. SRINATH. *Tech. Bull. Commonw. Inst. Biol. Control*, (7), 139–147; through *Rev. Appl. Entomology, Ser. A*, 1967, **55**, 95.—Results of a survey in India of possible natural enemies of nutgrass (one of the worst cane weeds in many areas) are discussed. This parasite was found attacking the weed round Bangalore, up to 20% of tubers being infected by the weevil in one area. Results of laboratory and field studies are given and a description of the insect and its life history. Leaves of infected plants began to dry up from the tips 2–3 days after the larvae had entered the stem and plants were completely dead in about 12 days. More intensive investigations on the food plant range of the insect is considered to be desirable.

Iron-manganese relationship of chlorotic sugar cane plants grown on a high-lime soil. S. C. SRIVASTAVA, M. P. AGRAWAL and S. M. H. JAFRI. *Soil Sci.*, 1966, **102**, (3), 208–211.—The effect of chelated manganese and sulphur dust spray was studied on chlorotic ratoon sugar cane plants growing on a high lime soil. Although the symptoms were indicative of iron deficiency, manganese treatment gave the best response, particularly in improving juice quality. When the chlorotic and healthy plants were analysed the chlorotic plants were found to be richer in iron but poorer in manganese than the healthy ones. It has been suggested that the inactivation of iron may have been caused by the deficiency of manganese. The development of manganese deficiency in the soils of the region where the disorder was noticed is also discussed.

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Trends in tillage systems. Conventional, minimum and zero practices. C. CAMERIS. *Sugar J.* (La.), 1967, **29**, (9), 9–12.—Minimum tillage involves the use of multiple hitches behind tractors whereby several operations, carried out separately in conventional tillage, are performed simultaneously. Zero tillage is the system recently found to be practical with certain crops, whereby chemicals are used for weed and pest control and the soil is left undisturbed so providing ground mulch and conserving soil and water. The practices are being studied in the U.S.A., not least by the Deere Company, the author's employers, but it is pointed out that the choice must be made by the individual farmer in full consideration of the ecological and other factors operating in his particular circumstances.

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The lesser corn-stalk borer (*Elasmopalpus lignosellus*), a new pest of plant cane in Cuba. L. C. SCARAMUZZA. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 5–12.—This pest, called ratoon borer in Cuba, has in the past confined its attacks to sugar cane ratoons from burned cane, but it has recently shown increasing partiality for new plantings of sugar cane where its damage is more serious. A description is given, with photographs, of the insect, its life history, habits and distribution.

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Influence of using various sugar cane leaves and parts of the sugar cane leaf on chemical composition. G. SAMUELS. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, (1), 22–28.—The importance of the method employed in taking samples of sugar cane leaves in connexion with foliar diagnosis is stressed. An accurate diagnosis of the sugar cane's fertilizer status is impossible if leaf samples are taken improperly. Variations were found in the nutrient content of the various types of leaf of the sugar cane plant as well as variation within the leaf itself. An account is given of the variations found. N and P contents of leaf blade were higher than those of the leaf sheath. The reverse applied for K. There was appreciable variation in a single leaf from base to tip.

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Evaluation of sucrose-enzyme relationships among 12 Puerto Rico sugar cane varieties. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, (1), 29–38.—Experiments over a period of 3 years are described. These were initiated (1) to study enzyme activity trends which would help account for characistic properties of given varieties and (2) to find enzyme activity patterns which would indicate at an early age the sugar-producing capacity of new or test varieties. Sugar and enzyme values varied greatly among the 12 varieties. Fructose and sucrose content differed by as much as tenfold among variety extremes. Amylase, invertase, tyrosinase and peroxidase all exhibited broad differences. Some variety characteristics were correlated with enzyme action. It is suggested that invertase might be employed as an early indicator of sugar-producing potential with test varieties.

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Purification and electrophoretic behaviour of sugar cane invertases. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, (1), 39–45.—In studying sugar cane enzymes a major problem is the purifying of the enzyme complex to a level which affords reliable analysis. This paper summarizes procedures of differentiated solubility, gel filtration and paper electrophoresis which have proved satisfactory for resolution of the enzymes from inert protein and from one another.

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Enzyme-sugar relationships in immature sugar cane treated with ascorbic acid, cysteine, hydroxylamine, cyanide, silicon and iron. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1967, **51**, (1), 46–54.—The potential significance or economic importance of the control of enzymes or certain enzymes in the living sugar cane plant are discussed. The results of treating immature sugar cane with various chemical additives are also discussed.

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Sugar cane: a basic record. R. F. DE ULLIVARRI and G. K. VOSS. *Idia*, 1966, (218), 17–43; through *Hort. Abs.*, 1967, **37**, (1), 235.—Notes on a regional survey of production, varieties, cultural practices, processing, by-products, trade and marketing in Argentina are presented. Charts are included.

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Pre-emergence herbicide screening in sugar cane on sandy soils. J. R. ORSENIGO. *Mimeo. Rep. Everglades Exp. Sta.* (Fla.), 1964, (65–9), 8 pp.; through *Hort. Abs.*, 1967, **37**, (1), 235.—A primary evaluation trial of various herbicides applied pre-emergence in 50 gal water/acre with the cane variety CP 50–28 is reported. Treatments which showed promise included "Fenac" at 6 and 9 lb/acre, "Diuron" at 4·8 lb/acre, "Trimeturon" at 7 lb, "Simazine", "Atrazine" and

"Propazine" at 4 lb/acre. On assessment 6 months after treatment "Chloramben" at 6 lb/acre, "Fenac" at 6 and 9 lb/acre, "Diorun" at 4·8 lb/acre, "Atrazine", "Propazine" and "Simazine" at 4 lb/acre and "Norea" at 8 lb/acre appeared to have the most beneficial effect on cane growth.

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Tractor-drawn sugar cane planter. R. G. MENON. *Indian Farming*, 1966, **16**, (2), 9–11; through *Hort. Abs.*, 1967, **37**, (1), 235.—Details of a planter designed at the Indian Institute of Sugar cane Research, at Lucknow are given.

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The effect of weeds on the cultivation of sugar cane. E. CERRIZUELA, J. A. MARIOTTI and R. A. ARÉVALO. *Rev. Indust. Agric. Tucumán*, 1965, **43**, 1–12; through *Hort. Abs.*, 1967, **37**, (1), 235.—The effects of clean cultivation, various frequencies of weeding and permanent weed cover on a plant cane crop were compared. Absence of weeding, as compared with clean cultivation, showed a reduction of millable stems of 70%. Maturation was more rapid and sugar content higher where weeding was neglected but yields were much reduced. Yields were closely related to the degree of freedom from weeds.

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A comparative trial of 6 pre-emergence herbicides in sugar cane. E. O. SÁNCHEZ, H. N. NARANJO and A. R. GOMEZ. *Agric. Trop.* (Bogotá), 1966, **22**, 263–265; through *Hort. Abs.*, 1967, **37**, (1), 236.—"Gesaprin 50M", "Karmex" and "Gesatop", each at 4, 5 or 6 kg/ha were greatly superior to 2,4-D amine, "Dowpon" and Esso herbicide. Plant height and tillering were best with "Gesaprin 50M", but were almost equally good with "Karmex" and "Gesatop". All three products were effective for at least 45 days. The grass *Digitaria horizontalis* was resistant to "Gesaprin".

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Virus of ratoon stunting disease not transmitted through seed of sugar cane. I. L. FORBES and R. PERDOMO. *Phytopathology*, 1966, **56**, 878; through *Hort. Abs.*, 1967, **37**, (1), 238.—Four plants of the variety CP 44-101 with severe symptoms of RSD were selfed and the resulting seed (about 3000 seeds) sown and grown on. Reasons are given for the firm belief that the disease is not transmitted through the seed.

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Studies on the cicada, *Mogannia hebes*, attacking sugar cane ratoons and its control in Taiwan. C. B. CHEN and T. H. HUNG. *J. Agric. Assoc. China*, 1966, (53), 31–41; through *Hort. Abs.*, 1967, **37**, (1), 239. The biology of the pest is described. Flooding with water for 7–14 days gave 80–100% control of the nymphs. In unirrigated and upland areas effective control was obtained by the removal of sugar cane roots after harvest and rotation with a green manure crop.

Naturally-occurring gibberellins in sugar cane. B. H. MOST and A. J. VLITOS. *Plant Physiol.*, 1966, **41** (suppl.), 40; through *Hort. Abs.*, 1967, **37**, (1), 240. Giberellins A_1 and A_3 were found in leaf and apical stem tissues of the sugar cane variety Barbados 41227. Methods of separating the gibberellins are described. Young cane growing under moisture stress contained at least two gibberellin-like substances.

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A field method for testing maturity of sugar cane. E. E. KHAFAGA *et al. Agric. Res. Rev., Cairo*, 1965, **43**, (3), 21–37; through *Hort. Abs.*, 1967, **37**, (1), 240. Tests were carried out (on varieties Co 281, Co 413 and N:Co 310) to determine the standard representative internodes to be used in maturity determinations using the hand refractometer. The 4th, 5th and 6th internodes were found to be representative in determinations of total soluble solids. Great differences in TSS percentages existed between the 1st and 5th internodes. Identical TSS percentages in standard internodes in two successive monthly tests are an indication of maturity.

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Studies on the stimulation of conidial germination in *Colletotrichum falcatum*. P. SINGH. *Indian Phytopath.*, 1965, **18**, (3), 291–302; through *Rev. Appl. Ent.*, 1967, **46**, 146.—Conidia (fruiting bodies) of *Colletotrichum falcatum* (*Glomerella tucumanensis*) were induced to germinate by various treatments for increasing the permeability of the spore wall, including pre-soaking, alternate wetting and drying, preheating, and some chemicals including EDTA, furfural, fumaric acid, oxalic acid and citric acid.

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Occurrence of two entomophagous fungi on sugar cane pests in Tanjore area of Madras State. H. DAVID. *Current Sci.*, 1964, **33**, (11), 349; through *Rev. Appl. Mycology*, 1967, **46**, (2), 107.—*Saccharicoccus sacchari* and *Proceras indicus* on sugar cane in Madras State in India were observed to be parasitized by *Aspergillus parasiticus* and *A. flavus* respectively. The two fungi were cultured on oat-agar medium, and artificial inoculation of the host insects was successful with the first but only partially so with the second.

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Sugar cane leaf scald. ANON. *Commonwealth Phytopathological News*, 1967, (2), 4.—Reference is made to the presence of leaf scald (*Xanthomonas albilineans*) having been confirmed on the sugar cane variety CP 36-111 on Kilombero Estate, Central Tanzania. This is a new record for Tanzania and the second report of the disease from the African Continent (the previous record being from Rhodesia). Destruction of infected material was undertaken.

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Studies on the rhizosphere of sugar cane in Trinidad. J. T. MILLS and A. J. VLITOS. *Trop. Agric.*, 1967, **44**, 151–157.—A description is given of a qualitative

study, over a two-year period, of the fungi that occur in the rhizosphere of sugar cane grown on very heavy clay soil in Trinidad. Comparisons were made with fungi isolated from similar soils which remained fallow. In spite of indications that there may be a rhizosphere effect associated with sugar cane root systems, it was found there was a considerable degree of similarity in the qualitative composition of fungi isolated from the vicinity of the root system and from fallow areas at a considerable distance from the roots. This account brings earlier work up to date.

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On the sugar cane diseases of north east Brazil. C. WISMER. *Brasil Açuc.*, 1966, **68,** (5), 32–35.—Results are given of a discussion or seminar held in August, 1966. Among the diseases discussed are leaf scald (*Xanthomonas albilineans*), cane smut (*Ustilago scitaminea*), eye spot (*Helminthosporium sacchari*), red spot (*Physalospora tucumanensis*) and pineapple disease (*Ceratocystis paradoxa*). Damage by the pest *Mahanarva indicata* ("Cigarrinha") in the Putami area is recorded.

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The economics of sugar cane cultivation (in Brazil). W. CARNEIRO. *Brasil Açuc.*, 1966, **68,** (5), 36–41. The history of sugar cane cultivation in Brazil is briefly outlined and the vicissitudes it has been through up to the present time mentioned.

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Sugar cane and its fertilizing. P. DE OLIVEIRA LIMA. *Brasil Açuc.*, 1966, **68,** (5), 49–53.—This is one of a series of articles on sugar cane cultivation in Brazil. The function of the basic elements in fertilizing is described and greater use of fertilizers urged. N-P-K formulas for fertilizing ratoon cane (600 and 850 kg/ha) are given.

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New equipment for efficient sugar cane cultivation. ANON. *Bol. Azuc. Mex.*, 1966, (205), 38.—Reference is made to a demonstration of tractors and other forms of field equipment for large scale cultivation at the Los Angeles Estate, Cosamaloapan, Ver., Mexico.

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Recommendations of the Tucumán Experiment Station on the use of chemical weedkillers with sugar cane. ANON. *La Ind. Azuc.*, 1966, **72,** 305–307.—For the guidance of cane growers, the correct use of herbicides such as 2,4-D, TCP and "Dalapon" at different seasons on plant and ratoon crops is discussed as well as costs. Growers with difficult or unusual weed problems are urged to consult the Experiment Station.

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Taiwan Sugar Corporation's problems and their solution. M. H. YUAN. *Taiwan Sugar*, 1966, **13,** (5), 7–9.—This large Corporation obtains its supplies of cane partly from its own plantations (about a third) and partly from private growers. It is pointed out that recent low prices have resulted in greatly reduced supplies from the latter, to the detriment of the mills. Ways and means of increasing supplies from mill farms in a Four Year Plan are discussed. This involves improved agronomy, acquiring neighbouring farmland and development of areas at present barren by improving water resources, i.e. through drainage or irrigation.

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A study on the use of vegetation for road-bank and bench terrace stabilization. T. T. CHANG. *Taiwan Sugar*, 1966, **13,** (5), 26–27.—Results of trials with ten different species, half of them grasses, are discussed. Five species were recommended: *Cenchrus calyculatus* and *Dactyloctenium aegypticum* for sandy soils, and *Cynodon dactylon*, *Chrysopogon aciculatus* and *Indigofera endecaphylla* (a legume) for clay or loamy soils.

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Sugar cane research in Mexico. ANON. *Bol. Azuc. Mex.*, 1966, (206), 12–26.—The work of the various sugar experiment stations in Mexico and the different lines of research on which they are engaged are described. Information is given on the performance and characteristics of some of the newer varieties of sugar cane bred in Mexico. Disease control measures and extension work currently in progress are reported.

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Control of the sugar cane borer with low-volume concentrates of insecticides. S. D. HENSLEY and L. DAVIS. *Sugar Bull.*, 1966, **45,** 86–88.—Use of concentrated insecticide formulations at ultra-low-volume rates of application (ULV) is a new method developed in the last six years. A programme designed to evaluate ULV application techniques for possible use in sugar cane borer control in Louisiana was initiated during 1965. Results from two experiments are considered in this paper. Further work is proposed.

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New systems of transfer loading cane versus the old system. G. R. TIMMONS. *Sugar Bull.*, 1966, **45,** 88–90. The pros and cons of the old and the new systems are discussed. The heavy initial costs of the new systems may rule out purchase by all except the few large producers in Louisiana.

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Crichton truck chain tightener. L. G. VALLANCE. *Australian Sugar J.*, 1966, **58,** 525–527.—A new piece of equipment for tightening down the chain of a loaded tram truck is described. It is mounted on the three-point linkage of a Ferguson tractor and the pressure for tightening down the chain is supplied by a hydraulic ram. The chain used to pull down the load is made fast to one end of the tram track. When the load has been pulled down, the tram's own chain is fastened and the tightener's chain released.

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Fertilizers for the future. ANON. *Australian Sugar J.*, 1966, **58,** 539.—Fertilizer production is expected to increase at an accelerated rate during the next decade. It is thought that production of ammonium

phosphates will increase rapidly. They will become the leading form of phosphate fertilizers in the United States. Most of the expansion will be in a straight diammonium phosphate (18-46-0) for use in blends. A substantial amount of two and three-component urea-ammonium phosphate grades will appear. Bulk blending and granulation will continue to grow.

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Size of cane farms (in Trinidad). S. N. GIRWAR. *Trinidad Island Wide Cane Farmers' Assoc., Ann. Rpts.*, 1963, 1964, 1965, 129.—Attention is drawn to the small size of the majority of cane farms in Trinidad, so small that most farmers have to supplement their farming income by outside employment. Less than 10% of the cane farms are regarded as viable economic units by modern standards. This and other handicaps under which the Trinidadian small cane farmer operates are analysed and discussed.

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The sugar cane industry in Egypt. M. HACHEM. *Sugar J.*, 1966, **29**, (7), 21–25.—The history of sugar cane cultivation and production of sugar in Egypt is traced from its introduction by the Arabs in 641 A.D. Present conditions and methods of cultivation are described in some detail, especially irrigation and manuring. The varieties of sugar cane now cultivated, pests and diseases, present and proposed future output, are discussed.

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Sugar cane borers in the Midlands. J. C. DICK. *S. African Sugar J.*, 1966, **50**, 1127.—Reference is made to the damage to cane in the Natal Midlands during the last two years by the noctuid borer *Sesamia calamistis*. This pest has long been known in the main or coastal sugar belt where natural enemies have kept it in check. It would now appear that under the different climatic conditions of the Midlands natural control may not be so effective. A description of the pest and the nature of the damage it causes to cane is given.

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Drainage of sugar lands. ANON. *Producers' Rev.*, 1966, **56**, (11), 29.—The importance of adequate drainage in the wet areas of the Queensland sugar belt is discussed. While improved cane varieties, fertilizing, and disease and pest control can do much to improve yield, the full potential of these factors can only be realized if the soil water complex is controlled to such an extent that surplus water does not become a limiting factor. The advantages of co-operative planning in overcoming drainage problems is stressed.

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Spain turns to new varieties. E. M. HERRERA. *Sugar y Azúcar*, 1967, **62**, (1), 31–32.—An account is given of variety trials in southern Spain, notably the Malaga and Motril-Salobreña areas, where sugar cane is grown commercially. It was confirmed that the two varieties N:Co 310 and CP 44/101 were both superior to the established variety POJ 2727 (long cultivated) in both yield of cane and sucrose content. They are now rapidly replacing POJ 2727. Details are given of yields obtained in the trials. Present production of cane sugar in Spain is about 30,000 tons per year.

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New cane disease in Puerto Rico. ANON. *Sugar y Azúcar*, 1967, **62**, (1), 38–39.—Leaf scald disease (*Xanthomonas albilineans*) has been recorded on the variety B 49-119 in the Juncos area and the variety Q-63 at the Gurabo Substation. These are the first reports of the appearance of the disease on one of the larger islands of the Antilles. The disease has two forms—chronic and acute. Symptoms are described and cane growers are urged to be on the alert for the disease and to report suspicious cases immediately. The disease can have disastrous results.

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Combating the rat. ANON. *Bol. Azuc. Mex.*, 1966, (207), 12–22.—Reference is made to the great damage to sugar cane caused by the rat, one of the worst pests of sugar cane in Mexico. Methods of reducing the rat population and the use of various poisons ("Warfarin", thallium, phosphorus, "Endrin") are discussed. Recipes for making up suitable baits, with information on their costs, are given.

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Removal of mosaic diseased stalks in July with a sugar cane knife found to reduce mosaic in seed cane. R. J. STEIB and S. J. P. CHILTON. *Sugar Bull.*, 1967, **45**, 98–101.—Removal of whole stools with a sugar cane knife, if one stalk was mosaic-infected, reduced subsequent infection considerably as did removal of individual stalks when less than 50% in a stool were infected. Results suggest that in addition to the present roguing practice, a final roguing in July, using the sugar cane knife, may be worth trying in Louisiana.

* * *

Hormones and sugar cane. X. U. S. SINGH. *Indian Sugar*, 1966, **16**, 541–546.—This paper deals with the effect of soaking sugar cane setts in indole-3-acetic acid solutions on germination and subsequent root, shoot and leaf development. Concentrations employed were 0, 5, 10, 20, 40 and 80 p.p.m., for 24 hours. The optimum concentration, giving the best germination and subsequent early growth, was considered to be 40 p.p.m.

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Phosphate fertilization of sugar cane in the soils of Bihar. V. PANDEY and D. P. SINHA. *Indian Sugar*, 1966, **16**, 559–564.—In the calcareous soils of northern Bihar soluble phosphate fertilizers are prone to be rendered insoluble, the free calcium carbonate causing the formation of tricalcium phosphate. The advantage of applying part (half) of the phosphate application as a foliar spray, in several applications, is pointed out. Trials also demonstrated the advantage of band placement of phosphate in the soil at 6 to 8 inches below the surface where there is a large concentration of roots.

Sugar beet agriculture

Influence of trace elements applied by various methods on the quality of sugar beet. P. V. KARPENKO and I. Y. YAREMENKO. *Khim. v Sel'sk. Khoz.*, 1965, **3**, (12), 8–11; through *Boron in Agriculture*, 1967, (76), 19. Mn, B, Mo, and Cu were applied at time of sowing to the exterior of the root, and by presoaking the seeds. Application at sowing produced an increase of 1·5–2 fold in the intensity of photosynthesis and almost 50% decrease in the respiration intensity. The content of sugars in the roots increased. Application to the roots decreased the total protein as well as noxious N. Presoaking the seeds compares well with treatment at sowing time in yield of roots and sugar content. In general B and Mn were the most effective. Ash content was not influenced by trace elements.

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The method of application of boron fertilizers under sugar and fodder beets. G. L. NELYUBOVA. *Dokl. Mosk. Sel.-khoz. Akad. K. A. Timiryazeva*, 1965, 49–56; through *Soils & Fert.*, 1966, **29**, (5), 470. Trials on derno-podzolic soils in the Moscow region are described, boron being applied by various methods, viz. dusted on seeds and applied in the row before, during or after sowing. An application of 0·5 kg/ha in the row gave the greatest increase in root yield.

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Normal and excessive fertilizing and the quality of the sugar beet. C. WINNER. *Zucker*, 1967, **20**, 111–118. Experiments are described in support of the view that in order to obtain good yields of high quality sugar beet it is necessary for mineral fertilizers, especially nitrogen, to be adjusted to local conditions of soil and climate. Excessive mineral fertilizing, especially with nitrogen, or application of nitrogen too late in the season, reduces the sucrose content of the beet and increases the molasses-forming substances. Results of trials in north west Germany are quoted. Attention is also drawn to problems of fertilizing resulting from modern modifications of beet cultivation techniques.

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The influence of density of planting on sugar beet yield. G. VERRES and E. BORNSCHEUER. *Zucker*, 1967, **20**, 149–156.—Experiments were carried out with 8 different densities varying from 45,000 to 115,000 plants per hectare. The maximum yield was obtained from fields with 85,000 plants/ha. With lower densities the increase in yield progressed faster than with higher densities. Quality of the beets, i.e. proportion of sucrose to molasses-forming constituents, also decreased with deviation from the optimum stand density.

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Beta vulgaris L.: **the characterization of three polyphenols isolated from the leaves.** R. L. GARDNER, A. F. KERST, D. M. WILSON and M. G. PAYNE. *Phytochemistry*, 1967, **6**, 417–422.—An alcoholic extract of leaves of *Beta vulgaris* (sugar beet) was found to contain five phenolic compounds. Two of these compounds were characterized using chromatographic and absorption spectral techniques. One of them yielded glucose and quercitrin upon acid hydrolysis; the second yielded xylose, glucose and a C-glycoside whose spectral and chromatographic behaviour was similar to that of vitexin. An isolation procedure for milligram quantities of the C-glycoside was devised. An acetyl derivative was prepared. A third phenolic compound was shown to be 3-hydroxytyramine by i.r. and u.v. spectra and further confirmed by the preparation of two derivatives. Previous work has shown this phenol when oxidized to be closely associated with resistance to the causal organism of sugar beet leaf-spot, *Cercospora beticola*, in culture.

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Weed control in sugar beets. R. H. BROWN. *Up and Down the Rows*, 1967, (142), 2, 8.—The advantages to be obtained from chemical weed control with sugar beet in spring are outlined. An account is given of experimental work on refinements in the use of pyrazon (sold commercially as "Pryamin"), the most extensively used herbicide in Canadian sugar beet fields.

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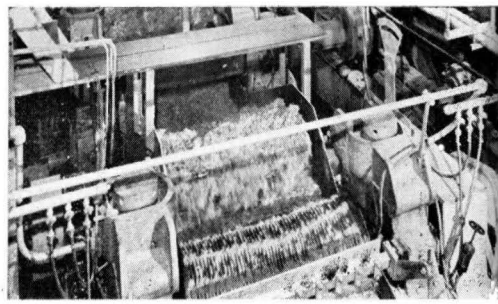
What determines sugar beet yield ? I. Soil and weather. P. J. GOODMAN. *British Sugar Beet Rev.*, 1967, **35**, 115–117.—Reasons why fertilizers or irrigation (in some districts) are needed in order to increase yield are discussed.

* * *

Beet on the small fen "skirt-land" farm. ANON. *British Sugar Beet Rev.*, 1967, **35**, 113–114, 132–133. It is explained that the term "skirt-land" farm is used in the fen areas of East Anglia for the black peat soils that are now rapidly wasting away, with organic matter reduced to 10–25%. The difficulties peculiar to these small farms and the results of a survey relating to them are discussed.

Cane sugar manufacture



Boiling house efficiency indicators. C. A. FORN. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (2), 65–76.—Formulae for expressing the efficiency of boiling house performance are reviewed and in some cases their derivation explained. It is considered that the ESG formula recommended by the I.S.S.C.T. expresses reliably the efficiency wherever conditions correspond—as in Cuba—to those on which the WINTER empirical formula was based. This is demonstrated by the closeness of agreement between actual yields and those calculated on the basis of the ESG formula.

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Results obtained making centrifugal sugar with 2½ strikes, high quality sugar with 2 strikes and export sugar with 2½ strikes. A. MOREIRA M. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 45–49.—Manufacture of two strikes increases losses by comparison with boiling 2½ strikes[1], but the product—centrifugal sugar or high-quality sugar for refining—is of much better quality and the boiling house works much better when milling rates are high and cane is giving high molasses production. If the increase in capacity of a refinery taking in these high-quality raws, and the lower amounts of chemicals required for their refining, are taken into consideration, the benefits of a two-boiling system outweigh the small increase in molasses loss arising from its use.

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Improvements in juice clarifiers using the parallel flow system. J. L. AVALO P. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 50–53.—Characteristics of various designs of clarifier are surveyed and an account given of a modification to a "Paraflow" clarifier in which a baffle was arranged in each compartment whereby the distance between juice inlet and exit was increased from its previous value of 30 in. The success of this modification is shown in the ability to obtain clear juice without turbidity even operating up to full capacity, while glucose analysis in the mixed and clear juice showed that inversion was not increased.

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Asepsis and the importance of microbiological purities in sugar manufacture. J. E. GARCÍA R. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 54–71.—Microbiological conditions in sugar manufacture—from the field to sugar store—are considered and it is concluded that with good organization between field, transport and factory, to permit milling within 48 hours of harvesting, deterioration is minimal and recovery considerably increased. Micro-organisms which enter the factory with the cane are developed and multiply during milling, leading to sucrose destruction and severe problems for the factory process and economy; to counter this, mill disinfection is necessary and inescapable. Contamination of materials in process, such as massecuites in the crystallizers, is due to micro-organisms which multiply in the medium. To minimize this, stale cane should not be crushed, since it spreads infection on the scales and thence to process, while drainage, sanitary services and general cleanliness are the first requirements as far as pathogenic micro-organisms are concerned. Under favourable conditions, micro-organisms can develop and cause rapid sucrose loss in the sugar stores. To avoid sugar deterioration in storage, it is necessary to maintain the necessary aseptic conditions in the factory. Considering that sugar is a food for human consumption it should be produced as pure as possible, washing in the centrifugals with bacteriologically-pure water and a germicide. The techniques should be applied uniformly in all sugar factories.

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Control of the quality of the imbibition process of the mills. E. F. GONZÁLEZ A. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 86–92.—A system whereby the efficiency of mixing of imbibition water or juice with the juice entering the mill in the cane can be calculated is presented together with examples.

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A ball mill for making sugar slurry. C. M. MADRAZO and E. L. CABUGASON. *Sugar News*, 1966, **43**, 663–666. Instead of buying an imported ball mill for making sugar slurry, the authors designed and built a simple, cheaper unit which is described in some detail. It comprises a horizontal cylinder of ⅜-in mild steel having a length of 13½ in and an inside dia. of 15 in. One end is closed and welded, and the other has a flanged cover of ¼-in mild steel plate held by 27 ⅜-in × ¾-in steel capscrews. A feeder opening of 4 in diameter is provided and the mill is rotated about its horizontal axis at 44 r.p.m. The mill contains 73 porcelain balls, of 1 3/16-in dia., weighing 2·85 kg, and 43 balls of 1⅝-in dia., weighing 3·86 kg, and into it is put 1 kg of triple-washed sugar and about 2·1 litres of *iso*-propyl alcohol The feeder aperture is closed and the mill run for 24 hr after which the slurry is removed and kept in a closed jar until required for pan seeding. Examination shows that it is as good as or better than slurry prepared with a commercial mill.

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[1] ALEMÁN: *I.S.J.*, 1959, **61**, 86; DÍAZ: *I.S.J.*, 1959, **61**, 176.

Pilot vacuum pan studies and experiments. C. M. MADRAZO and R. C. ALCANO. *Sugar News*, 1966, **43**, 681–682, 687.—A pilot-scale vacuum pan, almost identical to that described by MARTIN *et al.*[1] was built in 1961 and is used as an experimental unit and for training purposes. It is a coil pan of 4·5 cu.ft. capacity with its own condenser and heated by live steam to avoid the effects of the constantly varying exhaust steam pressure. The pan had been used for experiments on the effect of seeding technique on sugar yield[2] and for the identification of the plantations with high salt concentrations in the soil (and thus the cane juice) which led to formation of thin elongated crystals[3].

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"Poly-Cell" clarifier at Glades sugar factory. A. L. WEBRE. *Sugar J.* (La.), 1967, **29**, (8), 47–49.—As originally installed, the small experimental Bach "Poly-Cell" clarifier gave a very high throughput of juice which was not only clear but also of higher purity than that from conventional units. However, the mud density was intolerably low, suspended solids being less than 1%. To rectify this, the mud thickening space was increased by dropping the bottom by 5 feet and rewelding it to the skirt foundation. Various of the original arms were removed, leaving only a chain to keep the mud from building up on the cone. This gave mud at least as heavy as that from conventional clarifiers without impairing the juice or capacity. These results prompted the conversion of a 22-ft dia. unit to the "Poly-Cell" system and this is capable of dealing satisfactorily with juice from 3500 tons of cane per day. Juice purity is higher, glucose destruction less, and, because the shorter retention time entails a smaller fall in pH than before, less lime need be added to the raw juice to obtain a clear juice of pH 6·8–7·0.

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The rôle of sulphur in the manufacture of white sugar in India. D. R. PARASHAR. *Indian Sugar*, 1966, **16**, 671–676.—The effects of shortage of sulphur, as a result of imports reduction by the Indian Government to save foreign exchange, are discussed as concerning the white sugar producers of India. Since the total quota amounts to only 0·02% on cane, i.e. below the equivalent of the optimum degree of liming, techniques must be modified to make the best use of what sulphur is available. Adoption of simple defecation instead of sulphitation of juice has drawbacks as a result of poor filtration, scaling and enhanced colour. Similarly, sulphitation of syrup instead of juice requires 0·03%–0·04% sulphur on cane for adequate results and less gives a dark colour. Even with the improvement resulting from limited syrup sulphitation, the sugar produced would not give better than 29 I.S.S. sugar on double-curing, although single juice sulphitation might be a better proposition. The D.M.C. process of GUPTA *et al.*[4] is discussed; the better quality sugar would unfortunately entail a reduction of about 20% in factory capacity or a large investment in plant and the expenditure of foreign exchange on imports of 4-inch dia. brass tubes. The process can also not be used in carbonatation factories which would continue to require sulphur. It should, however, be given further factory-scale trial in the northern region of India where juices are much different from those of the south. The need for intensive search for ways to produce good sugar in conditions of sulphur shortage is emphasized as well as the need to advise the Government of the effects of the cuts in imports on sugar quality.

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Feed your seals grease. J. VAN HORN. *Sugar J.* (La.), 1967, **29**, (9), 16–17.—The various types of seal and their maintenance are reviewed.

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Selecting temperature measuring and control instruments. A. A. TROY. *Sugar J.* (La.), 1967, **29**, (9), 36–42.—A review is provided of the principles, characteristics and applications of the types of temperature-measuring equipment most commonly used in sugar factories; these include liquid- and vapour-filled instruments and resistance thermometers, a number of illustrations being provided.

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Expansion and modernization of Central Azucarera de Tarlac. F. C. BLAS. *Sugarland*, 1966, **3**, (9), 22–26.—The factory was acquired by Tarlac Development Corporation in 1958 and has since raised its capacity of 585,000 tons to 1,084,000 tons by 1964/65, the milling rate having risen from 5900 to 7000 t.c.d. An account is given of the many changes introduced in cane handling, preparation and milling, steam production, and the boiling house in order to achieve this expansion, together with projected developments for 1965/66.

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The Pampanga Sugar Mills. ANON. *Sugar News*, 1966, **42**, 736, 742.—A brief account is given of the history of the ownership of Pampanga Sugar Mills from 1919 to 1966, together with information on the expansion of sugar production since the factory's erection.

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Clarification studies on four sugar cane juices at San Carlos during the 1964/65 crop. C. M. MADRAZO and V. B. TONOLETE. *Proc. 13th Conv. Philippines Sugar Tech.*, 1965, 33–41.—Comparative studies were made of juice clarity and mud volume produced in clarification experiments, without using flocculation aids, conducted on juice from four cane varieties. Superior clarifying characteristics were exhibited by juice from POJ 3016 cane compared with those from H 37-1933, N:Co 310 and Co 440 cane.

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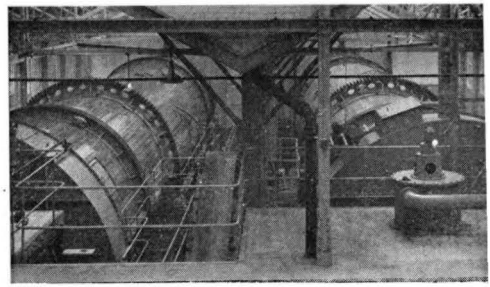
[1] *Sugar y Azúcar*, 1960, **55**, (12), 50–54.
[2] MADRAZO: *Sugarland*, 1965, **2**, (10), 20–22.
[3] *idem. Proc. 12th Conv. Philippines Sugar Tech.*, 1964, 200–204.
[4] *I.S.J.*, 1966, **68**, 340; 1967, **69**, 84.

Beet sugar manufacture



Temperature of beet stored in piles at Amasya sugar factory in 1964. S. MALKOC. *Seker*, 1966, **15**, (58), 1–6.—With an external temperature of 0–12°C, the temperature within the beet piles was generally 3–9°C. Temperatures in the top 1-metre depth of the pile was usually slightly higher than in the 1-metre depth below this, indicating good natural ventilation. Losses of sucrose other than those due to respiration were insignificant.

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D.D.S. diffusion and its economic characteristics. S. TELLI. *Seker*, 1966, **15**, (58), 14–18.—The advantages of the D.D.S. beet diffuser system are described. Special mention is made of the cooling of diffusion juice to 20–25°C, whereby fuel economy results.

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Nomogram for determining the basic technological parameters of crystallization and centrifugalling of low-grade massecuite. K. P. ZAKHAROV and M. I. DAISHEV. *Trudy Krasnodar. Nauch.-Issled. Inst. Pishch. Prom.*, 1965, **2**, 20–23; through *S.I.A.*, 1966, **28**, Abs. 966.—The nomogram[1] is reproduced with instructions and examples. A series of points (e.g. three) corresponding to the purity of saturated molasses at varying Brix are plotted for a given temperature, e.g. 60°C, on a graph with refractometric Brix as ordinate. A series of sloping lines enable Brix-purity lines for other temperatures to be plotted; the Brix and temperature corresponding to *minimum* normal purity can then be found by marking the Brix values recommended by SILIN for different centrifugalling temperatures, which lie along a curve. The nomogram can also be used to determine the optimum Brix of intercrystalline syrup at the time of dropping the massecuite.

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Ultra-acoustical method of analysing a crystal-containing mass in the automation of sugar crystallization processes. L. Z. AMLINSKII. *Avtomatika*, 1966, (2), 65–71; through *S.I.A.*, 1966, **28**, Abs. 1013.—The influence of Brix and temperature on the velocity of sound in sugar solutions and the influence of crystal content on sound absorption were investigated. The velocity of sound at 2 megacycles/sec varied, according to temperature, from 1510–1566 cm/sec at 11·4°Bx to 1853–1906 cm/sec at 73·0°Bx. The influence of temperature was relatively small; the velocity increased with temperature at low Brix and decreased with increasing temperature at high Brix, being nearly constant at 45°Bx. At 197 kc/s, the absorption of sound increased from $1{\cdot}00 \times 10^{-11}$ sec²/cm in solution to $1{\cdot}12 \times 10^{-11}$ at 1% crystal content, and thereafter increased linearly to $1{\cdot}40 \times 10^{-11}$ sec²/cm at 50% crystal content. The sound absorption was particularly sensitive to the presence of false grain, especially in pure solutions. A suggested design for an electronic type of ultrasonic analyser is outlined, suitable for the control of continuous sugar boiling.

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Aerodynamic resistance of the white sugar layer in silos. A. F. ZABORSIN. *Kharchova Prom., Inf. Nauk.-Tekh. Zbornik*, 1965, (3), 36–39; through *S.I.A.*, 1966, **28**, Abs. 1028.—Graphs are given showing the relation between air throughflow velocity, pressure drop and layer height, based on experimental results.

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Investigations of D.D.S. continuous diffusion with isotopes. II. Examination of the flow of the liquid phase. P. HOFFMANN, W. GAWLOWSKA, S. CIESLIK, A. POCZYNAJLO and S. GAWRYCH. *Gaz. Cukr.*, 1967, **75**, 5–8.—After laboratory dynamic and static tests to determine the most suitable isotope to use in studies of juice flow in a D.D.S. diffuser, factory tests were carried out with a ^{140}La-EDTA complex. The results of the tests are given in tabular and graph form. It was found that the juice does not flow in a straight line through the diffuser nor at a uniform speed, and that the flow rate is only slightly lower than that of the cossettes, being mainly affected by one factor—the quality of the cossettes. Over the range of scroll rotary speeds of 0·72–0·99 r.p.m., the juice flow rate was 0·31–0·32 m/min, compared with a cossette flow rate of 0·20–0·25 m/min.

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Investigation of invertase activity in beet. I. JANUSZEWICZ, W. KAZMIERCZAK and B. TOMCZYNSKI. *Gaz. Cukr.*, 1967, **75**, 9–11.—Examination of the effect of invertase in stored beet and diffusion, at Sidi Slimane sugar factory in Morocco, showed that the invert content rose by about 0·1% on beet per day, accompanied by an increase in enzyme activity. Small beets contained more invert than large roots. The difference between the sucrose contents as determined by hot digestion polarization and inversion polarization indicated the presence of dexto-rotatory substances in the beet, leading to a probable increase in the polarization value. However, increase in the invert content at the end of the tests cancelled out the probable effect of these dextro-rotatory substances on polarization. The effect of

[1] See *I.S.J.*, 1967, **69**, 52.

temperature on invertase activity was also studied. It was found that maintaining beet brei at 60–64°C for 4 hours reduced the activity by about 20–25%, while a temperature of 69–73°C for 4 hours reduced it by about 80–90%. Brei subjected to 70°C for 15 and 30 minutes showed a 60–85% and 80–90% drop in invertase activity, respectively. An enzyme activity of 100 mg invert/100 g beet/hr in 90 minutes' diffusion at 60–64°C resulted in a 0·15% loss of sugar on beet. Losses from invertase activity can be minimized by shortening the storage period and increasing the temperature at the feed end of the diffuser.

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The Swedish sugar industry—its development and present state. C. HÖWELER. *Zucker*, 1967, **20**, 85–93. A survey is presented of the Swedish sugar industry, with information on the six white sugar factories, two raw sugar factories and one refinery operated by Svenska Sockerfabriks AB., and on the Company's beet breeding station. Mention is made of the Institute for Sugar Technology at Arlöv and on the research and development work carried out at Svedala in collaboration with various firms which has resulted in a number of successful developments, including centrifugals, pulp presses, beet samplers and sugar silos. Several photographs of Swedish sugar factories are presented.

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Comparative evaluation of imported and Soviet-produced ion exchange resins. G. A. CHIKIN and V. V. RUNENKOVA. *Sakhar. Prom.*, 1967, **41**, (2), 12–16.—"Lewatit S-100", "Nekrolit MZ" and "Allasion CS" cation exchangers were compared with the Soviet KU-2 resin in 2nd carbonatation juice deliming tests, all resins being in the Na^+ form. The amount of Mg and Ca adsorbed by the resins was practically the same in each case. The KU-2 resin was thermally more stable than "Allasion CS" but slightly less stable than "Lewatit S-100". After regeneration with 10% NaCl solution the amount of Ca desorbed from the KU-2 resin was greater than in the case of the "Allasion CS". Breakdown of KU-2 resin did not exceed 2·2%. Comparison of MP-500 strongly basic and "Allasion AWB-3" moderately basic anion exchange resins, of West German and French origin, respectively, with Soviet AV-16g strongly basic resin showed that the last was approximately the same as the others as regards chemical stability but slightly inferior in mechanical stability. Demineralization tests conducted on 1st and 2nd product run-offs passed through "Allasion CS" and "Allasion AWB-3" and through KU-2 and AB-16g resins (the cation exchangers in H^+ form and the anion exchangers in OH^+ form) confirmed the slight superiority of the Soviet resins over those from France. Syrup purity was raised from 78·1 to 93·3 when passed through the Soviet resins, compared with a rise to 91·5 when passed through the French resins, while the colour was slightly higher at 2·4°St after treatment with the "Allasion" resins, compared with 0·9°St. after treatment with the Soviet resins.

Continuous means of obtaining sugar massecuites. N. A. SHEVANDIN. *Sakhar. Prom.*, 1964, **41**, (2), 17–19.—In a system devised by SHEVANDIN, POPOV and GULYI[1], a 65°Bx syrup is concentrated to 80–83°Bx in a single-pass surface heat exchanger and is then sprayed into the lower section of a crystal generator, the upper part of which is in the form of a truncated inverted cone. The syrup flows up through the vessel at a variable speed (under the effect of constriction and expansion of the cone) which is minimum in the upper part, where nucleation takes place. The cross-sectional area of the conical section is so selected as to allow a growth rate of crystals up to 70 mμ which is lower than the rate of massecuite flow. Hence, only those crystals which are larger than this will pass into the conical section. By this means twinning is prevented and crystals falling back into the lower part of the vessel should have a length of 1·0–1·2 mm. Since the crystals being formed will fall under gravity against the upward flow of mother liquor, the thickness of the diffusion layer adhering to the crystals will be very small so that the flow rate of the crystals will be high. From the bottom of the crystal generator the crystal fraction of the massecuite passes into a concentrator at a point above the crystal feed port. In the concentrator, a dynamic equilibrium is maintained between the amount of water evaporated from the massecuite and the water accompanying the mother liquor. The massecuite is concentrated to 93°Bx and then discharged to crystallizers as usual.

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"Terylene"-type cloths for juice and syrup filtration. B. Z. ZAK. *Sakhar. Prom.*, 1967, **41**, (2), 19–20.—Two grades of "Terylene"-type filter cloths were used to filter 1st and 2nd carbonatation juice on disc filters and 2nd carbonatation juice and syrup from standard liquor on leaf filters. Despite the fact that the tests were conducted in December-March, when substandard beet were being processed, the filtration rates obtained were greater than those achieved with belting cloths (on disc filters) or with cotton cloths (on leaf filters). TT-13 "Terylene"-type material proved better than TT-94, and both suffered less from blinding than caprone and cotton cloths. It is suggested that "Terylene"-type cloths should permit an increase in filter throughput to 1·2–1·4 sq.m./10,000 tons of beet. Although the cloths are expensive, it is pointed out that they would permit appreciable savings.

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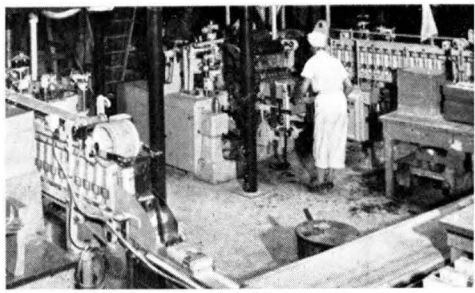
Modern views on the processing quality of sugar beet. J. TRZEBINSKI. *Biul. Inst. Hodowli Aklimat. Roslin*, 1964, (1/2), 41–45; through *S.I.A.*, 1966, **28**, Abs. 1058.—Recent investigations are reviewed with 14 references dated between 1928 and 1961. Less significance is now attached to "noxious nitrogen", and more importance is given to the K and Na contents and thin juice purity.

[1] U.S.S.R. Patent 185,287.

Sugar refining



An approach to loss control. T. KACZOREK and A. ANCONA. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 172–179.—See *I.S.J.*, 1967, **69**, 214.

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Wash house control—past, present and future. G. P. TREARCHIS. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 208–218.—Wash house control is discussed generally and exemplified by the system at Revere refinery. Controlled from one control panel, the system incorporates regulation of mingling through timed dosing based on the weight of raw sugar in the weighing hopper. Should the mingler become overloaded, additional syrup is added until the condition is corrected. The mingler discharges the melt to a mixer and then to two temperature-controlled coil heaters. The hot magma from these is discharged to two feeder troughs provided with level transmitters, signals from which are sent to an averaging relay regulating the quantity of magma fed to the mixer and to the heaters. The output from the relay is fed to a selector relay which selects the lower of two signals (that from the averaging relay or one from a level controller in the melter liquor strainer tank). This lower signal modulates the speed of the raw sugar feed to the hopper feeding the mingler. The Brix of the melt is continuously measured and controlled at a pre-set level by a recirculating system. The use of digital computers to control blending is also discussed, details being given of two systems: a so-called memory system which stores error pulses caused when a component is deficient and makes up the deficiency as soon as possible after the equipment is restored to normal operation, and a so-called pacing system, which is basically the same as the memory system, but in which all other components are slowed to maintain correct blending proportions when one component lags.

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Kinetics of non-sugar accumulation in massecuite boiling. N. A. SHEVANDIN. *Sakhar. Prom.*, 1966, **40**, (11). 17–20.—Test results obtained by various authors and factory data were used in a mathematical analysis of non-sugar accumulation during boiling, as expressed in terms of massecuite purity. Values of P_m (mother liquor purity at a given time from the start of crystallization) calculated from the formula $P_m = P_0 e^{-\left(\frac{\tau}{\theta}\right)}$ (where τ = time of process, P_0 = mother liquor purity at $\tau = 0$, e = base of natural logarithm, and θ = time constant, i.e. time in which the purity of the liquid phase would reach zero) deviated from calculated results processed by computer by $\pm$ 5–10% where syrup drinks were added periodically. Graphs of $\log \frac{P_m}{P_0}$ *vs.* τ (min) constructed from experimental data for 1st, 2nd and refined sugar massecuites gave values of θ of 1500, 1300 and 5900 min, respectively; substitution of these values in the above formula will give values of P_m of sufficient accuracy for heat process calculations. It is pointed out, however, that θ refers to a purely hypothetical set of conditions and that it is more practical to take the molasses purity at the point where the value of $\frac{P_m}{P_0}$ starts to fall very gradually, and in any case for practical boiling purposes θ should be determined in terms of the purities of the products entering the pan, heat exchange and factors relating to the syrup drinks.

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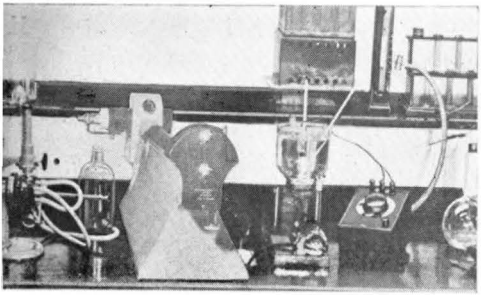
Pilot-plant tests on granular active carbons. L. G. VORONA, A. K. KARTASHOV, G. P. PUSTOKHOD and S. L. SHOIKHET. *Sakhar. Prom.*, 1966, **40**, (11), 20–25. Syrup of 53–70°Bx and 15–56°St colour content (the wide range was due to the processing of poor quality beet) was passed through a column containing 25 kg of AG-5 carbon. The average decolorizing efficiency for 10 cycles (each of 36 hr) was 35–37%, while an average purity rise of 0·15–0·20 units was also obtained. Similar tests with sulphitation juice of 14–29°St colour content and 12–14°Bx gave average decolorizing efficiencies of 43–47·8%. The carbon was regenerated respectively with superheated steam at 310–330°C, and with 0·3% NaOH solution at 95–98°C. Filtered sulphitation juice of approx. 10–24°St colour content was then passed through the carbon for 5 cycles, giving a decolorizing efficiency falling from approx. 61% in the 1st cycle to 40% in the 5th cycle. Regeneration with NaOH was found to take much longer than steam regeneration, required large quantities of water and was more complicated. In analysis of the condensate from the steam used for regeneration, non-sugar decomposition was found to be greatest at 180°C, when the pH fell to 2·6 and the acidity rose to 60,634 $\times$ 10^3 kg-eq/cu.m.



Laboratory methods & Chemical reports

Studies on the keeping quality of Indian plantation white sugars. Part II. X-ray diffraction studies on the constituents responsible for the development of colouring matter in sugar crystals. N. A. RAMAIAH. *Sharkara*, 1966, **8**, 10–17.—Examination of X-ray diffraction patterns from carbonatation and sulphitation sugars and analytical reagent grade sucrose showed them to be the same and no change was found with sugars which had deteriorated. This was to be expected since the colour had been found to be due to caramel[1] which has no crystalline form and so does not interfere with the patterns.

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Use of E. Calvet's microcalorimeter for the determination of the heats and speeds of crystallization. N. TIKHOMIROFF, F. PULTRINI, F. HEITZ and M. GILBERT. *Compt. Rend. Acad. Sci.*, 1965, **261**, 334–337; through *S.I.A.*, 1966, **28**, Abs. 1017.—The heats of crystallization of sodium thiosulphate and sucrose were measured by means of a microcalorimeter. Graphs of dQ/dt are shown, where Q is heat evolved and t is time, from which the heats of crystallization and mean and instantaneous crystallization speeds were calculated. In sucrose solutions with supersaturations 1·05–1·7 at 27°C, Q was proportional to the weight of solute crystallized. The heat of crystallization, 7·12 $\pm$ 0·3 cal/g was thus independent of concentration. Speed of crystallization decreased from the initial maximum, at first linearly and then exponentially.

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Threshold odour number in refined sugar products. S. SUBAYGIL. *Seker*, 1966, **15**, (58), 19–20.—The technique described, developed by Suchar Sales Corporation from a water odour test, involves preparation of a 50°Bx solution of the sample sugar, 200 ml aliquots of which are heated to 60°C before comparison with water. If odour is present, aliquots of 50, 12 or 2·8 ml are diluted to 200 ml and compared with water, in order to determine the threshold concentration at which odour may be detected. The Threshold Number is approximately equal to 200/volume in ml of the aliquot in the threshold solution.

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Determination of total sucrose in cane. ANON. *Bol. Azuc. Mex.*, 1966, (Nov.), 26–28.—Some elementary instructions are given as to the direct and inferential weighing of cane, juice, bagasse and the sucrose in each, as well as the application of the Java ratio for evaluation of cane deliveries in accordance with their weight and the crusher juice sucrose content.

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Methods of measuring the sucrose crystallization rate in pure and impure solutions. G. MANTOVANI. *Gaz. Cukr.*, 1967, **75**, 1–4.—The apparatus and methods used by the author for studies of sucrose crystallization and the effect of various non-sugars on the rate and crystal habit are described with 18 references to the literature. The thermo-syphon[2] was discarded after it was found that non-sugars affected the sucrose crystallization rate and pH of the solution, while organic colouring matter became included in the crystals. The growing of single crystals weighing on average 30–40 g is discussed; the technique used is to suspend the crystals in sucrose solutions containing specific non-sugars by a fine nylon thread[3]. Perfect monocrystals of sucrose were grown using this technique with a pure solution (changed every two weeks) with gradual cooling from an initial temperature of 50°C, so as to maintain a constant supersaturation. This method permitted crystals weighing 25–40 g to be obtained after 3 months. The solubility of sucrose crystallized from pure and impure solutions was determined by placing the crystals in open-ended plastic containers clamped around an axis to the end of which was attached a propeller. The apparatus was immersed in a water bath at 25° $\pm$ 0·01°C. The concentrations of the solutions were measured polarimetrically. The methods used to determine the quantities of the various non-sugars in sucrose crystals are tabulated together with the amounts or ranges of amounts found. Also tabulated are the effects of the various non-sugars on the sucrose crystal habit. The non-sugars studied included KCl[3,4], $CaCl_2$[5], raffinose[5], betaine, invert sugar, carboxymethyl cellulose and dextran.

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Bonding of calcium to beet pectin in sucrose solutions. R. KOHN and J. LOVIŠKA. *Listy Cukr.*, 1967, **83**, 17–24 —The proportion of calcium linked to the carboxyl groups in pectin and the concentration of free Ca^{++} ions in a sucrose solution were determined by a modification of the RAAFLAUB method[6,7] using

[1] *I.S.J.*, 1967, **69**, 000.
[2] *ibid.*, 1955, **57**, 147.
[3] *ibid.*, 1961, **63**, 351.
[4] *ibid.*, 1965, **67**, 249.
[5] *ibid.*, 1964, **66**, 366.
[6] *Hoppe-Seyler Z. Physiol. Chem.*, 1951, **288**, 228.
[7] *ibid.*, 1962, **328**, 198.

tetramethyl murexide as auxiliary ligand. The method was found to be practical for the direct determination of Ca^{++} ion activity in sucrose solutions. The stability constant K of the calcium-pectin complex in beet pectin samples was also determined. The interaction between Ca^{++} ions and free carboxyl groups in sucrose solution conformed to the multiple equilibria rule. The strength of the Ca-pectin bonds increased with decrease in the degree of esterification.

* * *

Determination of ash of Indian raw sugars by (the) C-ratio method. S. C. GUPTA N. A. RAMAIAH, A. P. GUPTA and I. S. JUNEJA. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 65–69.—Examination of the C-ratio (sulphate ash:specific conductivity) for a large number of Indian raw sugar samples, correcting the sulphate ash by deducting the silica content, gave an average value of 10·26. This compares with values of 16–18 for most temperate-climate countries where the conductivity is measured at a standard temperature of 20°C. The Indian measurements were made at the locally more practical temperature of 35°C, and the temperature difference is the reason for the divergence between the C-ratios. Studies are in hand to determine the proper correction factor to adjust to a C-ratio appropriate to 20°C from a measurement at 35°C, but in the meantime the ratio of 10·26 may be considered valid for 35°C.

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Studies on sugar crystals: difference in vacuum pan and khandsari sugars. S. GUPTA, S. K. D. AGARWAL and V. M. BHALWAR. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 70–78.—Samples of sulphitation vacuum pan and khandsari sugars were analysed for pol, reducing sugars, moisture, CaO content, SO_2 content, colour, viscosity, conductivity, turbidity and filtrability. The measurements are tabulated and discussed. Similar figures were found for pol, reducing sugars, SO_2, colour and viscosity, but the khandsari crystals generally had higher moisture, CaO content, conductivity and turbidity and lower filtrability.

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Physico-chemical studies on boron-glucose complexes. N. A. RAMAIAH and H. R. SRIVASTAVA. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 79–83.—The polarization of 0·2M glucose solution was measured, after completion of mutarotation, in the presence of varying concentrations of borax; the pol fell with increasing borax, reaching approximately zero at 0·16M borax. Polarizations were measured of solutions in which the proportion of borax to glucose was varied, and the difference between this pol and the pol of solutions containing only the glucose was recorded for the various proportions. The graph was in the form of a curve having a maximum corresponding to a 1:1 molar ratio, which indicates the formation of a molecular complex in which equimolar proportions of glucose and borax are involved.

One of the sources of unknown loss. H. G. KULKARNI and B. D. KOLSE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 130–133.—Expansion of evaporator capacity to meet increased mill throughput was achieved by using higher exhaust steam pressure and consequently higher temperature in the first body. The apparent purity of the juice entering and leaving remained unchanged but examination of the true purities showed that the effect on polarization of reducing sugar destruction masked the effect of sucrose loss and explained the high unknown loss figure which had been observed after increasing the factory throughput.

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A review of the methods of estimation of phosphate in technical sugar solutions. S. S. KATIYAR. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 147–157.—Gravimetric and volumetric methods described in the literature are considered inadequate for determining phosphate in sugar solutions. Since spectrophotometers and colorimeters are generally not available in Indian sugar factories, colorimetric methods are not suitable for these. A method developed at the National Sugar Institute involves precipitation of the phosphate as magnesium ammonium phosphate at a pH maintained by an ammonia-ammonium chloride buffer. The excess $MgCl_2$ is then titrated with EDTA solution. The precipitate is not filtered off but is kept from dissolving when the EDTA is added by titrating in the presence of 50% ethyl alcohol. With sucrose solutions, Eriochrome Black T may be used as an indicator, but with cane juice it is necessary to use dithizone, xylenol orange or pyrocatechol violet.

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Determination of mud retention. D. P. KULKARNI and M. R. SHINDE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 193–196.—Assay of mud retention by analysis of fibre in filter feed and in filter cake is not accurate because of the non-homogeneity of these materials so that e.g. sand in the cake sample will cause a rather large error. A second method involves the ratio of insoluble solids in the feed and filtrate, and this gives more accurate determinations. The insolubles are flocculated with "Separan AP 30" before filtering the filtrate and feed, respectively.

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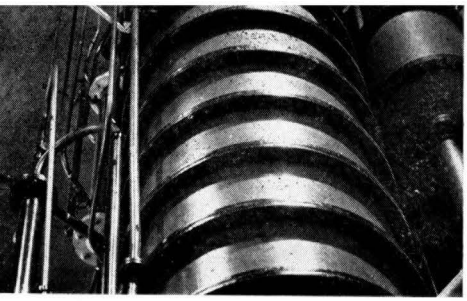
Reduced clarification factor. M. G. JOSHI, V. R. VARDE and R. T. PATIL. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 25–34.—A "reduced clarification factor" is introduced whereby, in order to be able to compare results from different parts of the season (when raw juice purity varies), the HONIG formula[1] is modified to a reference mixed juice purity of 85, the value taken for clear juice purity in the HONIG formula being given by $85 + r$, where r is the actual rise in purity from mixed to clear juice.

[1] Principles of Sugar Technology, Vol. I. (Elsevier, Amsterdam.) 1953, p. 614.



By-products

Trials of extraction of glutamic acid and betaine from molasses of sugar factories in the Krasnodar region. M. I. DAISHEV, I. P. NAZARENKO and V. YA. SEKMA. *Trudy Krasnodar. Nauch.-Issled. Pishch. Prom.*, 1965, **2**, 24–26; through *S.I.A.*, 1966, **28**, Abs. 976.—Extraction was carried out by an ion exchange process[1]. Yields of up to 5·2% of glutamic acid on molasses non-sugar (1·8% on molasses) and 10·3% of betaine (in the form of hydrochloride) on molasses non-sugar were obtained; the yield of betaine in the latter case was 59·6% on molasses betaine. Yields from molasses containing added cane molasses (in cases where raw cane sugar had been processed) were lower, mainly owing to the diminished concentrations in the molasses. It is pointed out that these yields are far in advance of those obtained in other Soviet regions.

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High yield pulps by hot caustic soda process. V. N. MUKHERJEA and S. R. D. GUHA. *Indian Pulp & Paper*, 1965, **20**, 139–144; through *S.I.A.*, 1966, **28**, Abs. 989. Bagasse, bamboo and other cellulosic materials are pulped by a combined chemical and mechanical method. The comminuted raw material is boiled with excess 5–20% NaOH at atmospheric pressure for 5–60 minutes, washed and mechanically pulped. The pulp is relatively light in colour. Two samples of bleached printing paper from 80% bagasse and 20% bamboo pulp are included. The process is simple and adaptable, but the bagasse papers are of low visual quality.

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Regeneration of carbonatation mud in the sugar industry. M. BOŠNJAK. *Tehnika*, 1966, **21**, (1), 2–4; through *S.I.A.*, 1966, **28**, Abs. 997.—Tests were carried out in rotary kilns or shaft kilns. The regenerated lime was of uniform quality and contained 93% of CaO and 7% of P_2O_5. The CO_2 obtained was suitable for carbonatation. Good results were obtained by a combined method using rotary and shaft kilns.

* * *

Artificial wood from bagasse. M. A. YOUNG. *Bol. Azuc. Mex.*, 1966, (208), 26–27.—The formation of bagasse board of better properties—higher breaking modulus, lower water absorption, etc.—may be achieved by using furfuryl alcohol as monomer and polymerizing this (by heating under pressure in the presence of a catalyst) instead of using urea-formaldehyde resin as a binder for the bagasse particles. The catalyst is an acid such as malic, oxalic or toluene sulphonic acid.

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Dry sugar beet pulp as a component of concentrate mixtures for the feeding of dairy cows. Č. OBRAČEVIĆ, S. BAČVANSKI, T. ČOBIĆ and S. MILOVANČEV. *Arhiv za Poljoprivredne Nauke* (Belgrade), 1963, **16**, (53), 28–39; through *S.I.A.*, 1966, **28**, Abs. 992.—Dried beet pulp was substituted for all or part of ground (milled) maize in a concentrate supplement added to a lucerne hay-maize silage ration. Good results were obtained with 80% of dried pulp and 20% of soya bean oil meal. No significant changes in milk yield or quality were observed. The nutritive value of the dried pulp was as follows (%): 88·4 dry solids, 8·7 crude protein, 0·56 crude fat, 19·0 crude fibre, 57·2 N-free extract, 3·0 ash, 85·1 oat feed units. The hygroscopicity of the pulp was reduced by 50% after milling.

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Chlorination of proteins. I. Conditions of the formation of active chlorine during albumin chlorination and its stability. II. Insecticidal and bactericidal properties of chlorinated proteins. J. VAŠÁTKO and L. STANKOVIČ. *Listy Cukr.*, 1967, **83**, 5–16.

I. Tests on chlorination of albumin are described in detail and the results applied to chlorination of V-K carbonatation chalk.

II. Tests on model preparations of V-K chalk by gassing a 16% sucrose solution containing $Ca(OH)_2$ and gradually concentrating the albumin showed that the insecticidal properties of the chalk depended on the degree of dispersion and the content of active chlorine. The bactericidal properties of the chalk were confirmed in tests with three different micro-organisms.

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Determination of the extractability of cane wax from dried filter cake. H. S. WU. *Taiwan Sugar*, 1966, **13**, (6), 12–13, 31.—Experiments were made on the extraction of cane wax from dried filter cake using benzene. The partition between sludge and solvent is such that the wax concentration in the former was always greater than the latter so that there seems to to be an economical limit to the number of stages possible; the recovery found in four stages was 39·5%, 24·4%, 9·5% and 2·9% of the original wax content.

[1] AIMUKHAMEDOVA *et al.*: *I.S.J.*, 1962, **64**, 277.

Patents

Production of L-glutamic acid. ASAHI KASEI KOGYO K.K., of Osaka, Japan. (A) **1,057,824.** 25th July 1963; 8th February 1967. (B) **1,057,825.** 25th July 1963; 8th February 1967. (C) **1,057,826.** 25th July 1963; 8th February 1967.

(A) An L-glutamic acid-producing bacterium is inoculated into a culture medium containing biotin in an amount in excess of that required for maximum growth of the bacterium, at least one surface-active agent (polyethylene sorbitan monopalmitate, polyethylene sorbitan monostearate, polyethylene glycol monostearate, polyoxyethylene alkylamine or polyoxyethylene phenylether), and a carbohydrate source (cane molasses untreated or treated with ammonium phosphate or ion exchange resin, Steffen waste, or a mixture of cane molasses and glucose). Fermentation is effected and at least one antibiotic substance (penicillin G, penicillin V, α-phenoxymethyl penicillin, leucomycin, erythromycin, tetracycline or a tetracycline derivative) is added to the medium at least 8 hr after the start of fermentation.

(B) An L-glutamic acid-producing bacterium (a microbacterium, micrococcus, brevibacterium or corynebacterium) is inoculated into a medium containing more biotin than required for its maximum growth, carbohydrate material (cane molasses treated with ammonium phosphate or ion exchange resin or Steffen waste), a nitrogen source, an inorganic substance and at least one surface-active agent which is either a non-ionic ester-ether, ether or ester, or a cationic polyoxyethylene alkylamine or amphoteric betaine-type material (polyethylene sorbitan monostearate or monopalmitate, polyethylene glycol monostearate, polyoxyethylene alkylamine or phenyl ether, or betainized polyoxyethylene stearylamine). The medium is cultured, adding at least one cationic or anionic surface-active agent (alkylamine acetate, alkyl dimethyl benzylammonium chloride, trimethyl octadecyl ammonium chloride or sodium lauryl sulphate) to the medium from the middle to the latter period of logarithmic growth of the bacterium (between the 8th and 11th hr after the start), fermenting aerobically to accumulate L-glutamic acid and recovering this.

(C) An L-glutamic acid-producing organism (a microbacterium, micrococcus, brevibacterium or corynebacterium) is inoculated and cultured on a medium containing beet molasses as a carbohydrate source, and at least one surface-active agent (polyethylene sorbitan monopalmitate or monostearate, sorbitan monolaurate or monostearate, polyethyleneglycol monostearate, polyoxyethylene phenyl ether, polyoxyethylene alkylamine, a betaine-type amphoteric surface-active agent or a fatty acid amide sulphonate-type anionic surface-active agent), or a higher alkanol (stearyl, palmityl or lauryl alcohol). Of the beet molasses, 5% as total carbohydrate is added at the beginning of the fermentation and further feed added when the sugar concentration drops to 1%.

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Beet harvesters. J. D. DYSON and C. R. DYSON. **1,058,191.** 13th January 1964; 8th February 1967.

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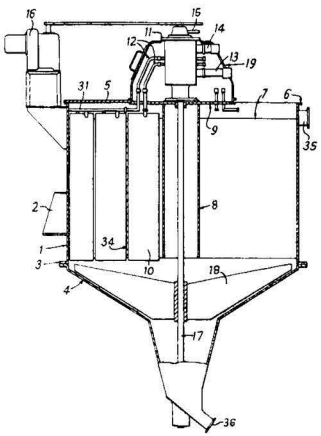
Continuous thickening filter. SOC. FIVES LILLE-CAIL, of Paris 8e, France. **1,058,349.** 1st December 1965; 8th February 1967.

The filter is housed in a closed cylindrical vertical tank having a frustro-conical bottom. The cylindrical part is divided into segments by radial partitions 7 which contain three concentric rows of vertical



flat suspended filter elements 10. The innermost row comprises only half the number of elements in each of the outer two rows and is separated from them

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

by a concentric partition 34 made up of segments. The elements each comprise a frame with a solid central partition having a filtering surface on each side of it and surrounded by a cloth in the form of a bag. The compartments for filtered juice in the facing half-elements of each row are connected to a common pipe (31 for the two outer rows) and thence by piping 12 to a rotating distribution head 11. The latter during rotation connects the inside of the filter elements to a vacuum source for withdrawal of filtered juice and to a sudden reverse flow of filtered juice under pressure, whereby the cake on the outside of the bag is discharged, to fall into sump 36, aided by blades 18 mounted on rotor 17. Juice to be filtered is admitted through port 35.

For cleaning or maintenance, cover 5 is removed when the outer rows of elements may be removed, after which the appropriate segments of partition 34 are dismantled and the innermost elements may be removed. The filter elements may alternatively be in the form of cartridges surrounded by spiral springs and covered with a filter-cloth, each compartment housing a number of such cartridges.

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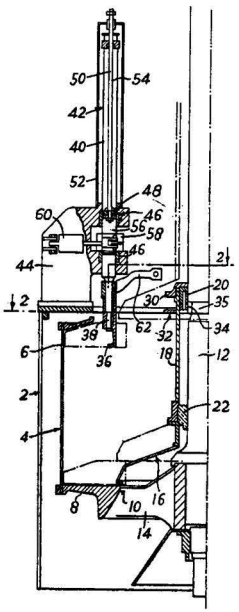
Centrifugal discharge device. Soc. Fives Lille-Cail, of Paris 8e, France. **1,058,784.** 26th February 1965; 15th February 1967.

The drum of the centrifugal is provided with a central aperture 10 having a cover 16 attached to a sleeve 18 which slides vertically about the central shaft 12, anti-friction rings 20 and 22 separating the sleeve and shaft. When the basket is ready to be discharged, the speed is reduced until it reaches a chosen value, e.g. 100 r.p.m., when the centrifugal force acting on inertia members 34 pivoting about pins 20 within the sleeve is not sufficient to overcome their spring loading towards the shaft; the members withdraw from groove 35 and permit the sleeve and cover to be raised by a hydraulic jack acting on a lever with a forked end, the prongs of which carry rollers which roll between the collars 30 and 32 at the upper end of sleeve 18. A pawl catch on the lever is positioned so that when the cover is in its down position, the catch prevents rotation of a guide arm 62 governing the rotation of the discharge plough 36. When the cover is raised outside the basket and above the plough (as shown by the broken lines), however, the catch is freed. A limit switch actuated by the rising sleeve allows the plough to be rotated about shaft 38 under the action of the hydraulic jack 60 and it then descends under the combined force of the hydraulic jack 42 and the weight of the cover 16 and sleeve 18 which rest on the heel of the plough 36, which now overlaps the edge of the discharge aperture. The sugar may thus be discharged completely without the need to clean the edge of the aperture, which is not usually reached by the plough. An adjustable abutment screw on the end of the guide arm 62 bears against sleeve 18 during the downward passage of the plough, maintaining the tip of the latter at a fixed clearance from the interior of the basket 4.

When the discharge is completed the plough is again rotated so that its tip draws away from the



basket and its heel is no longer under the cover. It is raised hydraulically, the pawl catch allowing it to rise to its withdrawn position while the cover descends to its lower position over the aperture.

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Manufacture of sugar. Fabcon Inc., of Chagrin Falls, Ohio, U.S.A. **1,061,698.** 29th December 1965; 15th March 1967.—Reduction of boiling time and low-grade sugar recovery increases when the liquor boiled has added to it, or to a massecuite produced from it, 0·1–0·5 p.p.m. of a sulphosuccinate ester, the ester groups of which are insoluble, per 1% of sucrose in the liquor or massecuite. The ester may be dioctyl potassium, dioctyl ammonium, di-*iso*-butyl sodium, di-*iso*-butyl potassium, di-*iso*-butyl ammonium, dihexyl sodium, dihexyl potassium, dihexyl ammonium, di-tridecyl sodium, di-tridecyl potassium or di-tridecyl ammonium sulphosuccinate. It may be added to the juice before the evaporator, in the evaporator, in the vacuum pan, or to the massecuite as the pan is struck, and it may be added in the form of a 50% solution in a 1:1 mixture of water and ethanol and/or propylene glycol.

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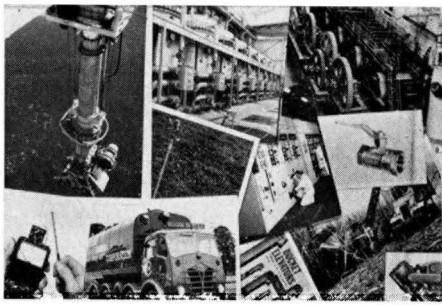
Beet harvester. S. A. M. Andersen, of Stenstrup, Denmark. **1,063,690.** 18th November 1965; 30th March 1967.

Trade notices



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

Acid cleaner for evaporators and vacuum pans. Hodag Chemical Corp., 7247 North Central Park Ave., Skokie, Ill., 60076 U.S.A.

Details are announced of "PH-2" granular acid cleaner specifically intended for use in removing deposits normally remaining after caustic boiling-out of evaporators and vacuum pans. It can be handled safely and easily, is readily soluble in hot or cold water, will rapidly penetrate the scale, and will rinse freely, leaving the metal surfaces clear and bright. It will not etch or corrode stainless steel, copper or brass.

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Pumps. Pompes Delasco, 27 Boulevard des Italiens, Paris 2e, France.

In the Delasco vacuum-pressure pump, three rollers mounted at equal intervals on the circumference of a driven rotor move along the side of a tube of special rubber compressing it against a rigid arcuate surface to create vacuum inside the tube as it reverts to its normal shape between two rollers. This vacuum sucks in feed into the tube and this is pushed along the tube by the action of the following roller and is eventually discharged from the other end of the tube. The pump is self-priming and reversible (by altering the direction of the rotor) and exists in a range to deliver from 1 to 3800 g.p.h. It has found use in sugar factories.

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PUBLICATIONS RECEIVED

LIGHT ALLOY FLOORING AND HANDRAILS. Non-Corrosive Metal Products Ltd., Horton Rd., Yiewsley, Middlesex, England.

Leaflets SfB (33) and SfB (34) describe, respectively, light alloy flooring and tubular handrails. The former are durable extruded aluminium alloy tongued and grooved planks, consisting of a serrated surface supported by integral beams. The sections are locked together to form panels and secured with light alloy nosing bars by argon arc welding. The panels are available up to 16 ft long and in any desired widths, although for economy they should be in multiples of 8 inches. The flooring is strong, one-third of the weight of steel, self-draining, corrosion-resistant, self-cleaning and presents a non-slip surface even under icy or slimy conditions. The light alloy hand railing is assembled from a number of components which cater for a wide variation of requirements since they can vary infinitely in height, angle of ramp and number of rails. Painting is unnecessary and maintenance minimal.

FLENDER MECHANICAL POWER TRANSMISSION EQUIPMENT. A. Friedr. Flender & Co., 4290 Bocholt, Postfach 139, Germany; Flender (U.K.) Ltd., Treefield Industrial Estate, Gildersome, Morley, Leeds, Yorkshire, England.

Catalogue W.100 gives full details of the Flender range of gear units, variable-speed drives, couplings, clutches, belt drives and bearings, sales of which in Britain, Australia, Canada and New Zealand will be handled by the newly-formed British subsidiary company. Individual leaflets are available for the separate products.

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Dorr-Oliver to market cane diffusers.—Following the agreement under which Dorr-Oliver Inc. will market Silver continuous centrifugals[1], a further agreement has been signed under which Dorr-Oliver will also sell Silver ring diffusers to the cane sugar industry outside most of the Western Hemisphere.

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BMA equipment for Chile.—Braunschweigische Maschinenbauanstalt A.G. has received an order worth DM.13 million (about £1,200,000) for the supply of equipment to Los Angeles, Llanquihue and Linares sugar factories, erected by BMA in 1953–1959. The order covers mainly measuring and automatic control equipment and is intended to raise the technological standards at the factories to the level at Nuble sugar factory (erected by BMA in 1966) and at Rapacco sugar factory (Valdivia province), which is the subject of a current order.

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New AEI Group.—The new Control and Machines Group, which started operations on 1st September, combines under single management the activities hitherto carried out by AEI's Industrial Group and Electronics Group. AEI Automation Ltd. is to be expanded to cover all control systems. Already supplying control systems incorporating computers of its own manufacture, it will also undertake contracts for which AEI is supplying all or part of the electronic or electrical content of industrial schemes. A new division in the Group, AEI Control Equipment Division, will manufacture and sell industrial electronic equipment, process components, control application equipment, small control gear, temperature controls, etc. It will be complementary to the Large and Small Electrical Machines divisions.

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Farrel licensing agreement for DDS cane diffusers.—An agreement has been signed between Farrel Corporation of Ansonia, Connecticut, U.S.A. and A/S. De Danske Sukkerfabrikker of Copenhagen, Denmark, which grants Farrel an exclusive licence to manufacture the DDS cane diffuser in the United States as well as the exclusive right to sell the units in the U.S. and its territories and with further possibilities for sale of the diffusers in most other parts of the world. The principals of the agreement are among the oldest and best-known names in the sugar industry; the Danish firm began operations as a sugar producer in 1872, the same year that the Farrel company manufactured its first sugar cane mill.

[1] *I.S.J.*, 1967, **69**, 286.

The late P. M. Silin

WE regret to report the death on 30th September 1967 of Professor PAVEL MIKHAILOVICH SILIN who was in his 81st year. He qualified in 1914 as a chemical engineer in food technology at Tomsk Technological Institute, subsequently working as an assistant lecturer in the departments of analytical and organic chemistry at the Institute. In 1921 he was appointed Professor of Technology at the Siberian Agricultural Academy in Omsk and in 1923 returned to Tomsk as Professor of Technical Chemistry at the University. In 1924 he was put in charge of the Department of Technology of Agricultural Raw Materials at Voronezh Agricultural Institute. For 25 years Professor SILIN worked at the Voronezh Technological Institute of the Food Industry. From 1949 he was head of the Department of Sugar and Starch-Syrup Technology at Moscow Technological Institute.

Professor SILIN's major contribution to science and food manufacture was the development of physico-chemical fundamentals of sugar production; he published more than 110 papers, of which a large proportion concerned the beet sugar industry. He studied the problems of the technological evaluation of beet, the theory and practice of diffusion, raw juice purification, juice evaporation, sucrose crystallization, molasses formation, sugar recovery from molasses, problems of factory heat economy and production control.

Dr. A. CARRUTHERS writes: "His many contributions to scientific literature spread over 50 years had established for Professor SILIN a world-wide reputation. His studies on the physico-chemical principles underlying the process of sugar extraction from beet certainly aroused the greatest interest among technologists everywhere. These and other equally revealing studies are fully described in his monumental publication entitled 'Technology of Beet Sugar Production and Refining'. Professor SILIN was a member of the Scientific Committee of the Commission Internationale Technique de Sucrerie (C.I.T.S.) and it was a memorable occasion when he presided over one session of the 12th Assembly, held in Paris in 1963. Regrettably, his health prevented him attending the 13th Assembly held at Falsterbo in June of this year for he had intended to contribute to the symposium on sugar crystallization.

"The charm of this gentle man was first made evident to the writer at an International Conference held in 1962 at Lodz, Poland. There he was surrounded by his devotees and, even at the ripe age of 75, he participated in animated discussions with them until well into the night.

"The name of SILIN will long be remembered with respect and affection."

Brevities

Drought in Central and South America[1].—Drought is reported to be affecting several countries of Central and South America, particularly Puerto Rico, where the loss to the coming crop has been put at 25%. Other countries reported to be affected are Brazil, Cuba, Mexico and Peru.

* * *

Brazil reduction of sugar production[2].—Brazil is planning to reduce this year's production of export raw sugar by 180,000 metric tons. The Export Director of the Brazilian Sugar and Alcohol Institute, Senhor Francisco Watson, announced in Rio de Janeiro that raw sugar production is to be reduced in order that the country may be able to export about 250,000 tons of invert molasses this year. On the 5th October it was announced that the Institute had sold a total of 105,000 tons of invert molasses to two American firms and that one of these had an option on a further 75,000 tons[3].

* * *

Mexican sugar production, 1966/67[4].—The 1966/67 season in Mexico has now come to an end and final production is put at 2,327,250 metric tons, tel quel. This compares with 2,011,390 tons and 1,982,969 tons manufactured in 1965/66 and 1964/65 respectively. An initial target has been set for the 1967/68 crop of just over 2·3 million tons.

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New sugar mill for the Philippines[5].—A new sugar mill is to be established at Bo, Man-it, Passi, Iloilo, Philippines, by the owner of the Ma-ao, Bacolod-Murcia and Talisay-Silay mills. The estimated cost of the new mill is about 40 million pesos (£7,000,000) and it is to have an output of 1,200,000 piculs (75,000 long tons) per year. There are also plans for erection of another mill in northern Iloilo, probably in San Dionisio.

* * *

Antigua sugar crop, 1967.—Grinding operations were complated at the end of August, when a total of 4779 tons of sugar had been made, 721 tons less than the original estimate of 5500 tons. Less than 200 acres of plant cane have been established for the next season's crop, and small-holding production is likely to be considerably below that of this year[6]. It will be remembered that the Antigua Sugar Factory Ltd. decided to close the factory after the 1966 crop, but the plant was taken over by the Antigua Government which has set up a Board to run the factory[7].

* * *

Indian sugar exports, 1968[8].—The Indian Government has announced that, during the 1968 calendar year, probably not more than 95,000 metric tons of sugar will be exported, compared with some 220,000 tons in 1967 and 441,000 tons in 1966. The sugar exports will be limited to supplies within the preferential quotas on the U.S. Market and in the United Kingdom.

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[1] *Public Ledger*, 16th September 1967.
[2] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (27), 15.
[3] *Public Ledger*, 7th October 1967.
[4] C. Czarnikow Ltd., *Sugar Review*, 1967, (836), 189.
[5] *Sugarland*, 1967, **4**, (1), 55.
[6] *Overseas Review* (Barclays D.C.O.), October 1967, 83.
[7] *I.S.J.*, 1967, **69**, 223.
[8] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (28), 19.

Brevities

Laboratory materials suppliers.—A new information service has been introduced by Hendon Chemical Consultants, of Ashbourne House, Alberon Gardens, London N.W.11, who have made records of suppliers in the U.K. of materials needed for use in laboratories. Users of the service are registered on payment of a fee of £1.1s. and are then entitled to ask for the suppliers of five products, free of charge; subsequent enquiries are charged at 5s 0d each. It is planned to extend the service to instruments and eventually to make the service international.

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St. Kitts (London) Sugar Factory Ltd., 1967 report.—Crop ended on the 28th July with 38,526 tons of commercial sugar obtained from 327,752 tons of cane, a yield of 8·38 tons cane per ton. In 1966 37,926 tons of sugar were obtained from 348,335 tons of cane, at a yield of 8·99 tons cane per ton sugar. An agreement has been entered into with Bookers Agricultural Holdings Ltd. who will place their technical and operational services at the disposal of the company. The arrangement will not involve Bookers Agricultural Holdings Ltd. in taking a financial interest in the St. Kitts company or in their General Managers, Henckell Du Buisson & Co. Ltd.

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Uganda sugar expansion[1].—A £1,000,000 scheme to expand sugar production at the Madhvani sugar works, near Jinja, was announced in August. A new mill tandem costing £500,000 has already been installed and will be in operation before the end of the year. In addition three boilers to generate 130,000 lb of steam an hour are being installed at a cost of £150,000 and equipment for juice processing, boiling and sugar curing, costing a further £150,000, is being erected. Other installations, including the development of a central workshop and further electricity production, will bring the total value of the scheme to over £1,000,000.

* * *

Peru sugar statistics[2].—Sugar production in the calendar year 1966 reached 814,016 metric tons, raw value, which with a carryover stock of 141,230 tons made 955,246 tons available. Of this, domestic consumption took 342,437 tons and exports 433,481 tons, leaving a carryover of 179,328 tons. In 1965 the initial stock of 113,140 tons plus production of 771,116 tons made a total availability of 884,256 tons, of which 355,886 tons was consumed locally and 387,140 tons exported. The bulk of the exports in both years went to the U.S.A. (359,510 tons in 1966 and 302,631 tons in 1965) while in 1966 the remaining exports included 67,696 tons to Chile, 5362 to West Germany, 297 to Switzerland and a total of 616 tons to other countries. In 1965 exports other than to the U.S.A. were 65,929 tons to Chile, 10,853 to New Zealand, 3747 to West Germany, 2000 to South Korea, 1782 to Switzerland, and a total of 198 tons to other countries.

* * *

Bahamas sugar factory[3].—According to an announcement by Owens-Illinois of the Bahamas Ltd., its new sugar factory on Great Abaco island is to be built by Owens-Illinois Inc. of Texas. The factory is scheduled to be put into operation in 1968 and will have an initial capacity of 50,000 tons of raw sugar per year, to be doubled later. About 10,000 tons are to be produced for local consumption and the remainder for export.

* * *

Chile-Colombia trade agreement[4].—An agreement has been announced by the Chilean authorities under the terms of which Chile will purchase from Colombia between 20,000 and 60,000 tons of raw sugar each year for a two-year period. A report by Agence France-Presse indicates that in return Colombia will secure tonnages of Chilean cellulose.

European beet sugar production, 1967/68[5]

Western Europe	1967/68	1966/67	1965/66
		metric tons, raw value	
Belgium-Luxembourg	550,000	415,700	421,739
France	1,820,000	1,824,000	2,396,942
Germany, West	2,050,000	1,956,000	1,596,516
Holland	761,000	585,868	607,998
Italy	1,556,000	1,404,784	1,268,665
Total E.E.C.	*6,737,000*	*6,186,352*	*6,291,860*
Austria	289,000	363,180	240,190
Denmark	322,000	325,555	240,605
Finland	50,000	57,000	47,322
Greece	122,000	116,950	109,667
Ireland	139,000	111,492	117,661
Spain	560,000	585,500	531,216
Sweden	250,000	215,740	201,805
Switzerland	56,000	59,564	45,689
Turkey	689,000	716,490	579,595
U.K.	1,025,000	956,820	956,959
Yugoslavia	525,000	588,392	370,629
Total Western Europe	10,764,000	10,283,035	9,733,198
Increase(+) or	+480,965	+549,837	—1,356,252
Decrease (—)	(4·68%)	(5·65%)	(12·23%)
Eastern Europe			
Albania	14,000	15,000	12,000
Bulgaria	225,000	225,000	214,665
Czechoslovakia	833,000	853,000	720,000
Germany, East	800,000	686,333	632,221
Hungary	422,000	469,333	458,277
Poland	1,625,000	1,721,417	1,504,970
Rumania	460,000	518,804	427,681
U.S.S.R.	9,300,000	9,165,000	9,400,000
Total Eastern Europe	13,679,000	13,653,887	13,369,814
Increase (+) or	+25,113	+284,073	—2,068,933
Decrease (—)	(0·18%)	(2·12%)	(13·40%)
TOTAL EUROPE	24,443,000	23,936,922	23,103,012
Increase (+) or	+506,078	+833,910	—3,425,185
Decrease (—)	(2·11%)	(3·61%)	(12·91%)

* * *

Greek sugar imports[6]

	1966	1965	1964	1963
		(metric tons, white value)		
Belgium/Luxembg.	2,569	3,109	1,662	—
Cuba	—	—	—	13,377
Czechoslovakia	8,894	2,647	4,082	8,562
France	18,784	6,337	20,675	9,628
Hungary	659	4,474	13,192	19,469
Poland	1,285	6,039	—	7,481
U.S.S.R.	—	—	30	10,630
U.K.	11,258	10,073	17,577	5,453
Yugoslavia	—	5	11,954	10,166
Others	2,122	1,056	1,090	2,641
	45,571	33,740	70,262	87,407

East German beet sugar factory for Uruguay[7].—According to the A.D.N. news agency, the East German foreign trade organization Chemie-Anlagen Export-Import and the Uruguay company Azucarera del Río Negro S.A. have signed a contract for the supply of a complete sugar factory to Uruguay. The plant will have a daily processing capacity of 2000 tons of beet.

[1] *Overseas Review* (Barclays D.C.O.), August 1967, p. 48.
[2] *Willett & Gray*, 1967, **91**, 320.
[3] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (23), 16.
[4] C. Czarnikow Ltd., *Sugar Review*, 1967, (828), 155.
[5] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (27), 1–2.
[6] C. Czarnikow Ltd., *Sugar Review*, 1967, (820), 120.
[7] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (24), 7.