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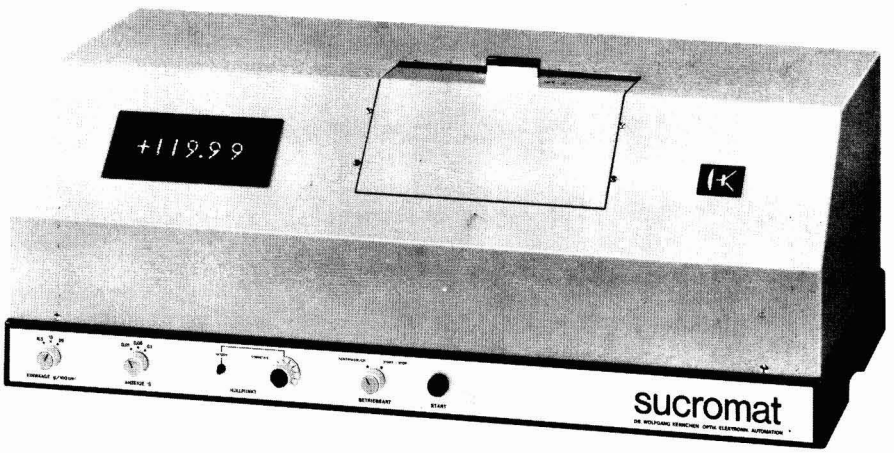

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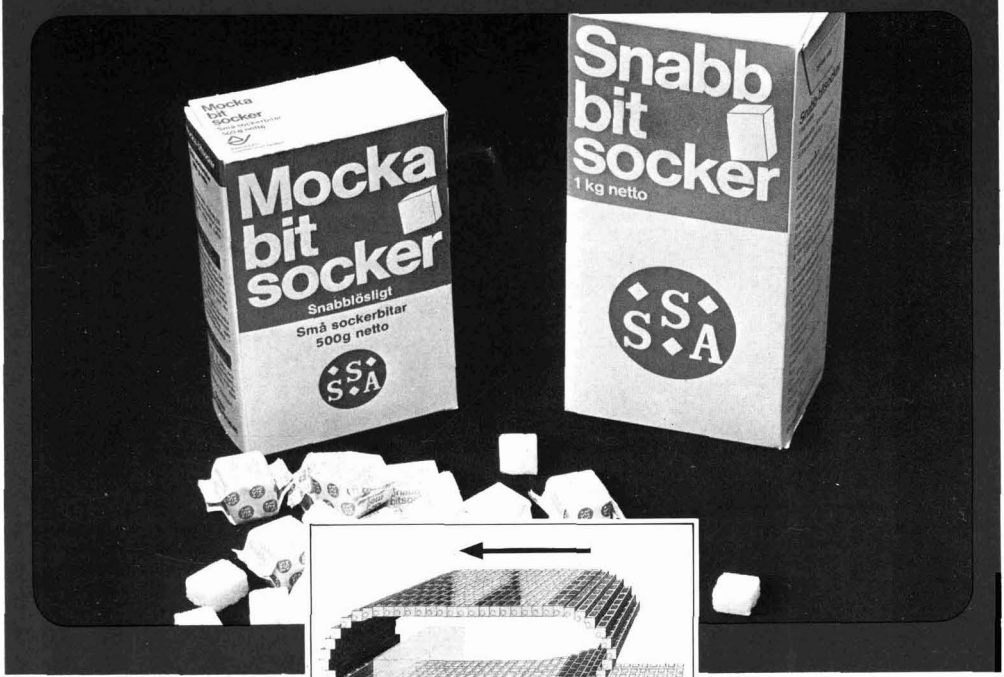

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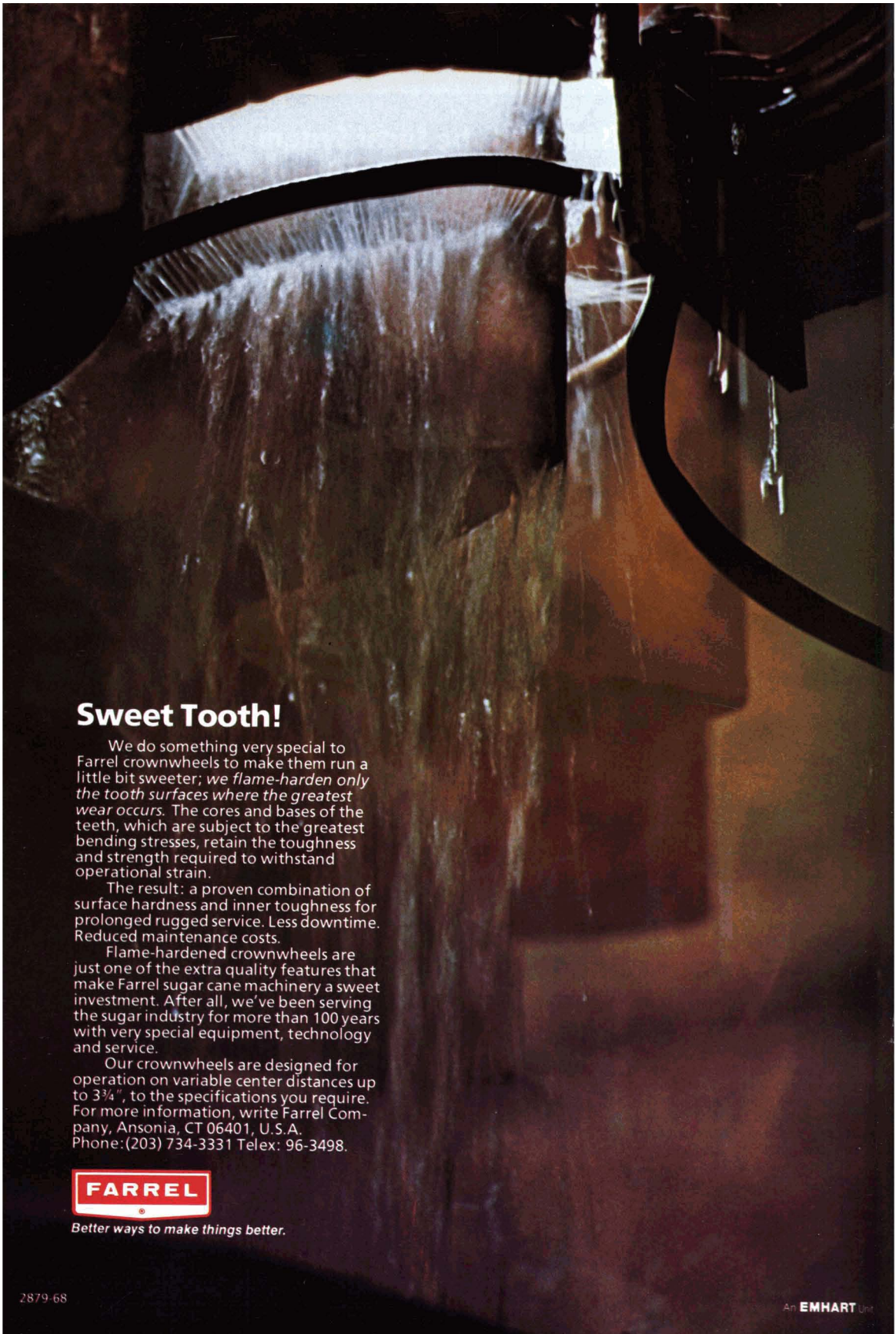

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Tear out the attached folder, discussing scale prevention as the modern way for maintenance of your heat transfer equipment.

Many factories still lose 2 to 5% time for cleaning evaporators plus lose full rate grinding time, syrup brix, steam, pan capacity, etc. due to scaling. It is not necessary. Hundreds of sugar factories and distilleries internationally are using Fabcon I-12 ST — the majority now for more than five years with consistent, excellent results. Many also use the caustic soda/Scalex boiling program of Fabcon to speed and improve cleaning thoroughness. They lose less caustic and they don't need acid or manual brushing.

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For heavier scaling which causes through-put, maceration, brix and steam losses — 8 to 12 ppm I-12 ST extends the evaporation cycle 2 to 4 times and still allows rapid, more thorough cleaning than before. 5 to 20% Scalex on active, caustic weight used in concentrated caustic following regular treatment with I-12 ST typically cleans the evaporator totally in less than four hours boiling time, requiring no acid or manual brushing thereafter.

Total chemical cost for I-12 ST/caustic and Scalex is a little more than prior cost for chemicals, labor, cleaning equipment and replacement tubes. The big savings, however, are amongst the following: Based on 100,000 tons cane,

1. Up to 100 tons extra sugar saved due to reduced lost time during peak ripeness of the cane.
2. 1 to 3% lower factory operating costs due to reduced lost time for cleaning.
3. 0.1 to 0.5 lower pol on cane losses in Bagasse and mud due to increased maceration and filter washing and to more uniform boiling house operation with fewer stops for cleaning.
4. Shorter stops of three or four hours for evaporator cleaning which can be included in other stops for factory maintenance, out of cane, etc.

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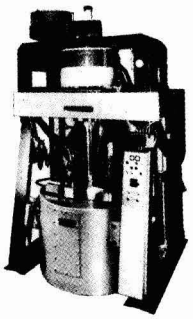
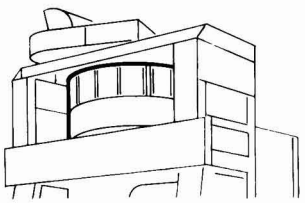
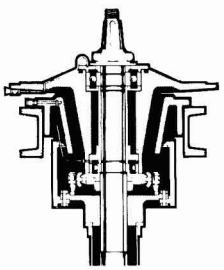


The Build Up



Motor



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Plough

- Motor specially designed to meet end-users power requirements.
- Special Suspension assists in dampening effects of out-of-balance loads.
- Plough operation ensures free discharge and completely cleared basket: cycle time kept to a minimum since sugar discharges in same direction of rotation.
- Automatic Feed Valve and Limiting Sensor arrangement ensures constant feeding independently of variations in massecuite.
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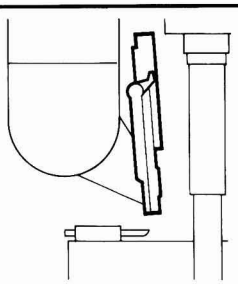
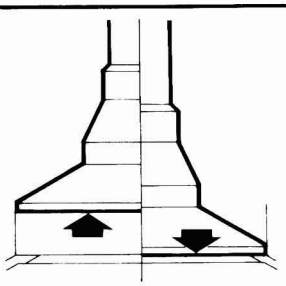
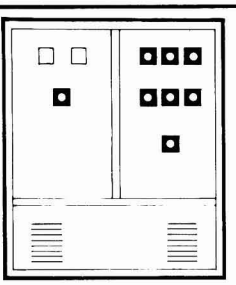


Feed Valve



Discharge Valve



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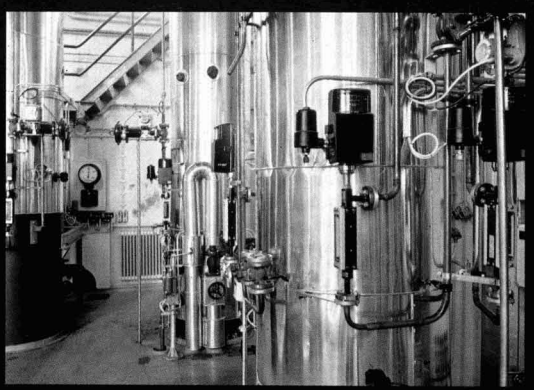

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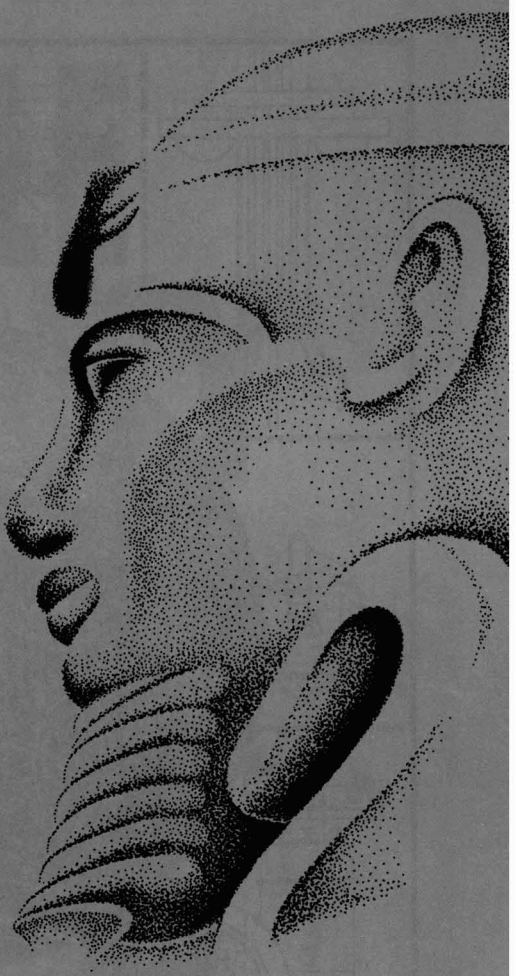
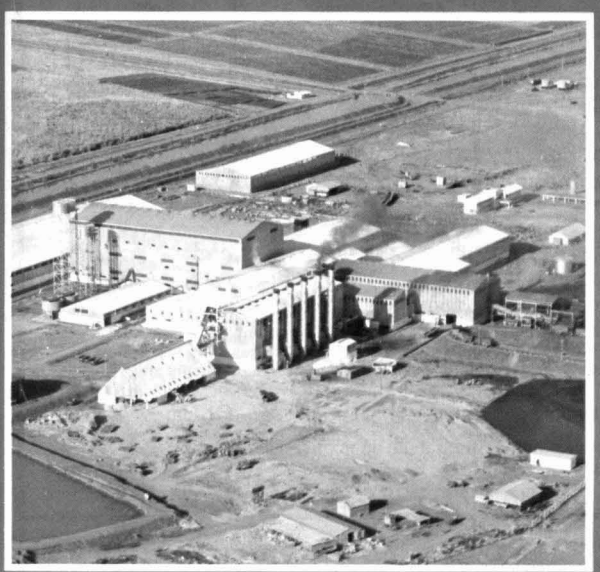
THINGS ARE HAPPENING IN THE SUDAN



"The food bowl of the Middle East" is how world experts are describing the Sudan. However, to transform the undoubted potential of this vast land into reality requires technical skills, experience and above all stamina and dedication.



Fletcher and Stewart Limited possess just such qualities – qualities which have born fruition in the successful completion of the sugar factory project at Sennar on the banks of the Blue Nile some 300 kms south of Khartoum.

The factory which was supplied and erected against a background of extremely difficult manufacturing, shipping and local construction conditions is further evidence of FS commitment to the developing sugar industry of the world.

FS is now concentrating on the completion of its second turnkey Sudanese factory at Hagar El Asalaya in the White Nile Province which is located approximately 96 kms distant from the Sennar factory.

Although they differ in certain respects, each factory is capable of processing 6500 tons of sugar cane per day and will between them have the capacity to produce 250,000 tons per year of refined sugar.

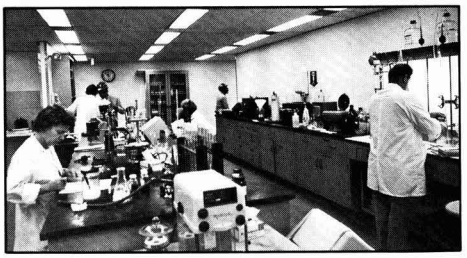
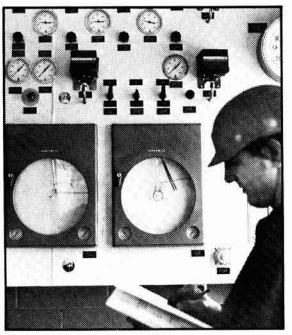
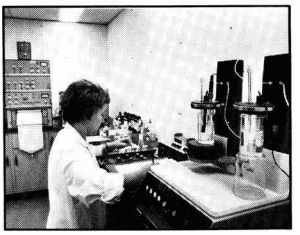
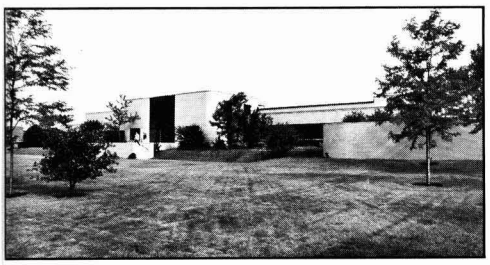
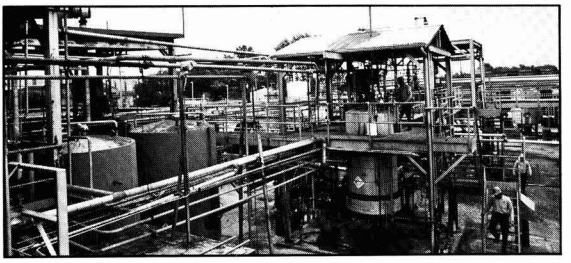
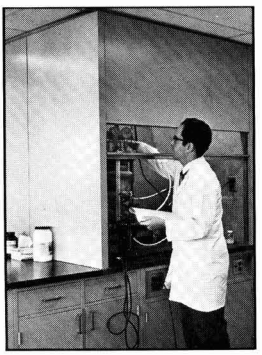
Things are happening in the Sudan!

FS

Fletcher and Stewart Limited

DERBY DE2 8AB ENGLAND

FS1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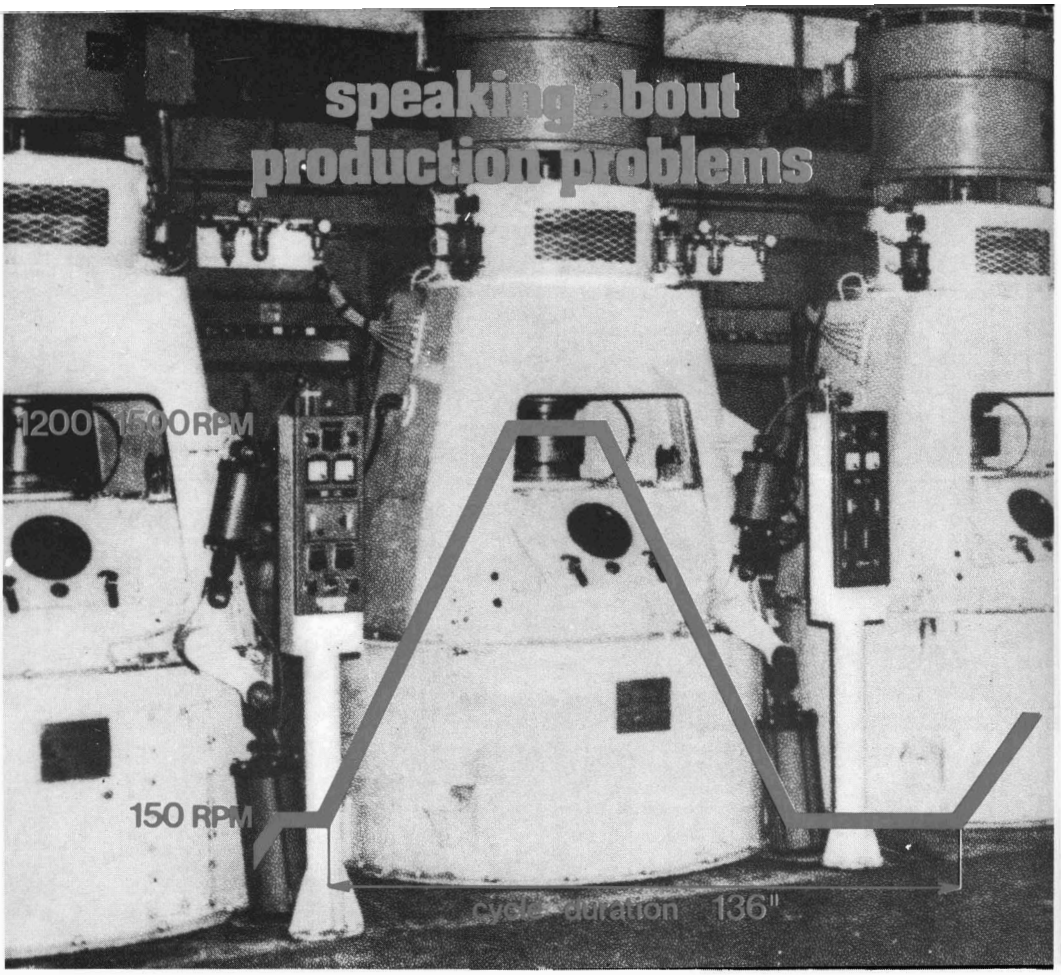

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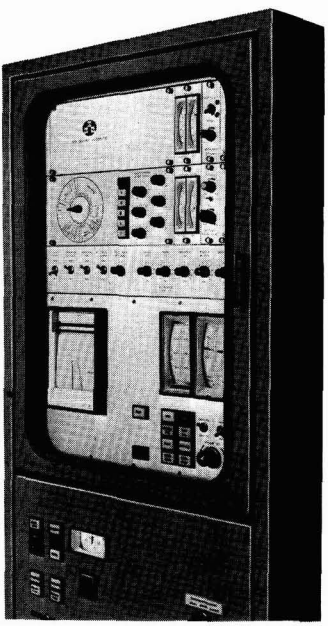
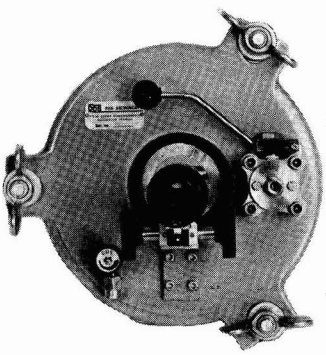
DDS Pan Boiling AUTOMATICS





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NOTES AND COMMENTS

World sugar prices

The optimistic tone at the end of August continued through September, buoyed by sales to China and slow but sure progress on sugar legislation in the USA, so that the London Daily Price for raw sugar rose during the month from £97 to £111 per ton. White sugar prices rose also but not to the same extent, the weight of surplus availabilities from both East and West Europe forcing a reduction in the premium over raw sugar from £5 at the beginning of the month to only £1.50 by 29th September, the last trading day of the month.

Discussing the future, E. D. & F. Man[1] note that, since 1975, "whilst producers were constantly hedged forward by up to 18 months, final buyers in general were only willing to buy on a hand-to-mouth basis. The improving tone and statistical background to the market appears now to be reversing that pattern, with final buyers seeking cover up to 18 months forward and producers, bolstered by ISA optimism, very reluctant to fix prices on anything except nearby short range shipment. There is little doubt that almost every producer is now enthusiastic for the success of the agreement, and several countries which six months ago were viewed as potential delinquent members have reaffirmed their allegiance and imposed controls on their industries. We believe this changed pattern will take the market to the minimum price area of the ISA during 1979 . . . though price movements from then on may become less certain . . ."

International Sugar Agreement

The Executive Committee of the International Sugar Organization met on 18th September and agreed to call a full session of the Council to consider postponement of the introduction of the Stock Financing Fund provided for in the International Sugar Agreement in view of the unlikelihood of US ratification by the 1st October.

The Council met on the 29th September and agreed (*a*) that all Members should be relieved under article 69 from their obligations under article 51 (relating to contributions to the Fund) and the relevant rules until 1st January 1979, (*b*) that exporting Members should be relieved under article 69 until 1st January 1979 from the obligations in article 53, paragraph 4, to comply with the provisions of article 51 as a condition of eligibility for loans from the Fund, (*c*) that the provisions of rule 510-2, sub-item (vii) should apply to sugar shipped prior to the date on which contributions under article 51 begin to be due in accordance with this decision, provided that the sugar is imported within six weeks of that date, and (*d*) notwithstanding rule 531-4, the first payments of loans under the provisions of article 53, paragraph 1, shall be made in respect of the fourth quarter of 1978, with the first priority thereafter to be applied to special stocks held in the third quarter of that year.

In effect the Council has postponed the inequitable levying of funds from existing members among smaller countries until, it is hoped, the US has ratified the Agreement and can contribute its share of the stock financing cost as a major member of the Agreement.

US sugar legislation

On the 14th September the House of Representatives Rules Committee considered the bills approved by the Ways and Means Committee (the same as the Vanik bill[2] but with the price escalator clause—based on production costs—deleted), as well as the de la Garza bill[3], approved by the Agriculture Committee, and passed both for discussion by the full House. Originally intended for the 20th September, consideration was postponed until 28th September at the earliest. With such procrastination, and the need to reconcile the final House bill with a Senate bill that goes well beyond the de la Garza proposals, and yet to be acceptable to the President, it was clear that the 1st October deadline for ISA ratification could not be met and, indeed, it seems likely that the new deadline of 1st January 1978 may not be met either.

The EEC and the ISA[4]

After conclusion of the International Sugar Agreement at the end of 1977, EEC sugar producers were afraid that the Community would not remain unaffected. It was feared that the provision limiting imports from non-member countries (article 57) could lead to difficulties in the placement of EEC sugar on the free market. However, it was clear that the extent of these difficulties would depend, among other things, on whether the OPEC countries and the Mediterranean states as well as Norway and Switzerland, which have had close trade relations with the EEC in the sugar sector, would join the Agreement. Whenever the prevailing price is below 11 cents a pound, the limit of imports by a member from a non-member is 55% of the average annual imports from that source during 1973-1976, omitting the year of lowest imports.

Exports from the EEC during this base period had not exceeded 1,660,000 tonnes, raw value, owing to bad weather, and it was feared that this provision could have serious consequences for EEC sugar exports. However, of the importing members of the Agreement (Bulgaria, Canada, East Germany, Egypt, Finland, Iraq, Japan, Kenya, Korea, New Zealand, Norway, Portugal, Singapore, Sweden, USA and USSR) exports to Iraq and the USA have little importance to the EEC, while exports to Norway would be reduced to 72,477 tonnes, white value, but exports to Israel, Nigeria, Switzerland and Yugoslavia are unaffected.

A survey of EEC sugar exports shows that difficulties would be met only if a number of other importers should join the Agreement; as long as this is not the case the EEC is in no hurry to become a member.

Indeed, there are several reasons why the Community should not seek to become a member before 1980: uncertainty as to the outcome of the Agreement pending US ratification, the planned renegotiations of quotas in 1980—exports in 1977-1979 will give a more realistic picture of the exporting potential of the EEC and so strengthen its bargaining position; and introduction of new rules for EEC sugar production under the CAP. If the US ratifies the Agreement, however, political pressure on the EEC to join could become stronger and

[1] *The Sugar Situation*, 1978, (328).
[2] *I.S.J.*, 1978, **80**, 289.
[3] *ibid.*, 258.
[4] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (25), 2-3.

a compromise should not be too difficult if the Community's surplus declines from its 1977/78 peak and the world's supply and demand balance should be more favourable in 1978/79.

Verenigde HVA-Mijen. N.V. 1977 report

Ethiopia.—In the 1976/77 milling season, production of sugar by Wonji and Shoa estates reached its normal level, viz. 70,988 tonnes as against 70,636 tonnes in 1975/76. Metahara estate continued to produce considerably less than its potential; neither in 1976/77, when sugar production reached 53,117 tonnes, nor in 1975/76 when 52,650 tonnes were produced, did production fulfil expectations. Labour problems were among the factors responsible for these disappointing developments. However, better results are anticipated for the 1977/78 milling season which so far has progressed satisfactorily.

Sudan.—Work on completion of the North West Sennar sugar factory, with a crushing capacity of 6500 tonnes of cane per day, has been continuing during and after the end of its first milling season, and has now more or less reached its final stage. Construction of its sister factory, Hager el Assalaya, with a capacity of 6500 t.c.d., also under HVA supervision, is expected to be completed in the current financial year. Transport problems have been among the reasons why construction of the Melut sugar factory, likewise with a crushing capacity of 6500 t.c.d., has meanwhile been similarly delayed. The tender prepared by HVA for the construction of a new sugar factory near Mongalla in Southern Sudan has been opened for offers, but no definite decisions have yet been made as to when the project will start.

Tanzania.—Following fulfilment of the management contract for the Kilombero Sugar Company in May 1977, HVA now provides management advice and technical assistance instead of being responsible for the total management of the project. During the year under review, HVA has commenced design of a sprinkler irrigation system for Kilombero I (Msolwa) covering an area of 2450 ha. Satisfactory progress has been made at Mtibwa Sugar Estates with the rehabilitation of the factory. Construction of the HVA-designed sprinkler irrigation system has been completed and, as soon as electricity is available, it will be put into operation. Agricultural services will be provided by HVA during a period of three years for the new Kagera sugar project, the factory of which is to be put into operation during 1980.

Ghana.—Shortage of foreign currency and economic difficulties facing the Ghanaian Government have seriously retarded the rehabilitation programme of the Ghana sugar industry. Abnormally dry weather conditions have caused a disappointing production of sugar. A study has been made during the year at the request of the Government and financed by the International Development Association aimed at either consolidation or expansion of the existing two sugar factories.

Ivory Coast.—In April 1977, HVA-ENCO, together with Ateliers Belges Réunies S.A. of Brussels, entered into a contracting agreement on a turnkey basis with the Government of the Ivory Coast for establishment of the Zuénoula sugar estate. A management contract was also signed which includes the planting of 5200 hectares with cane (of which 4200 ha are under irrigation) as well as complete management of the complex which should ultimately yield 50,000 tonnes of sugar per season. The first season will commence in December 1979.

Guinea-Bissau.—Consultations with the Government of Guinea-Bissau in respect of the sugar factory in the vicinity of Rio Gambiel are continuing, with the eventual aim of establishing a small-scale sugar project. An experimental farm has been set up with a number of sugar cane varieties.

Indian sugar industry situation

A crisis in the Indian sugar industry was recently described by F. O. Licht GmbH[1] who reported that great difficulties were being presented by the build-up of very high stocks, amounting to 4,554,000 tonnes at the end of June, against 2,045,000 tonnes a year earlier. This accumulation is the result of increased production and lower exports and consumption levels restricted by legislation governing prices. Faced with depletion of financial reserves during the 1976/77 season, when the industry lost some Rs. 600,000,000, and a likely Rs. 1,500,000,000 loss in 1977/78, there were fears that a large number of factories would be obliged to close prematurely or not operate at all during the coming season.

Since the opportunities for exporting sugar are limited by ISO requirements it was obvious that the situation could only be eased by measures to encourage domestic offtake and/or reduction in the unrealistically high level at which the cane price was fixed.

The representations of the industry met some success in mid-August when the Indian Government removed all restrictions on sales, movement and distribution of sugar[2]. There had been a dual pricing system for sugar and controls on the amounts of sugar made available. The "levy sugar"—65% of production—was much cheaper than the remaining "free market" sugar, which bore a high excise duty to cover the subsidy built into the levy price. There was considerable consumer resistance to this high price (over double the levy price), but this is expected to disappear now that there will be only one price, and consumption could rise to 5·5 million tonnes, against 3,279,700 tonnes in 1977/78. This would, of course, also improve the overall statistical position so far as the world market is concerned.

Strangely, however, the Government has raised the minimum cane price from 8·5 to 10 rupees per quintal, 8·5% sugar recovery basis, although the high cane price had been a cause of the stock problem and will lead to higher sugar prices than would otherwise be possible.

London white sugar market

On 2nd October trading commenced on a new white sugar contract in London. The Committee of the United Terminal Sugar Marketing Association (UTSMA) had announced in August proposals for such a contract to provide hedging facilities for white sugar traders and they were put to members for discussion and approval. The new Contract, UTSMA No. 3, provides for delivery of white beet or cane sugar of any origin, of minimum pol 99·8°, packed in 50 kg polyethylene-lined jute bags, f.o.b. and stowed at a number of European ports. The first delivery month is February 1979 and option trading is permitted.

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[1] *International Sugar Rpt.*, 1978, **110**, (23), 1–4.
[2] *ibid.*, (24), 12–13.

Formation of colour in cane juice by enzyme-catalysed reactions

Part II. Distribution of enzyme and colour precursors

By B. C. GOODACRE and J. COOMBS

(Tate & Lyle Ltd. Group Research and Development, P.O. Box 68, Reading, Berks., U.K.)

Introduction

IT has been established[1] that the major type of enzyme-catalysed colour produced during milling of cane is derived from oxidation products of *o*-diphenols such as chlorogenic acid produced as a result of the activity of an enzyme *o*-diphenol:O_2 oxidoreductase. Furthermore it has been shown that in model systems[2], when the activity of the enzyme is reduced by the use of specific inhibitors such as thioglycollic acid, the colour of the juice is reduced significantly. However, in these earlier experiments, immature cane tissue was selected on the basis of its high enzyme activity in order to determine the relative potential of the various types of inhibitors screened. What has not previously been established is the importance of colour derived via this route, as compared with the total plant pigments released during crushing of millable cane. In the present studies the distribution of both plant pigments (that is, colour due to compounds such as flavanoids, anthocyanins, carotenoids, xanthophylls and chlorophylls) and enzyme-derived colour was investigated in fully grown mature stems of two different varieties of sugar cane. One variety (B 44119) had a low natural pigmentation, whereas the other (B 51410) had a high anthocyanin content giving dark nodes in maturity.

Experimental

Sugar cane was grown in a heated greenhouse maintained at about 15°C. Entire stalks, approximately one year old, were harvested, most of the leaves removed, the individual nodes numbered and the stalks cut into portions comprising green leaves, leaf sheaths, the growing point, and the first well defined node. Subsequent parts of the cane stalks were subdivided to take each node (as a disc about 3 cm thick), and the internodes. In some instances the internodes were subdivided further in either vertical sections (i.e. top, middle and bottom) or into layers working from the rind in towards the central pith or storage tissue. Fresh weights were recorded, and the dry weight of representative samples measured before and after oven drying *in vacuo* at 105°C. Fresh juice was expressed from other representative samples of tissue, using a small stainless steel roller mill. The juice was collected in a glass beaker, and a portion (1 cm^3) added at once to 4 volumes of absolute ethanol. This procedure effectively minimized the formation of any enzyme-derived colour since the protein in the juice was rapidly denatured. The rest of the juice sample was left for a few hours at +20°C before the colour was measured.

Phenol oxidase activity was determined polarographically using a Clark-type oxygen electrode fitted in a temperature-controlled "Perspex" water jacket at 28°C. A 0·02–0·05 cm^3 sample of freshly expressed juice was added to 3 cm^3 of a solution of chlorogenic acid (5 mM) in distilled water. This resulted in a rapid decrease in the concentration of O_2 in the electrode vessel owing to the oxidation of the *o*-diphenol in a reaction catalysed by the phenol oxidase. This was monitored using a pen recorder calibrated so that the full-scale chart width corresponded to 0·001 cm^3 O_2 in 3 cm^3 of reaction mixture. Since the reaction mixture was saturated for both O_2 and chlorogenic acid the rate indicated by the initial slope was proportional to the level of phenol oxidase.

The absorbance of both the alcoholic and the aqueous samples of cane juice was measured using a Pye Unicam UV/visible recording spectrophotometer. Measurements were made at varying wavelengths using solutions prepared by mixing 1 volume of experimental sample with 4 volumes of 1M acetic acid/ammonia buffer of either pH 9 or pH 4. With other samples the pH of the juice was adjusted by addition of HCl or NaOH. Before taking the absorbance measurements any turbidity was removed by centrifugation and sometimes also by membrane filtration. The sugar content of the expressed juice was determined by measurement of the refractive index, using an instrument calibrated in Brix. All absorbance values were corrected for dilution with buffer, etc. The amino-nitrogen content of the juice was determined using an alkaline phenol determination on an "Autoanalyzer", following a Kjeldahl-type digestion.

Results

Colour in cane juice.—Although this paper presents results of studies on the distribution of different types of colour in the juice from cane tissue of varying maturity, interpretation of the results is not simple. This is due to the following factors: (*a*) although the unreacted phenolics absorb mainly in the UV region their absorption spectra tail into the visible region, (*b*) the chosen wavelength of 420 nm for most comparisons (based on the ICUMSA method) does not reflect the acuity of the human eye, and (*c*) the absorbance is affected by pH to a varying degree depending on the nature of the colorants. These problems are discussed in more detail in relation to the data presented in Fig. 1. The UV absorption spectra of juice from either immature tissue (growing point) or mature tissue are shown in Fig. 1A.

These traces were obtained from juice in which enzyme activity had been suppressed by addition of alcohol with no pH adjustment. The absorption spectrum of the juice from the growing point, with a maximum at 320 nm and a minimum at about 260 nm is very similar to that of authentic chlorogenic acid. By contrast, that from the juice of mature tissue is similar to that for flavanoid-type pigments. These two classes of phenols may thus be distinguished by taking the ratio of A_{320} to A_{280}, which will be about 2 for chlorogenic acid and about 0·5 for flavanoids. In subsequent figures these ratios are used to distinguish the major type of UV-absorbing substances present in the alcoholic solutions.

In the visible region A_{420} is influenced by the pH of the juice. As shown in Fig. 1B the pH profile of colour from juice expressed from immature tissue (growing

[1] Coombs *et al.*: *I.S.J.*, 1978, **80**, 000.
[2] Gross: *ibid.*, 1976, **78**, 69–73, 106–109.

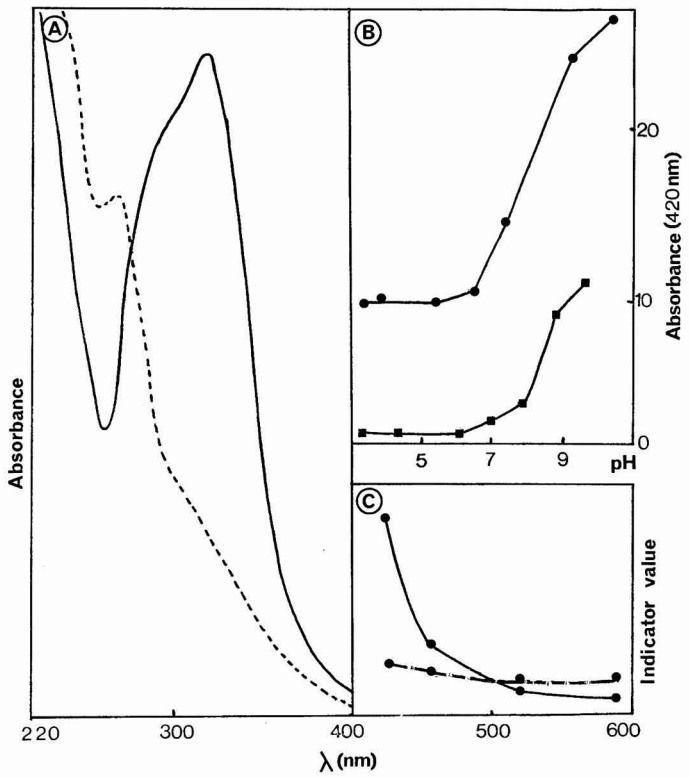


Fig. 1*A*. Absorption spectra recorded in the UV region for ethanol-juice mixtures from growing point (solid line) or mature tissue (broken line).

B. Absorbance at 420 nm for juice from growing point and first two nodes (●—●) or from ethanol-juice from rind (■—■), adjusted to indicated pH values using HCl or NaOH.

C. Indicator values (absorbance at pH 9 to absorbance at pH 4) for juice from growing point and first two nodes; (●—●) ethanolic solution, (●----●) aqueous solution.

point and first two nodes) differs from that of an alcohol/juice mixture from the pigment-rich rind. In both cases the A_{420} remains fairly constant between pH 4 and about 6·5, but increases rapidly as the pH becomes more alkaline. However, the relative increase is much greater for the pigments than for the enzymic colour. Further complications arise when the pH response of colour is considered over a wider range of wavelengths (Fig. 1C). This figure shows the indicator value (ratio A_{pH9}:A_{pH4}) as a function of wavelength. With aqueous solution containing enzymic colour the IV remains fairly constant. By contrast, the IV observed in ethanolic solution decreases rapidly at higher wavelengths and drops below that of the aqueous solution in the region of maximum response of the human eye.

Distribution of colour.—The main experimental results are presented in two sections, corresponding to the two fractions of cane which would either have been discarded as tops, or retained as millable cane in a hand-cut harvest. Since results obtained with the two varieties were essentially the same, only one complete set of data is presented. This was obtained for the variety B 49119.

A. Cane tops.—The distribution of colour in the juice from cane tops is shown in Fig. 2. No attempt has been made to indicate the varying length, or mass, of the nodes. The nodes are numbered in sequence. Data presented opposite a dividing line are derived from node tissue and those opposite a space from internode tissue. The A_{420} corrected for dilution of the juice adjusted to pH 4 or 9, or collected in ethanol and its pH adjusted to 9, is shown in Fig. 2A. The basic trends were the same with all three types of solution. The maximum absorbance was observed in juice expressed from the growing point. Levels of colour were higher in the nodes than in the internodes. The ratio of colour observed in the aqueous solution to that observed in the alcoholic solution, where enzyme colour generation was inhibited, was greatest in the region of the growing point and top two or three nodes (Fig. 2B). In the same region the IV_{420} for the aqueous solution lay between 3 and 4 in contrast to the value around 7 found in the lower portion of the stem.

The pattern of distribution of phenolics (UV-absorbing compounds determined at 320 nm) in the ethanolic solutions and of *o*-diphenol oxidase activity in the juice was similar to that of the colour (Fig. 3A), showing a peak at the growing point. The distribution of soluble amino-nitrogen was similar except that a high concentration was also observed in the leaves. In the region of the growing point the ratio A_{320}:A_{280} observed with ethanol extracts was close to two indicating a probable high content of chlorogenic acid (Fig. 3B). This ratio decreased further down the stem. In all cases the concentration of phenolics, phenol oxidase and nitrogenous compounds was higher in the nodes than in the internodes.

B. Mature cane stem.—In contrast to that in the tops, the distribution of colour was uniform throughout the mature part of the cane (Fig. 4A). With the larger size of the stem in this region it was possible to subdivide the tissue further. Hence data were obtained from samples of tissue taken from various positions along the internode, or from the outside (rind) or inside (storage tissue). In all fractions the A_{420} at pH 9 of the aqueous solution (Fig. 4A), where enzyme colour had developed, was about twice that of the ethanolic solutions at pH 9. Levels of colour were higher in the nodes than in internodes, and higher in the rind than in storage tissue. The ratio of A_{320} to A_{280} (Fig. 4E) in the ethanol extracts was in the region of 0·5 for all samples, indicating a higher relative contribution of flavanoid-type pigments. Again, the concentration of

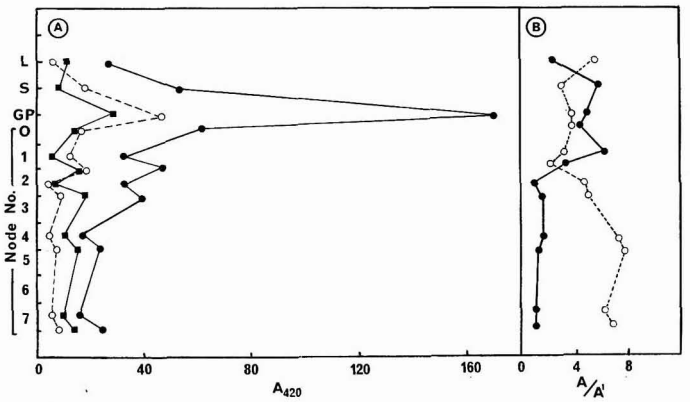


Fig. 2*A*. Absorbance at 420 nm for juice at pH 9 (●—●) or pH 4 (○----○) or for ethanol-juice mixtures from various regions (■–■).

B. Ratio of absorbance at 420 nm in juice (pH 9) to that in ethanol-juice mixtures (pH 9) (●—●). Indicator values (420 nm) for the juice (o----o). L = leaf, *S* = leaf sheath, GP = growing point.

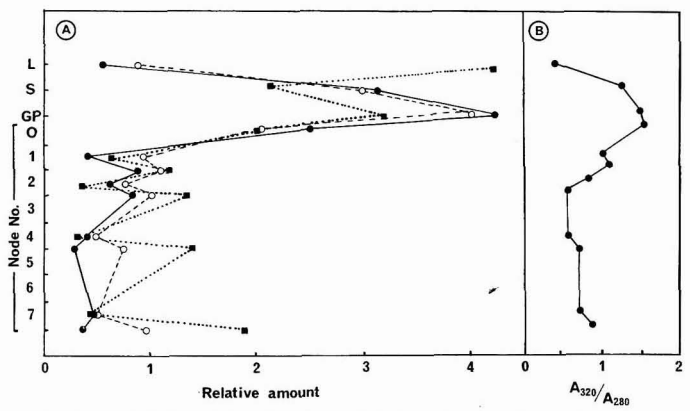


Fig. 3*A*. Distribution of phenol-oxidase activity (o----o), amino-nitrogen (■–■) and phenolics (A_{320} in ethanolic solutions) (●—●).

B. Ratio of absorbance at 320 nm to that at 280 nm recorded for ethanolic solutions.
L = leaf, S = leaf sheath, GP = growing point.

these was higher in the node and rind than in storage tissue (Fig. 4D). As expected from these observations all samples had a high IV (Fig. 4C).

The level of phenol oxidase activity and nitrogen was also determined. These parameters showed the same characteristics. Levels were higher at the nodes than in the internodes, and higher in the outer layers of the stem tissue than in the storage pith.

Discussion

It is well known that the immature part of the cane stem produces juice of a higher colour and lower purity than that obtained from the mature, ripe cane. This higher colour has been attributed to the higher level of amino acids and plant pigments in general, but no specific cause established. It is clear from the data presented here that a considerable amount of enzyme-catalysed colour production occurs in juice from this region. In all parts of the cane higher levels of colour were associated with higher levels of phenolics, amino-acids and of *o*-diphenol oxidase. It therefore seems reasonable to conclude that this colour was derived from the interaction of enzyme-generated quinones and amino acids or soluble proteins as suggested previously[1].

The present results as detailed above show the observed A_{420} in the juice as expressed from the cane. Obviously, the relative contribution to the total colour will be the product of these values and the volume of juice in each fraction. Owing to problems of total extraction using a small experimental mill the total juice content could not be measured accurately simply by milling. The juice content was therefore estimated by measuring the loss of weight on oven drying. Using these figures, together with the observed sugar content determined by RI measurement, it was estimated that the top part of the cane (node 7 and above) contained 21% of the total sugar (Table I). This value was close to that reported to occur in the discarded parts of hand-cut cane[3]. Depending on the pH at which colour was measured and the variety of cane sampled the juice from this part of the cane contained between 40 and 70% of the total colour. Only part of this colour could be attributed to the activity of phenol oxidase. Since the IV of the phenol oxidase-dependent colour was lower than that of the other pigments the relative contribution of enzyme-generated colour to total colour also depended on pH. At pH 9 about half the colour could be attributed to each source. At pH 4 over 70% of the colour was derived from the enzyme reaction. Similar results were obtained when the mature part of the stem was considered.

Table I. Distribution of sucrose and colour in cane stems. The variation indicated is that observed between stems of two varieties B 49119 and B 51410

	% of total
Sucrose in top (node 7 and above)	21
Colour in top measured at pH 9 (420 nm)	43–48
Colour in top measured at pH 4 (420 nm)	60–70
Contribution of enzyme colour in top pH 9 (420 nm)	52–58
pH 4 (420 nm)	70–80
Contribution of enzyme colour in mature stem pH 9 (420 nm)	47–58
pH 4 (420 nm)	60–70

[3] Staub: *Proc. 29th Ann. Congr. S. African Sugar Tech. Assoc.*, 1955, 104–106.

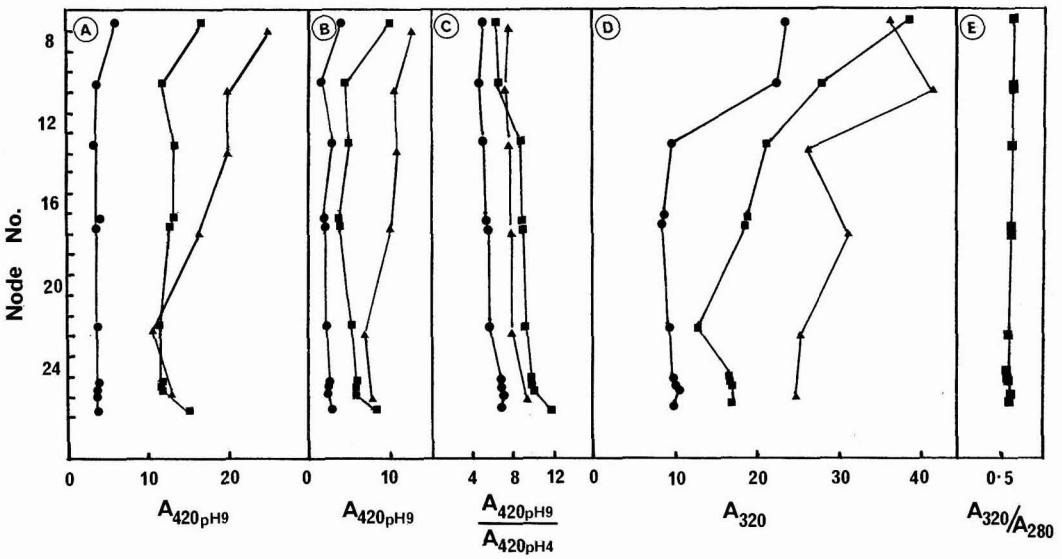


Fig. 4*A*. Absorbance at 420 nm for juice (pH 9) from (▲) nodes (■) rind and (●) pith.
B. A_{420} for ethanolic solutions (pH 9)as in *A*. *C*. Indicator values for aqueous solutions as in *A*. *D*. Absorbance at 320 nm for ethanolic solutions as in *A*. *E*. Ratio of absorbance at 320 nm to that at 280 nm for samples shown in *D*.

It seems clear that over half the colour which develops in the early stages of sugar extraction could have its origin in phenol oxidase-dependent reactions. The precursors of this type of colour appear to be associated with the parts of the tissue where growth and cell division are still occurring. Differences between mature and green cane would appear to be quantitative, in terms of the ratio of colour formed to sucrose content of the juice, rather than reflecting a difference in nature of colour present.

Summary

The distribution of phenols and enzyme (*o*-diphenol oxidase) associated with colour formation has been investigated in two varieties of sugar cane. One variety (B 49119) had a low pigmentation, the other (B 51410) a high anthocyanin content. Levels of phenolic matter and of enzyme were highest in the growing point and higher in the nodes and rind than in the storage tissue (pith) of the internodes. The amount of enzyme-dependent colour generated, on a unit juice weight basis, was considerably higher in the growing point, nodes and rind than in the pith. However, the amount of juice obtained from the high enzyme colour parts was relatively small. The differences therefore decreased in significance when the total colour produced per stem was calculated. The proportion of the total juice colour that could be attributed to enzyme reactions depended on maturity and juice pH. Even in the mature (ripe) part of the stem it amounted to more than half the total colour.

La formation de la coloration dans le jus de canne par des réactions catalysées par des enzymes. 2ème partie. Distribution de l'enzyme et des précurseurs de couleur

La distribution des phénols et de l'enzyme (*o*-diphénol-oxydase) associés à la formation de couleur a été étudiée sur deux variétés de canne à sucre. Une variété (B 49119) avait une faible pigmentation, l'autre (B 51410) une teneur élevée en anthocyanine. Les taux de matière phénolique et d'enzyme étaient les plus élevés au point de croissance et plus élevés dans les noeuds et dans l'écorce que dans le tissus de stockage (moëlle) des internoeuds. La quantité de cette coloration qui dépend de l'enzyme, sur base d'un poids unitaire de jus, était considérablement plus élevée au point de croissance, dans les noeuds et dans l'écorce que dans la moelle. Cependant, la quantité de jus obtenue à partir des parties à coloration par enzyme élevée, était relativement faible. Dès lors les différences diminuaient en signification lorsqu'on eut calculé la coloration totale produite par tige. La proportion de coloration totale du jus attribuable à des réactions enzymatiques, était fonction de la maturité et du pH du jus. Même dans la partie de tige arrivée à maturité, elle s'élevait à plus de la moitié de la coloration totale.

Farbbildung in Rohrsaft durch enzymatische Reaktionen. Teil II. Verteilung von Enzymen und Farb-Vorläufern

Die Verteilung von Phenolen und Enzymen (*o*-Diphenol-Oxidase) im Zusammenhang mit der Farbbildung wurde in zwei Zuckerrohrsorten untersucht. Eine Sorte (B 49119) hatte eine geringe Pigmentierung, die andere (B 51410) einen hohen Anthocyanin-Gehalt. Die Konzentration an Phenolen und Enzymen waren am höchsten am Vegetationspunkt und in den Knoten und der Rinde höher als im Lagergewebe (Mark) der Internodien. Die erzeugten Mengen an enzym-abhängiger Farbe, auf eine Gewichtseinheit Saft bezogen, waren beträchtlich höher beim Vegetationspunkt, in den Knoten und Rinden als im Mark. Jedoch war die aus den stark enzymhaltigen Teilen erhaltene Saftmenge relativ klein. Daher nahm die Signifikanz der Unterschiede bei Berechnung der

pro Stengel insgesamt erzeugten Saftfarbe ab. Der Anteil an der gesamten Saftfarbe, der den Enzym-Reaktionen zugeschrieben werden kann, hing von Reife und pH-Wert des Safts ab. Sogar im reifen Teil des Stengels betrug er mehr als die Hälfte der gesamten Farbe.

Formación de color en jugo de caña por reacciones catalizado por enzimas. Parte II. Distribución de enzima y de precursores de color

La distribución de fenoles y enzima (oxidasa para *o*-ditenol) asociado con formación de color se ha investigado en dos variedades de caña de azúcar. Un variedad (B 49119) contuvo pigmentación baja, la otra (B 51410) un contenido alto de antocianina. Niveles de materia fenólica y de enzima fueron lo mas alto en el punto de crecimiento y más alto en los nudos y en la corteza que en los tejidos de almacenaje (meollo) de los entrenudos. La cantidad generado de color enzima-dependiente, sobre un base de unidades de peso del jugo, fué notablemente más alta en el punto de crecimiento, nudos y corteza que en la meolla. Sin embargo, la cantidad obtenido de las partes de alto color enzimático fue relativamente pequeña. Por consiguiente, las diferencias disminuieron en significación cuando se calculó el color total producido por tallo. La proporción del color total del jugo que puede atribuirse a reacciones enzimaticas depiende de madurez y pH del jugo. Aún en la parte madura del tallo equivale más de la mitad del color total.

ICUMSA
International Commission for Uniform Methods of Sugar Analysis
17th Session 1978

RECOMMENDATIONS

THE following Recommendations were adopted at the 17th Session of ICUMSA in Montreal, during the 5th to 9th June 1978. They will be reproduced, together with the Referees' Reports, discussion, etc. in the bound volume of the 17th Session Proceedings which will be available in 1979 from ICUMSA Publications Department, P.O. Box 35, Wharf Road, Peterborough, England PE2 9PU.

Subject 1. Constitution and bye-Laws

Referee: A. CARRUTHERS (United Kingdom)

1. Recognising the views presented by the US National Committee, the Commission re-affirms its unequivocal committal to the Objects as stated in Article II of the Constitution. The Article clearly states that the Commission is concerned solely to promote scientific studies related to the analysis of sugars. This precludes the development and presentation of specifications for sugar and sugar products but does not restrict the authority of the Commission in defining the properties of pure sucrose.
2. A Steering Committee should be established, the duties of which shall be (i) to review the contents and list of Subjects to be studied and (ii) to examine critically the working procedures of the Commission with a view to presenting proposals which might lead to improvements.
3. Article VII of the Constitution should be changed so as to authorize the election of Honorary Life Vice-Presidents.

Subject 1A: Method specification

Referee: A. CARRUTHERS (United Kingdom)

1. The Commission, taking into account the proposals of the US National Committee as outlined in the Report, should develop guidelines relating to the status of methods.
2. The Commission should continue to emphasize the importance of collaborative studies being carried out between laboratories in different countries and of the results being submitted to statistical analysis.
3. It is recognised that a special category must be assigned to certain methods which are demonstrably scientifically exact but which, because they require very specialized equipment and highly developed techniques, are not suitable for designation as Official Methods.
4. For the presentation of methods, the Commission should adopt a definite format as outlined in the Referee's Report and as adopted in the new book of methods [Schneider, F. (Ed.): Sugar Analysis: ICUMSA Methods (ICUMSA, 1978)].

Subject 2: Laboratory apparatus

Referee: R. I. SAVAGE (United Kingdom)

1. Referees for other Subjects are requested to consider what instruments or apparatus of types especially useful for sugar analysis (whether or not restricted to their speciality) are suitable for international standardization and to communicate suggested specifications for such articles to the Referee for Subject 2.
2. The following table should be substituted for Table 1 (*Proc. 16th Session ICUMSA,* 1974, Appendix 1, page 11):

Nominal capacity, cm^3	50	100	200	400
ICUMSA flasks	±0·2	±0·05	±0·08	±0·11
ICUMSA special flasks		±0·02		

In consequence, paragraph 1.2.3 (e), *loc. cit.* should be changed to read "the legend 'ICUMSA' or 'ICUMSA special', to indicate the class of accuracy".

Subject 3: Sampling of sugar and related products

Referee: E. G. MULLER (United Kingdom)

1. The sampling procedure described in Recommendation 1 to the 16th Session 1974 (officially adopted in 1974) may also be used for powdered sugars and soft sugars.
2. The scheme described in Appendix 1 to the present Report shall be officially adopted for the sampling of sugar for technical purposes.
3. The procedure described in Appendix 4 to the present Report shall be officially adopted for the sampling of bulk raw sugars.

4. Estimates of analytical error should be established for all the Codex methods of analysis, under the aegis of subject 1A. The results should be made available before the 18th Session.
5. The sampling of molasses and other liquid sugar products should be studied.
6. Subject 3 should be renamed "Sampling of sugar and related products" instead of "Weighing, taring and sampling of sugars".

Subject 4: Specifications and tolerances for pure sucrose and reagents

Referee: G. J. A. RENS (Belgium)

1. The modified Karl Fischer method of Schneider, Emmerich & Ticmanis should be tentatively adopted for the determination of water in pure sucrose and glucose.
2. The method of Hibbert & Phillipson, using a sample weight of not less than 100 g, should be tentatively adopted for the determination of water-insoluble matter in pure sucrose and glucose.
3. The specifications and tolerances for pure sucrose officially adopted at the 15th Session (*Proc. 15th Session ICUMSA*, 1970, Rec. 1, page 35) should be maintained, but with the following amendment and additions:

Water-insoluble matter, %	not more than 0·002
Colour in solution at 420 nm, ICUMSA units	not more than 10
Raffinose, anhydrous, %	not more than 0·05

4. The specifications and tolerances for pure glucose officially adopted at the 14th Session (*Proc. 14th Session ICUMSA*, 1966, Rec. 5, page 15) should be maintained, but with the following amendment and addition:

Specific rotation, $[\alpha]_D^{20}$	52·75±0·25 (c=10 g/100 cm³)
Water-insoluble matter, %	not more than 0·002

5. A maximum content of 0·05% nitrilotriacetic acid (NTA) in EDTA is officially adopted.
6. The specifications and tolerances for hydrated neutral lead acetate [$Pb(CH_3COO)_2.3H_2O$] and for lead oxide (PbO), both as set out in Appendix 1 to the present Report, are tentatively adopted.
7. In the light of its use for defecation prior to the determination of reducing sugars, studies should be made on neutral lead acetate solution with a view to defining its optimal concentration and pH value (after addition, if necessary, of acetic acid or sodium hydroxide).
8. Definition of basic lead acetate solution in terms of the two parameters, basicity and total lead content (g PbO/dm³), is officially adopted.
9. A total lead content of 250 ± 5 g PbO/dm³ and a basicity of 36 ± 0·5% in basic lead acetate solution are tentatively adopted.

   An exception may be made, up to the time of the 18th Session of ICUMSA, in the polarization of raw sugars (see Subject 11, Recommendation 3) and further investigations should be carried out with the aim of achieving a uniform concentration.
10. The methods of Rens for the determination of total lead and basic lead, as set out in Appendix 3 to the present Report, are tentatively adopted.

Subject 5: Polarimetry

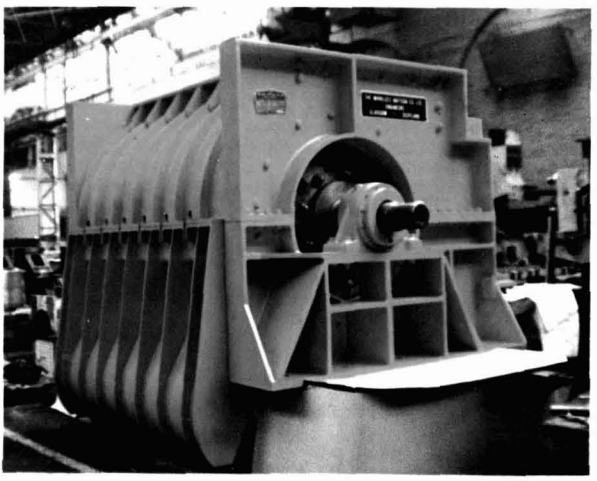
Referee: F. SCHNEIDER (Germany)

1. The 100°S point of the sugar scale cannot be re defined at present. The values which were tentatively adopted in 1970 (*Proc. 15th Session ICUMSA*, 1970, 42, Recs. 2 & 4) for the green mercury line and for yellow sodium light, remain in force for the time being.
2. The tentative status assigned in 1974 to Recommendations 3, 5 (second section), 6, 7, 8, 9, 11, 12 and 13 (*Proc. 16th Session ICUMSA*, 1974, 72-74) is suspended and they are recommended for further study.
3. The differences in connexion with the redetermination of the 100°S point, as shown in the present Report, should be clarified by the institutes concerned, if possible prior to the 18th Session of ICUMSA.
4. Saccharimeters with an angle of rotation of 2·5° or less at the 100°S point at a wavelength of 546 nm may be calibrated by means of a pure sucrose solution under the conditions described in Appendix 2 to the present Report (official).
5. Formula [3] and Table 4 in the Referee's Report to the 16th Session (*Proc. 16th Session ICUMSA*, 1974, 58-59) are officially adopted for the assessment of the dependence of the rotation value of pure sucrose on temperature (between 30 and 90°C) within the concentration limit of the "normal sugar solution" and at $\lambda = 546$ nm.
6. The formula of Emmerich, as included in the present Report [3], is tentatively adopted for the temperature correction of polarimetric sugar determinations using saccharimeters calibrated at 20·00°C. The formula is applicable for a temperature range of 10 to 30°C to samples with a sucrose content of 90 to 100% (sucrose concentration 23·4 to 26·0 g/100 cm³).
7. A method for the calibration of saccharimeters at temperatures higher than 20°C should be developed and the Einsporn formula revised, if possible before the 18th Session of ICUMSA.
8. The rotatory dispersion of technical sugar solutions between 546 nm (green mercury line) and 633 nm (helium-neon laser), inclusive, should be further and thoroughly investigated. The influence of extending the permitted range (540 to 590 nm) for practical polarimetry to 633 nm should be accurately evaluated.
9. The dependence of the rotation value of sucrose solutions on concentration should be studied at the 633 nm (helium-neon laser) wavelength.
10. The use of dye lasers for the adjustment of the reference wavelengths should be further studied.
11. The rotatory dispersion of sugar solutions after acid inversion or enzyme treatment should be studied.
12. The use of invariable standards other than quartz should be studied.
13. High accuracy density measurements, over as wide a concentration range as possible, should be carried out with a view to establishing a new density table to replace that of Plato.

    For technical applications at high concentrations and high temperatures, a combined density table should be compiled, based on the Czechoslovak values (Appendix 4 to the present Report) and on the Braunschweig table (published in 1963) with a view to recommending its adoption at the 18th Session of ICUMSA.

SMITH MIRRLEES

The Tongaat Shredder



Rotor

Extremely rigid construction, with 350 mm shaft (on 1 500 mm shredder) and no spacer discs.

Rotor elements (discs) are flogged up solid with large through-bolts, then locked together with 'Ringfeeder' double-taper clamps, giving a solid assembly.

The mass of construction renders a flywheel unnecessary. The inertia of the 1 500 mm shredder rotor with hammers is a 2 060 kg m^2.

Hammers

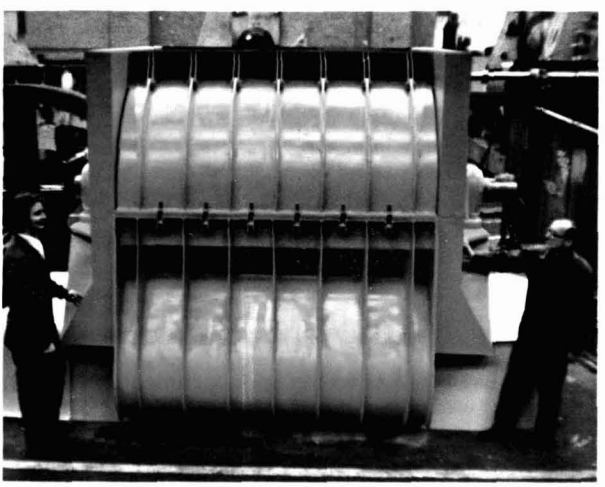
There is more than 100% coverage of hammers across the shredder width (46 hammers, each 50 mm + hardfacing, across 2 100 mm shredder).

Grid

The grid is fabricated completely from steel plate, and stress relieved.

Anvil bar and grid bars are identical and of a simple rectangular section.

Each grid bar comprises two 1 050 mm sections for ease of handling. The rectangular construction allows for 4 wearing corners for each bar.



RESULTS COUNT: Achieving at Tongaat 90% + D.I. (S.M.R.I. METHOD) on 30 TONS (Metric) fibre per hour.

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The work on density should be carried out within the framework of a new ICUMSA Subject.

Subject 6: Quartz control plates

Referee: K. ZANDER (Germany)

1. For the temperature correction of the rotation value of quartz control plates in the vicinity of 20°C, throughout the visible spectral range, the following formula is officially adopted:
$$\alpha_t = \alpha_{20}\,[1 + 1{\cdot}44 \times 10^{-4}\,(t - 20)].$$
2. The wavelength 632·9914 nm of the helium-neon laser shall be tentatively admitted as a reference wavelength for the measurement of quartz control plates. The conversion to the reference wavelengths of 546·2271 nm and 589·4400 nm shall be made by applying the formula for the specific rotatory dispersion of quartz given by Bünnagel in 1966 (*Proc. 14th Session ICUMSA,* 1966, 32).
3. In order to support Recommendation 2, the measurement of the rotatory dispersion of quartz blocks of different origin should be continued with a view to confirming the information given to the 15th Session (*Proc. 15th Session ICUMSA,* 1970, 46, Table 2).
4. The interchange of quartz control plates among as many national institutes as possible should be continued.

Subjects 7 & 8: Sucrose in factory and refinery products excluding beet, cane and crystalline sugars

Referee: J. V. DUTTON (United Kingdom)

1. Isotope dilution methods, including the Bruijn & Carreyett method, tentatively adopted in 1974, should be further investigated to ensure that pure sucrose is isolated from beet samples. Collaborative participation of several laboratories in isotope dilution methods, in order to determine inter-laboratory reproducibility, should be undertaken.
2. GLC methods should be further tested for their repeatability and for recovery of added sucrose. Attention should be concentrated on the GLC method giving the best repeatability and recovery of sucrose in order to determine its inter-laboratory reproducibility.
3. HPLC methods should be further tested, particularly with a view to minimizing column fouling and improving repeatability.
4. The tentative status of the Dutton method should be retained since results obtained in the Referee's laboratory have been shown to be consistent with those obtained by isotope dilution or GLC methods.
5. Since the Jackson & Gillis method IV is still a US Government method, it is retained as an official method, until further notice, for use in trade, in spite of its recognised shortcomings.
6. Further studies of enzymatic methods should be undertaken in order to determine whether repeatabilities, which are compatible with those of other methods, can be achieved.
7. The *B. stearothermophilus* "Autoanalyzer" method should be further studied.
8. The United Molasses Trading Company method, using a constant volume Lane & Eynon titration, should be tentatively adopted for the determination of total reducing sugars in molasses after hydrolysis. This method should be further tested to try to establish the reasons for the deviations found by some analysts. Consultation with the Referee for Subject 14 is recommended to decide under which Subject this further testing would be carried out.
9. The official status of the three polarimetric methods detailed by de Whalley (ICUMSA Methods of Sugar Analysis, Elsevier, 1964), namely the invertase method, the Paine & Balch method and the Osborn & Zisch method, should be withdrawn.
10. The problems of interferences from glucose and oligosaccharides in the determination of sucrose by NMR techniques should be further investigated.
11. In regard to the sampling procedures for collaborative tests, the relative merits of chloride methods and conductivity methods as means of assessing the uniformity of subsampling should be compared.
12. Future studies should take into account the purpose for which methods are required and apply different criteria in respect of accuracy, repeatability and reproducibility according to whether the methods are for reference or control purposes or for use in trade.

Subject 9: Sucrose in sugar beet

Referee: W. MAUCH (Germany)

1. Taking into account the importance of samples being both representative and homogeneous, proposals for the standardization of brei preparation and characteristics should be evolved; the treatment of beet slices or cossettes should also be considered.
2. The applicability of non-toxic clarification reagents (especially aluminium chloride) should be further studied.
3. Since polarimetric methods carried out at high temperatures (hot aqueous digestion, double extraction method) give values which are too high in the presence of high concentrations of invert sugar, these methods should be intensively checked with a view to clarifying, as soon as possible, their use as ICUMSA methods.
4. GLC methods (including that of Karr & Norman, tentatively adopted at the 16th Session) for the determination of sucrose in filtrates from brei clarified with lead acetate or aluminium chloride should be further investigated; their present status is, meanwhile, suspended.
5. The applicability of HPLC in the quantitative determination of sucrose should be further studied.
6. Investigations of enzymatic and biological methods for the determination of sucrose should be continued.
7. The random measuring error of the radioactivity in isotope dilution methods should not exceed $\pm 0{\cdot}1\%$ at the 95% significance level.

Subject 10: Sucrose in sugar cane

Referee: M. MATIC (South Africa)

1. Further comparisons between core and grab sampling of whole cane and hatch sampling of prepared cane should be carried out.
2. The hydraulic press method should be further studied.
3. A uniform way of calculating polarization % cane from basic analytical data should be established.
4. The GLC method for sucrose determination should be further studied.

Subject 11: Polarization of raw sugars

Referee: M. R. PLAYER (Australia)

1. Further duplicate polarization data should be submitted to the Referee to substantiate the suggested repeatability value of 0·11°S.
2. In the specification of the basic lead acetate solution, the equivalence of the total lead content (expressed as PbO) of 24·7 ± 1·0 g/100 cm³ for the specific gravity of 1·24 ± 0·01 should be confirmed.
3. The specification of a single wet lead solution, which would be suitable for all ICUMSA methods calling for this reagent, should be studied.
4. The tentative status accorded to centrifugation as an alternative to filtration should be withdrawn.
5. The coefficients in the temperature correction formulae should be critically examined with a view to officially adopting, at the 18th Session of ICUMSA, *either* the proposed values (0·00034 for quartz wedge polarimeters and 0·00020 for circular polarimeters) *or*, alternatively, the exact formulae already tentatively adopted within the framework of Subject 5 (Recommendation 6 above).
6. Clause 10 (Expression of Results), tentatively adopted in 1970 (*Proc. 15th Session ICUMSA,* 99) should be officially adopted, but with the following wording:

   "The corrections to be applied are those which are necessary to standardize the observer-polarimeter combination (scale and zero corrections), those which are necessary to allow for irregularities of apparatus (flask and cell corrections) and those which are required to allow for solution preparation and observations made at temperatures other than 20°C.

   "It is recognised that, if the above-described procedure involving the use of wet lead were modified so that dry lead was used for clarification, the modification would give rise to a slightly lower polarization; it is for this reason that some countries have long adopted the practice of subtracting 0·1°S from the polarization obtained by using wet lead as detailed in the procedure. Those countries which have adopted the procedure of subtracting 0·1°S may continue this practice provided that, in expressing their results, it is clear that 0·1°S has been subtracted.

   "The words 'results reported according to equivalent dry lead method' should accompany results reported in this way".
7. The method shown in its new format in Appendix 2 to the present Report should be adopted as the official method.
8. Since, with some sugars, the use of 1 cm³ of wet lead may produce solutions which are difficult to read, all aspects of clarification using wet lead should be further studied.

Subject 12: Refractive index

Referee: K.-J. ROSENBRUCH (Germany)

1. Following the official adoption at the 16th Session of formulae for the relationship between refractive index and sucrose concentration in aqueous solutions of pure sucrose between 18 and 40°C and between 0 and 85% concentration, the correction tables derived therefrom (Tables 1a, 1b, 2a and 2b in the present Report) should be officially adopted.
2. Collaborative studies to determine the refractive indices of aqueous solutions of fructose, glucose and invert sugar should be carried out with a view *either* to confirming Recommendations 3, 4 and 5 adopted in 1954 (*Proc. 11th Session ICUMSA,* 1954, 41) *or* to the provision of new and more precise tables.

Subject 13: Dry substance in sugar products other than sugar

Referee: G. MANTOVANI (Italy)

1. The Karl Fischer titration method, as set out in Appendix 2 to the present Report, and using methanol as solvent, should be tentatively adopted and submitted to further study.
2. The method using vacuum drying on sand, as set out in Appendix 3 to the present Report, should be tentatively adopted and the tentative status accorded in 1958 (*Proc. 12th Session ICUMSA,* 1958, 63, Rec. 1) to the method using aluminium powder should be withdrawn.
3. The Hawaiian methods for removing suspended solids prior to the measurement of refractive index or density, as set out in Appendix 4 to the present Report, should be further studied.
4. Procedures for the measurement of refractive index should be submitted to further collaborative studies.
5. Methods for the determination of water by means of gas-liquid chromatography, nuclear magnetic resonance, near infra-red spectroscopy and microwave techniques should be further studied.
6. The corrections required to convert refractometer solids to true solids should be further studied, with particular reference to glucose syrups, blends and similar products.

Subject 14: Reducing sugars

Referee: R. PIECK (Belgium)

1. The official status of the classical procedure of the Lane & Eynon method is withdrawn and the constant volume modification, as set out in Appendix 1 to the present Report, is officially adopted. In this method, the effects of the presence of calcium are minimized by the addition of EDTA solution (4 g/100 cm³); the correction factors to compensate for the presence of sucrose in the sample are those given in Appendix 1 to the present Report and the estimation of the "approximate sucrose content" required in the calculation may be achieved *either* as specified in section 1.4 of the present Report *or* by prior knowledge of this quantity.
2. Collaborative studies on the constant volume method should be undertaken to compare final volumes of 60 and 75 cm³ and to evaluate decalcifying agents other than EDTA.
3. For the specific determination of glucose and fructose, the enzymatic method described in Appendix 2 to the present Report should be further studied.
4. The Ofner and the Berlin Institute methods for the determination of medium invert sugar levels are retained as Official Methods and should be further studied, with particular attention to the correction in the Ofner method.
5. GLC and HPLC methods for the determination of reducing sugars should be further studied.

Subject 15: Oligosaccharides and glycosides

Referee: H. SCHIWECK (Germany)

1. The official status accorded to the Albon & Gross method (paper chromatographic method with visual comparison) and to the Braunschweig Institute method (using sample preparation with clarification and deionization and photometric comparison) for the determination of raffinose should be withdrawn in favour of tentative status.
2. The method of Schiweck & Büsching, involving the splitting of raffinose by α-galactosidase followed by the determination of the galactose produced by means of galactose dehydrogenase, should be officially adopted for the determination of raffinose in white sugar at levels exceeding 0·015%.
3. For raw juice, thin juice, thick juice, other syrups and molasses after dilution and filtration through membrane filters, but without clarification, the method of Schiweck & Büsching gives a result, expressed as raffinose, which includes raffinose, galactinol and other carbohydrates which yield galactose on hydrolysis. In the case of raw juice and extracts from beet, the result must be corrected for the inherent galactose content by determining this prior to treatment with α-galactosidase.

   Since, except in the case of raffinose, exact methods for the determination of carbohydrates yielding galactose (especially galactinol) are not available, the method of Schiweck & Büsching should retain its tentative status for this group of products and also for the determination of raffinose in solutions which have been clarified with basic lead acetate.
4. Other methods for the determination of raffinose, especially those using GLC and HPLC, should be further studied with particular attention to their inherent errors.
5. GLC and HPLC methods for the determination of galactinol (including the method proposed by the US National Committee included in Appendix 1 to the present Report) should be further studied.
6. Existing GLC and HPLC methods for the determination of kestoses should be further studied with particular attention to their inherent errors.
7. Workers in the field of Subject 15 should be urgently requested to prepare pure samples of galactinol, 1-kestose, 6-kestose and neo-kestose and to make these available to those working on the development of quantitative analytical methods.

Subject 15A: Pectin and polysaccharides

Referee: J. F. T. OLDFIELD (United Kingdom)

1. The methods of Carruthers & Oldfield and of Schneider, Emmerich & Laudien should be adopted as tentative methods for the determination of pectic acid in raw and diffusion juices at concentrations in excess of 50 mg/dm³.
2. The British Sugar Corporation method should be retained as a tentative method for the determination of dextran at concentrations in excess of 100 mg/dm³.
3. The British Sugar Corporation method should be retained as a tentative method for the determination of laevan at concentrations in excess of 100 mg/dm³.
4. The British Sugar Corporation method should be retained as a tentative method for the determination of araban at concentrations in excess of 50 mg/dm³.
5. Comparative studies of the photometric method of Reinefeld, Thielecke & Lucker, using metahydroxydiphenyl reagent to determine pectic acid after calcium precipitation, methanol precipitation or gel chromatographic isolation should be undertaken.
6. Comparative studies of the Braunschweig Sugar Institute modification to the method of Schneider, Reinefeld & Thielecke for the determination of polysaccharides should be undertaken.
7. Further studies of the dialysate procedure of Roberts & Friloux for the determination of total polysaccharides in sugar cane products should be undertaken.
8. Collaborative studies of the Cane Sugar Refining Research Project procedure for the determination of component sugars in hydrolysed arabinogalactan, and of the glucuronic acid component, for the assay of arabinogalactan in sugar cane products, should be undertaken.

Subject 16: Ash

Referee: P. DEVILLERS (France)

1. The gravimetric method for the determination of carbonate ash should be withdrawn since it yields results of a low order of precision and is, moreover, difficult to carry out.
2. The gravimetric method for the determination of sulphated ash should be retained with official status since it has been shown to be precise, having a standard deviation of about 0·1% on molasses.

   Temperatures of 650 and 800°C for the second stage of the incineration give results which differ slightly but systematically and the temperature of 650°C for the second sulphation and incineration should be officially adopted.
3. As the conductivity ash method at 50 mg.cm^{-3} gave differing results in interlaboratory tests with molasses, its status should be changed from official to tentative for this product. The explanation for the differences should be further studied in collaborative tests and an improved method description submitted to the 18th Session.
4. The conductivity method at 28 g/100 g is confirmed as the official method for determining the ash content of white sugars. The standard deviation of the method is about 0·0003 g/100 g. It is emphasized that the conductivity meter should be standardized with a salt solution of known composition.
5. The tentative status accorded at the 16th Session to the method for determining the ash content of insoluble matter in sugars should be withdrawn; the method is, as yet, too imprecise and should be the subject of further study.

Subject 17: Inorganic non-sugars

Referee: R. DETAVERNIER (France)

1. Analytical methods using atomic absorption (with or without flame or with carbon furnace) for the determination of elements designated as toxic by the Codex Alimentarius Commission and other authorities (As, Pb, Cu, Cd and Hg) and for those elements which are important in the detection of corrosion (Fe, Cr) should be defined.
2. Analytical methods using atomic emission for the determination of the elements referred to in Recommendation 1 should be studied.

3. Methods using differential pulse anodic stripping voltametry (DPSAV) should be compared with those using atomic absorption techniques.
4. For the determination of arsenic in white sugars at levels above 0·03 mg As/kg, the silver diethyldithiocarbamate method should be officially adopted.
5. Methods using ion-selective electrodes for the determination of nitrate, chloride, fluoride, sulphite and ammonium should be further studied.
6. For the determination of copper in white sugars, the oxalyl dihydrazide method should be compared with methods using sodium diethyldithiocarbamate and zinc dibenzyldithiocarbamate.
7. For the determination of SO_2 in molasses, pulp and other products, the Monier-Williams method (with and without the Tanner modification) should be further studied.
8. The method of Pérez & Kara-Murza for the determination of phosphate should be further studied.

Subject 18: Organic non-sugars

Referee: R. REINEFELD (Germany)

1. The method of Kubadinow & Wieninger for the determination of α-amino acid nitrogen using the copper complex should be officially adopted. Its use should, however, be restricted to beet brei and to raw and press juices, particularly in the field of quality control in beet laboratories.
2. The method used by Schiweck & Büsching, as defined in Appendix 2 to the present Report, should be officially adopted for the enzymatic determination of L-lactic and D-lactic acid.
3. The suggestion that the pyruvate formed during the enzymatic determination of lactic acid should be removed from the equilibrium by means of enzymatic amination should be further studied.
4. The tentative status assigned at the 16th Session to the method used by Büsching for the enzymatic determination of citric acid should be retained, but the reasons for the deviations which have occurred in interlaboratory tests should be further studied.
5. The method of Burba & Georgi for the fluorometric determination of amino acid nitrogen should be further studied.
6. The enzymatic determination of L-glutamic acid should be studied.
7. The analytical determination of betaine should be further studied by collaborative investigation using the method of Carruthers, Oldfield & Teague (officially adopted at the 14th Session) and also newly suggested methods using GLC and HPLC.
8. The analytical determination of pyrrolidone carboxylic acid, particularly by means of GLC, should be further studied.
9. The analytical determination of aconitic acid in cane sugar products should be further studied by comparative analyses.
10. The enzymatic determination of formic acid in industrial sugar juices should be further studied.
11. The determination of herbicides and pesticides and their metabolic products should be further studied with a view to developing a GLC technique which would, if possible, encompass several compounds of interest in a single analytical procedure.
12. Comparative tests should be carried out with the aim of developing a catalytic system for the Kjeldahl technique which would not only be suitable for sugar juices, but free of environmental problems.

Subject 19: Characteristics of white sugars

Referee: D. HIBBERT (United Kingdom)

1. The "MA/CV" method of Powers should be collaboratively studied and the results of such studies used to assess the relative merits of the methods of calculation proposed by Butler and by Rens. The method of Bennett, based on the work of Rosin, Rammler & Sperling, should also be included in these studies.
2. Studies on the Hanzas & Barr method and on the Spreckels method for acid floc should be continued.
3. The BNC method for loss on drying of white sugar should be officially adopted, but the temperature differential of 5°C at the time of weighing should be reviewed before the 18th Session.
4. The Commission of the European Economic Community should be informed of the unacceptability of their proposals for the determination of loss on drying of white sugars.
5. The Schneider, Emmerich & Ticmanis modification of the Karl Fischer method for determining total water in white sugar should be tentatively adopted. It should be collaboratively studied and compared with other Karl Fischer modifications with a view to recommending an official method for both total and surface water.
6. The method of Lavoie for the determination of insoluble matter, as detailed in Appendix 3 to the present Report, should be further studied.
7. Studies should be undertaken to enable ICUMSA to make appropriate recommendations to the Codex Sugars Committee on the analytical methods for powdered sugar.
8. Methods should be sought for determining the foaming tendency and "conditioning status" of white sugar.

Subject 20: Deterioration of sugars

Referee: J. M. HUTSON (United Kingdom)

[Report presented by J. V. DUTTON (United Kingdom)]

1. The relative humidity of air in contact with a sample of sugar should be referred to as the sugar's Relative Humidity (RH).
2. If there is evidence that a sample of sugar is at internal equilibrium, the word "Equilibrium" may be used before "Relative Humidity".
3. Instruments depending upon measurement of the resistance of an electrolytic solution, as described in the text, should be favoured for measurement of the RH of sugars.
4. Studies should be made of means to accelerate the arrival of a sample of freshly-made sugar at its equilibrium RH.
5. The relation between Dilution Indicator and RH of sugars should be studied in different parts of the world.

Subject 21: Microbiological tests

Referee: H. P. HOFFMANN-WALBECK (Germany)

Note. The descriptions of the media referred to are given (media 1-13 in *Proc. 16th Session ICUMSA* 1974, 283-284, Appendix 1, and media 14-17a in Appendix 1 to the present Report).

1. Medium 1 (ISO) and medium 5 (US National Committee) should be tentatively adopted for the enumeration of bacteria.

   Further comparative studies should be undertaken with all media (1 to 5 inclusive and Shapton medium) which have been proposed for the enumeration of bacteria, with special attention to media 1 and 5. For the enumeration of slime-forming bacteria, comparative studies should be made of media 13, 14, 15 and 15a (McCleskey-Favelle agar).

2. For the enumeration of yeasts and moulds, media 6, 7 and 9 (the latter containing anti-bacterial agents) should be comparatively studied.

   For the enumeration of osmotolerant or osmophilic yeasts, media 8, 17 and 17a (osmophilic malt agar) should be comparatively studied.

3. For the enumeration of bacterial spores, medium 10, Shapton medium and glucose agar should be comparatively studied.

4. For the determination of mesophilic bacteria, yeasts and moulds, an incubation temperature of 30°C should be officially adopted.

5. For the determination of bacteria by membrane filter techniques, filters with a pore size of 0·2 to 0·45 μm should be tentatively adopted.

6. For the determination of yeasts and moulds by membrane filter techniques, filters with a pore size of 0·8 μm should be tentatively adopted.

7. For the enumeration of bacterial spores, the elimination of vegetative organisms by heating at 100°C for 5 min should be tentatively adopted.

8. The elaboration of rapid methods to avoid long incubation periods of the nutrient media before enumeration should be continued.

9. For the determination of vegetative organisms and thermophilic spores, the test procedures for "bottlers" granulated and liquid sugar and for "canners" sugar described in Appendix 1 and Appendix 2 to the Referee's Report to the 15th Session (*Proc. 15th Session ICUMSA,* 1970, 224-230) should be officially adopted.

10. For the determination of mesophilic bacteria, yeasts and moulds, the membrane filter method described in Appendix 1 to the Referee's Report to the 16th Session (*Proc. 16th Session ICUMSA,* 1974, 284-285) should be officially adopted.

11. For the determination of thermophilic spores, the membrane filter technique and the plate count and tube methods should be submitted to further collaborative study.

12. The agar-containing media 3 and 7 described in Appendix 1 to the Referee's Report to the 16th Session (*Proc. 16th Session ICUMSA,* 1974, 283) and medium 16 in Appendix 1 to the present Report should be compared with corresponding media on nutrient cardboard discs.

Subject 22: Colour and turbidity

Referee: F. G. CARPENTER (USA)

1. For the determination of the colour in solution of all sugars, Method 4 should be officially adopted; results obtained by this method should be reported as "ICUMSA colour", "ICUMSA Method 4 colour" or "ICUMSA 420 colour".

2. For the determination of the colour in solution of dark sugars, such as raw sugar, Method 2 should be regarded as official; results obtained by this method should be reported as "ICUMSA Method 2 colour" or "ICUMSA 560 colour".

3. The filtration steps in methods 2 and 4 should be further studied with a view to making them more rapid, convenient and reproducible.

4. The pH should always be specified as adjusted to 7·0.

5. Further study should be made on a practical method in the determination of turbidity.

6. Further study should be made on specifications for instruments.

Subject 22A: Reflectance and visual appearance of white sugars

Referee: A. EMMERICH (Germany)

1. The influence of size, gloss and surface crystal structure on visual grading and on photometric measurements of white sugars should be further studied.

2. The method of measuring "transluminescence" as an alternative to the measurement of colour in solution should be examined, *either* under Subject 22A *or* under Subject 22.

Visual methods

3. The Braunschweig colour type series should be tentatively retained as a standard, with the intention of adopting it officially at the 18th Session when the measuring conditions have been finally settled.

4. Before reaching the final decision required by Recommendation 3 above, the following conditions should be carefully studied: light sources with a correlated colour temperature of 5000°K, white lining of the sample boxes and white or neutral-grey background.

5. For the control of dye mixtures used in the preparation of the standard colour series, the requirements of Recommendation 3 adopted at the 16th Session should be retained on a tentative basis, with the additional proviso that the mixture should show a smooth reflection curve in the visible spectral range, similar to that of white sugars.

6. Studies regarding the standardization of absolute values for the Braunschweig colour type series should be continued with special consideration being given to the CIE system.

7. Until suitable data are available for absolute standardization, the colour type series should be calibrated by means of the instruments used in Braunschweig at the Sugar Institute and at the Physikalisch-Technische Bundesanstalt (tentative).

Photometric methods

8. Studies on the conditions which must be met by photometric methods in order to enable comparable results to be obtained in different laboratories using different instruments should be continued.

9. In order to simplify evaluation when using tristimulus values, the determination of the chromaticity co-

ordinate z_E instead of the saturation p_0 should be tentatively adopted.

Subject 23: Rheological properties

Referee: T. MORITSUGU (USA)]
[Report presented by A. VANHOOK (USA)]

1. The rotating cylinder method for determining the viscosity of molasses should be adopted as an official standard and, especially in the case of non-Newtonian fluids, the conditions under which the viscosity of molasses is measured, such as temperature, concentration, pH, shear rate, geometry of the spindle and cup of the viscometer used, and any other pertinent variables should be clearly defined.
2. Investigations of factors influencing the rheological properties of molasses and massecuites should be continued, taking into account the effects of aeration.
3. The pipeflow method for determining the rheological properties of molasses and massecuites should be further studied with a view to developing it as a standard technique.

Subject 24: pH and ion-selective electrodes

Referee: J.-P. LESCURE (France)

1. The official status of the method for determination of the pH of industrial sugar solutions adopted at the 15th Session [*Proc. 15th Session ICUMSA*, 1970, 298-299, Rec. 4(*a*)], involving the dilution of viscous samples to 50°Bx, should be maintained since the validity of the method has been confirmed by interlaboratory tests on the pH measurement of molasses.
2. Determination of the pH of raw sugars by direct measurement on a 50°Bx solution should be officially adopted since the validity of the method has been confirmed by interlaboratory tests.
3. The official status of the method of Dubourg, Saunier & Devillers, for determination of the pH of white sugars, adopted at the 15th Session (*Proc. 15th Session ICUMSA*, 1970, 299, Rec. 6), is withdrawn and the method should now become tentative.
4. The exact conditions for the determination of the pH of white sugars by direct measurement on 50°Bx solutions should be further studied, particular attention being paid to the elimination of errors from dissolved CO_2 and from electrolytes originating from laboratory glassware.
5. The method of Covington & Ferra for establishing the performance of glass electrodes should be studied.
6. The effect of stabilization time on electrode response should be studied with a view to establishing both the time required to obtain a stable response after a change of sample and the resultant error when a shorter time is used. The error resulting from the standarization of electrodes by means of an aqueous solution of the ion being determined and using the same electrode for determining the same ion in a sample containing either sugar or sugar and lead acetate should be studied.
7. Use of the multiple additions method, proposed by Brand & Rechnitz, should be studied.

Subject 25: Crystallizng qualities of sugar solutions

Referee: F. HEITZ (France)

1. The tables of Vavrinecz and Charles for the solubility of sucrose should be officially adopted but further work in this field should be undertaken.
2. The "Saturoscope" method and "Polish" test, using the Wiklund relationship, for determining the saturation of low products should be tentatively adopted.
3. Further studies on the boiling point of low products should be encouraged.
4. Work should be undertaken on the crystalline form of sucrose and on its dissolution and crystallization velocities.

Subject 27: Refining qualities of raw cane sugar

Referee: J. S. KENIRY (Australia)

1. The CSR method for the determination of dextran in raw cane sugar, as described in Appendix 1 to the Referee's Report to the 16th Session (*Proc. 16th Session ICUMSA*, 1974, 363-367) should be tentatively adopted under the title "Haze assay for dextran-like material in raw cane sugar".
2. Studies should be continued to develop an acid beverage floc test for raw cane sugars and to establish a relationship between the results of such a test and the results of acid beverage floc tests on the corresponding refined sugar.
3. Work should continue to devise and prove simple procedures for the quantitative estimation of amylose and amylopectin in raw cane sugars.
4. A review should be undertaken of published methods for estimation of starch in raw cane sugar, with a view to recommending the adoption at the 18th Session of one such simple test as a tentative method.

Subject 28: Bone char and other adsorbents

Referee: K. R. HANSON (USA)

1. In the method for determining the bulk density of bone char, officially adopted at the 13th Session (*Proc. 13th Session ICUMSA*, 1962, 20, Rec. 1), the effect of enlarging the exit aperture size of the funnel to 12·7 mm should be studied.
2. In the water extract test for bone char, officially adopted at the 13th Session (*Proc. 13th Session ICUMSA*, 1962, 20, Rec. 1), the expression of results for calcium and sulphate should be allowed in any convenient units (such as mg/kg) and not restricted to meq.dm^{-3}.
3. The methods for anion exchange capacity of ion exchange resins described in Appendix 4a(b) and Appendix 4b(b) to the Referee's Report to the 14th Session (*Proc. 14th Session ICUMSA*, 1966, 161-162) should be further studied.
4. The tentative status of the method adopted at the 16th Session (*Proc. 16th Session ICUMSA*, 1974, 377, Appendix 2) for determination of the cation exchange capacity (Ca for Na) of ion exchange resins should be maintained.
5. Representatives of the different interests in ion exchange resin use should attempt to define the critical properties of ion exchange resins and to prepare procedures for this purpose. □

SUGAR CANE AGRONOMY

Automatic control of subsurface irrigation using tensiometers and evaporation pan for basic plant-water studies. J. C. Mongelard and K. How. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 187-191.—See Mongelard & How: *I.S.J.*, 1977, **79**, 75.

"New" ideas from around the world. K. Shoji. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 205-206.—The author briefly describes developments that have taken place in cane agriculture in countries outside Hawaii, and mentions factory design and operation.

Crop control tools—Laupahoehoe Sugar Company. L. Oudman. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 207-209.—The "tools" discussed include soil sampling and crop logging to determine cane nutrient requirements and utilization; general field observations for fertilization scheduling, to detect any crop shortcomings (including ratoon stunting disease outbreaks) and determine cane ripeness (plus a number of other factors established by aerial observation, e.g. field selection for harvesting and seed cane sources, location of storm damage sites, etc.); the use of observation plots for comparison of practices (without the need for experimental campaigns); cane sett treatment checking (for temperature and "Benlate" concentration); and a number of other checks, such as information on solar radiation, pan evaporation, rainfall and temperature. Harvest results are used for purposes of comparison between practices, varieties, etc.

Crop control tools—Hawaiian Commercial & Sugar Company. J. M. Sakuma. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 210-211.—Details are given of the modified Clements' crop logging system used for scheduling of fertilization, irrigation and harvesting.

Basic concepts of water and nutrient movement in soils. R. S. Uchida. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 212-214.—The important roles played by soil texture (as given by the relative proportion of particle size groups) and soil structure (the result of aggregation of smaller particles into groups) in determining water movement are discussed in relation to drip irrigation. It is explained how the two factors govern the quantity and size of pores in a given soil profile and hence influence the quantity of water a soil can store and thus water movement. Gravity and adhesion act on the water in the pores and cause it to move by capillary action. With time, gravity overcomes the capillary force and causes downward movement of the water, this effect being greater in large-particle than in small-particle soil, which is why good tillage and particle size uniformity are important for drip irrigation. Nutrient mobility in soils is also important where drip irrigation tubing is used for fertilizer application. The mechanics of movement of specific nutrients are briefly explained; movement is either in the form of mass flow, whereby the nutrient is dissolved in the soil solution and flows with the latter, or in the form of molecular or ion diffusion under the effect of concentration gradient.

Nitrate and water distribution in the soil under drip-irrigated sugar cane. M. A. Khan, R. E. Green, L. Santo and M. Isobe. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 215-222.—Investigations were carried out to determine the pattern of nitrate distribution in the soil after leaving drip irrigation tubing, and to relate this distribution to soil water movement. Full details are given of the studies, in which the effects of cane row spacing and drip line spacing (3-6 ft "pineapple" spacing with one line per two rows, and 4·5-ft spacing with one line per row) were also assessed. Results for a crop age of 5-10 months indicated close correlation between nitrate movement and water movement. Accumulations of nitrate below the uncropped inter-row spaces in the pineapple system suggested substantial losses by leaching under the effect of rain, such losses being apparently smaller for the closer line spacings. High nitrate concentrations in the soil 3 weeks after fertilization indicated that a 4-week fertilization cycle at the rates used was too short, and it is suggested that N fertilizer utilization can be increased by more frequent application at smaller doses compatible with the nitrate status of the soil.

Phosphate materials for drip irrigation. M. Smith. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 223-225.—Forms of phosphate fertilizers suitable for application through drip irrigation tubing are discussed.

Problems in the application of nutrients through drip irrigation systems. W. J. Sharratt. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 226-230.—The application of fertilizers through drip irrigation tubing is discussed, starting from the significance of the wetting pattern which develops under a drip irrigation system and the relationship between plant roots and the wetting pattern. Of nitrogenous fertilizers, anhydrous ammonia is one that can create a problem when the irrigation water is high in Ca, Mg and other dissolved elements, since precipitates rapidly form under these conditions. Phosphates produced by the wet process acid method contain a significant quantity of insoluble impurities which make them unsuitable for use with drip irrigation; dissolved salts in the irrigation water may react with impurities in liquid ammonium phosphates to form precipitates. The possibility of injecting wet process phosphoric acid into a drip irrigation system is suggested. Organic phosphates are of advantage chemically but are considered too expensive. Experience in California with fertilization of various crops through drip irrigation tubing is cited.

The influence of weather on the ripening response of "Polaris". K. How. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 231-234.—Investigations of the effect of weather factors on the ripening of two cane varieties treated with "Polaris" are reported. Results showed that the integrated effect of rainfall, radiation and minimum temperature on the ripening process varied according to variety, although in both cases maximum response was obtained at a medium radiation intensity of 350-500 ly.day^{-1} combined with a minimum temperature

above 60°F and a rainfall of 2-4 inches during the ripening period. In most cases, a favourable response was obtained with rainfall greater than 2 in, but a minimum temperature below 60°F and a radiation intensity below 350 ly.day^{-1} caused an unfavourable response in one variety and only a small positive response in the other. In the former variety, the adverse effect of the low minimum temperature was counteracted by high radiation, and in the latter variety by medium radiation. The overall results indicated that, for an unfavourable response to the ripener, the environmental conditions must be such that the cane is not under stress when sprayed and during at least the early part of the ripening period.

Physiological responses induced by cane ripeners. R. E. Coleman. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 235-238.—The physiological or biochemical changes that occur in cane in association with chemical ripening are described, and crop factors influencing the effect of a ripener are discussed. While varietal differences have occurred in the response to ripeners, it is stated that a number of ripeners have been developed (but as yet unregistered) which act on all varieties. Reference is made to the relationship between time and response and to the effect of method of ripener application.

The effect of elevation on age of harvest at Puna Sugar Company. R. S. Uchida. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 239-245.—Cane sugar yields over the 10-year period 1965-74 were analysed and showed a general increase with increasing age of cane at harvest, but also a decrease with increase in the number of ratoon crops, particularly beyond the 2nd ratoon crop. The ages at which maximum yields occurred depended on height above sea level and increased with elevation, e.g. 25-28 months at up to 800 ft compared with 31-33 months at above 1300 ft.

Status report on "Velpar" weedkiller for sugar cane. J. D. Riggleman. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 254-256.—The chemical and physical properties, toxicological properties and residual amounts found in cane, mode of action and behaviour in soil of "Velpar" herbicide are indicated. It can be used as a pre- or post-emergence treatment for plant and ratoon cane, and is effective against a wide range of weeds except established Johnson grass; it is partially effective against Bermuda grass and nut grass.

Cane desiccation with "Paraquat" at the Hilo Coast Processing Company. H. Kaya. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 257-261.—Application of "Paraquat" at unspecified rates a number of days before harvesting led to good cane burning. In all cases "Polaris" ripener had been applied before "Paraquat". Results showed that first expressed juice samples were of higher pol and purity than were those from cane not treated with "Paraquat", whether "Polaris" had been applied or not, while the amount of soil in trucked samples (determined as ash) was lower where the burn had been good than in burnt, untreated cane and considerably lower than in unburnt, untreated cane. Mixed juice colour was also lower after "Paraquat" treatment of cane than without treatment, while improvements in sugar colour may also have been a result of the cleaner, better burnt cane treated with "Paraquat". The monetary savings resulting from reduced haulage of the cleaner cane are calculated.

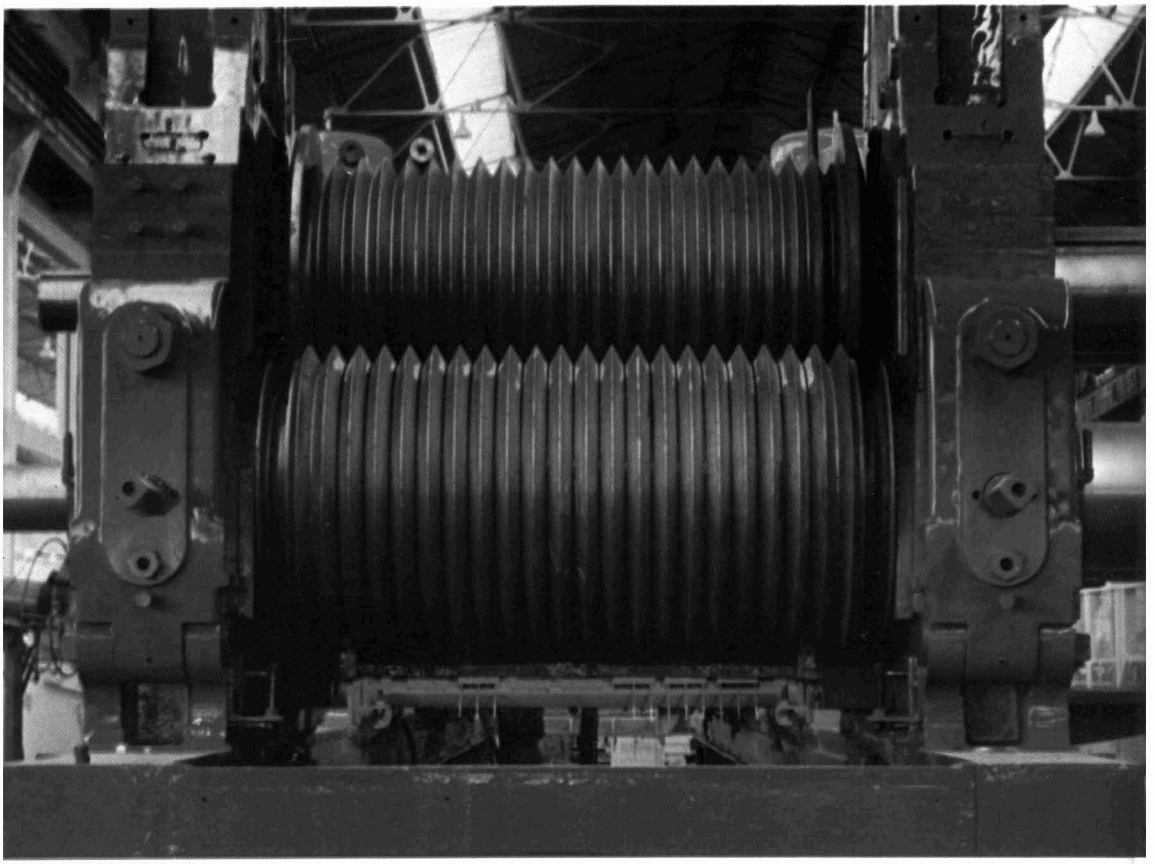
Aerial application of herbicides in Hawaiian sugar cane. R. V. Osgood. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 262-265.—See *I.S.J.*, 1977, **79**, 106.

Potential sugar cane ripeners. D. Takahashi. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 266-273.—Trials with a number of chemical ripeners are reported. Those singled out as showing promise have proved to be effective with several commercial cane varieties.

Yield response of gibberellin at Waialua Sugar Company. R. Sowers. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 274-277.—Application of gibberellic acid (as "Pro-Gibb Plus") to cane at the rate of 2 oz.acre^{-1} increased cane and sugar yield by comparison with untreated cane and cane treated with "Polaris" ripener. However, gibberellic acid plus "Polaris" treatment increased sugar yield to a much greater extent than did the separate treatments, while maximum gain was obtained by splitting the gibberellic acid rate into two equal doses of 1 oz.acre^{-1} five weeks apart. The economic benefits of the treatment are calculated.

Effects of the application of vinasse as a fertilizer on sugar cane quality. J. P. Stupiello, C. A. Pexe, H. Monteiro and L. H. Silva. *Brasil Açuc.*, 1977, **90**, 185-194 (*Portuguese*).—Use of distillery waste as a fertilizer produces an increase in cane yield per hectare but has a deleterious effect on cane quality, with lower pol % cane, lower Brix and pol % juice and lower purity. Trials with three levels of vinasse are reported with zero vinasse as control, and it is concluded that, to avoid unacceptable quality reduction, the vinasse level should be less than the lowest of the three examined, viz. 42 m^3.ha^{-1}.

Cultivation of first ratoon cane. T. Valdes M., R. Tihert and J. I. Martínez. *ATAC*, 1977, **36**, (3), 10-19 (*Spanish*).—Trials were made on comparable irrigated and rain-fed land whereby, 10-15 days after plant cane harvest, the ratoon crop was cultivated (to 25-30 cm in the inter-row) with and without application of fertilizer and the crop grown without cultivation but with and without fertilizer application. The irrigated crop was supplied with water as normal in March, April and May. All the trial areas were kept weed-free. The water content of the soils was measured at 10-cm intervals to 40 cm, both before and after the harvest, while counts and measurements were made of the number of stalks per linear metre of row and average height. The cane yield, sugar content and sugar yield per ha were recorded for all the trials. It was concluded that, unless necessary to control weeds, cultivation was to be avoided since, in its absence, the cane was taller and the sugar yield higher by 1 tonne.ha^{-1} under irrigated conditions and 0·72 tonne.ha^{-1} under rain-fed conditions. Soil density was increased down to 40 cm as a result of mechanical harvesting but no significant difference occurred when cultivation was employed.



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SUGAR CANE MECHANIZATION

Preliminary test on the Massey-Ferguson 201 "Cane Commander" cane harvester. V. L. F. Neto. *Brasil Açuc.*, 1977, **90,** 71-75 (*Portuguese*).—An account is given of trials with a MF 201 cane harvester, operated at three different speeds in burnt cane, and the capacity and field losses measured with three repetitions of each test. The results are tabulated and presented in graph form; the capacity is directly proportional to the speed, and the higher speeds result in a greater field loss.

Mechanized harvesting of sugar cane (adjustment of cultivation). F. O. Brieger and W. M. B. Leite. *Brasil Açuc.*, 1977, **90,** 166-172 (*Portuguese*).—Aspects which must be provided for in preparation for mechanization of cane harvesting are discussed; these include topography of the cane area (elimination of hollows formed by water, erosion, etc.), soil preparation (levelling, removal of trees, rocks, etc.), design and dimension of fields, row length and spacing, roadways, planting of cane and cultivation, and cane varieties. Proper attention to such factors permits delivery of harvested burnt cane to the factory within 24 hours, as at Usina Santa Lydia where the harvest has been mechanized.

Rubber tyre update. G. W. Freeland. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 114-117.—The advantages of rubber-tyred tractors over crawler types are given by a representative of a sugar company as lower capital and running costs, ability to complete a given task more quickly, and greater ease of movement between fields. Although power is not a limiting factor in rubber-tyred tractor operation, traction is a major problem; factors to be considered in endeavouring to overcome this are listed. Mention is made of ploughing equipment available in Hawaii.

Ground herbicide machinery for the Hawaiian sugar industry. J. F. Cykler. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 120-123.—A brief survey is presented of soil herbicide application machinery, and factors to be considered in design and operation of such equipment are listed and discussed.

Sugar loss-trash harvester studies at Laupahoehoe Sugar Company. W. Gibson, B. Gillespie and K. Mashima. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.*, 144-150.—At Laupahoehoe, cane is harvested by cutter-windrower whole-stalk machines and taken by grab loaders from the windrows to road transport; at the factory it is cleaned by the wet method. An alternative method is use of a chopper-harvester which delivers the cane directly to bins or road transport; at the factory the cane is conveyed directly to preparation equipment without wet cleaning. Comparison was made between the two methods and between the performances of a Toft and a Stubenberg-75 chopper-harvester. Results showed that considerable sugar losses (about 0·9 tons of recoverable pol per acre) occurred in the trash extractor fans of the Toft machine, while approximately the same loss resulted from the cross-flow cutter mechanism of the Stubenberg-75. With both harvesters, about 40% less "liliko" (dropped, harvested cane) was left in the fields when the cane was not burnt before harvesting, although both machines left a considerable quantity of such cane, that left by the Stubenberg harvester being almost double the amount left by the Toft. The cutter-windrower system included a "liliko" rake operating with the loaders. Trash extraction by blowing was better than by suction. About 1 ton of dry-weight soil accompanied 100 tons of net cane to the factory when chopper-harvesters were used. An increase of 0·66 tons.acre^{-1} in the sugar yield obtained with the Toft harvester by comparison with the cutter-windrower system (which gave 9·69 tons of sugar per acre) was attributed almost entirely to the omission of wet cleaning.

A level approach to an old problem. Anon. *Australian Sugar J.*, 1977, **69,** 353-355.—Details are given of a grader blade which is mounted between the front and rear wheels of a conventional rubber-tyred tractor. The blade, designed by a Mr. R. Maxwell, is attached by means of a ball joint fixed to the underside of the drawbar and is operated by two hydraulic cylinders which enable it to be raised or lowered. Lateral movement is controlled by a stabilizer bar. The blade does not interfere with normal tractor usage, and has a 9-inch ground clearance when raised, so that it can remain on the tractor under most working conditions. The blade has facilitated drain construction and levelling of uneven land; penetration of hard ground is made easy by utilization of the full weight of tractor plus driver. The grader is also applicable in irrigation contour work and firebreak construction.

Farm transport—cane growers build new haul-out units. Anon. *Producers' Rev.*, 1977, **67,** (10), 23-27.—It is stated that in the last few years there has been considerable effort by both amateur and professional designers in Queensland to find cane handling systems of high efficiency and economy plus high manoeuvrability, speed and simplicity of operation, as well as minimum labour requirements and reduced spillage and cane billet damage. A spate of wet harvests in some areas of Queensland has led to keen interest in the development of infield transport units able to operate under very wet conditions without causing soil compaction and damage to stools. While most infield cane transport is still based on cartage of the empty rail bin to the harvester, there has been a steady trend towards elevating and side-tipping units. Mention is made of a number of transport systems with illustrations.

Trend is to bigger bins and it will continue. Anon. *Producers' Rev.*, 1977, **67,** (10), 32-31.—It is the opinion of a representative of a cane transport system manufacturing company that eventually cane bins will generally be of 9 tonnes capacity, in contrast to 5 tonnes at present carried by most bins. One of the 9-tonne bins in use at Mossman factory is illustrated.

Tipper developmemt and performance. T. G. Fuelling. *Producers' Rev.*, 1977, **67,** (10), 47-52.—See *I.S.J.*, 1978, **80,** 48.

CANE PESTS AND DISEASES

Tassel rot of sugar cane in Maharashtra. M. B. Bachchhav and D. G. Hapase. *Maharashtra Sugar*, 1977, **2**, (9), 41.—An organism isolated from cane affected by a tassel rot was identified as *Fusarium monoliforme* Sheldon and was found to be pathogenic when inoculated into healthy cane.

Transmission by *Dactynotus ambrosiae* from mixed infections with sugar cane mosaic and maize dwarf mosaic virus strains. H. Koike. *Plant Disease Reporter*, 1977, **61**, 724-727.—Itchgrass (*Rottboellia exaltata*) inoculated simultaneously with sugar cane mosaic virus strain I (SCMV-I) and maize dwarf mosaic virus strain A (MDMV-A) became infected with both viruses. When the aphid *D. ambrosiae*, singly or in groups of 12-15, was allowed to feed on the infected plants and then transferred to healthy sweet sorghum, some of the sorghum plants became infected and exhibited symptoms of SCMV-I alone, MDMV-A alone or "mixed" symptoms of both strains. The inoculum from sorghum exhibiting mixed symptoms gave either mixed symptoms or individual symptoms on other plants, while juice from Johnson grass infected with the inoculum produced only MDMV-A symptoms.

The systemic distribution and relative occurrence of bacteria in sugar cane varieties affected by ratoon stunting disease. R. A. Bailey. *S. African Sugar J.*, 1977, **61**, 466-467.—See *I.S.J.*, 1978, **80**, 146.

How sugar cane diseases rob us of sugar. Anon. *Crystallizer*, 1977, **2**, (3), 10-11.—The effects of parasitic diseases such as smut and leaf scorch (infestations of which are serious in some areas of the Philippines) on cane are discussed and the point made that most of the factors which increase a cane's susceptibility to disease can be influenced by agronomic practices. The importance of adequate fertilization for disease resistance is indicated; while excessive N application will lead to development of soft, lush growth with weakened cell walls and hence increase disease susceptibility, a deficiency of K can create many problems and allow pathogens to penetrate the outer tissue, after which the infection may spread at an increased rate. P is essential for energy and early, fast growth, while S is necessary for protein formation; Ca, Mg and other elements also play important roles. Microbial competition with plants for soil nutrients can be very serious in low-fertility soils, while slow plant growth will also help infection.

Nematode population in relation to premature drying of sugar cane leaves during the summer months. F. C. Barredo. *Proc. 24th Ann. Conv. Philippines Sugar Tech.*, 1976, 128-132.—Premature drying of leaves in cane not affected by disease has been observed in fields where part of the crop does not show this characteristic, and examination in one case showed a high soil nematode population. A survey was therefore carried out and in nine out of ten areas a positive indication was found that a high population of nematodes (38% of which were plant parasitic) was associated with premature drying.

Distribution of plant parasitic nematodes associated with sugar cane. F. T. Gargantiel. *Proc. 24th Ann. Conv. Philippines Sugar Tech.*, 1976, 133-136.—A total of 235 composite soil samples from 62 field areas were surveyed by La Granja experiment station of the Philippine Sugar Institute. Nine genera of plant parasitic nematodes were associated with cane, viz. *Helicotylenchus, Pratylenchus, Tylenchorhyncus, Xiphinema, Hemicycliophora, Hoplolaimus, Criconemoides, Longidorus* and *Meloidogyne*. Of these, the first was the most abundant and widely distributed, constituting 33·91% of the total population and occurring in 71·91% of the samples. *Pratylenchus*, which occurred as 25·25% of the population and in 62·97% of the soil samples, ranked second, followed by *Tylenchorhynchus* and *Hemicycliophora* (22·69% and 8·22% of the population and occurring in 48·08% and 37·02% of the samples, respectively). The other genera were found in less than 20% of the soil samples and had very low population counts.

***Metarrhizium anisopliae* (Metch) Sorokin in the control of the froghopper (*Mahanarva fimbriolata* Stal) in the cultivation of sugar cane.** N. Macedo, A. de C. Mendes, P. S. M. Botelho and J. A. Magro. *Brasil Açuc.*, 1977, **90**, 76-79 (*Portuguese*).—A suspension of spores of the fungus *M. anisopliae* was sprayed over a heavily-infested ratoon crop of CB 49-260 cane. Counts were made in the treated cane and in a control area, the relative proportions of dead adult froghoppers being 52·42% and 8·41%, large nymphs 25·91% and 0·94%, and small nymphs 29·90% and 0·13%. The results indicate the possibility of using the fungus for the successful biological control of the froghopper.

Population curve of *Mahanarva fimbriolata* in Araras, SP, and its dependence on the water balance of the region. P. S. M. Botelho, A. de C. Mendes, N. Macedo and S. S. Neto. *Brasil Açuc.*, 1977, **90**, 155-161 (*Portuguese*).—Fluorescent light traps were used at seven locations in the Araras region of São Paulo state and counts of the froghopper *M. fimbriolata* made at intervals of two weeks from October 1972 to June 1977. The results show that appearance of the froghopper occurs between November and April and is closely related to excess of water in the soil; it reaches a peak in the second half of February.

Bait bags—a new and improved form of rat bait distribution. A. Teshima. *Rpts. 1976 Meeting Hawaiian Sugar Tech.*, 246-250.—Experiments with bags containing rat bait (oats treated with anti-coagulant) are reported. At three plantations involved, population reductions were generally in the range 80-93%; Norway and black rats were more inclined to consume the bait than was the Polynesian rat, but it is the Norway rat which is of major concern. However, the anti-coagulant used, "Diphacinone", is rather expensive and may be toxic to other animals.

A new technique in cane cultivation to improve the quality and quantity of cane. Salem Cooperative Sugar Mills Ltd. *Sugar News* (India), 1977, **9**, (4), 27.—A

unit for aerated steam treatment of cane setts at the rate of 2500 two-budded setts per charge has been developed and is described. Air from a compressor is mixed with steam in a chamber and fed into the treatment chamber which houses three large trays. After treatment at 50°C for 1 hour, the setts are treated with "Aretan" and planted.

An integrated schedule of sugar cane disease and pest control based on current investigations. D. N. Gupta, M. R. Gupta, A. Singh and G. D. Pandey. *Indian Sugar,* 1977, **27,** 265-266, 269.—A recommended schedule of treatment for control of specified pests and diseases at various stages in crop development from seed cane and sett selection up to and including the post-monsoon period (July-January) of cane growth is described.

Sugar cane nematodes and the host relationship. S. Varadharajan. *Sugar News* (India), 1977, **9,** (5), 21-23. A survey was conducted in cane fields of a village to determine the nematode population and possibly relate it to wilting of the cane. Twenty genera of nematodes were isolated from a composite made up from 25 samples of soil collected from 0·4 ha. The numbers of each genus found were related to the age of the crop (in the range 1-12 months). Some genera were found throughout the crop period, while some were recorded in different periods. The overall population was maximum at 4-5 months, after which it gradually decreased. Dominant were *Tylenchorhynchus* spp., followed by *Helicotylenchus* spp. and *Criconema* spp.

Rust disease of sugar cane in Taiwan: the causal organism *Puccinia melanocephala* **Sydow.** W. H. Hsieh, C. S. Lee and S. L. Chan. *Taiwan Sugar,* 1977, **24,** 416-419.—In 1977, more than 400 ha of cane fields were infected with rust, variety F 176 being severely affected. The causal agent was identified as *P. melanocephala,* and studies were carried out to establish its morphology and the effects of temperature and water potential on germination of its uredospores. The uredospores are described and photomicrographs reproduced. They germinated in water at 14-34°C (optimum 25°C). Induction of teliospore germination was unsuccessful. The uredospores remained viable up to 2 months when diseased leaves were detached and exposed to a temperature of 5°C, but viability was rapidly lost at temperatures of 26°C and above, indicating the possibility that high temperature is a limiting factor.

Parasites of *Matsumuratettix hiroglyphicus* **(Mats.).** S. L. Tang and Y. S. Pan. *Rpt. Taiwan Sugar Research Inst.,* 1977, (77), 49-58 (*Chinese*).—*Callidosoma matsumuratettix,* a species of earth mite, and *Pipunculus* sp. were found to parasitize *M. hiroglyphicus,* the vector of cane white leaf disease. *C. matsumuratettix* tended to increase in numbers from October to December and parasitized 7·8-21·5% of the host nymphs and adults on wild cane. In a cane field, *Pipunculus* sp. parasitized 20·3-21·8% of the vector nymphs collected in July-August while 8-18·3% of the nymphs found on wild cane in September-December were also parasitized. The actions of both parasites appeared to be an important mortality factor. Since the population of *M. hiroglyphicus* underwent a remarkable decline in December-April, the importance of spring planting of cane to prevent white leaf spread is suggested. A drynid was also found to parasitize the pest in wild cane, but only to a very small extent.

Aerated steam therapy—an improved method of heat treatment of sugar cane seed material. S. Edison. *Indian Sugar Crops J.,* 1977, **4,** 32-34.—A brief description is given of a unit developed at the Tamil Nadu Agricultural University, Coimbatore, for treatment of cane setts with aerated steam for the control of grassy shoot and ratoon stunting disease. The features of the system are compared with those of hot water and hot air treatment.

Scope of heat therapy for the control of red rot disease in sugar cane. A. Jha and R. K. Singh. *Indian Sugar Crops J.,* 1977, **4,** 47-48.—Treatment of red rot-infected cane setts from five varieties with hot air at 54°C for 8 hours or hot water at 52°C for 2 hours had insignificant effect on disease elimination from the clumps after planting, while percentage germination was lower in the treated than in untreated, diseased setts.

The problem of nematodes in sugar cane and their control. M. R. Gupta and S. R. Singh. *Indian Sugar,* 1977, **27,** 201-203.—A survey of nematodes in eight districts of western Uttar Pradesh where cane showed signs of retarded growth, drying of leaf tips and yellowing of leaves revealed eight genera: *Hoplolaimus* spp., *Helicotylenchus* spp., *Tylenchorhynchus* spp., *Pratylenchus* spp., *Meloidogyne* spp. and *Xiphinema* spp. Their distributions are tabulated. Application of 'Nemagon" at 32 litres.ha^{-1} or "Nemaphos" at 100 itres.ha^{-1} was effective in reducing the incidence by about 95% and increasing the cane yield by 22-35%.

Nematodes identified in sugar cane areas in the provinces of north-east Argentina. M. A. Costilla, T. A. Hasselrot de G. and S. González de O. *Rev. Ind. Agric. Tucumán,* 1978, **53,** (2), 55-59 (*Spanish*).—Cane roots and soil samples from the cane areas serving Ingenios Ledesma and La Esperanza in Jujuy and San Isidrí in Salta, and samples from the Famaillá, Cruz Alta, Tafí Viejo, Monteros and Capital departments of Tucumán were examined and the genera and species of nematodes present were identified. They are recorded and include parasites, saprophytes and saprophages, all common to the areas studied.

Chemical sterilizers prevent disease spread. R. Birch. *Cane Growers' Quarterly Bull.,* 1977, **41,** 54.—Advice is given on disinfection of cutter-planters and harvesters to prevent spread of disease between cane blocks or between farms sharing a harvester.

The *Eldana* **cycle.** R. J. Smaill. *S. African Sugar J.,* 1977, **61,** 555-557.—By means of a simple mathematical model, it is shown how the *Eldana* borer can multiply in harvested cane fields (even where the cane is cut to ground level and all stalks are removed) and produce sufficient offspring that after six generations (assumed to be the reproduction rate between harvests) the financial losses equivalent to the sugar eaten by the pest can be considerable. A reduction in the losses can be achieved by paying close attention to field hygiene, i.e. destroying all residual material from the cane, and harvesting early to avoid leaving mature cane standing in the field.

SUGAR BEET AGRONOMY

Phosphorus fertilization of sugar beets. D. T. Westerman, G. E. Leggett and J. N. Carter. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19**, 262-269.—In experiments to assess the P fertilizer requirements of sugar beet at different soil P contents and to determine the effects of P fertilization on soils already containing adequate available P, soil samples were taken and the P content determined by the sodium carbonate method; initial soil and beet petiole nitrate-N was determined with a specific-ion electrode. When the P content in the soil layer down to 9 inches was greater than 10 ppm, P fertilization did not significantly increase beet yield, although neither P fertilizer nor soil P affected beet sucrose content or impurity index. Beets did not respond to P application if the petioles from the most recently matured blades contained more than 1200 ppm phosphate-P in early June and 700 ppm in late August, under which conditions the blades contained 0·24 and 0·21% total P, respectively. Since the whole plant dry weights at thinning were related to final root yields, it was concluded that the yield potential resulting from P fertilization is established early in the growing season.

Use of maleic hydrazide in increasing the sucrose content of sugar beet. O. P. Singh, A. C. Bhalerao and A. R. Ghanekar. *Proc. 5th Joint Conv. Indian Sugar Tech. Assocs.*, 1975, (II), Ag. 95-Ag. 98.—Trials at three locations showed that spraying sugar beet with 0·2% maleic hydrazide (containing 33% active ingredient) at the rate of 500 litres.ha^{-1} 10 days before harvest increased the sugar content by comparison with untreated controls. Spraying 20 days before harvest had less positive effect.

Determination of beet population per hectare. L. Schmidt, A. Havlín and M. Hájek. *Listy Cukr.*, 1977, **93**, 193-201 (*Czech*).—A number of methods were tested in 1966 and again in 1976 and the results verified by programmable computer. The most suitable was found to be counting of the plants in 35 adjacent rows 10 m long in a section of field adequately representative of the overall beet area as regards plant growth. At a plant population of 70,000 per ha the method was accurate to within ±6-8%. The number of counts will depend on total beet area and the presence of headlands. Reference is also made to methods used in France.

The quality of the harvest: factor determining beet profitability. M. Martens. *Le Betteravier*, 1977, **11**, (113), 9, 12 (*French*).—Advice is given on how to achieve best results in beet harvesting by paying attention to leaf removal, lifting of the beets, loading and reclaiming from clamps. The adverse effect of leaves and petioles on beet sugar content, storage properties and processing as well as on total tare is such that their removal in the field is essential.

Harvesting mechanization and losses of sugar beet root and leaf yield. T. Karwowski. *Gaz. Cukr.*, 1977, **85**, 206-208 (*Polish*).—Reference is made to the literature on beet losses resulting from mechanical harvesting and also occurring during handling and storage at the factory. Attention is drawn to the adverse effect of an uneven seedbed, irregular rows and the use of agricultural machinery having wheels which are wider than the inter-row space so that they scrape along the upper edges of the beets. While, in theory, the 12-row Matrot tractor hoe should provide adequate inter-row spacing, in practice the hoe is not properly aligned with the tractor, so that the inter-row distance in some cases is inadequate. Added to this is the risk of incorrect adjustment of the hoe blades. It is considered that, by paying more attention to seedbed evenness, drilling and inter-row spacing, the farmer can reduce beet losses to below 10%.

The concentration of mineral components in plant and soil at the end of the sugar beet growth period. E. Jaszczolt. *Gaz. Cukr.*, 1977, **85**, 232-235 (*Polish*). Details are given of the concentrations of nitrate N, P, K, Mg, Na, Ca and Cl in soil samples taken from beet fields near Warsaw as well as their pH and salinity, while the same seven components were determined in beet roots and petioles of ripe leaves as well as the ash, sugar and dry solids contents. The beets revealed excessive nitrate N, while both soil and beets were deficient in K, indicating incorrect fertilization. Roots of the variety AJ-3 contained the highest sugar concentration of five named varieties.

Beet sampling in fields for sugar content determination. L. Schmidt and R. Bureš. *Listy Cukr.*, 1977, **93**, 217-225 (*Czech*).—Statistical evaluation of the results obtained in estimating crop yield on the basis of sugar determination in beet samples led to establishment of a method for up to 50 ha in which 8 or 9 samples (according to whether headlands are sown or not), each made up of 30 beets, are analysed. The first sample is taken in the 11th row (20 m from the left edge of the field), and subsequent samples are then taken at intervals of 5 m down and across the rows. Fields of 50-100 ha are divided into two halves for sampling purposes and 16 or 18 samples taken, while for 100-150 ha the number of samples is increased to 24 or 27. Accuracy has been found to be within the range between ±0·1% and ±1·0% at a probability of 95-99%. Reference is made to methods used in France.

Experiments on the importance of nutrient supply for sugar beet quality. I. Macro-nutrients (pot experiments). C. Winner and K. Bürcky. *Zucker*, 1977, **30**, 581-589 (*German*).—In pot fertilization experiments, N, P, K, Mg, Ca, S and Na were applied in specified proportions as a standard nutrient mix (plus given quantities of trace elements). Each of the macronutrient components was then reduced in quantity by a stated amount and the composite nutrient applied; similarly, each of the components was increased relative to the others, and the amount of the composite nutrient also doubled. The effects of the deficiencies and excesses on beet quality, weight and sugar content were determined. The results are given in the form of block diagrams, which clearly show the influence of each nutrient.


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Effect of increased nitrogen doses on the development of sugar beet processing quality and storage properties. J. Zahradníček, H. Pavlíčková and J. Jary. *Listy Cukr.*, 1977, **93,** 242-246 (*Czech*).—The effects of nitrogen on beet sugar, ash, α-amino N and dry solids contents were determined for dosage rates of 120, 150, 180 and 210 kg.ha^{-1} applied to the crop up to 28th July, after which the beets in the different trial plots were sampled at 14-day intervals up to 4th November. Results are given in graph and tabular form. Generally, the best overall effect was obtained with 150 kg N per ha, which dosage rate was also optimum with respect to daily losses in stored beet.

The specific beet and sugar losses resulting from mechanical harvesting. A. Bartha. *Cukoripar*, 1977, **30,** 169-171 (*Hungarian*).—Sugar and beet losses resulting from mechanical harvesting were investigated with three different harvesters. Tabulated data are given, showing the percentage of under- and over-topped as well as correctly topped beet, the drop in sugar content resulting from poor topping and the quantity of beets left in the soil and on the soil surface. Of the 10-14% crop loss, 54-60% was accounted for by the beets left in the field.

Experimental results on the control of weeds in sugar beet with products of recent formulation: "Metamitron" and "Ethofumesate". P. Catizone. *Ind. Sacc. Ital.*, 1977, **70,** 113-117 (*Italian*).—Comparative trials were made at two locations using the title herbicides and also "Pyrazon" ("Pyramin") and "Phenmedipham" ("Betanal"). "Metamitron", "Ethofumesate" and "Pyrazon" were used as pre-emergence treatments, as post-emergence in association with "Betanal" plus paraffin oil, and as pre-emergence with "Betanal" plus post-emergence paraffin oil application. "Ethofumesate" was used in conjunction with "Venzar" ("Lenacil"). "Metamitron" gave less variable results than the other treatments in respect of weed species controlled, environmental conditions and application dates, while the best results with "Ethofumesate" were obtained when it was used together with "Lenacil" as pre-emergence treatment followed by post-emergence application of "Phenmedipham" plus paraffin oil. Inter-row mechanical cultivation for weed control at one location, where infestation was light, proved economically similar to the use of chemicals.

Good emergence—prerequisite for high yield and quality. W. C. von Kessel. *Die Zuckerrübe*, 1977, **26,** (6), 8-12 (*German*).—Considerable differences were found between final beet plant populations in West Germany in 1977, the range generally being 40-90,000 plants per ha. Yield and quality differences resulted. It is stressed that optimum harvest conditions and maximum return will be obtained with regular stands at a population of 65-80,000 plants per ha. Optimum is a plant spacing of 20-22 cm. Topping difficulties will occur at below 20 cm, while "gappy" rows having large individual plants will also be difficult to harvest and lead to increased losses through beets left in the field and a reduced sugar content. Advice is given on how to achieve the optimum population by attention to seedbed treatment, correct sowing depth, adequate weed and pest control, proper fertilization, and use of optimum sowing techniques.

Sodium—important nutrient for sugar beet. W. Werner. *Die Zuckerrübe*, 1977, **26,** (6), 16-17 (*German*). Sodium has been found to raise both beet and sugar yield in tests conducted in various countries, particularly England and West Germany (particular reference being made to the findings of Draycott & Durrant[1]). Sodium is mostly taken into the chloroplasts without displacing K, the positive effect of which on cell growth is markely improved by Na application. Na has a positive effect on sucrose concentration in the leaves by altering the K:Na ratio which reduces the activity of the enzyme (starch synthetase) responsible for sugar conversion to starch. Advice is given on Na application to beet, including recommended dosage rates.

A further contribution to the phosphoric acid problem. W. Werner. *Die Zuckerrübe*, 1977, **26,** (6), 18-19 (*German*).—While the P requirement of sugar beet is 80-90 kg P_2O_5.ha^{-1} in a good crop, the amount extracted by the plant from the soil is not evenly distributed throughout the growing season, 60-80% of the total being taken up in June-July, and sometimes as much as 3 kg P_2O_5.ha^{-1}.day^{-1}. However, at normal soil moisture and even with good phosphate supply, the ground water (from which the beet must draw its phosphate) will contain at most 1-1·5 kg P_2O_5.ha^{-1} at any given time. This necessitates replacement of the extracted ground water P with an adequate, steady supply of readily soluble forms of phosphate from the soil reserve; the possibility of achieving this depends on the level of the reserve and, more important, its supply rate. Hence, this reserve must contain a large proportion of very readily soluble, reactive P compounds as particularly represented by "young" conversion products of phosphate fertilizers. It has been established that the effectiveness of such products is much greater than that of the same quantity of "old" soil phosphates. P has been found to increase both beet and sugar yield, but it needs to be applied so that it easily reaches the root system.

Agriculture and sugar beet in Denmark. W. C. von Kessel. *Die Zuckerrübe*, 1977, **26,** (6), 22-23 (*German*). A brief survey is presented of beet agriculture and sugar production in Denmark, with mention of agricultural machinery manufacture and beet testing and research.

Beet leaves—organic substance feeding. Anon. *Die Zuckerrübe*, 1977, **26,** (6), 24 (*German*).—The nutrient value of beet leaves incorporated in the soil is discussed and approximate quantities of N, P, K, Ca and Mg available from 1 ha of beets (assuming 30 tonnes of leaves per ha) are indicated. It is recommended to reduce the leaves to small pieces before adding them to the soil, since freshly harvested, whole wet leaves will not rot if ploughed in and can cause more harm than good; comminuted leaves, on the other hand, readily release their nutrients. This is of particular importance when wheat follows the beet crop.

Self-sufficiency in a cold climate. D. Charlesworth. *British Sugar Beet Rev.*, 1977, **45,** (4), 23-24.—Swedish beet breeding, beet growing and sugar manufacture are outlined.

[1] *Chil. Nitr. Agric. Servi. Inform.*, 1977, 137.

BEET PESTS AND DISEASES

Tests on *Cercospora* control. L. Lukács and J. Zana. *Cukoripar*, 1977, **30**, 161-163 (*Hungarian*).—Tests on *Cercospora beticola* (leaf spot) control are reported. Best results, in terms of beet and sugar yield, beet sugar content and conductimetric ash, were given by 0·6 kg "Fundazol" per ha. A combination of "Fundazol" with 1 litre.ha^{-1} "Titan" or with "Hormon R" did not give as good results as did "Fundazol" alone, while in some cases "Titan" alone at 1 litre.ha^{-1} was less effective than lack of treatment. Some differences were found in the beet varietal responses to treatment.

Derivatives of tin and benzimidazole, alone and mixed, compared with other products in the struggle against *Cercospora beticola* Sacc. G. C. Buongiovanni. *Ind. Sacc. Ital.*, 1977, **70**, 118-120 (*Italian*). In some districts of Italy, strains of *C. beticola* have developed which are resistant to control by benzimidazole derivatives. These strains of the leaf spot fungus have been efficiently controlled by mixtures of triphenyl tin hydroxide (150 g.ha^{-1}) with either "Benomyl" (50 g.ha^{-1}) or methyl thiophanate (70-100 g.ha^{-1}), the first of these mixtures affording a profit of 67,000 lire.ha^{-1} greater than control by the use of 300 g.ha^{-1} of triphenyl tin hydroxide alone.

Influence of various moisture regimes, levels of nitrogen and varieties on incidence of root rot (*Sclerotium rolfsii*) of sugar beet (*Beta vulgaris*). N. L. Bhatia and H. C. Sherma. *Sugar News* (India), 1977, **8**, (10/11), 17-19.—Trials in 1972-73 and 1973-74 involved three moisture regimes (irrigation applied at 70, 50 and 30% depletion of moisture in 1 m soil profile), three levels of N applied (60, 120 and 180 kg.ha^{-1}) and three beet varieties. Lowest incidence of root rot was observed with irrigation at 30% depletion and when 180 kg N per ha was applied in the first year but only 120 kg.ha^{-1} in the second; in both years 60 kg N per ha caused the second highest rot incidence, the maximum occurring when irrigation was applied at 70% depletion. Varietal differences occurred in rot resistance, the best variety being Maribo "Resistapoly".

***Rhizoctonia* root rot resistance in sugar beet: breeding and related research.** R. J. Hecker and E. G. Ruppel. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19**, 246-256. It is stated that, although losses from root rot caused by *Rhizoctonia solani* have not been assessed in the USA, incidence and severity of the disease are gradually increasing throughout the country. Limited protection is afforded by crop rotation, but the fungus survives as a saprophyte in the soil for several years, the incidence decreasing with time in the absence of host crops. On the other hand, incidence has been found to be very high in beet as a monoculture or with two-year rotations. In a programme of beet breeding for resistance to the disease, resistance has been slowly but continuously improved. Details are given of the programme and of results obtained in field tests. It was found that two generations of back-crossing were only slightly effective in incorporating resistance into a susceptible genotype, although up to 70% of the plants in the most resistant breeding lines showed effective resistance in contrast to 0-5% of commercial hybrids. Selection solely for resistance did not drastically reduce the genetic variance for sucrose yield components.

***Penicillium claviforme*: sugar beet pathogen and antagonist of *Botrytis cinerea*.** W. M. Bugbee. *Canadian J. Plant Sci.*, 1976, **56**, 647-649; through *S.I.A.*, 1977, **39**, Abs. 77-1451.—Beet storage rot caused by *B. cinerea* was completely inhibited by an isolate of the storage rot fungus *P. claviforme*, in tests in which cores of beet tissue were incubated on cultures of the fungi separately and together. Storage rot caused by *Phoma betae* was not inhibited. Growth of *B. cinerea* was inhibited 50-100% in liquid cultures containing diluted filtrates of *P. claviforme*. Differing reports as to the prevalence of *B. cinerea* as a storage rot pathogen may be due to this antagonism.

Pesticide interactions in sugar beet. I. Spray compatibility. K. N. Giannopolite. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (30), 337-342 (*Greek*).—Interactions between pesticides in a combination may occur during tank mixing and/or after application to the beet. However, the term "compatibility" applies only to interactions during tank mixing—physical compatibility indicates miscibility, while chemical compatibility indicates that both active and surface-active ingredients of the combined products remain active after mixing. It is stressed that physical and chemical compatibility are not the only factors governing the efficiency of a combination.

Which soil pesticide treatment for pest damage control? G. H. Winder, R. A. Dunning and W. A. Thornhill. *British Sugar Beet Rev.*, 1977, **45**, (4), 5-8, 36. While in the UK there is no really major pest problem that occurs every year, there are many pests which can attack beet sporadically and may be very important to the grower of the beet which they infest. Mention is made of pygmy beetles; millepedes, springtails and symphylids; wireworms; leatherjackets; *Trichodorus* spp. and *Longidorus* spp., nematodes responsible for Docking disorder; and black and green aphids, especially *Myzus persicae*, the virus yellows vector. While soil treatment with "Dacamox", "Temik", "Vydate" or "Yaltox" granules or gamma-BHC spray before or at sowing will effectively control the pests (details are given of which pesticide is suitable for a given pest), it is difficult for the farmer to decide whether to treat the soil, since the question is of a preventive measure, i.e. application must be made before the pests attack. Of the five chemicals mentioned, only gamma-BHC is safe to apply in considerably diluted aqueous solution, while the other four contain highly poisonous active ingredients which, in the absence of pest attack, may adversely affect the crop; moreover, on certain soils, a greater amount of pesticide may be necessary for adequate control, leading to greater risk to the crop. For control of a broad range of pests, "Temik" is considered the most effective, but is expensive at relatively high application rates; gamma-BHC is relatively effective and inexpensive, and can be followed by other sprays for aphid and virus yellows control.

CANE SUGAR MANUFACTURE

Energy consumption in the sugar industry. F. Duguid and R. Alpine. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 26 pp.—The oil, electricity and firewood consumption in cane agriculture, factory processing and sugar distribution to the consumer is calculated for a factory of 4800 t.c.d. crushing capacity supplied with rain-fed plantation cane during a 150- and 270-day season and for an open-pan factory of 100 t.c.d. crushing capacity also supplied with rain-fed plantation cane. The results demonstrate the differences between the two technologies and season lengths, and also show how savings in steam can be achieved in the traditional cane sugar factory in order to achieve a bagasse surplus (for use as a by-products raw material) or to produce more steam and hence power for feeding into the national grid or for local supply. A possibility of energy saving in the open-pan process is also shown, but further research is required.

Recent developments in large-scale vacuum pan sugar technology with particular reference to developing countries. A. W. MacGillivray and G. Wood. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 30 pp.—The origins of modern cane sugar technology are traced and developments in recent years indicated, covering cane harvesting and reception, preparation, milling and diffusion, steam generation, clarification and evaporation (in which there have been few changes, it is stressed), boiling and massecuite curing in centrifugals. In comparing large factories with small open-pan factories, the authors consider it more logical, as regards utilization of scarce resources, operating costs, export potential and by-products availability, to concentrate on large factories rather than small units.

The impact of sugar technologies on social change and development. A. H. Barclay. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 18 pp.—It is dointed out that the establishment of new sugar inpustries in rural African areas can have serious effects on the local population, mainly because of the need for highly skilled labour and management, which creates sharp divisions of class and status within the factory; workers recruited from the local population will tend to remain among the bottom ranks of unskilled workers. The vacuum pan factory is compared with the open pan unit, which does not make such great demands on labour skills and is socially more flexible. However, there are a number of factors needing to be considered in deciding on the form of technology best suited to a given locality and situation, and these are discussed; they include local population participation in ownership and factory control (usually precluded with vacuum pan factories because of their high costs), and cane supply requirements.

The sensitivity of sugar technology performance to changes in technical and economic parameters. R. Alpine. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 15 pp.—The results discussed in the paper by Alpine & Duguid (see *I.S.J.*, 1978, **80,** 309) are investigated to see how they are affected by variation in important technical parameters such as cane yield and sugar recovery in the factory and variation in economic factors.

Impact of different sugar technologies on the economic environment. R. Alpine. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 20 pp. The socio-economic effects of large-scale sugar factory and open-pan factory operation are compared, including employment generation, development of an engineering industry to supply equipment and spare parts, training of skilled personnel (which could have benefits outside the sugar industry) and distribution of the sugar to local markets.

Present and potential sugar production and consumption in Africa. T. Gedamu. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 77 pp.—Sugar production, consumption, exports and imports in 1964-74 are examined for African countries. While all have increased over the period, they have done so at different rates, the increase in per caput consumption being slightly behind the rise in production, while exports have risen more than have imports. It is pointed out that, of the forty-odd independent countries of Africa, consumption is largely concentrated in just twelve (which represent high population concentrations); Tanzania, Ethiopia, Nigeria, Madagascar and Ghana accounted for approximately 74% of the total African consumption. It is predicted that by 1985 Africa could meet domestic requirements and export 3·2 million tonnes more sugar than in 1973/74, assuming 41% of production exported as in 1973/74, when 5·6 million tonnes of centrifugal sugar was produced, and assuming that preferential treatment were given to developing countries within the terms of the ISA. The potential of molasses as raw material for citric acid and sorbitol manufacture in Africa is also discussed.

Economy of scale in the sugar industry. J. M. Paturau. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 33 pp.—The various factors making up the total cost of production of a tonne of cane sugar are examined in order to show how the cost falls with increase in production capacity. The investigation covers cane agriculture, transport and processing. While a large sugar central can bring social and economic benefits, it is pointed out that increase in factory capacity and improvement in steam economy will result in significant increases in the volume of surplus acid condensate which, however, is easy to render usable with proper cooling and aeration; condenser cooling water should pose no real effluent problem if used in a closed circuit through a cooling pond, but cane wash water constitutes a serious source of pollution and generally necessitates rather sophisticated treatment. Boiler stack emission (fly ash and smut) can also prove a nuisance to the local population, but currently available equipment such as dry collectors and wet scrubbers can reduce the load to an acceptable level. Brief mention

is made of the benefits deriving from use of bagasse for board manufacture and of molasses for alcohol production.

Pollution control in the sugar industry. P. Kiravanich and Y. Unkulvasapaul. *Paper presented at Joint UNEP/UNIDO Seminar on Implication of Technology Choice in the African Sugar Industry,* 1977, 31 pp.—The pollution of the Maeklong River in Thailand by sugar factories located along its banks is discussed[1]. Since the central treatment plant built by the Ministry of Industry proved inadequate to handle the effluent, and condenser water of high BOD load was discharged untreated into the river, sugar factories were required to treat the water in aerated lagoons and reduce its BOD content to 20 mg. litre^{-1}. Although the problem is now under control, questions remain on future management of the river, optimum level of discharge, optimum level of river quality to be maintained, etc. For an investigation of the problem, the National Environment Board has developed a computer programme for simulation of the river; verification of the model was carried out by means of two field sampling programmes, and the model can thus be used for prediction of water quality under various conditions. The economics of pollution control are discussed under costs of damage to the various industries and activities and treatment costs to maintain the river dissolved oxygen content at 4 mg.litre^{-1}.

Sugar colour improvements by secondary screening of raw juice and the clarification of *C*-melt. N. L. C. Suzor. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 17-24.—To avoid excessive colour formation in clarified juice[2], bagacillo is removed from raw juice by passing the latter over two DSM screens of 1-mm bar spacing and then over three DSM screens of 0·5-mm bar spacing. The result is a negligible increase in colour throughout the clarification station. The purity rise from mixed to clarified juice is 0·96 compared with 0·20 when the raw juice contained bagacillo. Non-sugar removal is also greater than previously. It is also proposed to replace double purging of *C*-massecuite with phospho-defecation of the *C*-melt. In a pilot plant scheme, the melt passes from a constant head tank to a reaction tank where phosphoric acid and milk-of-lime are added; the melt is then sent through an aerator (a centrifugal pump casing fitted with an open-centre cruciform impeller) to reduce the impurities content. A polymer flocculant is injected between the aerator and the flotation clarifier. While use of 750 ppm P_2O_5 and 1580 ppm lime (as 65% CaO) on melt solids gave 30% greater colour removal than in a system where no phosphoric acid or lime was added, the improvement fell to 22% after a few weeks' operation, and at 500 ppm P_2O_5 addition the colour removal was lower than without addition. Since conductivity ash was reduced by 11% when no phosphoric acid or lime was added, compared with less than 3% when both were used, the author recommends adoption of the simpler system involving only aeration, polymer addition and flotation.

Fire protection and business interruption insurance for sugar factories and associated industrial areas. W. M. Eller. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 25-28.—A brief survey is presented of the modernization of the fire prevention system adopted by Hawaiian Commercial & Sugar Co. at Paia and Puunene factories in order to meet insurance requirements. The survey covers water supply means; an annunciation system showing water flow in each of the risers supplying water to sprinkler systems as well as pump readiness and operation; sprinkler systems (14 at Puunene and 6 at Paia); inspection of pumps and valves and of building interiors (for housekeeping and storage of combustible materials); and training and readiness of fire brigades. Since installation of the new systems, only one fire has occurred; response of the automatic sprinklers is described as "impressive", as was the water pressure for hoses used to wet adjacent areas.

The "Datapoint" mini-computer experience of the Amfac plantations. D. V. Enerson. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 29-38.—Amfac Inc. owns five plantations on four islands and operates a central data processing centre in Honolulu, so that agricultural staff have experienced problems in data processing. In an effort to solve these, the company installed a "Datapoint 2200" fully-programmable, multi-functional mini-computer. Details are given of the processor and ancillary equipment, of its application for agricultural and factory reports and calculations as well as accounting, and of future plans. Print-outs of a daily and a weekly report for Pioneer factory are reproduced.

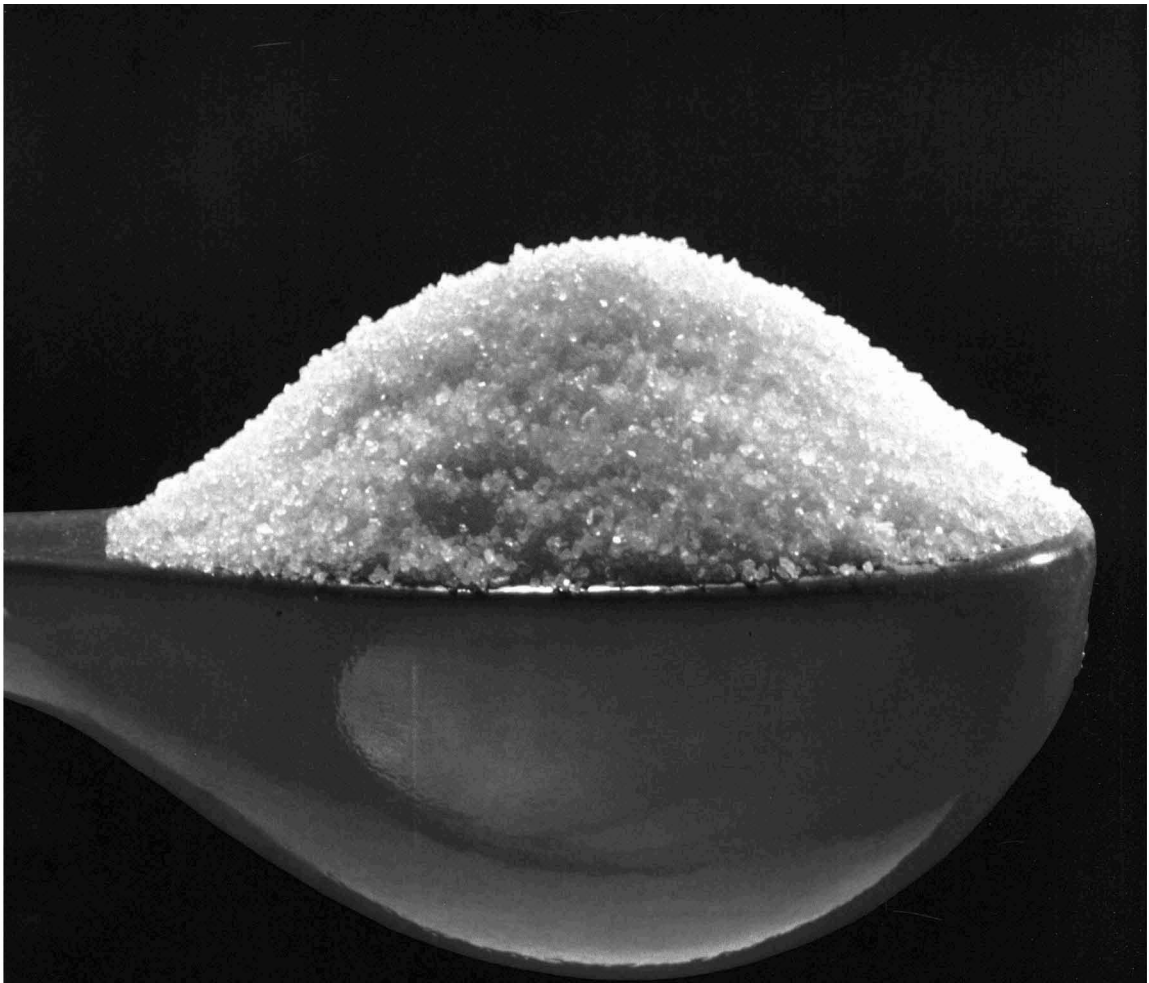
Computer system application for sugar cane milling process. C. C. Harrison. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 39-51.—The inputs, instrumentation, computer hardware and software required for a cane milling control system aimed at achieving uniform throughput, optimizing mill performance and allowing operators of mills or other process equipment to adjust to changes in flow rates or power usage are described Because such a system would be ultimately very complex, it should be introduced in stages. Details are given of each of four phases as well as a schedule of proposed system inputs. Application of the system for maintenance of maximum crushing rate, adjustment of mill roller settings, establishment of optimum imbibition: cane ratios and for total factory coordination is described, and an explanation given of the computer software. The potential financial gains possible as a result of increased milling extraction beyond 94% are indicated.

Computerized weighing and material handling. M. Kleban. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 52-54. The author discusses the advantages of the mini-computer in such operations as weighing. The chief merit is the flexibility and multi-functional characteristic of such a system—any deviations from a given system involves merely change of a programme rather than a change of hardware where a single-function electronic system is used.

The "Perfic" ash removal system. N. Bacon and T. Fetalvero. *Rpts.* 1976 *Meeting Hawaiian Sugar Tech.,* 55-57.—Details are given of various modifications made to the wet ash removal system used for the three boilers at Puunene factory. The alterations, made necessary by repeated ash arrestor hopper chokes, have been successful in eliminating the problems and improving the efficiency of the hoppers.

[1] See also Abdulbhan & Suksupha: *I.S.J.,* 1976, **78,** 266-269, 297-299.

[2] Suzor: *ibid.* 309.



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BEET SUGAR MANUFACTURE

The cost per kWh in a sugar factory. I. T. Bene. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (30), 343-351. **II.** P. Christodoulou. *ibid.*, 352-363 (*Greek*).

I. The cost of electricity generation in a sugar factory is examined where the latent heat of steam from a back-pressure turbine outlet is also used for heating purposes. Fuel oil of a given price and calorific value is considered. The use of turbo-sets operating on high-pressure steam to produce power for supply to the public grid is discussed in the light of experience at the five Greek sugar factories which have fed $22{,}500 \times 10^3$ kWh annually into the public network.

II. The actual costs of power generation are worked out for pressures of 75, 40 and 25 atm and corresponding temperatures of 550, 450 and 360°C of steam fed to a back-pressure turbine, allowance being made for exergy loss.

The sugar industry of Rumania. F. Weiszfeiler. *Zeitsch. Zuckerind.*, 1977, **102,** 734-736 (*German*).—A survey is given of the Rumanian beet sugar industry, with a map showing approximate locations of the 17 factories (including Timisoara II at present under construction) and a table of beet and sugar data.

Intensity of heat transfer during massecuite boiling. V. R. Kulinchenko, V. T. Garyazha and Yu. G. Artyukhov. *Izv. Vuzov, Pishch. Tekh.*, 1977, (4), 153-156 (*Russian*). An equation for calculation of the Nusselt number $Nu = 75\ Pr^{0.2} K^{0.7}$ (where Pr is the Prandtl number and K is the thermal conductivity of a given fluid) proved to be inapplicable to the case of massecuite boiling, where the latter was carried out at pressures in the range 5·2-68·4 kPa, Brix values in the range 73·6-92·4° and crystal contents in the range 10-50%. The reason given is that boiling cannot be regarded as a steady-state process, especially at low pressures, since at any moment sharp fluctuations may occur in one or more parameters, although the overall picture could still be that of a process taking place under regular conditions without any disturbances. The equation has therefore been modified to $Nu = 75 \times 10^2\ Pr^{0.3} K^{0.5} Fo^{0.4}$ at $100\ kPa > p > 20$ kPa (p being pressure and Fo the Fournier number), at which scatter did not exceed ±27% of the mean.

Effect of reducing sugars and their degradation products on properties of sugar solutions. V. A. Golybin and S. Z. Ivanov. *Fiz.-khim. Osnovy Pishch. Tekh.*, 1974, (2), 12-14; through *S.I.A.*, 1977, **39,** Abs. 77-1398.—Model juice containing 12% sucrose was subjected to five model purification schemes with 1% lime consumption; quality parameters at each stage are tabulated. Dorr simultaneous carbonatation degraded only 63·4% of the reducing sugars and led to subsequent rapid colour increase. The Danish and French schemes which included "cold" defecation, gave 97·3 and 96% degradation, respectively, and good thermal stability in all juices.

Coked molasses in the storage tank: a case of deterioration of beet molasses in the US. H. Olbrich. *Branntweinwirtsch.*, 1977, **117,** (6), 104-105; through *S.I.A.*, 1977, **39,** Abs. 77-1411.—At Wahpeton beet sugar factory, North Dakota, molasses which had been stored for a year had changed into a mass so hard and compact that it could only be removed by blowing up the tank. The coked molasses had a pH of 5·1 and contained 57·43% dry solids, 4·84% sulphated ash, 0·98% total N (Kjeldahl) but no sucrose. A mould of the species *Penicillium roquefortii* was detected.

Studies on the filtration impediment in a beet sugar factory. I. On the filtration impediment caused by tyrosine. K. Sayama, Y. Senba and T. Kawamoto. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1977, **27,** 1-7 (*Japanese*).—After low green syrup filtrability had fallen at a Japanese sugar factory, samples were analysed. Tabulated data show that glutamic acid, tyrosine and aspartic acid were the major amino-acids in syrup and 2nd juice. Tyrosine was also found to have a marked inhibitory effect on filtration and represented 79% of the scale in a massecuite mixer. Tests showed that ion exchange treatment of low green syrup with "Amberlite IR-120" in H^+ form removed an appreciable quantity of tyrosine.

On the filtration test of low-grade sugar solution using a pre-coat filter. T. Yamauchi and Y. Takatori. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1977, **27,** 8-18 (*Japanese*).—In view of difficulties of economical filtration of green syrup and final molasses by conventional means, tests were carried out with a laboratory-scale rotary vacuum filter using a special scraper for precoat application and "Perlite" as filter aid. Optimum conditions are given, under which satisfactory filtration rates were achieved and filtrates obtained which were suitable for use as edible syrups. A factory-scale plant for edible syrup production from molasses was designed, comprising plant for filtration, demineralization, decolorization and evaporation. The total handling costs were calculated for treatment of 10 tonnes of molasses daily; the costs of filtration and evaporation constituted almost half of the total.

Aspects of the energy economy in French sugar factories. J. Ledoux. *Sucr. Belge*, 1977, **96,** 447-456 (*French*).—After recalling the development in energy costs since 1973 and its effect on the cost price of sugar, the author describes measures adopted in France to encourage a reduction in energy consumption by sugar producers, viz. introduction of a parafiscal tax on consumption where this exceeds a set value, and introduction of premiums to be paid where investment has been made for purposes of reducing fuel and energy consumption. The steam consumption at each process station of a hypothetical sugar factory is indicated. The point is made that the values given are only approximate and that the total consumption is below the average for a French sugar factory; but the energy balance is claimed to correspond to that of a new factory operating an optimum heat exchange scheme. Advice is given on how to obtain optimum conditions in boiler and hot water heat exchanger operation, diffusion and boiling.

An example is described of a sugar factory slicing 3900 tonnes of beet daily which reduced consumption by means of certain measures which are described; the investment costs were somewhat high, but it is calculated that, with 20% of the costs paid by the Government, 2·7 campaigns would suffice to cover them.

Optimization of low-grade massecuite ripening. I. Fundamental balances in optimization of temperature control. J. Buriánek and H. Ondrušková. *Listy Cukr.*, 1977, **93**, 252-261 (*Czech*).—In recent years there has been a considerable fall in juice purity in Czechoslovakian sugar factories, resulting in an increase in the quantity of low-grade massecuite, and in molasses yield and sugar content per unit sugar yield. Hence, it is important to optimize low-grade massecuite crystallization whereby exhaustion is maximum. The process is examined theoretically, and calculated values are given of massecuite sugar content at constant mother liquor purity and of temperature to give a required supersaturation as a function of massecuite composition and mother liquor purity. Tests conducted at Nymburk and České Mezírící on control of cooling temperature without water dilution confirmed the validity of the theoretical assumptions.

Experiences in forced ventilation and freezing of beet, using flumes as air ducts. A. B. Shuvalov. *Sakhar. Prom.*, 1977, (12), 24-25 (*Russian*).—At Nurlat sugar factory forced ventilation of stored beet has been carried out since 1962, and every year 20-42,000 tonnes are stored in a frozen state. However, experience with wooden or metal air ducts has shown that their life is limited to 1 year. Recently, use has been made of the concrete flumes, with two fans feeding air via corrugated iron piping into the flumes and thence to the centre of the pile. Means are provided for prevention of change in air pressure. When the air temperature falls below 0°C, the fans are switched off, and are switched on again at the onset of continuing frosts in November-December in order to freeze the beets. Once the temperature inside the pile falls to —8°C, the fans are switched off and the beets can be stored until February-March.

Protection of disc filter frames from damage by corrosion. V. F. Rafal'skii, N. P. Romenskii, V. P. Zubchenko and I. K. Klebanova. *Sakhar. Prom.*, 1977, (12), 25-27 (*Russian*).—Disc filters used for 1st and 2nd carbonatation juice and syrup have been found to suffer from corrosion of the frames. Tests at a sugar factory have demonstrated the effectiveness of their treatment with rust remover and application of an epoxy resin protective surface. The procedure used is described.

The A2-PVU-40 vacuum pan. V. T. Garyazha *et al.* *Sakhar. Prom.*, 1977, (12), 27-30 (*Russian*).—After tests with an imported vacuum pan having two calandrias, a new vacuum pan was developed in which massecuite circulation is increased by injection of steam into the calandria tubes[1]. This is achieved by means of a small calandria, identical in shape and parallel to the main floating calandria but having tubes 140 mm in height as opposed to 1100 mm in the main calandria; the tubes of the small calandria, which is mounted below the main one, carry 1-mm diameter perforations which are at an angle of 15° to the tube wall so as to permit flow of steam into the calandria and massecuite above. Steam is fed into the lower calandria from below the pan floor, while the main calandria receives steam via a lateral port. Tests at Elgava sugar factory with beet syrup and raw cane sugar remelt indicated a 3% increase in massecuite crystal content as a result of the increased circulation, while the colour of *A*-sugar fell by more than 10% and the linear crystal growth rate for the raw sugar massecuites rose by 130-180%. The degree of variance in crystal size fell by 10-28%, while the boiling time was cut by up to 45% for 1st and 4th products (raw cane sugar) and 30% for 2nd and 3rd products (beet). The heat transfer coefficient was 23% higher for 1st product and 58% higher for 4th product than with conventional boiling, while the increase for 2nd and 3rd beet products was 60 and 100%, respectively.

Variants of processing conditions in massecuite boiling with surfactant additions. Ya. G. Ropotenko, Yu. D. Kot and I. G. Bazhal. *Sakhar. Prom.*, 1977, (12), 34-36 (*Russian*).—Advice is given on the dosage rates and points in the boiling process at which to add surface-active agents to *A*, *B* and *C* massecuites, according to massecuite purity ranges, in order to prevent foaming, improve crystal size distribution, prevent twinning and reduce viscosity.

Optimization of a scheme for vacuum-condenser plant in a beet sugar factory. V. I. Dovgopol, S. A. Zozulya, A. I. Khomenko and Yu. F. Tsyukalo. *Sakhar. Prom.*, 1977, ((12), 45-51 (*Russian*).—While existing types of condensers available in the USSR provide required heat and process conditions only in small factories (up to a daily slice of 2000 tonnes.day^{-1}), there are a number of problems concerning the use of surface condensers, so that their use is not envisaged in the near future. A number of suggestions for solving the problem of steam usage and condensation are examined and criticized, and information is given on the design of a direct-flow mixing condenser which proved very reliable at a number of factories but still did not provide the requisite fall in temperature of the incondensable gases withdrawn. However, a scheme was tested in which 85-90% of pan and evaporator vapour was condensed in this unit after slight modification, while the rest of the vapour and incondensable gases passed from the first condenser to a counter-flow, segmented-tray condenser. Results showed a 15-fold drop in hydraulic resistance, a 20-30% reduction in cooling water consumption and a considerable reduction in plant dimensions. An additional pump is needed, however.

New ion exchange systems for the beet sugar industry. III. Processing of ion exchange waste. D. Costesso, A. C. Gupta and K. W. R. Shoenrock. *Zucker*, 1977, **30**, 673-675 (*German*).—See *I.S.J.*, 1977, **79**, 173.

First campaign at Appeldorn sugar factory. Anon. *Zucker*, 1977, **30**, 689-690 (*German*).—Brief information is given on the layout and equipment at the new raw sugar factory of Pfeifer & Langen at Appeldorn in West Germany, and a list is given of manufacturers who have installed equipment in the factory.

[1] Garyazha *et al.*: *I.S.J.*, 1976, **78**, 185.

NEW BOOKS

1976 Annual Report. R. L. Cushing. 85 pp; 20·0 × 26·6 cm. (Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, USA.) 1977.

Reports on a very wide range of research projects are summarized under the various divisional headings: "Breeding and selection", "Environmental studies", "Irrigation", "Nutrition and fertilizers", "Growth and metabolism", "Pests and their control" (including weeds, rats, insects and diseases), "Harvesting", "Cane and juice processing at the factory", "Environmental quality", "Energy" and "Miscellaneous". Highlights of this work mentioned in the Director's letter of introduction to the report include discovery of a new strain of the cane smut causal organism, varietal distribution in Hawaii, investigations on the transmission of Fiji disease by the leafhopper, application of drip irrigation, study on the effect of weather and the physiological status of the cane plant in response to gibberellic acid and cane ripeners, a re-investigation of sulphitation in the raw sugar factory, and the search for better herbicides and means of controlling ants.

Annual Report 1976-77. 79 pp; 21·0×29·7 cm. (South African Sugar Association Experiment Station, Mount Edgecombe, Natal, South Africa.) 1977.

This report, introduced by the Chairman of the Experiment Station Committee and by the Director, Dr. G. D. Thompson, records the work done under a series of headings. "Coordinated projects" include a study on fertilizer needs for former wattle land when used for cane, identification of nematodes as the cause of poor growth in the Upper Tongaat region, soil salinity treatment in the Nkwaleni Valley, preparation of new experimental land at La Mercy which includes a run-off and erosion study, investigations into low cane sucrose in the Natal Midlands and into cane growth potential in Table Mountain Sandstone soils. "Agricultural Engineering" covers trials with the McConnel Stage 2 and the Experiment Station's own designs of harvester, and the Edgecombe cane cutter as well as machines for planting and application of chemicals. The reports under "Agronomy" are of work on chemical ripeners, herbicide screening, herbicide phytotoxicity, minimum tillage and nematicides, as well as research on sugar beet growing, moisture stress effects on cane, water duties at Pongola, varietal performance and testing, etc. The remaining sections, "Chemistry and soils", "Entomology and nematology", "Land and water management", "Plant breeding", "Pathology", and "Biometry" discuss progress in these fields, while separate sections describe other functions of the station including extension services, scientific liaison, training and service departments. A comprehensive overview is given of the station's work, while a list of publications indicates where more detailed reports on individual topics are to be found.

Annual Report 1978. 36 pp; 10·0×27·1 cm. (Queensland Cane Growers' Council, Edward Street, Brisbane, Queensland, Australia.) 1978.

This report, well-illustrated with a number of excellent colour photographs, provides a detailed account of the work of the Council in providing technical, legal, industrial and financial services to cane growers. In addition, background information on the Australian economy is included as well as discussions on the 1977 International Sugar Agreement and export marketing contracts with Japan, Malaysia and other countries, and domestic sugar and cane prices. The 1977 crop in Queensland and New South Wales is described, and reports presented on Australian participation in the 1977 ISSCT Congress in Brazil, the 1977 meeting of the QSSCT, etc.

Sugar y Azúcar Yearbook 1978. 179 pp; 20·7×28·6 cm. (Palmer Publications, 25 West 45th Street, New York, NY 10036, U.S.A.) 1978. Price: $30.00.

This book is a revised edition of the 1975 yearbook and comprises a directory of cane sugar factories in 82 countries (and occupying 52 pages, the balance being advertisements). The capacities of the factories, names and addresses of the owners and, where available, the managers' names are included as well as, for appropriate countries, information on sugar producers' associations and research stations.

Production of microbial protein from farm industry by-products. C. Rolz and S. de Cabrera. 171 pp; 16·0×20·7 cm. (Instituto Centroamericano de Investigación y Tecnologia Industrial, Apartado Postal 1552, Avenida La Reforma 4-47, Zona 10, Guatemala City, Guatemala.) 1977. Price: $CA15.

This monograph, in Spanish, has been produced by the Heads of the Applied Research Division and Microbiology Section, respectively, of the Institute, and is concerned with production of microbial protein as an ingredient in fodder and food. In industrialized countries lacking cheap carbohydrate sources, efforts have been concentrated on use of other raw materials including hydrocarbons, alcohols and cellulose. Agriculturally-based tropical countries, by contrast, should devote their research efforts to utilization of agricultural products including by-products from sugar cane. As a stimulus to such research the authors have provided a work which includes a survey of the characteristics of the micro-organisms which may be used in the production of microbial protein, characteristics of the substrates derived from agro-industry, technical and economic aspects of microbial protein production and development of protein substances derived from the micro-organisms. A guide to the technical literature on the subject is provided, with 59 pages of references.

Report, 1974/75 season. 87 pp; 19·5×27·6 cm. (Centro de Investigación y Mejoramiento de la Caña de Azúcar, Casilla 2731, General Saavedra, Santa Cruz, Bolivia.) 1976.

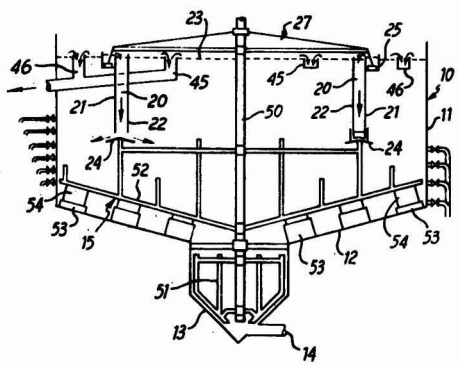
This well-printed report provides much detail of the work of the Bolivian sugar cane research station under its Director, Guillermo Kenning Voss, covering irrigation × fertilizer × varietal trials, evapotranspiration in cane, seed production, pest and disease control, fertilizer trials, varietal trials and introduction of improved varieties. A list of diseases prevalent in the Santa Cruz cane area is presented and details of weather conditions are given.

PATENTS

UNITED KINGDOM

Citric acid production. Pfizer Ltd., of Sandwich, Kent, England. **1,418,561.** 26th June 1973; 24th December 1975.—An aqueous medium containing carbohydrate (cane molasses or beet molasses) as the source of assimilable carbohydrate as well as other essential nutrients is fermented continuously with a citric acid-producing yeast (*Candida guilliermondii* ATCC 20376) with continuous addition of carbohydrate and yeast nutrients, medium containing citric acid being withdrawn at such a rate as to leave a constant volume, maintaining the pH of the medium at 2·5-4·5 (2·8-4) (by addition of gaseous or aqueous ammonia) and the temperature at 22°-35°C (22°-32°C) (26°-30°C) (and the medium aerated by sparging with 0·3-1·5 volumes of air per volume of medium per minute) and recovering citric acid from the withdrawn medium.

Clarifier. Sugar Research Ltd., of Mackay, Queensland, Australia. **1,419,495.** 28th December 1971; 31st December 1975.

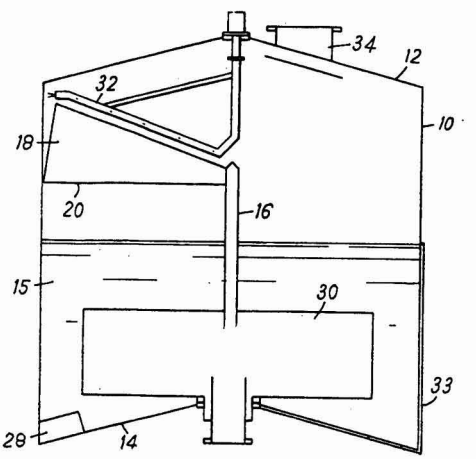


The clarifier comprises a tank 10 having a cylindrical upper body 11 and a frustro-conical bottom 12, a central sump 13 and a mud outlet 14. A central rotating shaft 50 carries radial arms 27 at the ends of which are scrapers which dip into an annular trough 25, the outer wall of which is higher than the juice level 23. The inner castellated wall of the trough is attached to and feeds into an annular feed well 20 formed by cylindrical walls 21, 22, the inner wall 22 rising above the juice level 23. Beneath the bottom of the feed well is a circular deflector plate 24 mounted on the frame 52 which is itself mounted on shaft 50. The shaft also carries mud thickening stirrer arms 51 and the frame 52 also carries mud scraper blades 53 which are of greater height nearer the centre of the clarifier (where the mud is thicker and the linear speed smaller than nearer the periphery), and which are staggered on adjacent arms of the frame so that the whole of the bottom 12 is swept by the scrapers.

Tangential feed pipes supply cloudy juice into the trough 25, flocculant solution being added just before the juice enters the trough, so as to avoid damage to floc formation. The juice enters the feed well and is directed horizontally by deflector 24. Clear juice is withdrawn through circular launders 45 and 46 while mud settles on the bottom of the vessel and is swept into the sump 13 by scrapers 53. Pockets of juice and air are liberated by stirrer 51 and the mud is withdrawn through pipe 14. The size of the overflow sections of the castellated wall of trough 25, and the rate of admission of juice are such as to eliminate turbulence and allow gentle controlled flow which encourages settling.

Continuous vacuum pan. Soc. Fives Lille-Cail, of Paris, France. (*A*) **1,421,576**; (*B*) **1,421,577.** 22nd March 1973; 21st January 1976.

(*A*) The pan comprises a cylinder 10 with conical top and bottom 12, 14 and a cylindrical heating element 30. It is divided into compartments by a series of radial vertical walls 15 all but one wall having an aperture 28 for communication of one compartment with the next. Above the compartments is a perforated pipe 32 which rotates about the pan axis and can supply feed liquor to each, the rate of addition to each being regulated by either the rate of flow of liquor or the length of time the pipe is over the compartment, and this variation being governed by a cam-type or other controller for the motor of the rotating shaft, etc. The feed liquor is sprayed onto the sides of the walls 15, so keeping them free of incrusted crystals. As the liquor loses water by evaporation it is replenished by feed liquor and the massecuite so formed passes through apertures from the first compartment after the wall 15 without an aperture to the last from which it is withdrawn.



(*B*) The amount of liquor fed to each compartment is controlled by a series of shutters 18 so that at a constant speed of rotation of arm 32 the time spent over the open

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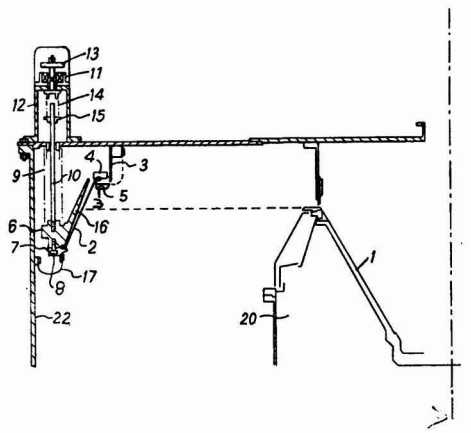
area between shutters, and so supplying feed to the individual compartments, is as required. An additional feed supply to each compartment may be through the wall of the cylinder, under the control of a valve governed by measurement of the density of massecuite in the final compartment. Additionally, density measurement may also be applied to regulation of the steam pressure in the heating element 30.

Beet harvesters. Ransomes, Sims & Jefferies Ltd., of Ipswich, Suffolk, England. **1,425,317.** 2nd November 1972; 18th February 1976. **1,426,548-1,426,550.** 2nd November 1972; 3rd March 1976.

Continuous centrifugal. Fives Lille-Cail of Paris, France. **1,426,289.** 18th May 1973; 25th February 1976.

Crystals discharged over the rim of the cone-type centrifugal basket 1 are flung by centrifugal force against the resiliant sleeve 2 which is frustro-conical in shape and deflects the sugar downwards within casing 22. The upper edge of the sleeve is provided with a bead which is clamped between screw 5 and belt 4 mounted on support 3 which is rigidly fastened to the casing. The lower edge is also provided with a bead and attached to the heavy ring 6 which is mounted on vertical shaft 10 and may be thrust downwardly by spring 9 and raised by the electromagnets 11. The ring also carries a crown portion 16 which protects the sleeve 2 in the event of its being struck by a particularly massive amount of discharged material.



The operation or the electromagnets causes the ring to oscillate vertically, the sleeve stretching and contracting, so that any sticky material clinging to it is discharged with the rest of the sugar crystals.

Cane harvester and windrower. Sugar Cane Growers Cooperative of Florida, of Belle Glade, FL, U.S.A. **1,427,274.** 18th January 1974; 10th March 1976.

Animal fodder. Beecham Group Ltd., of Brentford, Middx., England. **1,427,798.** 25th February 1973; 10th March 1976.—A self-setting feed block mix comprises 0·9-1·2 (1) parts of water, 0·8-1·3 (1) parts of molasses, 3·0-5·0 (4) parts of a feed (e.g. wheat) and 3·5-5·0 (4) parts of a concentrate in the form of a mixture of 16·25-30% (23-28%) of urea, 13·75-21·25% (16-19%) of a lignosulphonate binder, and 18·75-37·5% (18·75-25%) of calcined magnesite (plus 20-30% salt and 12-17% of vitamins and/or minerals). The mix is poured into a mould to produce a feed block.

Cane harvester. F. W. McConnel Ltd. and J. C. Hudson. **1,427,930.** 2nd May 1972; 10th March 1976.

Preparation of sucrose derivatives. Tate & Lyle Ltd., of London, England. (*A*) **1,430,288.** 26th October 1973; 31st March 1976. (*B*) **1,431,559.** 26th October 1973; 7th April 1976.

(*A*) Sucrose is reacted with (10 moles of) methane sulphonyl chloride in N,N-dimethyl formamide to yield 6,6′-dichloro-6,6′-dideoxysucrose and/or 1′,6,6′-trichloro-1′,6,6′-trideoxysucrose which are separately isolated from the reaction mixture by column chromatography or converted to their hexa- and penta-acetates, respectively, which are separated from each other by column chromatography and the acetates then deacetylated.

(*B*) 6,6′-Diazido-6,6′-dideoxysucrose is hydrogenated using as a catalyst palladium on $BaSO_4$ or charcoal, platinum oxide or Raney nickel, to give 6,6′-diamino-6,6′-dideoxysucrose. This may be reacted with acetic anhydride in methanol to yield 6,6′-diacetamido-6,6′-dideoxysucrose, and this, when reacted with acetic anhydride in pyridine, yields 6,6′-diacetamino-1′,2,3,3′,4,4′-hexa-*O*-acetyl-6,6′-dideoxysucrose.

Batch-type centrifugal discharge valve. The Western States Machine Co., of Hamilton, OH, U.S.A. **1,434,097.** 25th May 1973; 28th April 1976.—See US Patent 3,773,253[1].

Centrifugal screen. Maschinenfabrik Buckau R. Wolf AG, of Grevenbroich, Germany. **1,434,769.** 22nd June 1973; 5th May 1976.—Circular elements in the form of wires, filaments or bars of suitable cross section are coated with a protective material of a thickness half of the desired clearance between them when employed as a centrifugal screen. At intervals around the circles this coating is removed and the rings, held together on a core in the desired position, are then fastened together by deposition of metal in an electrolytic bath, by welding or soldering the unprotected metal parts together or by bonding a synthetic material unaffected by solvent which removes the coating. The joints form ribs longitudinal to the axis of the basket. Once rigidly fastened together, the elements are treated to remove the remaining coating, which leaves a circular gap between them for separation of the mother liquor from solids which remain in the centrifugal. In the case of a continuous centrifugal, adjacent circular elements are of different diameters so that the basket built up is frustro-conical, and separation of sugar crystals and molasses is aided by steps or variations in the angle to counteract the decreasing fluidity of the massecuite as mother liquor is lost. As another alternative, the conical centrifugal basket can be built up in exactly the same manner but using suitably shaped coated elements in the form of bars which are joined by electrolytic deposition, soldering, welding or bonding, these joints forming circles around the axis of the basket and the gaps between bars being longitudinal to the axis.

[1] *I.S.J.*, 1975, **77**, 220.

Czechoslovakia sugar exports[1]

	1977	1976	1975
	tonnes, raw value		
Algeria	6,315	0	0
Benin	0	0	1,630
Bulgaria	0	0	7,935
Cameroun	0	43	2,489
Chad	0	43	3,283
Cyprus	0	0	1,087
Gabon	0	175	1,946
Germany, West	1,059	435	15,452
Hong Kong	0	326	109
Hungary	0	0	11,773
Iceland	0	130	626
Indonesia	25,107	0	0
Iraq	0	0	10,729
Italy	43	0	1,202
Ivory Coast	0	0	1,087
Jordan	2,173	542	15,178
Kenya	11,717	0	10,598
Kuwait	0	0	1,087
Lebanon	4,826	0	4,674
Mali	0	0	1,956
Malta	0	0	1,087
Nigeria	0	0	2,119
Norway	2,317	10,054	7,516
Saudi Arabia	110,949	26,174	75,928
Singapore	0	0	1,087
Sri Lanka	4,598	0	0
Switzerland	1,457	900	7,983
Syria	0	0	7,517
Turkey	0	0	12,500
UK	0	0	1,705
USSR	0	31,522	1,086
Yemen Dem. Rep.	0	0	13,424
Other countries	173	65	2,235
	170,734	71,496	227,028

Süddeutsche Zucker AG Interim Report 1977/78.—Because of the world sugar surplus, the beet area for the 1977/78 crop was reduced by 5·5% to 109,000 ha (in contrast to 115,300 ha in the previous year). Because of poor weather conditions followed by frost, drilling of all but 5% of the area had to be postponed until early April. Considerable rainfalls after sowing led to somewhat muddy conditions, while cool weather retarded germination. Nevertheless, emergence was helped by warm conditions with moderate rainfalls, so that stands in the early growth period were particularly uniform, with few gaps. The favourable conditions in the summer months led to an unexpectedly high yield of 5,770,000 tonnes of beet (compared with 5,680,000 tonnes in the preceding year), while both quality and sugar content were higher than in 1976/77. In an almost trouble-free campaign, 786,000 tonnes of sugar were produced (by comparison with 733,900 tonnes in 1976/77); of this, 29,500 tonnes exceeded the maximum quota set for the company, and had to be sold as C-sugar outside the EEC. A Quentin unit and vertical crystallizers installed at Gross-Gerau factory fully came up to expectation in helping to raise sugar output. The aggregate daily slice of the seven Südzucker factories was 59,300 tonnes (compared with 58,700 tonnes in 1976/77). The 1977/78 campaign was a trial period for beet payment on the basis of sugar content, a system welcomed by farmers who adopted many of the measures recommended by the company for raising beet quality and thereby gained from the payment system. Sugar sales by Südzucker in 1977/78 totalled 490,000 tonnes (a gain of 86,000 tonnes on the previous year), the most important customers outside West Germany being Italy and Switzerland.

Yeast factories for Cuba[2].—A new torula yeast factory, the first of ten, is being erected close by Central Guatemala in the municipality of Mayarí. It is to be completed by the end of 1978 and will produce yeast from molasses, for incorporation in poultry and pig fodder.

Brazil sugar expansion[3].—Sugar production in the State of Ceará is to be increased to 2·9 million bags of 60 kilos each. In order to attain this goal, four new sugar factories will be built, in Uruburetama, Baturité, in the Ipiapaba Mountains and in the Cariri Valley.

Guatemala sugar statistics[4]

	1977	1976	1975
	tonnes, raw value		
Initial stocks	37,457	45,755	59,387
Production	486,894	517,312	384,146
	524,351	563,067	443,533
Exports	293,610	321,475	203,872
	230,741	241,592	239,661
Consumption	221,932	204,135	193,906
Final stocks	8,809	37,457	45,755
Exports			
Canada	—	—	10,399
Egypt	—	—	6,672
France	—	—	11,863
Italy	—	—	30,098
Morocco	—	13,767	13,776
Portugal	—	—	13,242
United Kingdom	—	—	62,344
USA	293,610	307,708	55,478
	293,610	321,475	203,872

Egyptian beet sugar company[5].—A contract was signed at the beginning of 1978 for the formation of Egypt's first large beet sugar company. The Delta Sugar Company, as it is called, will produce 100,000 tonnes of beet sugar a year on an area of 132,000 feddans of reclaimed land. Taking part in the project will be Arab and foreign investors including the Arab Company for Investment, the Islamic Development Bank and some French companies. Also the International Finance Corporation, an affiliate of the World Bank, is investing US$23 million. The sugar complex, which is sponsored by the Société des Sucreries et de Distillerie d'Egypte, is expected to start production in 1980.

Congo sugar project[6].—The Republic of the Congo and the Canadian company, Redpath Industries Ltd., have signed an agreement to develop sugar processing plants at Nkayi, about 220 km west of Brazzaville, according to an announcement by the Congo Government. In the first phase of operations, Redpath will aim to improve agricultural and industrial methods leading to production of 75,000 tonnes of sugar in three season's time and 92,000 tonnes in the season after that. Sugar production in the Congo in 1976 was 30,000 tonnes, compared with around 100,000 tonnes in 1965, before the Congo's French sugar companies were nationalized in 1969. Sugar industry sources said the decline in production is due mainly to continued use of outdated machinery. In the second phase of the programme, Redpath will produce a scheme for the most efficient use of resources, while in the third phase the Congo Government will hand over the organization of the sugar processing plants to Redpath.

Uganda sugar production decline[7].—In the 1970/71 crop year Uganda produced 154,065 tonnes of sugar which was a record for the country. In the following years production declined, reaching only 19,513 tonnes in 1976/77. According to an official statement from Uganda, sugar production in 1977/78 was lower than that of 1976/77. Consumption in Uganda reached its peak in 1971/72 when more than 164,000 tonnes of sugar was consumed. Officially reported consumption in 1976/77 was only 14,147 tonnes. In the light of lower production in 1977/78 and the unlikelihood of sugar imports by Uganda, consumption in that year could be as low as 10,000 tonnes. The main reason for the decline in Uganda's sugar production is the severe lack of trained personnel for the efficient operation of the sugar industry as a whole. It is unlikely that a sufficient number of personnel will be trained in time to save Uganda's once-prosperous industry from a total collapse.

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (24), S4–S5.
[2] *Cuba Economic News*, 1977, **13**, (81), 11.
[3] *Westway Newsletter*, 1978, (57), 6.
[4] *I.S.O. Stat. Bull.*, 1978, **37**, (5), 50–51.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (22), 19.
[6] *Reuters Sugar Rpt.*, 26th June 1978.
[7] *World Sugar J.*, 1978, **1**, (2), 26.

Finland sugar imports and exports[1]

	1977	1976
	—— *tonnes, tel quel* ——	
Imports		
Argentina	10,744	0
Belgium	10,437	0
Brazil	35,594	46,003
Cuba	83,050	67,165
Dominican Republic	11,986	22,811
Germany, West	5,189	1
Other countries	77	2
	157,077	135,982
Exports		
Algeria	5,002	0
Denmark	656	19
Germany, West	1,232	1,735
Holland	1,750	0
Iran	1,700	0
Israel	1,537	1,922
Morocco	5,300	0
Norway	17,393	17,674
Somalia	1,000	0
Sweden	1,198	3,546
Switzerland	2,200	0
United Arab Emirates	900	0
USSR	17,150	0
Other countries	321	196
	57,339	25,092

Dominican sugar refinery possibility[2].—To reduce the gap between the amount of sugar available for export and the quota granted to the Dominican Republic under the International Sugar Agreement, the authorities may reconsider a project to erect a large sugar refinery. At present, two small refineries produce about 90,000 tonnes a year, while domestic demand is estimated at 150,000 tonnes. The new unit would, no doubt, have a capacity of 300,000 tonnes per year.

Retail prices of sugar[3].—Retail prices of sugar in 16 selected world capitals in July 1978 have been published by the Foreign Agricultural Service of the US Dept. of Agriculture and are reproduced below, in increasing order and all in terms of US$ per kg: Mexico City $0.26, Brasilia $0.37, Pretoria $0.40, Ottawa $0.42, Canberra $0.45, London $0.50, Buenos Aires $0.62, Paris $0.63, Washington $0.66, The Hague $0.77, Bonn $0.77, Rome $0.79, Stockholm $0.88, Brussels $0.99, Tokyo $1.18 and Copenhagen $1.51. It is interesting to note that, within the EEC, the retail price of sugar varies from 0.50 per kg in London to $1.51 per kg in Copenhagen.

Dutch sugar factory closed by fire[4].—Operations at the Suiker Unie sugar factory at Groningen were halted by a fire that wrecked the power plant. The campaign at the factory was halted and planning started for redistribution of the beets scheduled for processing at Groningen. No estimate was available of the extent of the damage or the time that the factory would be closed.

Mexican bagasse cellulose production[5].—Between 1970 and 1977, cellulose production from bagasse in Mexico increased by 124% to 180,000 tonnes.

New Morocco sugar factory[6].—The Ksar-el-Kebir sugar factory opened on June 23, 1978. The factory, 120 km south of Tangiers, will produce 45,000 tons of sugar a year from 300,000 tons of sugar beet.

Taiwan sugar production[7].—In the 1977/78 season, sugar production in Taiwan was only 727,000 tonnes, 150,000 tonnes less than in the previous season. As a result of the decrease, exports to Japan, which had been expected to be about 200,000 tonnes, will be reduced.

Indonesia sugar imports[8]

	1977	1976	1975
		tonnes	
Australia	75	38	14
Belgium-Luxembourg	0	0	2
Brazil	48,705	0	0
China	0	25,976	21,692
Cuba	66,135	0	5,029
Czechoslovakia	0	11,550	6,750
Denmark	0	0	1
France	0	0	46
Germany, West	2	4	16
Holland	50	25	43
Hong Kong	4	5	24
India	93,184	160,783	34,650
Malaysia, West	80	26	0
Poland	0	0	5,000
Singapore	77	19	21
Switzerland	11	5	14
Thailand	2,250	0	0
UK	6	3	8,040
US	34	19	42
Vetnam	11,250	3,100	9
Oer countries	2	0	5
	221,865	201,553	81,389

UK sugar use in fermentation chemicals production. The UK Chemical Industries Association has announced that it has negotiated up to £1 million worth of rebates from the EEC Commission to encourage British firms to use sugar as a nutrient for micro-organisms in the production of fermentation chemicals. It is estimated that, as a result, sugar consumption by the UK chemical industry will rise from 77,000 tonnes in 1977 to 94,000 tonnes in 1978.

South African factory closure plans[9].—C. G. Smith Sugar Ltd. and the Tongaat Group have jointly bought the Melville Sugar Estates and factory at Stanger, Natal North Coast, for R 7,000,000. Melville is one of the oldest sugar enterprises in Natal, the original mill having been erected in 1862. The factory has been progressively enlarged to a crushing rate of 80 tonnes. hr^{-1} and the factory produced 41,236 tonnes in 1977/78. The company was bought by S. A. Board Mills Ltd. in 1952 and became part of the Anglo-American Corporation in 1974 when it became a wholly-owned subsidiary of the Mondi Paper Co. Ltd. Mondi have now sold the factory and 2770 ha of land with 2155 ha under cane to Smith Sugar and Tongaat; the joint owners will close the factory and divert the cane to Gledhow and Tongaat factories.

Papua New Guinea sugar project.—Papua New Guinea is planning to become self-sufficient in sugar production by 1985. The Prime Minister, Michael Somare, said that the Government had accepted the recommendations of a British consulting firm, Booker Agriculture International, which had urged that the industry should be based at Gusap in the Madang province, the only place in Papua New Guinea where sugar could be produced at import parity prices. The Government has authorized establishment of a company, Ramu Sugar Pty. Ltd., to operate the project, which will be designed to produce 30,000 tonnes of sugar a year. The company would initially be wholly owned by the Government although shares would be offered to investors.

New Spanish sugar factory[10].—Azucarera del Guadiana is to invest 385 million pesetas ($5,100,000) in building a sugar factory at La Garrovilla (Badajoz).

[1] C. Czarnikow Ltd., *Sugar Review*, 1978, (1403), 163.
[2] *Westway Newsletter*, 1978, (57), 6.
[3] *World Sugar Journal*, 1978, **1**, (3), 27.
[4] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (28), 28.
[5] *Bank of London & S. America Rev.*, 1978, **12**, 432.
[6] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (22), 20.
[7] *Zuckerind.*, 1978, **103**, 714.
[8] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (25), S7.
[9] *S. African Sugar J.*, 1978, **62**, 343.
[10] *Bank of London & S. America Review*, 1978, **12**, 514.

Dominican Republic sugar exports[1]

	1977	1976	1975
	tonnes, raw value		
Algeria	0	0	4,167
Finland	12,421	23,576	23,076
France	0	0	12,037
Holland	0	0	11,897
Iran	0	0	22,557
Italy	0	0	56,625
Morocco	0	14,059	29,655
Portugal	13,520	10,506	13,596
Rumania	0	0	32,753
Senegal	0	13,602	6,959
Sweden	11,520	0	24,668
Tunisia	0	23,442	7,030
UK	0	12,559	28,412
USA	866,432	900,389	701,858
West Indies	0	721	0
	903,893	998,854	975,290

Mozambique sugar company troubles[2].—Sena Sugar Estates Ltd., the formerly British-owned company in Mozambique, was nationalized following the establishment of independence from Portugal. In the subsequent four years, the formerly profitable enterprise has been reduced to a disastrous state, with debts amounting to $50 million, with the main factory at Marromeu idle for two years, and with cane plantations in poor condition. The present administration has no recovery plan, and the management announced in a circular to workers that it is preparing to close down.

Cuba bagasse board plant[3].—The Camilo Cienfuegos bagasse board factory is being erected in the north-east of Havana Province. It will cost 9,000,000 pesos and will be the largest in the country, covering a land area of 14 hectares and having a daily capacity of 300 tonnes of bagasse from which it will make 120 tonnes of board of varying thicknesses between 8 and 25 mm, and of density 650 kg.m^{-3}. The boards will be used by the Furniture and Packing Enterprise and by the construction sector. When covered with decorative paper or given a veneer finish they will serve as a substitute for imported laminated materials and plywood, so effecting a considerable saving in hard currency.

Malaysia sugar refinery plans[4].—Sabah Sugar Industry, Sdn.Bhd. is to build a sugar refinery in Sandakan residency. Eastern Sabah, according to the Sabah State Government. Initial output will be about 18,000 long tons a year, and about double when the refinery is fully operational. The company is a subsidiary of the Sabah State Economic Development Corporation. A site has been approved for the refinery but no start-up date indicated.

Japan beet sugar production[5].—A total of 2,332,528 tonnes of beet from an area of 49,181 hectares (a yield of 47·4 tonnes.ha^{-1}) was sliced in the 1977 campaign to yield 336,178 tonnes of white sugar, corresponding to an average extraction rate of 14·41%. In the 1976 campaign 2,168,726 tonnes of beet from 42,261 ha (a yield of 51·3 tonnes.ha^{-1}) had yielded 312,205 tonnes of white sugar, corresponding to an extraction rate of 14·40%. The beet area for 1978 has been increased by 17·4% and a record output of more than 400,000 tonnes of sugar is expected.

Swaziland sugar project[6].—Within the framework of the EEC Indicative Aid Programme for Swaziland, the Royal Swaziland Sugar Corporation is undertaking a project for the construction of a sugar factory with a capacity of 250 tonnes of cane per hour, together with the creation of a new 9000-hectare irrigated sugar cane plantation. The project also involves the construction of a dam, the provision of administrative buildings, housing and amenities for the staff and labour force, estate roads and bridges, all in the Umbuluzi Valley in the Northern Lowveld of Swaziland. The total cost of the project will be approximately £83,000,000. The corporation has recently signed an agreement with the Industrial Development Corporation of Africa whereby it will receive £12,000,000 in credit facilities mainly for the purchase of sugar machinery and construction services from South Africa.

China sugar imports and exports[7]

	1977	1976	1975
	tonnes		
IMPORTS			
Argentina	21,115	0	0
Australia	271,648	225,471	36,965
Brazil	163,967	0	71,942
Cuba	228,087	254,315	182,877
EEC	326	0	0
Guyana	0	9,779	4,347
Hong Kong	0	0	5,853
Nepal	0	300	0
Philippines	277,418	81,104	11,016
Peru	25,948	0	0
Thailand	687,826	56,216	0
	1,676,335	627,185	313,000
EXPORTS			
Refined sugar			
Burundi	0	0	310
Hong Kong	26,927	11,146	22,324
Iran	0	0	20,351
Jordan	0	6,500	0
Mali	0	2,350	3,697
Sierra Leone	0	82	1,054
Singapore	256	2,006	50
Sri Lanka	0	0	10,000
Sudan	10,328	0	10,000
Other countries	0	1	102
Total refined sugar	37,511	22,085	67,888
Raw sugar			
EEC	58	5	11,384
Hungary	0	0	9,131
Other countries	34	8	2
Total raw sugar	92	13	20,517
Total, raw value	40,865	24,019	94,309

Burma sugar project[8].—The Asian Development Bank has approved a $31,500,000 concessional loan to help finance an integrated agriculture and agro-industrial scheme in Burma. The loan will cover 83% of the foreign exchange costs of the Pyinmana integrated sugar project in the Northern Central Valley of the Sittang River Basin, Burma's sugar cane belt. The Bank will provide financing for irrigation, drainage and road development, agricultural development and cane supply and development of a new cane sugar factory. The Burmese Government has obtained $6,500,000 in financial assistance from the OPEC Special Fund to meet the foreign exchange requirement of the fourth component, the rehabilitation of the existing Pyinmana sugar factory.

Pakistan sugar expansion.—The Pakistan Government estimates that per caput sugar consumption will rise by 50%—from 9 kg to about 14·5 kg—by 1982/83 to give a total offtake of 1,200,000 tonnes/year as against the current 700,000 tonnes. Present demand can be met by the country's 27 sugar factories which have an aggregate crushing capacity of 60,000 t.c.d. when operating in a normal 150-day season and obtaining an average recovery of 8·5%. To meet the expected increase in demand the Government proposes to erect 14 new sugar factories by 1982/83.

[1] *I.S.O. Stat. Bull.*, 1978, **37**, (7), 37.
[2] *To the Point*, 18th August 1978; F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (25), 22.
[3] *Cuba Economic News*, 1978, **14**, (84), 9.
[4] *Reuters Sugar Rpt.*, 7th July 1978.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (25), 24.
[6] *Standard Chartered Review*, September 1978, 35.
[7] *I.S.O. Stat. Bull.*, 1978, **37**, (7), 29.
[8] *Reuters Sugar Rpt.*, 23rd August 1978.

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