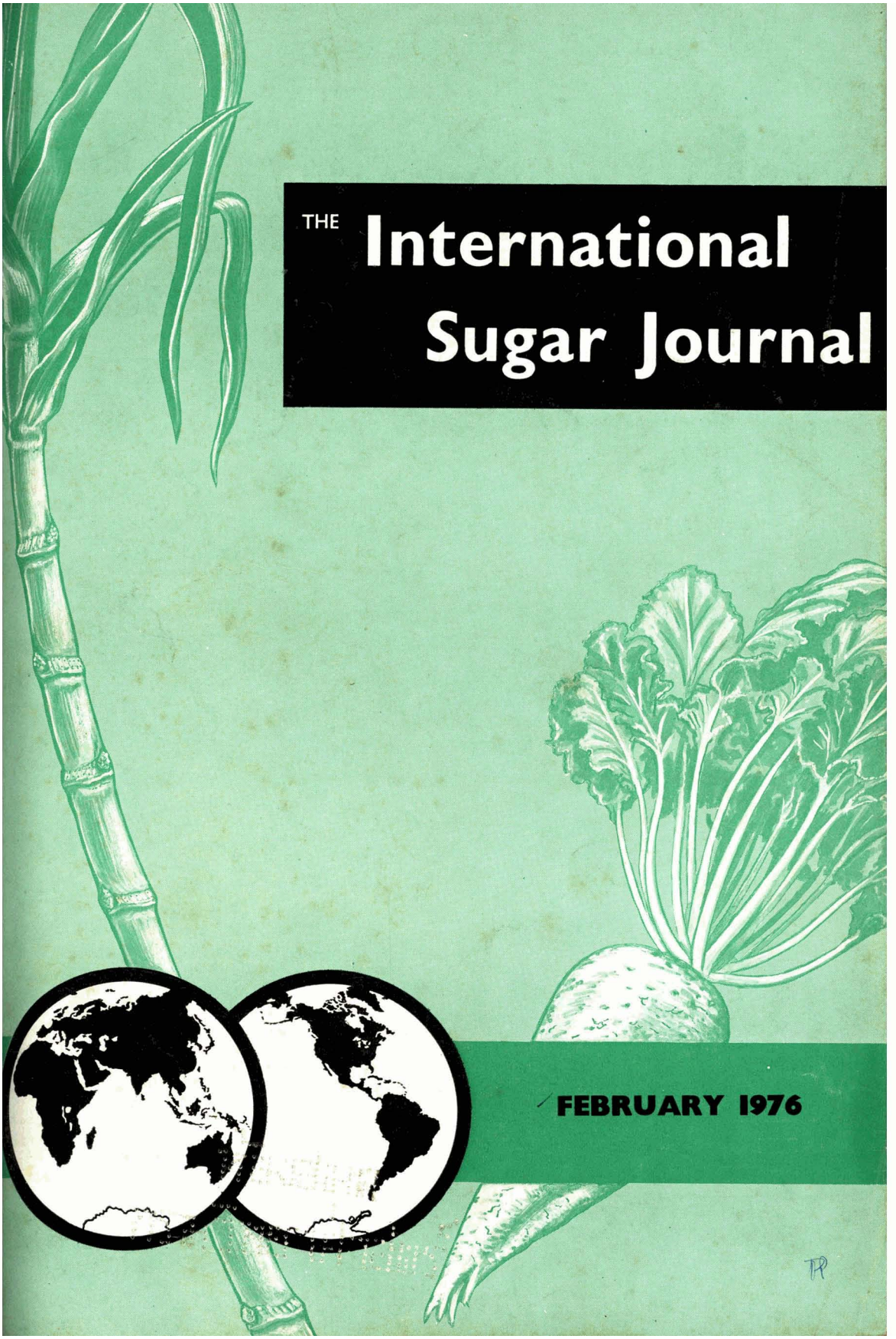
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P2

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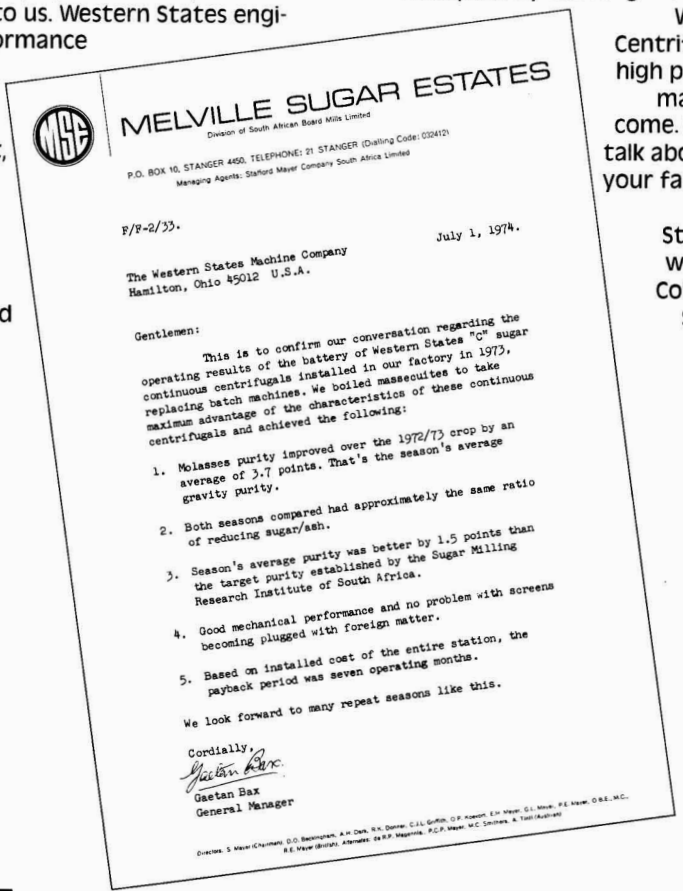

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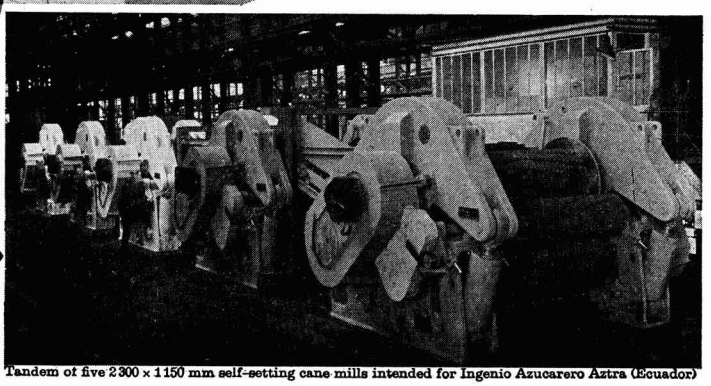

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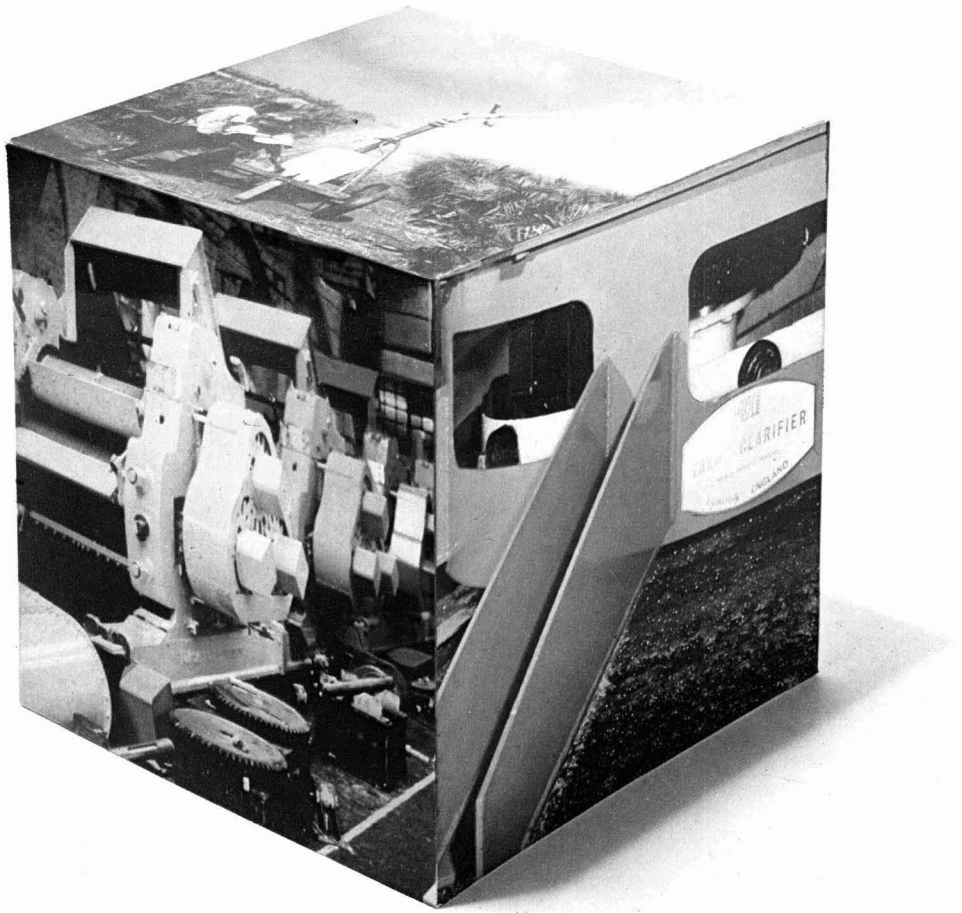

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International Sugar Journal

February 1976

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La chimie de la précipitation au phosphate de calcium en clarification de jus de canne. 2ème Partie. J. GUERRA D. *p.* 35–39

Des équations sont données concernant la distribution de variétés ioniques de phosphate et d'aconitate dans des solutions sucrées diluées en fonction du pH et les valeurs trouvées pour le pH de la gamme 4–9 à des intervalles de 0,5 unité sont reprises sous forme de tableau. A partir de ces données on a calculé des valeurs de $Q_{(d)}$ et $Q_{(t)}$ (produit ionique associé à la précipitation de phosphate dicalcique resp. tricalcique). Les rapports molaires $Ca:PO_4$ ont également été calculés à partir des données de distribution reprises au tableau. Des équations ont été établies pour le calcul du pH d'un jus dans son état initial formulé (dans lequel tous le constituants sont en solution et qu'il n'y a pas de précipité) ainsi que le calcul de l'addition de NaOH et de $Ca(OH)_2$. Le produit de solubilité du $CaHPO_4$ trouvé par l'auteur et par d'autres, est discuté, tout comme le rapport molaire $Ca:PO_4$ dans le précipité, le mécanisme de formation du précipité et le rôle double de la chaux en clarification, c.à.d. comme base et comme source de calcium.

* * *

L'hydraulique, la mécanique et l'économie de l'irrigation par infiltration et ruissellement de la canne à sucre hawaiienne. W. GIBSON. *p.* 40–44

Divers aspects de l'irrigation par ruissellement et infiltration, telle que pratiquée à Hawaii, sont examinés, particulièrement les besoins en eau, la conception et les caractéristiques hydrauliques des tuyaux de distribution ainsi que l'installation sur champ des systèmes d'irrigation. On discute des avantages et des inconvénients des tuyaux à une ou à deux chambres. L'obturation des orifices est le problème principal. Les coûts d'exploitation des systèmes sont également donnés.

* * *

L'amidon de canne. 1ère Partie. Isolement et affinité pour l'iode. J. C. STEVENSON et E. WHAYMAN. *p.* 44–46

On décrit des essais au cours desquels des grains d'amidon sont isolés à partir de canne à sucre du Queensland et leurs dimensions déterminées en faisant des photographies de grilles de microscope électronique. L'affinité pour l'iode d'amidons de différentes variétés de canne a été déterminée potentiométriquement et les teneurs en amylose calculées. On a trouvé que le diamètre maximum des grains varie de 1 à 5 μm tandis que les affinités pour l'iode étaient constantes à environ 3,2%.

Die Chemie der Calciumphosphatfällung bei der Reinigung von Rohrzuckersäften. Teil II. J. GUERRA D. *S.* 35–39

Es werden Gleichungen für die Verteilung von Phosphat- und Aconitat-Ionensorten in verdünnten Zuckerlösungen in Abhängigkeit vom pH-Wert angegeben. Die bei pH-Werten im Bereich zwischen 4 und 9 in Intervallen von 0,5 Einheiten erhaltenen Werte sind tabellarisch zusammengestellt. Aus diesen Zahlenangaben wurden die Werte von $Q_{(d)}$ und $Q_{(t)}$ (Löslichkeitsprodukt von Dicalcium bzw. Tricalciumphosphat) berechnet. Die $Ca:PO_4$-Molverhältnisse wurden ebenfalls aus den tabellarisch erfassten Verteilungswerten errechnet. Der Verfasser hat Gleichungen zur Berechnung des pH-Wertes eines Saftes in seinem ursprünglichen Zustand—wenn sich alle Konstituenten in Lösung befinden und kein Niederschlag vorliegt—und zur Ermittlung der Natriumhydroxid- und Calciumhydroxidzugabe entwickelt. Er diskutiert das von ihm und von anderen Autoren gefundene Löslichkeitsprodukt des Dicalciumphosphats, das $Ca:PO_4$-Molverhältnis im Niederschlag, den Mechanismus der Fällung sowie die Doppelrolle, die der Kalk bei der Saftreinigung spielt, nämlich als Base und als Calciumlieferant.

* * *

Hydraulik, Mechanik und Wirtschaftlichkeit der Unterflurbewässerung und der Tröpfchenberegnung von Zuckerrohr auf Hawaii. W. GIBSON. *S.* 40–44

Der Verfasser diskutiert die verschiedenen Aspekte der beiden auf Hawaii praktizierten Bewässerungsverfahren, der Tröpfchenberegnung und der Unterflurbewässerung, insbesondere den Wasserbedarf, die konstruktiven und hydraulischen Merkmale der Verteilerrohre sowie die Installation der Bewässerungssysteme auf den Feldern. Die Vor- und Nachteile von Einkammer- und Zweikammerrohren werden besprochen. Das Hauptproblem liegt in der Verstopfung der Austrittsöffnungen. Der Verfasser gibt auch die Betriebskosten für die beiden System an.

* * *

Zuckerrohrstärke. Teil I. Isolierung und Jodaffinität. J. C. STEVENSON und E. WHAYMAN. *S.* 44–46

Die Verfasser berichten über Versuche, bei welchen Stärkekörnchen aus Zuckerrohr aus Queensland isoliert wurden und ihre Grösse mit Hilfe von Aufnahmen von Elektronenmikroskop-Fadenkreuzen bestimmt wurde. Die Jodaffinität von Stärken aus verschiedenen Rohrsorten wurde potentiometrisch bestimmt; der Amylosegehalt wurde berechnet. Es wurde festgestellt, dass der grösste Durchmesser der Körnchen zwischen 1 und 5 μm schwankte und die Jodaffinität konstant bei etwa 3,2% lag.

La química de la precipitación de fosfato de calcio en la clarificación de jugo de caña. Parte II. J. GUERRA D. *Pág.* 35–39

Se presentan ecuaciones para las distribuciónes de especies iónicos de fosfato y aconitato en soluciones diluidos de sacarosa como funciones de pH, y tablas de dados obtenido para valores de pH en la gama 4–9 con intervales de 0·5 pH. De éstos se han calculado valores de $Q_{(d)}$ y $Q_{(t)}$, los productos iónicos asociado con la precipitación de $CaHPO_4$ y $Ca_3(PO_4)_2$, respectivamente. Las relaciones molares $Ca:PO_4$ se han calculado también de los dados tabulados de distribución. Se han desarrollado ecuaciones para calcular el pH de un jugo de su condición inicial (formulado), donde todos constituentes estan en solución y no hay cualquier precipitado, y para calcular el adición de NaOH y $Ca(OH)_2$. El producto de solubilidad de $CaHPO_4$, como evaluado por el autor y por otros, se discute, tanto como la relacion $Ca:PO_4$ en el precipitado, el mecanismo de formación del precipitado, y el papel doble de cal en clarificación, es decir, como base y como fuente de calcio.

* * *

Hidraúlica, mecánica y económica de irrigación subterránea de caña da azúcar en Hawai. W. GIBSON. *Pág.* 40–44

Se discuten varios aspectos de irrigación subterránea de bajo y de grande profundez ("drip" y "sub-surface", respectivamente) como practicado en Hawai, en particular los requisitos en agua, diseño del tubo de distribución y su caracteristicos hidraúlicos, y instalación en el campo de sistemas de irrigación. Ventajes y desventajes de tubos de uno y dos cámeras se discuten. La obstrucción do los orificios es el mayor problema encontrado. Se indican también los costos de operación de las sistemas.

* * *

Almidón de caña. Parte I. Aislamiento y afinidad para iodo. J. C. STEVENSON y E. WHAYMAN. *Pág.* 44–46

Se recordan experimentos en que gránulos de almidón se han separado de caña de azúcar en Queensland y los tamaños de los gránulos se han determinado por uso de fotográficos de rejas de un microscopio electrónico. El afinidad para iodo de almidones de diferentes variedades de caña se ha determinado por potenciómetro y los contenidos de amilosa se han calculado. Los diámetros máximos de los gránulos variaron entre 1 y 5 μm y las afinidades para iodo estuvieron sin excepción acerca de 3·2%.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII FEBRUARY 1976 No. 926

Notes & Comments

EEC beet price recommendations

The EEC Commission recently published their recommendations concerning farm prices in 1976/77 and, so far as sugar is concerned, they propose an increase of about 8%. The farmers organizations have described this as inadequate and claims have been made for increases of up to 13%. A period of lobbying and negotiation will follow since the Commission's proposals may be amended by the Council of Ministers of Agriculture who will decide the final figure in February.

C. Czarnikow Ltd.[1] note: "It is the Commission's declared intention to endeavour to stabilize the area sown to sugar beet in the Community at around the 1975 level and there have been protestations on the part of beet growers that this will not be possible unless a price is authorized which keeps the return from the crop within the European Community in line with the general level of inflation. While concern on the part of farmers and their representatives can be readily understood, it seems unlikely that there will be any major change in the area next year, though there will no doubt be some adjustments here and there as individual farmers change their programmes, as it is difficult to see, within the presently recommended programme, what crop they may fruitfully move into which would offer them a better return. Most parts of the Community have had very bad growing conditions for sugar this year; many of them for the second season in succession. Given average growing conditions it may be anticipated that there will be a substantial increase in sugar production in the EEC in 1976/77".

* * *

UK Sugar Board

The annual report of the UK Sugar Board for 1974 was published in December 1975. The total amount of sugar imported under the Commonwealth Sugar Agreement amounted to 1,385,164 long tons from 1974 quotas and 53,497 tons of 1973 quota sugar which had been delayed by *force majeure* from shipment in that year. The 1974 imports compare with a total quota of 1,717,500 tons and the difference was largely due to shortfalls of 307,591 in the supplies from the West Indies and Guyana, while there was a 17,595 tons shortfall from Fiji owing to a crop deficiency and a nominal shortfall of 150 tons in the Mauritius quota.

The negotiated prices fixed for 1974 were £61, £57 and £50 per ton, respectively, for the West Indies & Guyana and Fiji, for other developing countries, and for Australia, but these were raised to £83, £79 and £61, respectively, as a result of further discussions early in the year. The increases of £22 and £11 were applied to sugar supplied in 1972 to avoid contravention of EEC regulations so that they did not form part of the Board's 1974 negotiated price payments. In order to secure fulfilment of supplies from Guyana the Minister of Agriculture agreed to pay a price of £140 per ton and similar increases were made for the other suppliers in October.

With the ending of the Agreement, the Board's main function is administering the price equalization scheme whereby beet sugar subsidizes the refined cane sugar produced from raws imported at the prices agreed by the Minister and the representatives of the ACP countries. This task will be taken over by the Ministry of Agriculture when the Board is abolished later this year.

* * *

USSR 1974 beet campaign[2]

Final figures for the 1974 campaign have now become available from official Soviet sources. The beet harvest amounted to 77,948,000 metric tons against 87,047,000 tons harvested in 1973. The decrease of some 9·1 million tons was mainly due to the bad crop in the Russian S.F.S.R. which produced 10 million tons less than in the 1973 crop; in the Ukraine there was a small increase of 738,000 tons to 48,258,000 tons.

The overall crop yield was 21·6 tons per hectare as against 24·7 tons in 1973 but reflected the average between 13·4 tons for the R.S.F.S.R. and 37·9 tons for the Kirghiz S.S.R. The Russian figure was particularly bad and compared with 20·3 tons.ha^{-1} in 1973 while the lowest figure for the other Republics was 22·8 tons.ha^{-1} in the Byelorussian S.S.R.

* * *

India and the world sugar market[3]

During the past year or so India has become a major force in the world market. From being a supplier of small quantities of raw sugar only a few years ago to fill quotas in the United Kingdom and the USA, the country has expanded production to the level where more than 400,000 tons were exported in 1973/74 and nearly 950,000 tons in 1974/75. Exports nowadays are mostly in the form of white sugar.

The growth in the level of exports has been the result of planned increases in production together

[1] *Sugar Review*, 1975, (1261), 201.
[2] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (35), 12–13 vii.
[3] C. Czarnikow Ltd., *Sugar Review*, 1975, (1257), 185–187.

with fiscal policies which have held domestic consumption in check, despite a rapidly expanding population. Thus, while production has increased by 54% in the four seasons from 1971/72 to 1974/75, consumption has actually fallen by 9%.

It was at one time anticipated that production in 1975/76 would show a further increase and early in the growing season a quantity of five million tons was generally mentioned. Weather conditions have not been favourable, however; some areas have suffered flooding while temperatures in general have been below average. Currently it is anticipated that output will fall slightly below the 4·8 million tons achieved in 1974/75. Stocks, however, rose by 400,000 tons during last season so that exports in excess of one million tons during 1975/76 appear well within the bounds of feasibility provided facilities can deal with this tonnage.

There follow statistics of sugar movement in India for the years October/September 1974/75 and 1973/74.

	1974/75		1973/74	
	(metric tons, tel quel)			
Initial Stocks		828,000		843,300
Production		4,794,000		3,950,000
Adjustment		—		3,800
		5,622,000		4,797,100
Domestic Consumption ..	3,460,000		3,523,100	
Exports	941,000		446,000	
		4,401,000		3,969,100
Final Stocks		1,221,000		828,000

* * *

Japan sugar imports deferment[1]

Japan will certainly fail to fulfil sugar import commitments for the first year of a five-year sugar import agreement with Australia, the Japan Sugar Refiners Association has stated.

Japanese refiners, hit by sluggish domestic consumption and a fall in sugar prices, called in early December for a second deferment of part of 390,000 metric tons to be shipped from Australia in the first half of 1976. The amount included 90,000 tons postponed from the second half of 1975.

The Japanese plea for the second deferment was made in talks with CSR Ltd., the sole Australian sugar shipper.

The Association said the five year agreement is for a total of 600,000 tons of raws from Australia annually, at the fixed price of £228·80 per ton. But last September Australia agreed to Japan's request to defer 90,000 tons from the second half of 1975 to early 1976.

The Japanese sugar industry was to send a mission to Australia in January 1976 to negotiate the new deferment with Australian shippers. However, it is not yet known how much raw sugar Japan will have to postpone until after next June.

Japan's domestic sugar consumption is declining about 20% from the normal level of about three million tons annually, reflecting prolonged economic slump.

The Association estimated surplus stocks of imported raws at about 600,000 tons or equivalent to three months' needs.

In an effort to reduce the stocks Japanese refiners and traders have asked for deferment of contracted shipments from other sources as well as cancelling parts of import deals. Trade sources said they are already paying a considerable amount in cancellation fees to overseas shippers.

The Association said industry leaders are studying measures to ease the current situation, including formation of an anti-recession cartel enabling refiners to collectively tighten production cutbacks or curb deliveries of white sugar.

* * *

Verenigde HVA Maatschappijen N.V. 1974 report

Early in February it was announced that the Ethiopian government had decided it wished to gain control of the HVA sugar companies operating in that country and a commission was established to negotiate the acquisition of majority shareholdings by the Government. The results of negotiations and the form of management of the sugar factories have not yet been announced. In the meantime production was continuing as usual, but with little or no labour troubles, in contrast to the 1973/74 season. Production at Wonji and Shoa mills amounted to only 71,666 tons in 1973/74 as against 74,533 tons in the previous season, and this figure was only reached by extension of milling. Metahara mill had even more labour trouble and in spite of extending milling until the rains set in, production was only 48,992 tons as against 57,249 tons in 1972/73.

In Tanzania, the milling season of Kilombero sugar factory (now officially named Msolwa) ended in February 1975 with a production of only 35,300 tons, well below the previous crop of 39,100 tons. Causes were unfavourable distribution of rain, and inadequate technical supplies for plant and transport. Finance for a second mill (officially named Ruembe) has been agreed and the factory is to be built by a Dutch/Danish consortium with production scheduled for 1976.

After taking over the management of Asutsuare and Komenda sugar mills in Ghana, many defects in installations were found, and limited cane supply resulted in a low production totalling 8000 tons; the mills and distillery have been overhauled and a production of 12,000 tons is anticipated for 1975. Studies have started for a new mill project.

Sudan has decided to build a further mill, Asalaya, of the same type and size (6500 t.c.d.) as the Sennar mill and this is also to be built by Fletcher and Stewart, Ltd. A third 6500 t.c.d. plant is to be built near Melut by a Belgian consortium. Negotiations with a Czechoslovakian supplier for a mill near Mongalla in the southern Sudan have been broken off and HVA are negotiating on behalf of the Sudan Government with potential suppliers in other countries. A complete survey of the country is being undertaken with a view to further expansion of the Sudan sugar industry.

HVA are providing consultancy services in Indonesia, Peru, Trinidad and El Salvador; in the last, a definitive contract was drawn up for supply of the El Jiboa mill. Construction has started and the first milling season is scheduled for 1977. Planned output is 50,000 tons of sugar per annum with possibility of expansion to 90,000 tons.

[1] *Public Ledger*, 13th December 1975.

The chemistry of calcium phosphate precipitation in cane juice clarification

By JORGE GUERRA DEBÉN
(Associate Professor, School of Chemical Engineering, University of Havana, Cuba)

PART II

Distribution of dissolved phosphate species as functions of pH

For a dilute solution containing phosphate the following chemical reaction equilibria and constants may be set up:

$$H_3PO_4 \rightleftharpoons H_2PO_4^- + H^+ \qquad (H^+)(H_2PO_4^-)(H_3PO_4)^{-1} = K_{1F}$$

$$H_2PO_4^- \rightleftharpoons HPO_4^{2-} + H^+ \qquad (H^+)(HPO_4^{2-})(H_2PO_4^-)^{-1} = K_{2F}$$

$$HPO_4^{2-} \rightleftharpoons PO_4^{3-} + H^+ \qquad (H^+)(PO_4^{3-})(HPO_4^{2-})^{-1} = K_{3F}$$

Conservation of total phosphate in solution imposes the condition $(\Sigma PO_4) = (H_3PO_4) + (H_2PO_4^-) + (HPO_4^{2-}) + (PO_4^{3-})$. Simple algebra leads, among other possibilities, to

$$(HPO_4^{2-}) = \frac{(\Sigma PO_4)}{\frac{(H^+)^2}{K_{1F}K_{2F}} + \frac{(H^+)}{K_{2F}} + 1 + \frac{K_{3F}}{(H^+)}}$$

from which (HPO_4^{2-}) can be calculated given the three constants, the solution pH and the total phosphate concentration. Concentrations of remaining phosphate species then follow from simple substitutions into the expressions which define the constants.

It proves convenient to generalize by defining the new quantities $(H_3PO_4)_u$, $(H_2PO_4^-)_u$, $(HPO_4^{2-})_u$ and $(PO_4^{3-})_u$; these correspond to a solution for which $(\Sigma PO_4) \equiv 1$; thus, they are equal to the molar fractions of the respective species in a solution containing an arbitrary (small) concentration of total phosphate. Results are shown in Table IV and Fig. 7.

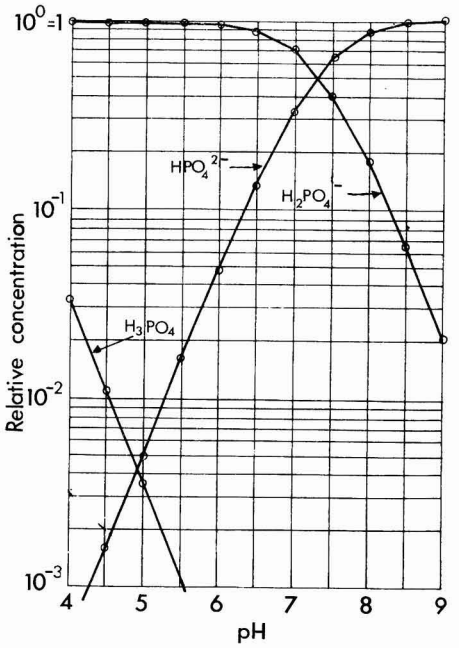

Fig. 7. Distribution of phosphates

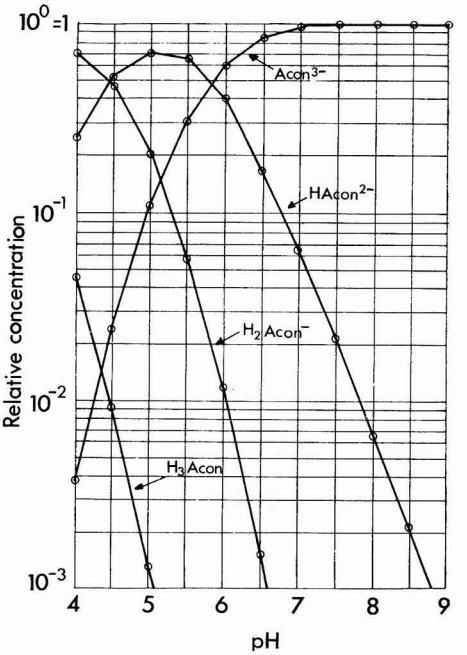

Fig. 8. Distribution of aconitates

It may be noted that practically all of the total dissolved phosphate (93·97%) is present as the species HPO_4^{2-} at pH 8·5; this value of pH was chosen to define total demand of base in the alkali addition experiments. Assuming that this is the phosphate species predominantly involved in the precipitation reaction, it will practically reach its maximum concentration at pH 8·5; higher pH values are not convenient, of course, because of detrimental effects on reducing sugars and sucrose itself.

Distribution of dissolved aconitate species as functions of pH

The same types of equations and deductions apply here as for phosphates. Results are given in Table V and Fig. 8.

Note: Values of dissociation constants of both acids are those applicable in water solutions for lack of data on sugar solutions. Since the molar concentration fraction of sucrose at 15°Bx is of the order of 0·01 no great deviations from the laws of dilute solutions may be expected on this account except for the intrusion of specific interactions. An effect of

Table IV. Distribution of phosphates

$K_1 = 2{\cdot}856 \times 10^{-3}$, $K_2 = 4{\cdot}926 \times 10^{-8}$ and $K_3 = 4{\cdot}8 \times 10^{-13}$

pH	$[H_3PO_4]_u$	$[H_2PO_4^-]_u$	$[HPO_4^{2-}]_u$	$[PO_4^{3-}]_u$	$[\Sigma kPO_4^{k-}]_u$
4·0	$3{\cdot}381 \times 10^{-2}$	$9{\cdot}657 \times 10^{-1}$	$4{\cdot}757 \times 10^{-4}$	$2{\cdot}283 \times 10^{-12}$	0·9667
4·5	1·093 ,,	9·875 ,,	$1{\cdot}538 \times 10^{-3}$	$2{\cdot}334 \times 10^{-11}$	0·9906
5·0	$3{\cdot}472 \times 10^{-3}$	9·916 ,,	4·885 ,,	$2{\cdot}345 \times 10^{-10}$	1·001
5·5	1·089 ,,	9·836 ,,	$1{\cdot}532 \times 10^{-2}$	$2{\cdot}272 \times 10^{-9}$	1·014
6·0	$3{\cdot}336 \times 10^{-4}$	9·527 ,,	4·691 ,,	$2{\cdot}252 \times 10^{-8}$	1·047
6·5	$9{\cdot}579 \times 10^{-5}$	8·651 ,,	$1{\cdot}348 \times 10^{-1}$	$2{\cdot}046 \times 10^{-7}$	1·135
7·0	2·346 ,,	6·700 ,,	3·300 ,,	$1{\cdot}584 \times 10^{-6}$	1·330
7·5	$4{\cdot}329 \times 10^{-6}$	3·910 ,,	6·090 ,,	$9{\cdot}244 \times 10^{-6}$	1·609
8·0	$5{\cdot}909 \times 10^{-7}$	1·687 ,,	8·312 ,,	$3{\cdot}990 \times 10^{-5}$	1·831
8·5	$6{\cdot}679 \times 10^{-8}$	$6{\cdot}032 \times 10^{-2}$	9·397 ,,	$1{\cdot}426 \times 10^{-4}$	1·940
9·0	$6{\cdot}967 \times 10^{-9}$	1·990 ,,	9·801 ,,	4·704 ,,	1·980

Table V. Distribution of aconitates

$K_1 = 1{\cdot}58 \times 10^{-3}$, $K_2 = 3{\cdot}5 \times 10^{-5}$ and $K_3 = 1{\cdot}5 \times 10^{-6}$

pH	$[H_3Acon]_u$	$[H_2Acon^-]_u$	$[HAcon^{2-}]_u$	$[Acon^{3-}]$	$[\Sigma kAcon^{k-}]_u$
4·0	$4{\cdot}462 \times 10^{-2}$	$7{\cdot}049 \times 10^{-1}$	$2{\cdot}467 \times 10^{-1}$	$3{\cdot}701 \times 10^{-3}$	1·210
4·5	$9{\cdot}184 \times 10^{-3}$	4·588 ,,	5·079 ,,	$2{\cdot}409 \times 10^{-2}$	1·547
5·0	1·258 ,,	1·988 ,,	6·956 ,,	$1{\cdot}043 \times 10^{-1}$	1·903
5·5	$1{\cdot}156 \times 10^{-4}$	$5{\cdot}773 \times 10^{-2}$	6·390 ,,	3·051 ,,	2·245
6·0	$7{\cdot}151 \times 10^{-6}$	1·130 ,,	3·955 ,,	5·932 ,,	2·582
6·5	$3{\cdot}144 \times 10^{-7}$	$1{\cdot}570 \times 10^{-3}$	1·738 ,,	8·246 ,,	2·823
7·0	$1{\cdot}130 \times 10^{-8}$	$1{\cdot}785 \times 10^{-4}$	6·249 × 10⁻² ,,	9·373 ,,	2·937
7·5	$3{\cdot}733 \times 10^{-10}$	$1{\cdot}865 \times 10^{-5}$	2·065 ,,	9·793 ,,	2·979
8·0	$1{\cdot}198 \times 10^{-11}$	$1{\cdot}893 \times 10^{-6}$	$6{\cdot}622 \times 10^{-3}$	9·934 ,,	2·993
8·5	$3{\cdot}804 \times 10^{-13}$	$1{\cdot}901 \times 10^{-7}$	2·104 ,,	9·974 ,,	2·998
9·0	$1{\cdot}205 \times 10^{-14}$	$1{\cdot}903 \times 10^{-8}$	$6{\cdot}662 \times 10^{-4}$	9·993 ,,	2·999

this type to be on the alert for is known to occur between sucrose and lime, leading to highly increased lime solubility and formation of "calcium saccharates".

Solubility product principle. Calculation of the ionic product which governs the precipitation reaction. K_{PS} of $CaHPO_4$

Tables II and III provide experimental data on solutions which were *presumably* in equilibrium with their respective precipitates. From these data the ionic precipitation products $Q_{(d)}$ and $Q_{(t)}$ can be easily calculated by means of formulae 8 and 9 at the beginning of this section.

Twenty-eight experimental values of $Q_{(d)}$ were calculated (a few from runs not reported here); the pH value involved ranged from 5·30 to 6·58; calcium in solution from 0·00063 to 0·00625; total phosphate in solution from 0·00028 to 0·00359. Their distribution, as examined by the test of GEARY & PEARSON[16], showed no evidence of non-normality, at 95% probability. STUDENT's test next showed that

$$\bar{Q}_{(d)} = (2{\cdot}31 \pm 0{\cdot}34) \times 10^{-7} \quad (P = 95\%)$$

Calculation of values of $Q_{(t)}$ from the same data showed very disparate results, with differences amounting to as much as 1×10^3 in several instances.

These results show that

(*a*) an ionic precipitation equilibrium has become established after completion of base addition in a time interval of the order of 2 to 3 minutes or less;

(*b*) the precipitation reaction is governed by $Q_{(d)}$, thus corresponding to the formation of $CaHPO_4$ as primary product of the reaction;

(*c*) by definition: $K_{PS} = \bar{Q}_{(d)} = (2{\cdot}31 \pm 0{\cdot}34) \times 10^{-7}$.

Molar ratio of calcium to phosphate in precipitates

Tables II and III also provide data for the direct calculation of the molar ratio

$$r_p = Ca : PO_4 .$$

The mean of thirty-six experimental values thus calculated is $r_{total} = 1{\cdot}7436$. Careful qualitative comparison of results shows a preponderance of values lower than r_{total} for treatment with NaOH and a preponderance of values higher than r_{total} for addition of $Ca(OH)_2$. The respective means are $r_{Na} = 1{\cdot}6389$ and $r_{Ca} = 1{\cdot}8483$. To the eye, a graph of the distribution shows bimodal features. Thus, there appears to exist some specific effect of the kind of base used upon the ratio. Pending closer study, a rounded value

$$R = 1{\cdot}75 \simeq r_{total} = 1{\cdot}7436$$

is now accepted for this ratio.

The ratio 1·75 differs considerably from the theoretical ratio of unity for $CaHPO_4$ and is definitely higher than the value 1·5 for $Ca_3(PO_4)_2$. The implications of this result, which is completely at odds with the result of the previous section, are postponed for later discussion.

In order to simplify the methods of calculation to follow, it will henceforth be assumed that the precipitate has the composition formula

$$CaHPO_4{,}0{\cdot}75\ CaO.$$

From the definition p = millimoles of precipitate *per cm³ of juice* it now follows that

PO_4 = millimoles phosphate in precipitate per cm³ $= p$

Ca = millimoles calcium in precipitate per cm³ $= R \times p$.

Calculation of the pH value of a juice in its initial, as formulated, condition

By definition we may say that a synthetic juice is well formulated if its constituent materials are in solution, no precipitate whatever being present. For a well formulated juice the condition of solution electroneutrality may be written in the form

$$2a + c + (H^+)_i = (\Sigma kPO_4^{k-})_u\, b + (\Sigma kAcon^{k-})_u\, d + K_w/(H^+)_i$$

[16] In EILON: "Industrial Engineering Tables", pp. 23–24, 113.

Table VI. Solubility product of $CaHPO_4$

	Holt *et al.*[17]	Demontovich & Sarubina[18]	Shear & Kramer[19]	This work
K_{PS}	$3{\cdot}94 \times 10^{-7}$	$5{\cdot}6 \times 10^{-7}$	$3{\cdot}2 \times 10^{-6}$ (a) $3{\cdot}4 \times 10^{-6}$ (b)	$2{\cdot}31 \times 10^{-7}$
Solvent	H_2O (?)	H_2O, CO_2	H_2O (?)	Sucrose at 15°Bx
Temp.	38°C	19–22°C	(a) room temp. (b) 38°C	90°C

and the juice solution will take on a value of pH such as to satisfy this equation. This computation has been handled by a simple trial and error incremental procedure on pH. Once the answer is found, a numerical calculation is made of $Q_{(d)}$ and compared with K_{PS} in order to determine if the juice is indeed well formulated; $Q_{(d)} < K_{PS}$ insures against possible supersaturation of the juice.

Calculation of the course of NaOH addition

The initial stage of making alkaline before precipitation begins is handled by means of the condition of solution electroneutrality expressed in the form

$$2a + c + \Delta Na + (H^+) = (\Sigma kPO_4^{k-})_u\, b + (\Sigma kAcon^{k-})_u\, d + K_w/(H^+)$$

in which ΔNa denotes the millimols of NaOH added per cm³ of juice. Obviously, $\Delta Na = 0$ for the initial condition of the juice. An increment is applied to the initial pH, and ΔNa and $Q_{(d)}$ are calculated; if $Q_{(d)} < Kps$ the amount of base added is short of the amount required for juice saturation. This incremental process is continued until the pH value is found at which $Q_{(d)} = K_{PS}$; the value of ΔNa at this pH is equal to the number of moles of base added to bring the juice to the saturation point.

From the point of saturation on

(*a*) conservation of mass in respect of the phosphate content of the entire system (liquid phase + solid phase) imposes the condition $(\Sigma PO_4) = b - p$;

(*b*) conservation of mass for the calcium content of the entire system imposes the condition $(Ca^{2+}) = a - (R \times p)$; and

(*c*) saturation of the liquid phase imposes the condition $(Ca^{2+})\,(\Sigma PO_4) = K_{PS} \times D_F$.

Substitution of the first two conditions in the third yields

$$a - (R \times p) = (K_{PS} \times D_F)/(b - p),$$

which is equivalent to a second-degree equation in p. For incremental values of pH above the saturation point, D_F is first calculated and the second-degree equation is next solved by the quadratic formula. Calculation of (ΣPO_4), Ca and (Ca^{2+}) easily follows. Finally, the number of moles of NaOH added is obtained from the equation of electroneutrality by substitution of (ΣPO_4) for b in the phosphate term and substitution of (Ca^{2+}) for a. A simple analysis shows that the desired root of the radical involved is the negative one.

Calculation of the course of treatment with $Ca(OH)_2$

Here the analysis is slightly more involved because part of the calcium added as lime may find its way into the precipitate. The same principles are applied and the answers found by the quadratic formula and back substitutions.

Curves of the course of treatment with NaOH and with $Ca(OH)_2$ calculated by this theory are shown, together with experimental data points, in Figs. 1–6.

Discussion

Solubility product of $CaHPO_4$

Table VI includes the value of the solubility product of $CaHPO_4$ as found here and values of other workers. Different experimental conditions as to temperature and solvent allow only a rough comparison. This work agrees reasonably well with Holt *et al.*[17] and Demontovich & Sarubina[18]. All results considered, the data of Shear & Kramer[19] appear to be on the high side.

Molar ratio of calcium to phosphate in precipitate

Discussing the solubility of tricalcium phosphate in water, Linke[20] states that so-called tricalcium phosphate is, apparently, a solid solution of the dibasic salt and calcium oxide. Eisenberger *et al.*[21], reviewing the $CaO/P_2O_5/H_2O$ system, conclude that tricalcium phosphate and hydroxyapatite do not exist in (the presence of) aqueous solution as well characterized and stoichiometric compounds but what is found instead is a series of solid solutions of $CaHPO_4$ and CaO with the apatite structure; the compound $Ca_3(PO_4)_2$ only represents, in their opinion, a particular point within a wider, continuous range of compositions. According to Shear *et al.*[22] the ratio shows variation depending on the excess of solid phase, yet the ionic product $(Ca^{2+})(HPO_4^{2-})$ remains constant. Bond[23] found that the ratio of CaO to P_2O_5 in cane juice precipitates ranged from 0·47 to 2·38, depending mainly upon the CaO content of the juice. Data of Bennett & Ragnauth[24] on cane juices shows that the ratio ranged from approximately 1·58 to 1·86.

Mechanism of precipitate formation

The above opinions and results do not contradict but rather support the results of this work with regard to $Ca{:}PO_4$ ratio and K_{PS} of $CaHPO_4$. The results, sharply at odds with each other, can be reconciled on the hypothesis that the precipitation process is controlled by the equilibrium reaction

$$Ca^{2+} + HPO_4^{2-} \rightleftharpoons CaHPO_4$$

as a primary reaction step. This reaction can proceed very rapidly from left to right on account of its purely ionic character. Solid calcium phosphate thus formed proves to be an unstable precipitate, incongruent with the solution phase. A secondary, necessarily slower reaction next takes place between the two phases in the course of which the solid fixes upon itself or co-precipitates an additional moiety or addendum of calcium withdrawn from the solution.

In order to look closer into this hypothesis an additional experiment was made consisting in the

[17] Holt, La Mer & Chown (1925). Quoted in Reference 20.
[18] Demontovich & Sarubina (1925); quoted in Reference 20.
[19] Shear & Kramer (1928); quoted in Reference 20.
[20] Linke: "Solubilities of inorganic and metal-organic compounds", 1958.
[21] Eisenberger, Lehrman & Turner; quoted in Reference 20.
[22] Shear, Washburn & Kramer: quoted in Reference 20.
[23] Bond: *Ind. Eng. Chem.*, 1925, **17**, 492.
[24] *I.S.J.*, 1960, **62**, 13–16, 41–44.

treatment at 90°C of four identical samples of synthetic juice approximating to formula C, by adding to them identical amounts of calcium saccharate solution. The first sample was filtered immediately; sample 2 was kept covered at 90°C with brisk stirring for ten minutes, then filtered; samples 3 and 4 were handled like sample 2 but filtered after 20 and 30 minutes had elapsed, respectively. Table VII shows analytical results for calcium in the precipitates and in their respective mother-solutions and pH values at filtering time; Fig. 9 shows the pH variation as a function of time. These data show that at fixed composition of the entire system a transfer of calcium takes place from the liquid into the solid with an attendant drop of pH. This sluggish drop of pH below the value attained at the completion of lime addition and extending for some time thereafter is well known to the industry. Another explanation of it has been given by HOLT *et al.*[25] on different though somewhat related grounds. A third, more common explanation imputes the pH drop to the slow dissolution of lime particles; this explanation is ruled out in the case here reported because saccharate of lime was used. An approximate numerical examination was made of the problem in terms of solution electroneutrality, solubility product and mass balances; it showed that the amount of calcium transfer observed is consistent as to magnitude with the observed pH variation.

Table VII. Calcium exchange

t, min	0	10	20	30
$[Ca^{2+}]$	4·205	4·055	4·030	3·925
Ca	9·225	9·310	9·360	9·450
Sum	13·430	13·365	13·390	13·375
pH	8·50	7·90	7·62	7·48

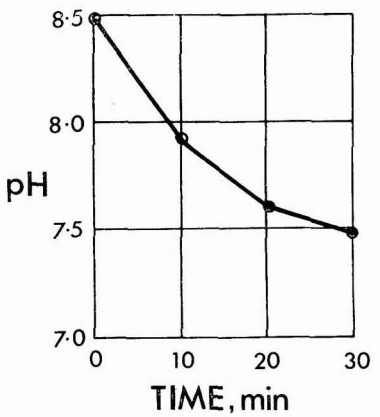

Fig. 9

It is obvious that the secondary reaction can get under way as soon as a very small number of solid $CaHPO_4$ nuclei is first formed; thenceforth both primary and secondary reaction can proceed side by side. This could be significant in filtration of refinery liquors, as it may be slowed down by *in situ* accretion of residual calcium in percolating fluid on solid in filter cake; this would occur with a drop of pH.

The ability of primary solid $CaHPO_4$ to take up additional calcium from the liquid phase by a second type of reaction mechanism immediately suggests that other ionic solution components besides calcium may enter the solid phase. General principles of structural substitution in ionic crystals would point to divalent positive ions with radii close to that of calcium as likely substituents in the addendum; these include Mg^{2+}, Mn^{2+}, Fe^{2+} and others. Apart from specific effects, the relative proportions of calcium and substituents in the addendum might be expected to depend largely upon their relative concentrations in solution. It follows from this reasoning that the lower the excess calcium concentration in the liquid phase the larger the proportion of substituents to enter the solid.

Dual role of lime in juice clarification. Adjustment of juice calcium-to-phosphate ratio to achieve "balanced" precipitation

A careful comparison of Figs. 1–3 showing the course of the liquid phase compositions of juices A, B and C upon gradually making alkaline with NaOH brings out an interesting feature. All three juices have identical calcium contents to start with (0·005 mM. cm^{-3}) and increasingly graded phosphate contents (0·00206, 0·00353 and 0·00500 mM.cm^{-3}). The expected gradual decrease of these components in solution as pH rises and precipitation augments is seen to take place in all three cases. It so happens, though, that on completion of the addition of base at pH 8·5

(*a*) juice A has given up or surrendered by precipitation practically all of its phosphate yet it holds in solution rather a large fraction of its initial calcium;

(*b*) juice C has surrendered by precipitation practically all of its calcium yet it holds in solution rather a large fraction of its initial phosphate;

(*c*) juice B (intermediate as to initial phosphate) has given up practically all of its calcium yet it holds in solution a sizable though smaller fraction of its initial phosphate content.

The cause of this diversity is obvious. Formation of the solid phase proceeds by continuous withdrawal from solution of calcium and phosphate at a fixed molar ratio R = 1·75 (or close to this average value). For an initial molar ratio in the juice (R_{juice}) greater than R (as for juice A), there is present in the juice to start with a greater amount of calcium than can be precipitated by the available phosphate; for an initial molar ratio R_{juice} less than R (as for juices B and C) there is present in the juice to start with a greater amount of phosphate than can be precipitated by the available calcium. It follows that a juice for which $R_{juice} = R$, on treatment with NaOH, will surrender by mutual precipitation practically all of its calcium and phosphate contents. Fig. 10 shows the course of addition of NaOH, as by calculation, to such a "balanced" juice.

It also follows that the treatment of an identical "balanced" juice with $Ca(OH)_2$ instead of NaOH is bound to take on quite a different course because lime will act both to make the juice alkaline, thus raising the pH and forcing the precipitation of calcium phosphate, and it will also act to boost the juice ratio of calcium to phosphate. Since by definition a "balanced" juice contains precisely the relative (or stoichiometric) amounts of calcium and phosphate which mutually precipitate each other, so must necessarily all of the calcium contributed by the added lime remain dissolved. Fig. 11 shows the course of addition of

[25] HOLT, LA MER & CHOWN: *J. Biol. Chem.*, 1925, **44**, 509, 567.

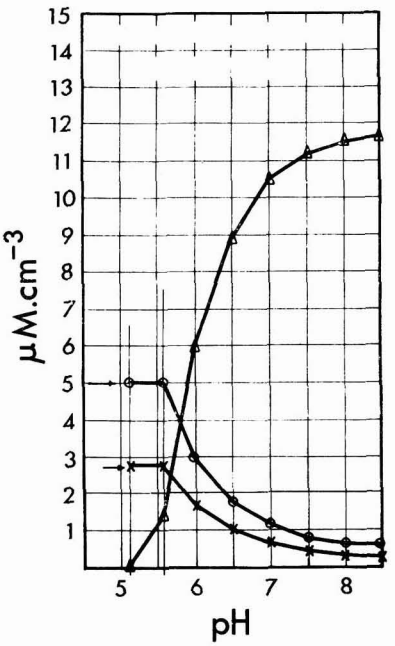

Fig. 10. ○ = $[Ca^{2+}]$; × = $[\Sigma PO_4]$; △ = ΔNa.

$Ca(OH)_2$ to the identical balanced juice of the previous paragraph. Addition of $Ca(OH)_2$ increases the calcium content of the juice, at pH 8·5, by 23·3% (in spite of the attendant surrender of calcium by precipitation); addition of NaOH lowers the calcium content at pH 8·5 by 86·9%, so that there remains in the juice only 13·1% of its initial calcium content.

This example brings out sharply the dual role, obviously and ineluctably exercised by lime in juice clarification on account of its chemical nature, of acting both as a base and a source of calcium. Furthermore, these two quite unlike roles are unchangeable as to their relative proportions: one mole of lime means, inflexibly, two equivalents of base and one mole of calcium. Since juices vary widely and nearly independently as to

(*a*) buffer capacity and

(*b*) calcium and phosphate contents, and hence as to

(*a'*) requirement of base for the adjustment of pH needed to induce precipitation, and

(*b'*) requirement of calcium or phosphate (or neither) to achieve proper balance needed for almost complete surrender by mutual precipitation of both these components

it will only very rarely happen that lime alone will closely meet all specifications.

Therefore, on the working hypothesis that it would prove convenient to render juices alkaline in such a manner that, at any desired final pH, they have minimal mutually compatible contents of both calcium and phosphate, the following conclusions are in order:

Case (a): Should a juice fortuitously or by design happen to be balanced ($R_{juice} = R$), its treatment with NaOH is indicated. This base should be added in the amount required to adjust final juice pH to whatever value is desired on other accounts;

Case (b): Should a juice be somewhat lacking in calcium ($R_{juice} < R$), addition of lime is indicated in just the amount required to set $R_{juice} = R$; this brings us to *Case (a)* (see above);

Case (c): Should a juice be lacking in phosphate ($R_{juice} > R$), addition of phosphoric acid or alkali phosphate is indicated in just the amount required to set $R_{juice} = R$; this brings us to *Case (a)* (see above);

Case (d): Should a juice be very highly lacking in calcium ($R_{juice} << R$) and of quite low buffer capacity it may happen that the amount of lime required for balancing is so large that the desired final pH is overshot before the lime addition is all in. This type of juice should for simplicity be treated by first adding calcium chloride in just the amount sufficient to set $R_{juice} = R$; this brings us to *Case (a)*.

Notes:

Case (b): The lime added for balancing may boost the pH beyond the point of saturation and thus induce partial precipitation which is next completed by NaOH.

Case (c): Use of a highly basic phosphate such as Na_3PO_4 for balancing may boost the pH beyond the desired final value if juice buffer capacity is low; a less basic phosphate is indicated. Use of phosphoric acid may cause inversion losses. Use of "lime phosphates" is not considered here; these materials require special consideration because they bring into the juice both phosphate *and* calcium.

Case (d) Other balanced treatments are possible in this case.

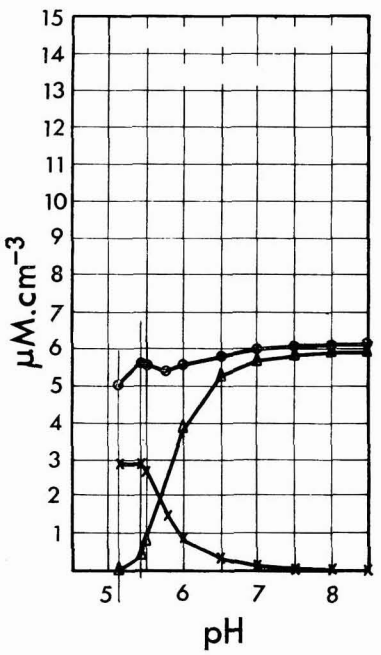

Fig. 11. ○ = $[Ca^{2+}]$; × = $[\Sigma PO_4]$; △ = $\Delta Ca(OH)_2$

(To be continued)

Hydraulics, mechanics and economics of subsurface and drip irrigation of Hawaiian sugar cane*

By WARREN GIBSON

(Experiment Station, Hawaiian Sugar Planters' Association, Honolulu, Hawaii, USA)

Paper presented to the 15th Congress ISSCT, 1974

Introduction

SUBSURFACE and drip irrigation of sugar cane in Hawaii is a system which continuously feeds water to the cane roots through a network of small-diameter tubes (12–20 mm) with small-diameter orifices (0·4–0·6 mm). The tubes are installed between or adjacent to the cane lines and are either on the surface or slightly below (drip) or approximately 40 cm below the surface (subsurface). Drip irrigation tubes are destroyed at harvest; subsurface tubes are used for longer periods and can irrigate several successive crops.

With both furrow and sprinkler systems, water is applied at intervals of 10 days and sometimes considerably more, depending largely on the availability of water. Two to three days after application, the water retained by the soil becomes increasingly difficult for the cane roots to extract. It is known that highest cane production (per unit of time) is obtained when there is no water stress placed on the plant, and a certain amount of yield is sacrified by applying water at intervals rather than by continuous "feeding".

Subsurface and drip irrigation systems appear to overcome the inherent disadvantages of furrow irrigation and, to a degree, sprinkler systems, because they can continuously "feed" the cane roots through a network of small tubes installed along the cane lines. The advantages may be summarized as follows:

A relatively low capital cost.
A probable increase in water efficiency, providing the opportunity of increasing total yield.
Very high irrigator man-day performance.
Elimination of furrows with associated costs.
The opportunity of continuous "feeding" of water, which eliminates the built-in water deficit created by interval irrigation.
A potential increase in fertilizer efficiency and a decrease in application costs since fertilizers can be applied through the system.
A probable decrease in weed control costs by screening out weed seeds from the water and by decreasing the moisture in the upper soil layer.

In Hawaii, first work in this concept was done in 1959 by the HSPA Experiment Station Agronomy Department. Polyethylene tubes 5 cm in diameter, with orifices 3·2 mm in diameter, were buried and the wetting patterns studied. In 1965 a study of wetting patterns under continuous water replenishment was made by the Station Engineering Department, using low flows under low heads and small-diameter orifices.

The first successful installation of this basic system in Hawaii was completed by the Station Engineering Department in March 1970 at the Kunia Substation[1]. This was a subsurface system consisting of polyethylene extruded tubing 12·7 mm in diameter buried 30 and 45 cm, spaced 1·5 m apart, with plastic orifices inserted every 1·5 m along the tubing. The cane was harvested at 19 months of age. Yield was approximately 2·7 tons per ha per month, and the tubing held up well.

D. J. MARTIN, manager of Olokele Sugar Company, and J. LANGA, irrigation engineer at that time, are credited with the first Hawaiian sugar plantation installations which provided the necessary impetus to stepped-up research and development. Olokele's first trial was installed in March 1971 and the first crop cane field installation of drip irrigation was 14 ha in June 1972.

In 1973, drip irrigation was installed on approximately 1,200 ha. Estimates for 1974 are approximately 2,400 additional ha. Subsurface irrigation remains on an experimental basis. If current problems are solved, and it is expected that they will be, it is predicted that most of the present approximately 48,000 ha of irrigated cane will eventially be under subsurface and drip irrigation.

WATER REQUIREMENTS

Basic research on water requirements of sugar cane in Hawaii has established that best yields are obtained when the plant uptake of water, after a full leaf canopy has been established, is equal to pan evaporation from a standard US Weather Bureau pan[2]. As the curve for the yield relationship to pan ratio (available water to pan evaporation) is nonlinear, economics generally dictate that a pan ratio of less than 1·0 be used.

Irrigation water efficiency (ratio between water available to the plant and water applied) depends on the system, soil type, and other factors but, generally, furrow irrigation efficiency is between 30% and 40% and sprinkler irrigation efficiency is between 65% and 75%. Experimentation is being carried out to determine water distribution and efficiencies under drip and subsurface irrigation but the results are not yet available. For design purposes we are assuming the efficiency of drip irrigation to be at least 80%.

Source water during the peak-use period (PUP) is generally limited, and dictates that something less than a pan ratio of 1·0 be used as the base for determining the amount of water to be applied. A pan ratio of 0·8 is common in the Hawaiian industry. With this ratio, an assumed application efficiency of 80% and daily evaporation of 8 mm, the application requirement becomes 8 ha-mm per ha-day. If this amount is applied continuously over a period of 24 hours the flow required is 55·6 litres per minute per hectare

$$\left(\frac{8\ \text{ha-mm}}{\text{ha-day}} \times \frac{10^4\ \text{litre}}{\text{ha-mm}} \times \frac{\text{day}}{1440\ \text{min}} = 55{\cdot}6\ \text{litres/min/ha}\right)$$

* Series Paper No. 339 of the Experiment Station, HSPA.

[1] VAZIRI: *Ann. Rpt. Expt. Sta., HSPA*, 1971, 14–16.

[2] ANON.: *ibid.*, 1962, 81–82.

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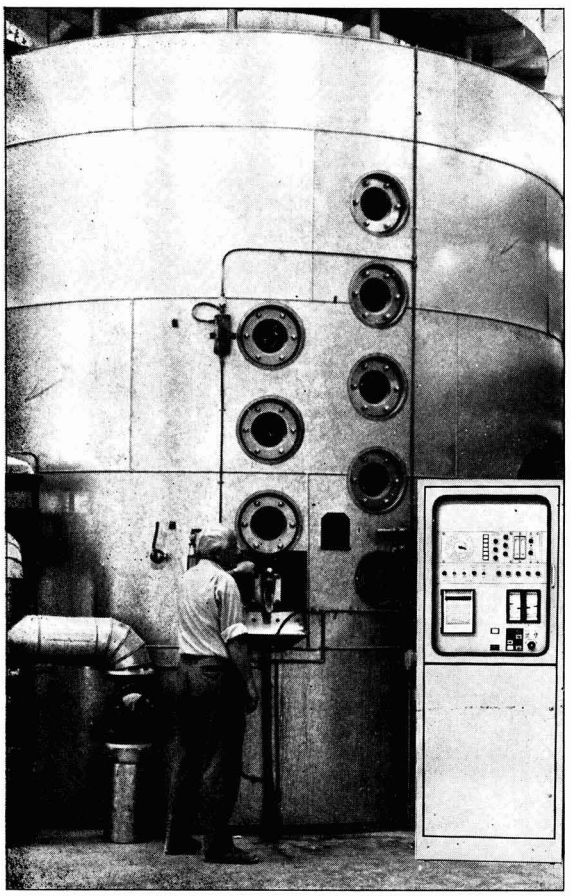

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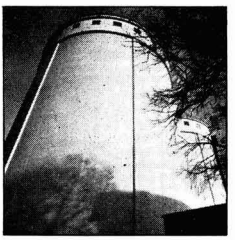

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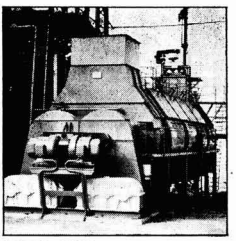

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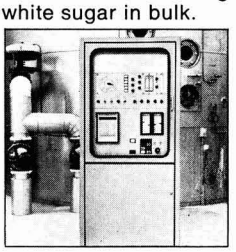

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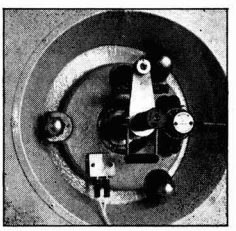

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Please send detailed information about the checked off items

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- ☐ DDS Automatic Pan Controller
- ☐ The direct view DDS Pan Microscope
- ☐ DDS Cane Diffuser
- ☐ DDS Beet Diffuser
- ☐ DDS Silo
- ☐ DDS Prelimer

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Present practice is to apply the daily requirement during a 12-hour period, and the design flow rate for a 24-hour application must be doubled, amounting to approximately 110 litres/min/ha. As this higher design flow rate increases the cost of mainlines (and submains, if used) by approximately 40%, experimentation is in progress to determine whether a continuous 24-hour application during PUP has any adverse effects of practical importance.

The Distribution Tube

The first distribution tube to receive wide acceptance was dual-chamber extruded polyethylene to approximately 0·8 mm wall thickness. Latest dual-chamber tubes are extruded to 0·3 mm wall thickness or manufactured from either 0·15 or 0·3 mm polyethylene film. Single-chamber tubes in use are either extruded to 0·3 mm wall thickness or manufactured from 0·13 to 0·3 mm film. Tubes supplied by one manufacturer have punched orifices, all others have laser-burned orifices.

The dual-chamber tube

The dual-chamber tube had a conveyance chamber operating at high head (approximately 7·3 m) and a distribution chamber at very low head (60 cm and lower). The distribution chamber has more orifices than the conveyance tube, and the conveyance tube is considerably larger, approximately 13 mm in diameter. Fig. 1 illustrates the configuration of the dual-chamber tube.

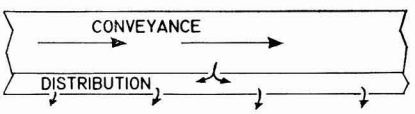

Fig. 1

The advantage of the dual-chamber tube is that very uniform flow rates are obtained from the distribution chamber even when there is a high head loss in the conveyance tube caused by friction or by running the tube up-slope (Table I).

Table I. Hydraulic characteristics of 12·7 mm (distribution tube) diameter dual-chamber tube installed on zero slope (field test data)
Orifice diameters: 0·51 mm; inner orifice spacing: 46 cm; outer orifice spacing: 183 cm.

Length, m	*Conveying chamber pressure, m*	*Distribution chamber orifice flow, litres/min*	*Total flow, litres/min*	*Head loss, m*
0	10·6	0·0280		
30	8·5	0·0299		
61	7·1	0·0280		
91	6·6	0·0238		
122	6·2	0·0250		
152	6·0	0·0238		
183	6·0	0·0261	9·95	4·6

This high uniformity of distribution-tube orifice flow rate is due to the specific discharge rate equation for the dual-chamber tube:

$$Q = CA\sqrt{\frac{2gh}{N^2 + 1}}$$

where Q = flow through distribution chamber orifice (when conveyance and distribution orifice areas are the same), C = coefficient of discharge, A = orifice area, g = acceleration of gravity, h = head and N = ratio of number of distribution chamber orifices to conveyance tube orifices. In Fig. 1 the ratio is 4.

In contrast to what occurs in the single-chamber tube, as the head (h) drops owing to friction or installing the tube up-slope, there is little effect on the discharge (Q) on account of the factor $N^2 + 1$. This hydraulic characteristic is an important feature as it permits a high degree of flexibility in the design and operation of a subsurface or drip system. The disadvantage of the dual-chamber is its susceptibility to orifice plugging owing to low head (and thus velocity) in the distribution chamber.

Cost of the dual-chamber tube is approximately US$49 per 1000 m. With unequal row spacing ("pineapple planting"), discussed later, this amounts to approximately US$178 per ha.

The single-chamber tube

For the single-chamber tube, the orifice discharge rate is:

$$Q = CA\sqrt{2gh}$$

As head (h) drops owing to friction or installing the tube up-slope, there is a direct effect ($\sqrt{h}$) on the discharge (Q), unlike the effect in the dual-chamber tube which is $\sqrt{\frac{h}{N^2 + 1}}$.

The advantages of the single-chamber tube, in comparison with the dual-chamber, are its lower cost and the potentially decreased susceptibility to orifice plugging. Disadvantages are poorer distribution with long runs, increased total flow rate, which increases mainline costs, and decreased field layout flexibility.

The disadvantages may be partially overcome by increasing the diameter of the tube (to decrease the head loss due to friction) and decreasing the operating head and orifice size, to reduce the total flow rate. Also, to decrease the total flow rate per unit of length, the space between orifices might be somewhat increased without too seriously affecting soil water distribution. Length of maximum tube runs must be less than with the dual-chamber tube and very little increased head, due to installing the tube up-slope, can be tolerated.

A single-chamber tube incorporating most of the compromises discussed was developed and tested, and is now in production. Water distribution was found to be excellent and total flow rate acceptable (Table II).

Table II. Hydraulic characteristics of 21 mm diameter single-chamber tube installed on zero slope (field test data)
Orifice diameter: 0·38 mm; orifice spacing: 61 cm.

Length, m	*Chamber pressure, m*	*Orifice flow, litres/min*	*Total flow, litres/min*	*Head loss, m*
0	1·77	0·0322		
30	1·65	0·0318		
61	1·55	0·0299		
91	1·49	0·0307		
122	1·46	0·0318		
152	1·43	0·0318	7·76	0·34

Cost of the single-chamber tube is estimated at US$36 per 1000 m or approximately US$131 per ha, giving savings over the dual-chamber tube of US$47 per ha. This saving of approximately US$23 per ha-year (for Hawaii's 2-year crop) will probably be somewhat offset by an increase in capital outlay for larger mainline pipe, but there is a decreased capital and operating cost, owing to the lower operating heat.

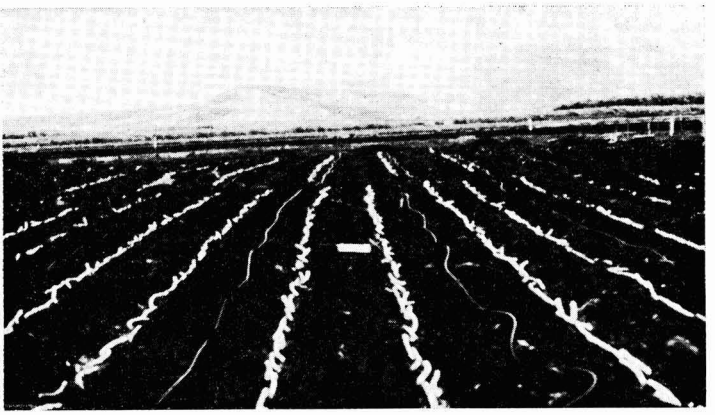

Fig. 2. An experimental plot using unequal row spacing or "pineapple planting"

Tube-caneline relationship

With drip irrigation in which the tube is installed on or near the surface and destroyed by harvesting, the amount of tube per ha is a critical cost factor. Tube for most of the Hawaiian area has, therefore, been installed in what has become known as "pine-apple planting"—one tube serving a pair of cane-lines each spaced 0·91 m away with 1·83 m between pairs, so that a single tube serves a 2·74 m space which requires 3650 m of tube per ha (Fig. 2).

To assure good seed germination, the general practice is to place the tube directly over one caneline and apply water continuously until a thorough wetting is obtained and then to move the tube to the adjacent caneline. When this caneline has been wetted, the tube is moved and placed in a shallow furrow between the canelines. Tubes are moved by hand and this costs approximately 2·5 man-hours per move per ha. With fine soil preparation, it has been demonstrated that tube moving is not required, nor is it required for starting ratoon crops.

With subsurface irrigation, the tube is mechanically injected to a depth of approximately 40 cm and is used to irrigate the plant crop and 2 or 3 ratoon crops, having a total life of 6 to 8 years. Basic research has shown that best yields are obtained under sub-surface irrigation when the tube is close to the seedpiece[3]. To accomplish this and yet have flat culture, one of the major objectives of installing subsurface or drip irrigation, the seedpiece is placed in a furrow approximately 20 cm below the original soil surface and this furrow is backfilled when the cane is approximately 4 months old. Research has shown no detrimental effect on yield of this practice and it is thought likely that the ratoon crops might be improved by having the stools firmly established at this depth[3].

Subsurface irrigation has been installed in a few hectares with "pine-apple planting" (1 tube to 2 cane lines) or with 1 tube serving a single caneline.

INSTALLATION

Two types of infield installations are being used. In the one which is most commonly used, the water distribution tubes (lateral lines) are attached to sub-mainlines which are in turn supplied by mainlines (Fig. 3). In the other, the lateral lines are connected directly to the mainlines (Fig. 4). Common to both types is the supply system consisting of a pump or gravity-head supply line, water treatment facilities, controls, and supply lines conveying water to the infield mainlines.

The advantages of connecting directly to the mainline are (1) cultivation machinery can travel over the mainline whereas it must turn around if sub-mains are used, and (2) lower costs. Greater care must be taken in sizing pipe to assure the desired flow uniformity. For a stylized field layout (actual field layouts are usually more expensive owing to non-uniformity of terrain and shape), material costs of mainlines and submains are approximately US$77 per ha when the land slope is 5%, lateral tube length is 120 m, and the design flow rate is 140 litre/min/ha. For the same conditions, the material cost is approximately US$59 per ha when only a mainline is used. Labour and machine standards are being determined for the two installation methods.

WATER TREATMENT

Orifice plugging is the greatest single problem associated with subsurface and drip irrigation. The problem has not been satisfactorily solved, but preliminary results of an extensive research programme are encouraging. The Experiment Station, Hawaiian Sugar Planters' Association, has an inter-disciplinary

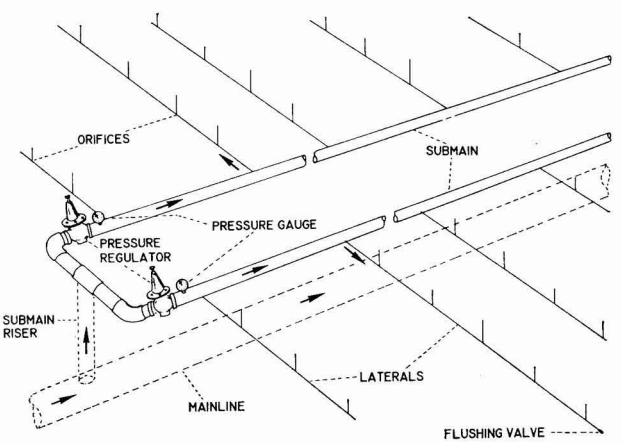

Fig. 3. Mainline—submain installation of drip irrigation system

[3] MONGELARD: Unpublished data.

project aimed at solving the plugging problem. Up to the present we have learned the following:

(1) How to measure rapidly the solids content of water (in ppm) and determine the quantities of organic or inorganic solids.

(2) How to determine rapidly the range of particles sizes (as % by volume) of the solids in water.

(3) That solids consist of a variety of substances: plant fibres, algae, diatoms, soil particles, gelatinous materials, microorganisms, etc., and that these are generally found in all water sources.

(4) That most of the solids in source water are less than 60 microns in size after a 150 micron screening.

(5) That the solids are negatively charged.

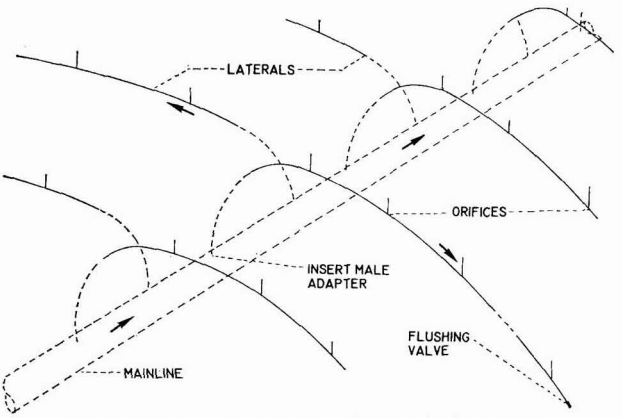

Fig. 4. Mainline-only installation of drip irrigation system

(6) That simple screening does not remove solids smaller than 60 microns.

(7) That sand filtering reduces the solids content of source water to approximately 2 to 3 ppm while simple screening leaves approximately 10 ppm if the source water contains as much.

(8) That the suspended solids less than 60 microns in size aggregate, apparently on account of microbial activity, to become flocculant masses larger than the tube orifice sizes.

Table III. Test variables in attempts to solve the plugging problem

Reducing solids in source water to:		*by:*
Approx. 10 pp;	< 60 microns	Screening
Approx. 2–3 pp;	< 60 microns	Bed filters
Approx. 2 pp;	< 25 microns	Cartridge filters
		Micron screens
		Chemical treatment
		Flotation
		Settling

How can we live with it?

Kinds of material—Film *vs.* extruded polyethylene
Material wall thickness
Orifices
  Punched *vs.* laser
  Size
  Inner–outer relationship
Pressures
Configuration—dual *vs.* single
Flushing
Chemical treatment
  Chlorine
  Pentachlorophenol
  Copper
  Other

Fig. 5. Tube farm to determine degree of orifice plugged under various water treatments

(9) That plugging appears to be caused by a number of factors including algal growth at the orifice, mats of aggregated solids, and salt crystallization which occurs after the flow of water has been reduced.

(10) That the most promising chemical treatments so far tested prevent aggregation of solids in laboratory tests. They also control algae and may help to prevent insect damage to the tubing.

(11) That periodic flushing of the tubes removes at least some of the accumulated solids and reduces plugging. Present methods of flushing are far from satisfactory.

A tube farm (Fig. 5) and pilot water treatment plant have been established to

determine the degree of plugging, using three contamination levels of source water under various operating conditions. Table III presents the variables under investigation.

Summary

The Hawaiian sugar industry is rapidly converting furrow-irrigated lands to drip irrigation. Subsurface irrigation is being investigated in field trials. Gross water applications are considerably less than for furrow irrigation and somewhat less than for sprinkler irrigation. The dual-chamber tube, with its specific hydraulic characteristics, is being used to convey and distribute the water to the cane. The single-chamber tube is being tested in the field. Two methods of installation are discussed, the mainline-submain system and the mainline-only system. Orifice plugging is the greatest problem and an interdisciplinary research programme, aimed at solving it, is presented.

Cane starch

Part I. Isolation and iodine affinity

By J. C. STEVENSON* and E. WHAYMAN†

Introduction

THE determination of starch levels in Queensland canes and raw sugars is performed using reference starches from other plant sources[1]. Because this analysis relies on the blue colour of an amylose-iodine complex, expression of starch level as parts per million of reference starch gives no indication of the absolute concentration of cane starch present unless the two are of very similar composition. This project was designed to compare the properties of starches extracted from cane and the reference starch.

Estimations of cane starch amylose contents have been made previously in Louisiana[2], South Africa[3] and Mauritius[4]. No such work has been reported in Queensland. The Louisiana and South African analyses were performed on starch solubilized before its separation from the crude plant extract. In this project, the granules were isolated and studied. A powder was then prepared and this used in the iodine affinity determinations.

Experimental

Isolation of starch

Cane juice was collected from the first mill of the milling train at various Queensland sugar mills. This fraction was chosen because the juice had not been subjected to any rise in temperature and granules were expected to be undissolved. Centrifugation of the juice at 1800 *g* produced a brown residue which was washed several times with water until the discarded supernatants were clear. A dilute aqueous slurry of the residue was transferred to a separating funnel where it was mixed with an equal volume of an organic solvent, immiscible with water, e.g. chloroform or toluene. When the mixture was shaken vigorously, an emulsion formed which, upon standing, separated into two layers. The granules were found to be in the aqueous layer and this was run off. Successive application of this technique removed all other suspended and colouring matter from the starch fraction. Use of one solvent only did not give the same degree of purity of the final fraction, so two were used but in no definite order. The granules were concentrated by centrifugation and stored at 2°C.

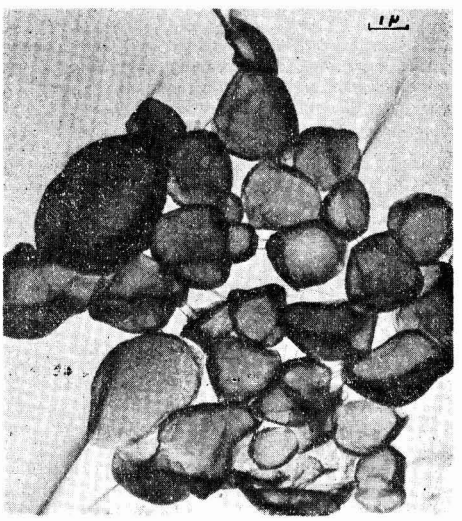

Fig. 1. Electron micrograph of N:Co 310 cane starch granules

All discarded fractions were examined for the presence of starch using the blue colour produced with acidic iodine solutions as an indicator. Where starch was detected, it was examined microscopically to ensure that there had not been a preferential loss of any granule size.

Preparation of starch powder

Water was removed from the granule concentrate by centrifugation at 1800 *g* with several washes in ethanol. The starch was then transferred to a thimble in a Soxhlet extractor, and extracted for 30 minutes with 95% ethanol. A vacuum oven operating at 30°C was used to dry the granules over phosphoric

* Technical Correspondence School, South Brisbane, Queensland, Australia.
† Sugar Research Institute, Mackay, Queensland, Australia.

[1] *Proc. 15th Session ICUMSA*, 1970, 317–320.
[2] Cashen & Friloux: *J. Agric. Food Chem.*, 1966, **14**, (4), 435.
[3] *Ann. Rpt. Sugar Milling Research Inst.*, 1969, 6.
[4] *Ann. Rpt. Mauritius Sugar Ind. Research. Inst.*, 1971, 97.

oxide overnight. Frequent stirring in the initial stages ensured that no clumping occurred. The fine powder was in a desiccator over fused calcium chloride.

Microscopic examination

Electron microscope grids were precoated with collodion and a dilute aqueous suspension of undried granules applied to their surfaces. When the suspension had dried out, it was reinforced with carbon. A "JEM-30-Superscope" was used to study the granules which were photographed, e.g. Fig. 1. Granule size determinations were carried out by preparing photographs of standard grids.

Determination of purity

The starch was hydrolysed to glucose by amyloglucosidase. Glucose produced was hydrolysed by glucose oxidase to gluconic acid and hydrogen peroxide. The latter was determined using peroxidase and *o*-dianisidine. The experimental details were the same as those of DEKKER & RICHARDS[5].

Determination of amylose content

Starches can be characterized, and the linear fraction of "amylose" content determined colorimetrically by the extent of complex formation with iodine[6] or Congo red[7]. There were some initial difficulties with the colorimetric techniques owing to the low optical density readings generated. These were later overcome, but the technique first adopted for characterization of the starches was the potentiometric determination of iodine affinity by the method of SCHOCH[8]. In this, starch solutions are titrated with an iodine solution and the bound and free iodine calculated from a calibration of EMF against free iodine. The upper linear portion of the plot of bound *vs.* free iodine is extrapolated back to zero free iodine as shown in Figs. 2 and 3, and the iodine affinity calculated as:

$$\% \text{ Iodine Affinity} = \frac{\text{mg bound iodine at zero intercept} \times 100}{\text{mg dry sample weight}}$$

Chemicals

BDH potato starch (Batch No. 2499440)
Nutritional Biochemicals Corporation amylose (Control No. 2704)
Nutritional Biochemicals Corporation amylopectin (Control No. 2172)

RESULTS AND CONCLUSIONS

An electron micrograph of starch granules isolated from the variety N:Co 310 is shown in Fig. 1. A range of sizes and shapes of granules was found in the extracts from each cane variety. Most granules were irregularly shaped with a predominance of granules resembling elongated spheres. Many granules had some flattened surfaces.

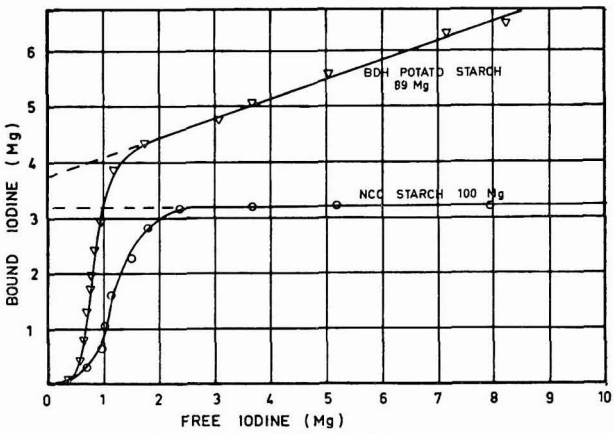

Fig. 2. Iodine affinities of whole starches

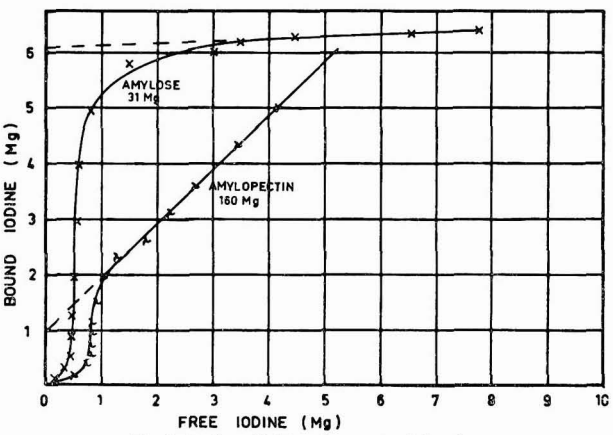

Fig. 3. Iodine affinities of corn starch fractions

The maximum diameter of granules ranged from 1 μm to 5 μm.

The standard one-hour incubation with amyloglucosidase specified in the method cited for starch purity determination proved inadequate to achieve complete hydrolysis of the starch to glucose, and a longer period of incubation was found necessary. For instance, a purity of 91% was indicated for a starch after one hour's incubation, while a figure of 99% was obtained after 26 hours' incubation.

Potentiometric titrations were performed using amylose, amylopectin, BDH potato starch and the following cane starches:

Variety	*Mill area*
N:Co 310	Mackay
N:Co 310	Bundaberg
Q 58	Mackay
Q 63	Mackay
Q 80	Ayr
Q 85	Ayr
Q 85	Tully

[5] *J. Sci. Food Agric.*, 1971, **22**, 441.
[6] CARROLL & CHEUNG: "Methods in Carbohydrate Chemistry" Vol. IV., Ed.: R. L. WHISTLER. (Academic Press, New New York and London). 1964, p. 170.
[7] GILBERT & SPRAGG: *ibid.*, p. 168.
[8] *ibid.*, p. 157.

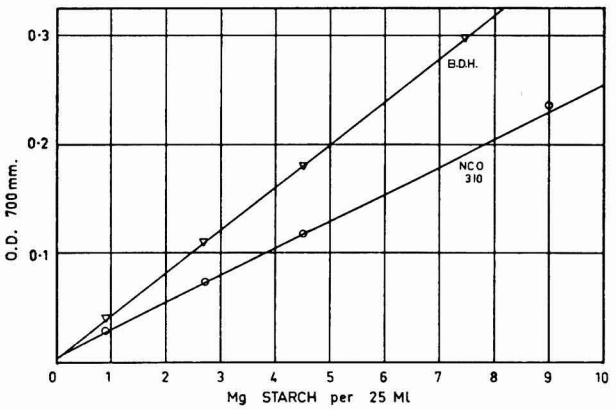

Fig. 4. Optical density of whole starch-iodine complexes

Table I shows the iodine affinities of these substances and the calculated amylose contents of the starches.

Table I. Iodine affinities of amylose and apparent amylose contents of starches

Substance	*Iodine affinity* (%)	*Apparent amylose content* (%)
Amylose	19·6	
Amylopectin	0·6	
BDH potato starch	4·2	19
Cane starches	3·2	14

The starches from cane varieties specified all analysed as 14 ± 1% amylose.

The amylose contents were calculated assuming that the cane starch is a mixture of the standard amylose and amylopectin used in this study, i.e.

$$\% \text{ amylose} = \frac{As - Ap}{Ao - Ap} \times 100$$

where As = iodine affinity of starch, Ap = iodine affinity of amylopectin and Ao = iodine affinity of amylose.

It is most unlikely that this is correct, and there are certain to be unclassified intermediate fractions, but the amylose contents are included purely for comparative purposes.

The technique used to dissolve cane starch throughout these investigations was to treat the wetted starch with alkali for half an hour and then neutralize the solution obtained. This solution technique was compared with dissolution in dimethyl sulphoxide, boiling water, and alkali treatment followed by neutralization and boiling. In none of these cases was a truly clear solution obtained and the haze was thought to be due to the presence of high-molecular weight polysaccharide components.

It was finally found that a clear solution could be obtained by a 5-minute pretreatment of the starch granules at 55°C and pH 2 with half the acid used for neutralization followed by addition of the total alkali. The solution is then held cold for half an hour, boiled, cooled and neutralized.

Regardless of the solubilization technique employed, the iodine affinities of the cane starches remained very close to 3·2. These low iodine affinities and, by inference, amylose contents were completely reproducible and are therefore considered to be valid estimates. The difference between the iodine affinities of cane starch and the reference BDH starch indicates that the total quantity of starch in cane is under-estimated by the standard analytical technique. This was confirmed by the preparation of standard graphs relating optical density at 700 nm to concentration using BDH starch and the isolated cane starch granules. The different slopes indicated that a correction factor of about 1·6 should be applied to the total quantity of cane starch estimated, as shown in Fig. 4. This result is very similar to that reported from Mauritius[6] but disagrees with quoted figures from Louisiana and South Africa. The latter results however were obtained from starch solubilized before its separation from the crude plant extract, and therefore the preferential recovery of one component may well have occurred.

As whole granules were used in this work the main doubt remaining is whether the granules recovered were representative of the total starch in cane. Owing to the variability of cane preparation between varieties and mills, and therefore presumably different initial starch extractions, and also owing to the differing ratios of organic solvents to starch content, a spread of results would be expected if granules of differing amylose content were present in cane and fractionation was occurring. It is more likely that the consistency of the results is due to uniform granule composition, and that cane starch in the varieties and districts quoted is of very similar composition.

SUMMARY

Starch granules were isolated from Queensland sugar cane and their sizes studied by electron microscopy. The iodine affinity of starches from different cane varieties was determined potentiometrically. The granules were found to vary in maximum diameter from 1 μm to 5 μm and the iodine affinity was consistent at 3·2%.

China sugar statistics[1].—Production of beet sugar in China in 1974 is estimated at 1,000,000 metric tons, raw value, as against 850,000 tons in 1973. Cane sugar is set at 2,900,000 tons, compared with 2,450,000 tons in 1973. On a basis of reports by supplying countries, imports were only 410,562 tons in 1974 (30,949 tons from Australia, 358,670 tons from Cuba, 10,760 tons from Guyana and 10,183 tons from Jamaica) as against 735,848 tons in 1973 (66,220 tons from Australia, 367,598 tons from Brazil and 302,030 tons from Cuba). Exports were reduced from 155,000 tons in 1973 to 50,500 tons in 1974 while consumption increased from 3,550,000 tons to 3,800,000 tons in 1974.

* * *

Chile sugar production expansion[2].—For the 1975/76 season Industria Azucarera Nacional S.A. is to grant sugar beet growers a credit of 800 pesos a hectare and provide seed, fertilizers and pesticides. During 1974/75 sugar beet production was 1·4 million tons, equivalent to 206,000 tons of sugar, from a planted area of 40,000 hectares and 56,000 ha has been planted for the 1975/76 crop[1]. Iansa has a minimum target of 250,000 tons of white sugar for the 1975/76 season, and anticipates a production of 280,000 tons.

[1] *I.S.O. Stat. Bull.*, 1975, **34**, (8/9), 28.
[2] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (30), 11.

Sugar cane agriculture

Underground water—an asset to protect. G. J. HAM. *Cane Growers' Quarterly Bull.*, 1975, **38,** 118–119. Increases in cane and rice production in Queensland have substantially reduced the quantity of water available from underground aquifers, necessitating drilling for new sources. However, water from many such sites has proved unsuitable for irrigation; but when a site is abandoned, there is a danger that the "pipe" of sand left by the withdrawal of the casing may allow this poor quality water to pollute an aquifer of good quality water at higher levels, especially when the latter type of aquifer fails to provide an adequate flow rate and the bore has to be deepened through its clay base to locate a larger aquifer, which may contain saline or otherwise unsuitable water. Advice is given on the best means of avoiding this problem, instances of which have been recorded in the Lower Burdekin area in 1974.

* * *

The changing status of Q canes in the Burdekin district. C. A. REHBEIN and M. J. BRAITHWAITE. *Cane Growers' Quarterly Bull.*, 1975, **38,** 120–122.—The pattern of cane varietal change in the district since establishment of the Ayr Experiment Station in the early 1950's is examined.

* * *

Control of pineapple disease and other germination problems. M. A. HETHERINGTON. *Cane Growers' Quarterly Bull.*, 1975, **38,** 123–124.—Conditions favouring the spread of the pineapple disease fungus and symptoms of the disease are described and means of preventing it examined.

* * *

The value of Bureau research. ANON. *Cane Growers' Quarterly Bull.*, 1975, **38,** 125–128.—Illustrations are given which depict the valuable work carried out by the Bureau of Sugar Experiment Stations in combating serious pests and diseases in Queensland and which also show the damage which results from the cane grub, leaf scald and Fiji disease. Gumming disease and downy mildew are now almost forgotten, while effective control measures have been instituted for other diseases such as ratoon stunting disease.

* * *

Basal stem and root rot. H. L. BOYLE. *Cane Growers' Quarterly Bull.*, 1975, **38,** 129–130.—Symptoms of this fungal disease are described. Measures to minimize crop loss include hilling-up and irrigation (both to encourage stooling). There is no fungicide effective against the disease, which occurs sporadically in a cane block rather than throughout the field.

* * *

Leaf scald disease in Q 93 at Bundaberg. G. J. PERSLEY. *Cane Growers' Quarterly Bull.*, 1975, **38,** 131–132.—The history of the disease in the Bundaberg district is outlined and outbreaks in Q 93 cane in 1974/75 are described. Reasons for the outbreak are suggested, including the presence of a grass known to harbour leaf scald, and weather conditions in 1974 which favoured the disease.

* * *

Wallabies in the Herbert River district. R. E. KERKWYK. *Cane Growers' Quarterly Bull.*, 1975, **38,** 133–134.—Damage to young cane by wallabies has been somewhat extensive during a number of seasons (the type of damage is clearly shown in a photograph), and growers are advised to obtain a permit for shooting the animals, since there are no other preventive measures.

* * *

***Antitrogus* grub damage at Bundaberg.** J. F. REIMERS. *Cane Growers' Quarterly Bull.*, 1975, **38,** 135–136. The damage caused by *A. mussoni* to cane on one farm in the Bundaberg area is described with the aid of photographs. The pest has a one-year life cycle, so that populations can build up rapidly. The simplest and most effective means of control is BHC dust applied at the rate of 125 kg.ha^{-1} in the half-open drill during the last cultivation; this will ensure adequate protection for the plant and two ratoon crops.

* * *

Resurgence of soldier fly damage at Maryborough. J. WRIGHT. *Cane Growers' Quarterly Bull.*, 1975, **38,** 137–139.—The soldier fly has become a serious pest in several areas of Queensland, and at Maryborough an estimated 2033 tons of cane was lost in 1974. Possible reasons for the resurgence of the pest and counter-measures involving use of "Dieldrin" are described.

* * *

Recent nitrogen investigations in the Burdekin area. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1975, **38,** 140–141.—Nitrogen trials on ratoon cane in 1973 and 1974 are described and recommended rates of application given for early- and late-harvested crops.

* * *

Standover in the Innisfail area—is it possible? I. J. STEWART. *Cane Growers' Quarterly Bull.*, 1975, **38,** 142–144.—Advantages and disadvantages of standing cane over to the next season are discussed from both agricultural and factory processing standpoints. Abnormal weather conditions in the Innisfail wet belt districts forced growers to adopt the measure in 1974. The best means of tackling the problem of standover cane are described.

* * *

New unit handles the slush. ANON. *Producers' Rev.*, 1975, **65,** (3), 9.—A pivot steer unit fitted between a Massey-Ferguson tractor and cane trailer transfers a major part of the load of the trailer to the drive wheels of the tractor, while the front wheels of the trailer can

be lifted clear of the ground, thus transferring further load to the tractor. The wheels of the tractor can be replaced with specially designed tracks in about 2 hours, the basic standard hub assembly being used to mount the tracks. The system is of particular value in wet and muddy infield conditions.

* * *

Failures of plant cane. ANON. *Producers' Rev.*, 1975, **65**, (3), 91.—Failures of plant cane experienced by many Mackay farmers in 1974 were attributed to extension of the 1973/74 very heavy wet season into March-April, and the cold and wet condition of the soil was not favourable. Despite the use of mercurial fungicides, which are effective for 6 weeks, shoots became infected with fungal rot because of the delayed emergence. The use of trash planters made wetting of the plant material with the mercurial solution difficult; other features of such planters which require careful attention are also described.

* * *

Soil care neglect is costly. J. D. VEURMAN. *Producers' Rev.*, 1975, **65**, (3), 109.—It is stated that, of 1600 growers supplying cane to the six factories in the Mackay area, only 115 are applying soil conservation measures. Penalties for neglecting to safeguard soil against erosion are declining crop yields and increased fertilizer usage. Advice is given on measures to prevent erosion.

* * *

Cultivation of sugar cane in Mexico. C. PASSOS. *Brasil Açuc.*, 1975, **85**, 192–197.—A brief historical account is given of the Mexican sugar industry.

* * *

Evaluation of the performance of cane harvester topping mechanisms. J. BRITO M. and J. ABREU C. *CubaAzúcar* 1975, (Jan./Mar.), 3–14.—The work of the topping mechanisms of cane harvesters was evaluated in terms of the efficiency of top removal and of the loss of cane stalk. A first series of tests involved adjustment of the topping height by the machine operator so as to assess working capacity under conditions similar to normal. A second series was to determine the optimum area where the topper could work, while the third was to compare the performance of the topping mechanisms and pneumatic removal systems of the Claas Libertadora 1200 and Soviet-built KTP harvesters.

* * *

Incidence of sugar cane shoot borer in relation to planting time. S. SITHANANTHAM, R. DURAI and S. MUTHUSAMY. *Indian Sugar*, 1975, **24**, 867–870.—Increase in the incidence of *Chilo infuscatellus* was favoured by increased maximum temperature, lower relative humidity and lower rainfall, so that planting in December-February for the normal main crop and in September for the special crop season is recommended.

* * *

Investigations on sugar cane chlorosis in Uttar Pradesh. V. Soil factors responsible for iron chlorosis. U. S. SINGH and P. D. BAJPAI. *Indian Sugar*, 1975, **24**, 873–874, 879.—Cane chlorosis was found to be due not to iron deficiency in the soil, since large amounts of the element were present, but to inadequacy of its availability to the cane, possibly because of the presence of excess P and Ca which turned the iron into an insoluble form.

Evidence for the presence of the toxin-binding protein on the plasma membrane of sugar cane cells. G. A. STROBEL and W. M. HESS. *Proc. Nat. Acad. Sci.*, 1974, **71**, 1413–1417.—Results of tests, which are reported, have suggested that the helminthosporoside-binding protein in sugar cane[1] is present on the external surface of the plasma membrane of the plant cell, The protective effect of antiserum applied to susceptible plant tissue (whole leaves) supports this idea, while further evidence includes the successful pyridoxylation and reduction of the binding protein *in vivo* followed by its isolation, the reaction of cane cells and free protoplasts with the antiserum, and agglutination of cane protoplast preparations with antiserum to the binding protein.

* * *

The yellow sugar cane aphid *Sipha flava* Forbes and its control. B. R. DÍAZ. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 1–6.—The yellow aphid has become a harmful and persistent pest of recent years in Guatemala, affecting a good number of estates, and use of insecticides has tended to reduce the population of its natural enemies. Trials with "Metasystox" applied at 357 g a.i. per hectare showed complete control of the pest while not affecting its predators.

* * *

"Integrated phytosanitation". K. BLASBERG. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 7–15.—The title concept covers the application of chemical agents for the control of harmful insects which do not affect their predators, and for the control of diseases and weeds without harming the crop. An account is given of such action in a number of crops with details of the nature of the chemical and biological control methods.

* * *

The Mexican sugar industry. Development of the cane field during the last 25 years. S. FLORES C. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 17–52.—Progress of the Mexican sugar industry between 1947 and 1972 is reviewed. Cane production has increased five times and sugar output 4·5 times, largely as a result of the needs of an increasing population. Cane yields have risen from 52·3 tons.ha^{-1} in 1947 to 63·4 tons.ha^{-1} in 1972 although factory recovery has remained stable at about 9·0%. More than 40 small factories were closed but 15 new larger ones were built. Problems have arisen from replacement of low-fibre noble canes, rich in sucrose, with new higher-fibre varieties of lower sucrose but greater resistance to pests and diseases. More rational fertilizer usage, based on soil and leaf analysis and field experiments, has been introduced, but the quality of cane has been reduced because of the increasing proportion of trash with the introduction of mechanical harvesting and loading. Delays between cutting and milling are a source of loss as is the extension of the season to seven months in order to process all the crop. Field problems include integration of cane areas into economic units for use of machinery, provision of irrigation and drainage in marginal areas, field preparation and cultivation, and the use of fertilizers and pesticides, as well as control of harvesting, provision of extension services and training of farm personnel.

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

SUGAR Technologist (Dutch; age 29), presently employed in tropics, seeks new position anywhere in the cane industry. Please write to Box 499, *The International Sugar Journal Ltd.*, 23A Easton Street, High Wycombe, Bucks., England.

The importance of plant health in the cultivation of sugar cane and the biology and habits of the principal insects attacking the crop. V. SANCHESVIESCA G. *Mem.* 1° *Congr. Centroamer. Técn. Azuc.*, 1973, 53–60. The yield and quality of sugar cane are subject to diminution as a result of attack by pests during its growing cycle, and in Guatemala a number of pests have become a major cause of loss; these include the moth borer (*Diatraea saccharalis*), mealy bug (*Pseudococcus sacchari*), army worm (*Laphygma exigua*) as well as a local pest, *Chinche salivosa*. An account is given of each, the damage it causes and control measures employed.

* * *

Quality of cane as a function of its maturity. A. L. FORS. *Mem.* 1° *Congr. Centroamer. Técn. Azuc.*, 1973, 1973, 61–82.—The photosynthesis of sucrose in the cane plant is described and the influence of climate, particularly rainfall and temperature, is discussed. The importance of mineral elements is also considered and reference made to experiments in Cuba using auxins for ripening cane at the most convenient time.

* * *

Economic analysis for determining the optimum dose in complete fertilization of sugar cane under two systems and planting distances. E. A. PANIAGUA U. *Mem.* 1° *Congr. Centroamer. Técn. Azuc.*, 1973, 83–101.—An account is given of field trials in which cane was grown in double rows 3 ft apart with a 6 ft inter-row distance and using simple placement of setts (instead of double overlapping lines). The higher planting rate compared with single rows 6 ft apart required greater amounts of fertilizer, but the resultant higher cane yield more than covered the cost.

* * *

Preservation of the soil. G. D. JACKLIN. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 11–12. The author emphasizes the urgency of the need to prevent further excessive loss of soil from cane lands, and briefly indicates the various causes of large-scale losses which have already taken place in Australia.

* * *

Irrigation in Australia. E. R. HOARE. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 27–36. The subject of water availability is discussed generally, and the irrigation system in Australia, which is used for a number of crops, is described together with details of water consumption and problems associated with river systems. As regards the sugar industry, mention is made of the considerable quantities of water consumed and waste products which result from processing.

* * *

A review of sugar cane irrigation. K. C. LEVERINGTON and D. R. RIDGE. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 37–43.—In this survey, the climatic conditions in irrigated cane areas of Australia, Hawaii, Rhodesia and South Africa are tabulated and the effects of irrigation on cane yield in various countries indicated. It is pointed out that, since the responses of cane to irrigation have been greater under con rolled experimental conditions than in the field, correct irrigation scheduling is highly important. The theory of scheduling is briefly explained and scheduling practices are described. Irrigation systems are then examined, viz. furrow, spray and trickle. The first is restricted to those countries having cheap labour and suitable soils, while spray irrigation has undergone changes since its introduction to replace furrow irrigation. The advantages and disadvantages of trickle irrigation compared with the other two systems are discussed.

* * *

Water supplies for the irrigation of cane. D. W. BEATTIE. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 45–50.—Information is given on cane irrigation in Queensland, including the number of hectares under irrigation in the major cane-growing areas and irrigation water sources in 1972/73. Water supply problems that have occurred during the last 10 years are outlined, and details given of measures which have been approved to overcome them. The limitations on use of underground water supplies are indicated, and controls on the use of both surface and underground water are explained. Possible future developments involving water conservation are listed and their costs mentioned.

* * *

Irrigation systems in the Queensland sugar industry. R. B. MOLLER and L. S. CHAPMAN. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 51–55. After a brief examination of water sources in Queensland, details are given of the techniques and equipment used in three major cane areas. While both furrow and sprinkler irrigation are used in the Bundaberg and Mackay districts, furrow irrigation is the only system used in the Burdekin area. The potentials of trickle and solid-set irrigation are discussed.

* * *

Water requirements and irrigation scheduling of sugar cane in Queensland. I. Water requirements of sugar cane in Queensland. G. KINGSTON and G. J. HAM. *Proc.* 42*nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 57–67. **II. Irrigation scheduling of sugar cane in Queensland.** G. KINGSTON and L. S. CHAPMAN. *ibid.*, 69–76.

I. The cane water requirements were determined at Ayr and Bundaberg experiment stations and found to be in close agreement with results reported elsewhere in the world. A significant, positive correlation was established between evapotranspiration and pan evaporation where the cane canopy was well developed, but not where there was a relatively open canopy as with young cane. Elevated Class A pans had no advantage over standard pans. The correlation between evapotranspiration and standard pan evaporation became closer with the length of period during which data were averaged to yield mean daily data; it is recommended that evapotranspiration be calculated from the average evaporation of 14 days, since the evaporation average would be more sensitive than the average of a longer period while giving almost the same precision in evapotranspiration calculation. Daily evapotranspiration rates were closely related to stalk elongation rates. Since the evapotranspiration:pan evaporation ratio fell with increase in soil moisture stress, irrigation schedules based on a pan factor of 1·0 may be excessive, and investigations of this are thought necessary.

II. Results are given of trials on irrigation scheduling based on (i) soil moisture tension and (ii) Class A pan evaporation data, while a system of supplementary irrigation to establish the cane stool during dry spring months (late September and late November) before the onset of the wet season was also tested.

The effects of irrigation on plant and ratoon cane yield and sugar content are tabulated for (i) and (ii) and for plant cane in the case of the supplementary irrigation trial. Advantages of the schemes are discussed in relation to water availabilities and future allocations in Queensland. The supplementary irrigation method was found to be of great value.

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Water quality and watering problems. D. R. RIDGE and G. J. KELLY. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 77–84.—The quality of surface and ground water used for cane irrigation is discussed, with emphasis on the problems created by high salinity and sodium content. Mention is made of poor infiltration rates in furrow irrigation and of water pump corrosion, while advice is given on the best approach to the problem of iron in natural water which can lead to incrustation of screens, discharge boxes and delivery lines. While chemical removal of deposits is considered too costly, treatment with molasses has been successful in some cases, and its use under certain circumstances is advocated.

* * *

Land and water management on cane farms. H. S. PINK. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 85–89.—In a discussion of soil erosion by rain and water, the author indicates the problems created in Queensland where there is a call for increased cane area. While cane, as a standing crop, is a most efficient soil-conserving agent, there are times during its growth cycle when the land is vulnerable to erosion, particularly on steep slopes. Extensive cane-growing areas are located on sloping land, and it is felt that restrictions should be imposed on new land used for cane so that steep slopes are avoided, particularly where the soil type is such that losses are high. Poor drainage in some areas is also a major problem, leading to low cane yields and sometimes complete crop failures.

* * *

The economic assessment of large-scale irrigation projects. D. WESNEY and R. F. WOOLCOCK. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 91–97.—In an explanation of the procedures used in economic evaluation of large-scale irrigation projects by government authorities, the authors use the 15 years' experience of the Bureau of Agricultural Economics in Canberra as a background. One finding of interest is that, while large-scale projects have provided substantial benefits to the region in which they are located and particularly to the farmers, their economic value to the nation as a whole is small (few in Australia during the last 15 years showing returns greater than 5–6% in real terms).

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Some factors influencing the decision to irrigate sugar cane. G. A. FERGUSON and R. J. HAMPSON. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 99–103.—The economic advantages of cane irrigation are discussed under three basic groups: those resulting from increased cane and sugar yield, those given by the greater crop reliability in both plant and ratoon cane with ability to produce peak crops consistently, and secondary benefits such as cane maturity control, fertilizer application scheduling, weed control (through rapid canopy development) and other farming operations. Factors influencing the cost of irrigation are also discussed for different groups of growers: farmers who use partial irrigation because of limited water supplies or those in areas of usually adequate rainfall who need only occasional supplementary irrigation, those who do do not use any irrigation, and those who rely on irrigation for all the water supplied to the cane.

* * *

Further aerial baiting trials against rats in cane fields. B. E. HITCHCOCK and R. E. KERKWYK. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 105–107.—Trials are described in which rat baits containing thallium sulphate were applied at the rate of 0·84 and 1·68 kg.ha^{-1} under conditions of high rat incidence. The greater rate gave far better results than did the lower rate, even when the latter was used for two applications. Aerial baiting was about as effective as manual baiting under conditions of both high and low rat incidence, but the proportional reduction in damage, compared with unbaited fields, fell with increasing rat incidence irrespective of the method of applications. (See also HITCHCOCK: *I.S.J.*, 1974, **76**, 141.)

* * *

Resistance to yellow spot disease in *Saccharum* species and hybrids. B. T. ROACH. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 109–114.—Screening trials to determine the resistance of cane clones to yellow spot showed that while clones of *Saccharum spontaneum* and its F_1 hybrids with *S. officinarum* displayed generally high levels of resistance, *S. officinarum* appeared to be the major contributor to susceptibility in commercial hybrids. (The level of susceptibility was about the same for *S. officinarum*, *S. robustum* and *S. edule*, but *S. robustum* is little used for hybridization in Australia, while *S. edule* is not used in breeding because of its aborted inflorescences.) Commercial hybrids were found to be more susceptible to the disease than were the basic species from which they were derived; radiation-induced mutation was found to be capable of producing genetic variability as regards yellow spot resistance. The results of the trials are tabulated.

* * *

Diagnosis of R.S.D. by electron microscopy of sugar cane tissue diffusates. D. S. TEAKLE, P. M. SMITH, A. C. HAYWARD and D. R. L. STEINDL. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 115–116.—A method is described in which ratoon stunting-infected cane stalk, leaf sheath, leaf midrib or lamina tissue is cut across the vascular bundles into thin slices which are then immersed in water; the bacterium[1] diffuses into the water, is concentrated by centrifuging and then identified by negative-stain electron microscopy. Recovery of the bacterium was better from lower older leaves than from upper young leaves, indicating that the former are more highly infected with RSD.

* * *

Some aspects of the calcium silicate trials at Mackay. M. B. C. HAYSOM and L. S. CHAPMAN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 117–122. Three methods were used to determine available silicon in five soil types; use of 0·02N calcium chloride at a 1:10 soil:reagent ratio or 0·01N sulphuric acid at a 1:200 ratio, both with 16 hours' shaking of the test sample overnight, gave Si values which were significant-

[1] TEAKLE *et al.*: *I.S.J.*, 1975, **77**, 174.

ly related to cane yield and appeared to be suitable for prediction of sites where silicate application would be of benefit (assuming a critical soil Si level of 20 ppm). The values given by the H_2SO_4 method were much higher because it brought into solution sesquioxide compounds containing adsorbed silicon and because of formation of silicic acid; the $CaCl_2$ method, which gave values close to those given by distilled water extraction, was found to be a fairly rapid method for determination of water-soluble Si. Use of 0·5N NH_4OAc (pH 4·8) at a ratio of 1:20 with 1 hour shaking proved unsuitable. Application of calcium metasilicate at 4 tons.ha^{-1} increased cane yield compared with untreated controls and cane growing on soil treated with 4 tons of lime per ha (which also gave a greater yield than did the controls). In only one case, however, was the cane sugar content raised by the silicate treatment compared with the control, while in the other four cases it was somewhat lower than the control.

* * *

Long-term effects of sugar cane production on some physical and chemical properties of soils in the Goondi mill area. N. R. MACLEAN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 123–126.—Details are given of soil analyses in this area of Queensland. Physical and chemical properties are compared for uncultivated and cultivated soil to establish what changes have occurred since cane was first grown in 1885. Soil layers of 0–15, 15–30, 30–45 and 45–60 cm were investigated; the top layer revealed a small but significant decrease in pH and a considerable increase in available P. The K status of both soils was about the same, while Ca and Mg levels in the top 30 cm were lower in the cultivated soil. There were no significant differences in cation or anion exchange capacities. The bulk density at the cultivated soil surface and at the top of the subsoil in the cultivated inter-row spaces was greater as a result of compaction, while total porosity was significantly lower than in the uncultivated soil. This deterioration in soil structure plus the drop in available Ca and Mg are considered potential threats to cane yields in the future. It is pointed out that mono-culture in other tropical countries has often led to a serious decline in soil fertility.

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Train running simulation. E. E. SHEPHERD. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 127–132. Information is given on the programme for the IBM 1130 computer installed at the Sugar Research Institute to assist in answering questions concerning cane railways and assessing the capabilities of railway systems, with details of the input data required. How the programmes can be applied to simulation of train running is explained.

* * *

Modifications to cane transport and handling equipment. W. A. GREENWOOD and J. B. HAYES. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 133–139. The replacement of 2·4-metric ton cane bins with 5·5-ton bins at Racecourse was accompanied by introduction of rotary couplers and the installation of a rotary tippler. Descriptions are given of the various items mentioned, as well as the spotting device installed to position the trucks and bring them to rest on the tippler with the minimum of shock. Modifications to harvesters and infield transport were necessitated. Despite teething troubles, the system has a number of advantages, including a one-third greater haulage capacity for the same tractive effort.

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Critical path programming of resources for land preparation. R. OVIANO. *ATAC*, 1975, **34**, (2), 4–14.—The application of the critical path techniques for organization of a land preparation programme is explained with the aid of diagrams and tables.

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Sugar cane research in Argentina. *Mem.* 1973, *Est. Exp. Agric. Tucumán*, 1974, 9–70, 121–128.—The report includes descriptions of work carried out at Tucumán on fertilizers, irrigation, mechanical harvesting, cane flowering and crossing, cultivation and herbicide usage, cane breeding, deterioration of cane and its effects on juice gums and other characteristics, aconitic acid analysis in cane juice and molasses, and production of furfural from bagasse.

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Maintaining sugar cane quality during harvest. B. J. COCHRAN and W. A. HADDEN. *Sugar J.*, 1975, **37**, (10), 49–52.—Cane harvesting operations which affect the amount of extraneous matter delivered with the cane to the factory are surveyed, including: field conditions, topping height, burning, and piler and loader grab operation. Increased losses are also caused by harvesting the first row and opening the field, so that there is increased damage to the cane lying in the path of the harvester while it is cutting the second row. Lodged cane harvesting also poses problems and necessitates reduced speeds; otherwise, 20–30% of the cane may be left in the field. The five main types of extraneous matter are indicated and Louisiana factory performances and trash quantities shown.

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Drip irrigation system design for sugar cane fields. I. P. WU. *Hawaiian Planters' Record*, 1975, **59**, 1–13. From a mathematical analysis of the hydraulics, charts are developed for rapid designing of drip irrigation systems using maps, simple profile checks in the field or computer programmes. The charts are applicable to calculation of main, sub-main and lateral line parameters and also enable the economics to be assessed.

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Studies on intercropping of cotton (*Gossypium hirsutum* L.) in spring-planted sugar cane (*Saccharum officinarum* L.). N. P. WANKHEDE and K. S. PARASHAR. *Indian Sugar*, 1975, **24**, 951–954.—Trials are reported in which five varieties of cotton were grown as intercrop in cane fields. Results indicated that cane yield and quality were unaffected by the cotton, which escaped attack by the pink and spotted boll worms. Cotton yield ranged from 2·3 to 8·4 quintals per ha. The economics are briefly examined. Since cotton has a deep taproot system, it does not compete with cane for nutrition and water requirements; moreover, it is a short-term crop.

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Fuels from crops: renewable and clean. R. W. GRAHAM. *Mech. Eng.*, 1975, **97**, (5), 27–31.—The subject of growing crops for use as fuel is discussed generally, the approach being that of converting solar energy into biomass. The biomass yield from photosynthesis for various crops, including sugar cane, is indicated; this shows that only Napier grass is better than cane in this respect, while corn and rice are not as good as cane.

Sugar beet agriculture

Epidemiological observations on the sugar beet powdery mildew epiphytotic in western USA in 1974. E. G. RUPPEL, F. J. HILLS and D. L. MUMFORD. *Plant Disease Reporter*, 1975, **59**, 283–286.—Reference is made to the outbreak of powdery mildew in 13 states in 1974[1]. Attacks ranged from mild to severe and caused reductions of up to 6·8 metric tons per ha in beet yield and up to 1·5% fall in sugar content. Good control was obtained with two applications of sulphur dust at 22–45 kg.ha^{-1} or one application of wettable sulphur at 11·3 kg in 142 litres of water per ha, whereas "Benomyl" was generally not effective at the maximum permissible rates. (At present there is no chemical officially registered in the US for use against the disease.) Delay in the onset and reduction in the severity of attack were observed where sprinkler irrigation was used in contrast to furrow irrigation. Crop rotation and maintenance of optimum soil moisture are recommended as means of reducing losses from the disease; adjacent fields of overwintering beet could act as reservoirs of inoculum for succeeding crops and should be avoided. No beet varieties resistant to powdery mildew have been bred in the US although in trials differences have been found in the degree of susceptibility between varieties. Association between the spread of powdery mildew and dissemination of conidia is suggested; the onset of mildew also appeared to be connected with plant age, and did not usually develop until 2½–6 months after planting. A new virulent indigenous race or a newly introduced race of the causal agent (*Erysiphe polygoni* or *E. betae*) may explain the sudden outbreak in the US.

* * *

Results of investigations on the processing properties of sugar beet. M. Z. KHELEMSKII, N. T. POEDINOK, S. N. KALINA, D. G. GOMANYUK and T. A. KURBET. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23**, 18–29.—Investigations of factors influencing beet processing quality are reported, covering soil and climatic conditions, varietal parameters and topping height. Methods of determining processing quality are briefly discussed.

* * *

Problems of sugar beet pathology in India—a critical appraisal. K. SINGH, S. N. SRIVASTAVA, C. SEN and V. P. AGNIHOTRI. *Indian Sugar*, 1975, **24**, 961–973. Beet diseases which have been reported as occurring in India are listed and their symptoms, causal agents and possible control measures described. Future problems in beet pathology are summarized.

* * *

Estimation of initial occurrence of the mangold fly and black bean aphid in 1975. H. BERNARDOVÁ, E. SCHELLEROVÁ and J. ŠAFRÁNKOVÁ. *Listy Cukr.*, 1975, **91**, 75–79.—Estimates of the first generation of the mangold fly (*Pegomyia hyoscyami*) and of the black bean aphid (*Aphis fabae*) were obtained from counts of larvae in beet piles and residual soil from these at 68 Czechoslovakian sugar factories. The probable intensity of the first attack by *A. fabae* was also calculated for the various regions, although high correlation was found between development of the pests and weather conditions.

* * *

Selection of breeding material for tolerance to beet virus yellows. V. RÍMSA, Z. PETRÁK, M. JÍLKOVÁ, J. CHOD and J. POLÁK. *Listy Cukr.*, 1975, **91**, 91–94. The glutamic acid and glutamine contents were determined in beet progeny infected with virus yellows and the beet then divided into tolerant and susceptible groups. The virus titre was also determined serologically in each case, whereby it was found that the order of level of precipitation in the dropwise reaction corresponded to that of the glutamic acid:glutamine ratio, which tended to be greater in the tolerant samples. Tabulated data are also given showing the adverse effect of the disease on beet in the form of reduced weight and sugar yield.

* * *

Some results of beet payment on sucrose basis at Karabaltinskii sugar factory. M. N. BARKO and F. I. KHAMAZA. *Sakhar. Prom.*, 1975, (4), 67–70.—The sucrose content of beet supplied to this Kirgizian sugar factory is discussed and the various collective farms supplying the beet are indicated. Of these, only one was entitled to a premium for beet of a high sucrose content, while the rest supplied beet which warranted a penalty.

* * *

Varietal trials with beet seed in 1974. L. SCHMIDT, J. JAROŠ and D. MRÁČKOVÁ. *Listy Cukr.*, 1975, **91**, 97–103.—Beet varietal trials held in Czechoslovakia in 1974 are reported and the results tabulated.

* * *

The struggle against black fly. L. VAN STEYVOORT. *Le Betteravier*, 1975, **9**, (88), 7.—It is pointed out that black fly is not as harmful as green fly (which is largely responsible for the spread of beet virus yellows), but in large numbers it can cause crisping of the beet leaves, so that when 15–25% of the beets bear large numbers of the pest, treatment is recommended; in the absence of treatment, by the beginning of July the beets may suffer from the effects of black fly. On the other hand, treatment after 15th July is not advised, since the pest falls victim to parasites and fungal diseases.

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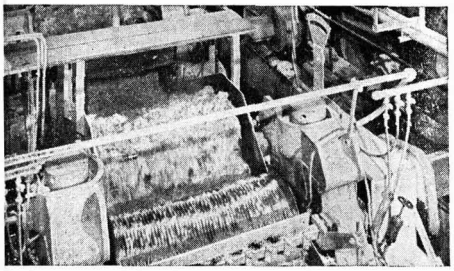
[1] KONTAXIS: *I.S.J.*, 1975, **77**, 275.



Cane sugar manufacture

Observations on the importance of design in calandria pans. M. ANDUX. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 155–159.—Aspects of pan design which govern capacity and operation are surveyed.

* * *

Need for a coordinated programme for the control of micro-organisms, clarification of juice and control of scale in sugar factories. R. W. KUHLMANN, S. A. QUAIYOOM and H. BAENA. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 161–173.—The inter-relationship of microbial infection, juice clarification and scale formation is discussed, and the use of materials produced by Buckman Laboratories Inc. described and discussed.

* * *

Optimal utilization of the calorific value of bagasse. R. VELAZQUEZ R. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 175–176.—With the increase in costs of oil and other fuels it is essential to extract the most heat from bagasse, and the advisability of drying bagasse is discussed.

* * *

Application of the "Rototec" process in sugar factories. F. DIAZ D. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 177–207.—A detailed account is given of this process for metallization, i.e. building up of worn surfaces with metal using an oxyacetylene flame.

* * *

Modernization of milling plants. J. SANCHES A. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 209–217. Aspects of modernization are briefly discussed with a note on ancillary equipment which can be the source of unwanted mill stoppages.

* * *

The diffuser at Ingenio San Antonio, Nicaragua, C.A. L. RIVAS L. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 219–256.—The reasons for installing a diffuser and for selecting the Extraction De Smet design are summarized, and an account is given of the unit, its operation, factors influencing its performance, comparative data from before and after installation of the diffuser, and future plans.

* * *

Experience with the influence of the perforations of the baskets and screens on centrifugal capacity. D. HAECKEL. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 257–262.—Comparison between the performance of centrifugals of identical size but different makes showed a large difference in capacity which was found to be due to inadequate molasses drainage through insufficient perforations in one machine. Similar comparison of two continuous machines, working with the same massecuite at the same temperature, showed different throughputs; this was attributed to one having a screen perforation of only 7% of the total surface as against 10% for the other.

Location of imbibition. S. VIEGO. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 263–269.—The author explains his hypothesis that the ideal location for addition of imbibition water to a bagasse blanket is from above, on the feed side of the mill, at the point where there is a change in juice direction from the same as the bagasse to the reverse direction.

* * *

Coarse grooving in mills. S. VIEGO. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 271–276.—The history of coarse grooving of crushers and mills is briefly summarized and an account given of the geometry involved.

* * *

Factors influencing the feeding of mills. A. VIGIL. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 277–284.—Twelve factors affecting mill feeding (polished rollers, soil and trash in cane, rounded grooving, etc.) are listed and briefly discussed.

* * *

Experience with the diffuser at Ingenio Montelimar and comparison with the work of mills alone before its installation. R. SCHAER. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 285–292.—An account is given of 8 years' experience with the bagasse diffuser, and calculations are given of comparative costs of straight milling and milling-diffusion, from which it is concluded that the installation paid for itself in less than three years.

* * *

Diffusion of sugar cane—an extended evaluation. J. C. P. CHEN. *Mem. 1° Congr. Centroamer. Técn. Azuc.*, 1973, 293–313.—Aspects of diffusion are discussed, including cell rupture, clarification in the diffuser, bagasse dewatering, sucrose in bagasse, influence of insoluble solids on juice purity, sweetwater from the mills, cane diffusion and sugar recovery.

* * *

Evaluation of post-freeze cane juice quality. J. C. P. CHEN and J. J. CHEN. *Sugar J.*, 1975, **37**, (9), 21–24. Results are reported of tests on three cane varieties to determine the effect of frost. It was found that the rate of deterioration was governed by a combination of three factors: the freezing temperature, the duration of the lowest temperature, and the post-freeze temperatures. Varietal differences were found as regards resistance and tissue damage. pH was not a good guide to deterioration. Lodged and mechanically-harvested cane displayed more damage than did standing cane, while deterioration was more rapid in burnt, cut cane than in standing cane, which was more affected than unburnt, cut cane, since the latter was piled on the ground and thus protected. The degree of juice decomposition was indicated by the quality of juice in the cane tops, which were found to play a significant "negative" role in cane processing,

particularly after frosts, because of the increase in acidity; however, this increase did not necessarily indicate an increase in the invert sugar:sucrose ratio, since some invert sugar is being decomposed while sucrose is being inverted. Decomposition products from deteriorated cane adversely affected juice clarification and raw sugar refining quality. The effect on juice quality of length of topping (1, 2 or 3 feet) was also determined.

* * *

Cane receival at Millaquin. R. L. MULLER. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 13–18.—Details are given of the cane reception system at Millaquin which was modified to allow for increases in the crushing rate, to minimize labour requirements and to improve efficiency. The major changes included installation of a rotary tippler to discharge cane from rail trucks and the location of rail and road truck weighbridges at the appropriate tipping points. All phases of the work, from truck movement to juice sampling (using the electronic sample tracker described earlier[1]) and data entry are directly controlled by computer; this provides a comprehensive reporting scheme for use by management and cane testers, inspectors and growers.

* * *

Remote computer access. R. F. SUTHERLAND. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 19–21.—The system used by Babinda sugar factory, whereby the computer facilities at James Cook University are linked by telephone to a terminal installed at the factory, is described and the economics, advantages and disadvantages discussed. The system is intended to provide daily cane summaries and harvesting reports, weekly varietal and harvest reports, and details of cane payments.

* * *

A case for PERT/CPM. W. A. GREENWOOD. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 23–25.—It is shown how use of a programme based on a combination of Programme Evaluation and Review Technique (PERT) and Critical Path Method (CPM) enabled a highly complex reconstruction programme at Racecourse sugar factory to be analysed in great detail, thus providing for early decision making and for production of a very accurate schedule. The programme involved re-location of existing equipment (in the case of the pan and centrifugal stations, at new floor levels) and installation of new equipment. The chief features of the two network scheduling schemes are outlined.

* * *

Closing the tie-line. R. J. MCINTYRE. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 141–146.—The question of considerable power fluctuations in the tie-line between a factory turbo-alternator and the supply grid where public electricity is temporarily used (for various reasons which are listed) is discussed. A number of ways in which power flow can be controlled are suggested; of these, the most preferable is considered to be governing of the turbo-alternator by one of three methods listed. Charts showing the effect of grid frequency changes on the output of a turbo-alternator synchronized to the grid demonstrate the problem of parallel operation in Queensland.

The Racecourse central control room. N. A. NIELSEN and B. MCEACHRAN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 147–151.—The central control room at Racecourse houses consoles for control of the milling train, evaporator, juice flow, temperature and pH from the milling train to subsider, and power house equipment. Details are given of the controls and their operation.

* * *

Roller bearings in cane crushing mills. U. J. ACKEUS. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 157–160.—The author, representing The SKF Ball Bearing Co. (Aust.) Pty. Ltd., describes the spherical roller bearings used in a mill at Pleystowe and explains how they are sealed against juice entry; their lubrication and best method of dismounting are also mentioned. Measurements by a shock pulse meter at the beginning and end of the 1974 season showed negligible wear.

* * *

The spherical roller bearing mill. G. D. JACKLIN, B. J. DOOLAN and T. W. GATLEY. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 161–165.—Details are given of the new mill installed at Pleystowe which is provided with spherical roller bearings (see preceding abstract). At an average throughput of 294 t.c.h., it has crushed almost 780,000 metric tons in its first season. The mill has "set new standards of cleanliness and of lubrication requirements, and has shown itself to be a fine piece of machinery with promise of giving very long trouble-free service".

* * *

Torque requirements of a roller bearing mill. D. MACEY and J. A. MCGINN. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 167–170.—Comparison was made between the torque requirements of the Pleystowe mill (see preceding abstract) and those of No. 1 mills at Farleigh and Marian in order to determine losses due to friction in conventional mill bearings. Results indicated that the use of roller bearings in a mill can reduce torque by up to 25%; they also showed that torque variability in all three mills studied was high, either because of shaft misalignment or because of unstable cane feeding.

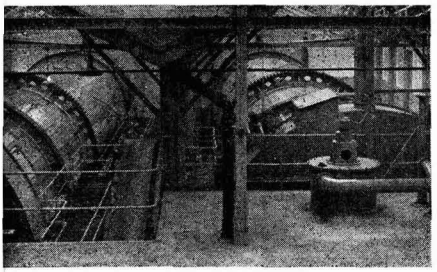
* * *

High-speed vibration. Some aspects of detection and correction. H. G. DICKS. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 171–179.—The stroboscopic and wattmeter methods of measuring vibrations created by machinery in motion are described and the problem of vibrations and how to eliminate them are discussed.

* * *

Pan stage centralized control at Racecourse mill. L. BATES, E. E. MCDOUGALL and G. A. WALLACE. *Proc. 42nd Conf. Queensland Soc. Sugar Cane Tech.*, 1975, 203–206.—The pan station central control at Racecourse is described. Manual operation of the system has permitted 127 m^3 of massecuite to be dropped and the pan recharged with 55 m^3 of footing in $14\frac{3}{4}$ minutes compared with an estimated 30 minutes under the previous scheme, while even further time reductions are considered possible. A ten-position switch is used to control pan down-time; this is minimized by breaking the vacuum with steam and spraying the pans with hot clarified juice, which maintains the heating surfaces in a very clean condition. Despite the installation of louvre-type baffles, entrainment has been excessive.

[1] MALAN: *I.S.J.*, 1970, **72**, 57.



Beet sugar manufacture

Influence of the method of diffusion water acidification on formalin activity. F. HOLLAUS. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Addition of SO_2 to the water used in a tower diffuser was found to reduce formalin activity and to cause an increase in the growth of anaerobic bacteria (*Clostridium thermohydrosulfuricum* and *C. thermosaccharolyticum*) in the upper part of the tower and increase in the aerobic bacteria in the lower tower sections and in the circulation juice. The effect of SO_2 on formalin activity, as expressed by pH, is indicated by graphs.

* * *

Analysis of rheological measuring systems for control of sucrose crystallization. D. SCHLIEPHAKE and K. AUSTMEYER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The sensitivities of two rheological measuring systems used for boiling control (the viscosity/consistency transmitter and the "Rheometer" control point transmitter) were determined on the basis of empirical characteristic lines obtained for the period of syrup concentration before seeding. Calculation methods are also described with which the frictional resistances for Newtonian mono-phase fluids measured by sensors can be represented as a function of the movement of the sensor and of the fluid viscosity. The experimental data are used to discuss the problems which arise in determination of the rheological properties of massecuite of high crystal content, particularly in the case of rotary measuring cylinders.

* * *

The conditioning of white sugar silos. V. MAURANDI and G. MANTOVANI. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The factors to be considered in pre-conditioning white sugar for storage in silos and in conditioning the silos themselves are discussed. Experiments at 20°C on sugar samples stored at various R.H. values demonstrated the effect of the sugar ash content on the amount of moisture absorbed. Equations are derived from the experimental data for calculation of isotherms, whereby the optimum storage conditions may be achieved.

* * *

Production of lime and CO_2 in the sugar industry. I. SUÉ. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Comparison was made between five different forms of fuel used for lime kilns, viz. solid fuel (coke or anthracite), heavy oil, natural gas, light petroleum gas (butane or propane) and light virgin naphtha. The effect of each on the quality of lime, waste gas properties, auxiliary equipment requirements, sugar factory operations, kiln design and operation, and costs was determined, and factors of importance in the selection of a new kiln are indicated.

* * *

COD balances as a tool in the waste water management of sugar factories. R. DE VLETTER and E. WIND. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Determination of the effluent COD as a criterion of purification efficiency is discussed and application to the waste water recycle scheme at Vierverlaten sugar factory, Holland, is described by way of example.

* * *

Juice coloration during sugar house work. L. WIENINGER and N. KUBADINOW. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Investigations showed that the colour of thick juice boiled in a pilot plant vessel for the same period of time rose by 44% (420 ICUMSA units) with increase in the boiling temperature from 74° to 79°C. The importance of this for white sugar quality is discussed, and absorption spectra for thick juices and molasses of 420 ICUMSA units colour measured at 240–600 nm are examined.

* * *

The effect of physico-chemical pretreatment of raw juice on subsequent purification. V. PREY, H. ANDRES, and T. DIETMAIER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Laboratory tests were conducted on raw juice pretreatment with flocculant followed by the KRÜGER system of lime-phosphoric acid treatment. Data, which are tabulated, indicate that the colour of juice from poor beet can be reduced by judicious selection and use of flocculant and subsequent purification. In all cases addition of hydrogen peroxide in purification had a favourable effect. Final decolorization and deliming with resin gave a virtually colourless juice.

* * *

Elimination of non-sugars in lime-carbonate purification, particularly with the use of calcium saccharate. J. DEGEEST, J. HOUSSIAU, G. RENS, M. RENS, R. VANDEWIJER and R. PIECK. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—A materials balance for molasses sugar extraction by addition of powdered lime is drawn up on the basis of laboratory tests up to production of thick juice from the saccharate. The balance is then extrapolated to white sugar and to the secondary molasses obtained from crystallization of the thick juice. It has been found that more than 80% of the initial molasses sugar can be recovered as white sugar, but the crystallization process can be carried out on a factory scale only if the quantity of raffinose precipitated together with the sucrose is reduced to permit a normal crystal growth rate. Two possible uses of saccharate are described: (1) as liming agent for raw juice treatment, trials on which have, however, shown that the thin juice has more colour and lime salts than in conventional treatment, and (2) treatment of stored *B*-syrup during the post-campaign period to yield extra white sugar.

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Beet juice purification with magnesium oxide. J. ŠTUDNICKÝ, A. DANDÁR and J. VAŠÁTKO. *Paper presented to the 15th Gen. Assembly CITS*, 1975. Addition of 1·5% magnesium oxide to cold raw juice

which was then heated to 95°C followed by filtration gave better quality juice than did conventional liming and carbonatation, but filtration was unsatisfactory although clarifier mud settling was apparently adequate. Investigations are being carried out on means of improving the filtration.

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Progress of calcium, iron, magnesium, silicon in evaporation. Combating corrosion and scale formation. P. DEVILLERS, R. DETAVERNIER and M. GROULT. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Details are given of the calcium, iron, magnesium and silicon contents in weekly juice samples (before and after evaporation) submitted by nine French sugar factories. The results are discussed and their importance for evaporator tube corrosion and scaling indicated.

* * *

Possibility of using ammoniacal condensate as nitrogen nutrient complement in RT-Lefrançois biological treatment. A. SIMONART, J. P. DUBOIS and R. PIECK. *Paper presented to the 15th Gen. Assembly CITS*, 1975. Investigations on the use of evaporator condensate as N nutrient in activated sludge treatment of flume and wash water using the RT-Lefrançois process at Tirlemont beet sugar factory are reported. The water, treatment of which in the fermenter lasts only 3–4 hours, suffers from a deficiency of N and P which must therefore be supplied from another source. The N in the condensate can be directly assimilated by most of the bacteria, which has led to a change in morphology of the activated sludge and to an increase in the biological activity.

* * *

Microbiological supervision of the diffusion system by lactic acid determination. P. W. VAN DER POEL. *Zucker*, 1975, **28,** 295–298.—Causes and development of microbial infection in beet diffusion are examined and the financial advantages of checking for infection by determining lactic acid are indicated. Since both the enzymatic method of L-lactate determination developed by SCHIWECK & BÜSCHING[1] and the total lactic acid method of STARK *et al.*[2] are used by the Central Laboratory of N.V. Centrale Suiker Mij. in Holland, the relationship between the two values was determined and a regression equation derived. The lactate is determined daily, after which the formalin dosage is adjusted. Average campaign values are given of raw juice and cossette lactate for all the sugar factories owned by the company and the financial equivalent of the losses calculated. This is done regularly with the aid of a computer.

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Ion exchange resins in the sugar industry. D. HERVÉ. *Zucker*, 1975, **28,** 299–306.—See *I.S.J.*, 1974, **76,** 279.

* * *

Thick juice storage. M. MOORE and J. KARR. *Sugar J.*, 1974, **37,** (5), 7–9.—Significant sugar losses occurred when thick juice of 65–69 refractometric dry solids content was stored in sealed plastic containers at one of three temperatures (15, 30 or 45°C) for varying periods up to 120 days. The initial pH was adjusted to 7·0, 8·5 or 9·5. It is suggested that the losses were probably due to microbial activity. Minimum losses occurred at 69 RDS, pH 9·5 and 15°C, but the colour increased slightly. The purity loss calculated for optimum storage conditions was 0·00935 units per day. It is concluded that at pH 8·5–9·5, the rate of sucrose decomposition will fall with increase in RDS and decrease in storage temperature.

* * *

New beet sugar factories open in Red River Valley. ANON. *Sugar J.*, 1974, **37,** (5), 10.—Some information is given on the Hillsboro and Wahpeton beet sugar factories in North Dakota, both of 5000 tons per day slicing capacity, and mention is made of a third factory planned for completion by the start of the 1975/76 campaign at Renville, Minnesota.

* * *

Sugar boiling: some facts and some fancies. J. G. ZIEGLER. *Sugar J.*, 1974, **37,** (6), 10–15, 16–21.—The author discusses a number of ideas which occur in the literature and which he regards as erroneous. He examines possible reasons for the persistence of these ideas, and shows that there is no intermediate oversaturation zone, that air leaking into a pan does not form additional grain, that there is no evidence that mechanical stirrers form grain, that higher boiling temperatures do not produce harder crystals, that water feed probably does not wash out grain, that false grain is not eliminated by a water or syrup drink, and that there is no confirmation that a tight massecuite produces better crystals. He also discusses the question of faster crystal growth at elevated temperatures, shock seeding (which he describes as a myth), uniformity of grain size, circulation in a vacuum pan, conglomeration, seeding, false grain formation, massecuite curing and measurement of oversaturation. He then reviews general rules for good boiling practice.

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The magoxide process. K. W. R. SCHOENROCK, C. L. KSIEH and P. RICHEY. *Sugar J.*, 1974, **37,** (6), 25–29. Laboratory and factory trials on addition of magnesium oxide to 1st carbonatation juice showed that it was effective in reducing molasses purity and evaporator scale compared with addition of soda ash or where no additive was used.

* * *

An industry in permanent evolution. II. A sugar factory in 1960. J. C. GIORGI. *Sucr. Franç.*, 1975, **116,** 261–265.—The processes and equipment used in a beet sugar factory slicing 2500 tons of beet per day are described and illustrated.

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Comparative tests on disc-type water separators preceding beet washers. E. T. KOVAL', B. P. LYSIKO, V. A. SEMENOVSKII, N. D. KHOMENKO, V. G. YARMILKO, N. M. DATSENKO and A. P. LAPIN. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **23,** 48–55.—Details are given of tests conducted on two disc-type water separators of Soviet manufacture. One model is shown to be much better as regards the amount of beet lost with the water, and the economics of this loss reduction are discussed.

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The DDS diffuser and its economic characteristics. A. F. ANDERSEN. *Ind. Alim. Agric.*, 1975, **92,** 411–417. See *I.S.J.*, 1975, **77,** 122.

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[1] *I.S.J.*, 1972, **74,** 88.
[2] *ibid.*, 1956, **58,** 106.

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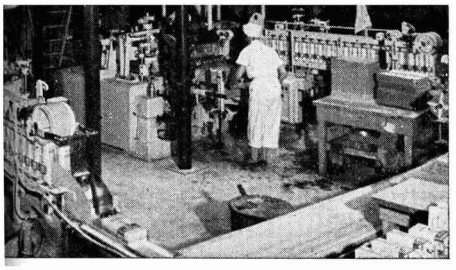


Sugar refining

Irreversible adsorption of colorants on sorbents in sugar manufacture. G. A. CHIKIN and V. F. SELEMENEV. *Izv. Vuzov, Pishch. Tekh.*, 1975, (2), 179–181.—The mechanism whereby colouring matter is adsorbed on active carbon is explained as an ion exchange process, in which functional groups in the solution react with those in the carbon to form covalent bonds.

* * *

Reactivation of decolorizing resins. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1974, **90,** 227–229.—Details are given of the process used at Skrivany sugar factory in Czechoslovakia to regenerate "Wofatit ES" strongly basic resin of the polystyrene type. Colouring matter is first removed with three volumes of recycled brine at 80°C, the resin cooled to 40°C or lower and regenerated at no higher than 40°C with 10% sodium chloride + sodium hypochlorite solution containing a maximum of 3% free chlorine. The resin is then treated with three volumes of 10% fresh brine at 80°C, followed by rinsing with water. The treatment increases the decolorizing efficiency by some 20% per cycle.

* * *

The efficient use of energy in steam and power generation. E. G. CLARKE. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 68–70.—The author indicates ways in which the efficiency of steam and power generation can be improved and power availability at turbines increased by using the lowest steam pressure consistent with process requirements.

* * *

Utilities conservation in cane sugar refining. J. D. RYAN. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 71–76.—The programme for efficient use of steam and power at Amstar Corp. is outlined and four basic steps in the balancing of power and steam usage described which need consideration: (1) reduction of power consumption, (2) minimization of steam requirements for power generation by a turbo-generator, (3) reduction of exhaust steam losses by equipment which by-passes the turbo-generator, and (4) obtaining power from the public grid or using diesel generators to produce some. The author examines the question of energy conservation in some depth, dealing with specific refinery equipment and processes in turn.

* * *

The British Columbia Sugar Refining Company Limited. M. RYCHKUN. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 77–82.—Possible means of reducing energy consumption in a cane sugar refinery and a beet sugar factory are examined, and steam balances for the Manitoba Sugar Co. and the author's refinery tabulated. Particular attention is focused on thick juice storage and beet pulp drying. The difference between the energy balance for a factory and a refinery is shown to be considerable in terms of the amount required to produce 1 lb of sugar; despite the advantages of continuous operation which a factory has over a refinery, the latter consumes less than half the energy used by the former.

* * *

New waste water treatment system at the Colonial Sugars Refinery. R. L. KNECHT *et al. Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 107–115.—The system used comprises two linked spray ponds in which the effluent is cooled from 126°F to 85°F (at an ambient air wet bulb temperature of 80°F) at a flow rate of 7000 gal.min^{-1}; the waste water is simultaneously aerated. Raw sewage, separated from the process effluent, is treated by an aeration plant of six concrete tanks, which reduces the BOD_5 by 98% and total suspended solids by 95%. Further modifications to the effluent treatment plant are expected to reduce the temperature and BOD_5 to required levels.

* * *

The British Columbia Sugar Refining Company Limited. The Vancouver refinery. K. M. FOO. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 116–119.—A short description is given of the processes at this refinery which handles more than 120,000 tons of raw sugar per year.

* * *

Some engineering developments in CSR refineries. TECHNICAL STAFF, CSR LIMITED. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 121–133.—Modifications and adaptations of refinery plant made in CSR refineries in recent years are described with the aid of illustrations. Reasons for the alterations are classified as (i) improved housekeeping, i.e. eliminating problems created by gland leaks, (ii) reduction of installation or maintenance costs, (iii) improved product quality, and (iv) reduction of sugar losses.

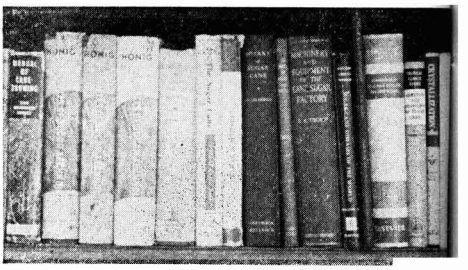
* * *

Comparison of raw sugar scales. W. L. REED. *Proc. 33rd Meeting Sugar Ind. Tech.*, 1974, 134–150. Comparison is made between the operation and accuracy of a Fairbanks-Morse sugar scale installed at Revere refinery in 1965 and a Servo-Balans scale installed at the same refinery in 1967. Factors possibly affecting performance are examined.

* * *

Selecting a powdered activated carbon. A. Y. HYNDSHAW. *Sugar y Azúcar*, 1975, **70,** (6), 44–48.—The structure of activated carbon and the mechanism whereby it adsorbs colour and other impurities are described and details given of a test procedure for use in selecting the most suitable type for a given application. The various forms of carbon application in refining are surveyed.

New books



75 years of scientific progress. ANON. 48 pp; 22½ × 17½ cm. (Bureau of Sugar Experiment Stations, 99 Gregory Terrace, Brisbane 4000, Australia.) 1975.

This booklet has been published to mark the 75th anniversary of the founding of the BSES. It features the various activities of the Bureau and traces the history and developments within each sphere (soils and agronomy, disease control, pest control, milling research, varietal production and advisory services). A list is given of staff members since 1950, and a brief chronology is presented covering events involving the Bureau since 1950. A short subject index concludes the booklet, which is a most interesting publication worthy of one of the world's leading cane sugar industry research organizations.

* * *

Costs and yields of mechanization of sugar cane cultivation. L. V. GENTIL. 129 pp; 15·5 × 21·2 cm. (Editora Ellos Ltda., Rua General Osório 550 conj. 1 & 2, Ribeirão Preto, São Paulo, Brazil.) 1975.

This small book is an account of a two-year study carried out at Usina São Martinho, Pradópolis, SP, Brazil, and was originally intended as a university thesis. The costs and performance of machines carrying out a range of operations (excluding harvesting) were analysed; they included land clearing, ripping, liming, disc ploughing, harrowing, fertilizer application, furrowing, planting of cane, covering, cultivating, loading, trash raking, ploughing-out of old stools, application of filter cake, transport, contouring and field supervision. Development of skill became evident on examination of progress in application of mechanization since 1947 at São Martinho. Measurement of yield is made in terms of hectares per hour, and actual and theoretically possible yields compared. It was observed that transport (50%) and loading (25%) together made up three-quarters of the annual costs of mechanization. Readers having sufficient knowledge of Portuguese to make use of the information collected should write to the author at Caixa Postal 78, Piracicaba, São Paulo, Brazil.

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Relatório 74. ANON. 32 pp; 28 × 21 cm. (Instituto do Açúcar e do Alcool, Praça 15 de Novembro 42, 20.000 Rio de Janeiro, Brazil.) 1975.

This small booklet is the report of the Brazilian Sugar institute and is a beautifully printed and profusely illustrated account of its work during 1974, with information on sugar and alcohol production in the regions and over recent years, details of domestic consumption, sugar exports by regions, markets and shipping dates, and exports of alcohol and final molasses. A section describes and illustrates the Recife bulk sugar terminal while others give information on the application of the special export fund and on the national programme for sugar cane improvement (Planalsucar), recovery of agricultural areas, and social welfare activities.

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Sugar y Azúcar Yearbook 1975. Ed. D. SMITH. 168 pp; 23 × 30 cm. (Sugar y Azúcar Yearbook, 25 West 45th St., New York, N.Y., 10036 USA.) 1975. $25.00.

The 1975 edition of this yearbook comprises a directory of the 1508 cane sugar factories in operation at the beginning of the year in 68 countries as well as details of autonomous refineries processing imported raw sugar, of sugar manufacturers associations and of research stations. The book is separated into sections covering North America, West Indies, Central America, South America, Europe, Continental Africa, Continental Asia, and Australia and the Island Nations (including Indonesia, Taiwan, Japan and Mauritius). The name of each factory is given together with its daily crushing capacity, name and address of operating company and name of the factory manager. The details are set out in very clear type with the factory name in bold. In certain cases, information is given on projected plants. Of interest is the inclusion of the names of factories in Mainland China. The yearbook should prove of value to all those wishing to have such information in an easily readable form.

* * *

The industrial utilization of sugar and mill by-products (a literature survey). M. J. KORT. 167 pp; 21 × 30 cm. (Sugar Milling Research Institute, University of Natal, Durban 4001, Natal, South Africa.) 1975.

The 1975 edition of this book covers work published in various scientific journals during 1974 and follows the style adopted in the previous report[1], with relevant references appended to each chapter. The book is divided into seven chapters: By-products from sugar manufacture; livestock feeding; industrial uses of refined sugar; recent developments in sucrochemistry; nutrition and toxicology; other sweeteners, both natural and synthetic; and a summary and conclusions.

An indication of the continuing expansion of the literature is the larger number of references (1520) than in the 1974 edition (1169) which was already 16·6% greater than in the 1973 Report. On the other hand, there is very little that is new; sugar factory by-products are still finding extensive applications as is bagasse, but no new industrial use of refined sugar has been found. A warning is given that a very high price of sugar on the world market could encourage greater use of synthetic sweeteners. In all, this is a very useful bibliography, and we would not hesitate

[1] *I.S.J.*, 1975, **77**, 58.

to recommend it to anyone wishing to have details of the literature on a particular subject at his fingertips.

* * *

International Commission for Uniform Methods of Sugar Analysis: Report of the Proceedings of the Sixteenth Session. 383 pp; 16 × 24 cm. (The General Secretary, ICUMSA, c/o British Sugar Corporation Ltd., P.O. Box 35, Wharf Rd., Peterborough, England PE2 9PU.) 1975. Price: £6.00.

This volume reproduces in full the texts of the reports on 28 subjects, each concerning a particular field of sugar analysis, presented by their Referees together with recommendations at the 16th Session of ICUMSA held in Ankara on 2nd–7th June 1974 under its President, Dr. A. CARRUTHERS. Also included are appendices, mainly consisting of significant contributions from Associate Referees, and the text of the various discussions. The subject matter is well set out, with very clear type on a matt paper, and undoubtedly there are many readers who would find the latest edition of this authoritative work a valuable asset.

* * *

Zuckerwirtschaftliches Taschenbuch (Sugar economic pocket book) **1975/76.** Ed. K. DANKOWSKI, R. BARTH and G. BRUHNS. 248 pp; 10 × 15 cm. (Verlag Dr. Albert Bartens, 1000 Berlin 38, Postf. 380 250, Germany.) 1975. Price: DM 27.--.

The latest edition of the pocket book, first compiled by A. BARTENS and H. MOSOLFF in 1954, contains 69 tables of statistics, 6 graphs and 3 maps, and is a useful collection of information on world, European and West German sugar production, consumption and trading as well as beet agricultural data (and cane data for North America). Laws and regulations applicable to world and EEC trading in sugar are also stated, and details are given of sugar factories in individual countries. In most cases, the information is given in English, French and German. The reader particularly interested in the EEC sugar industries would find this small volume a very useful acquisition.

* * *

F. O. Lichts Internationales Zuckerwirtschaftliches Jahr- und Adressbuch (F. O. Licht's International Sugar Economic Yearbook and Directory) **1975.** Ed. H. AHLFELD. 467 + 64 pp; 22 × 29 cm. (F. O. Licht KG, 2418 Ratzeburg, POB 1220, Germany.) 1975. Price: DM 75.--.

The latest edition of the Licht Directory follows very much the same style as previous editions, with sections devoted to laws and international organizations, the West German beet sugar industry, the beet sugar factories of the world, the cane sugar factories of the world, sugar machinery manufacturers' reports, a Buyers' Guide and a separate appendix containing world sugar statistics. There are also three articles: US sweetener competition and policy (by M. L. HAYENGA), the Indian sugar industry (by J. S. MEHTA), and the US sugar policy (by T. C. EARLY).

The obvious value of the book lies in the details of the world's sugar factories, and it is probably for these that most readers would buy it. It is difficult to comment on something which has come to be accepted as a household word, since to do so would merely be to repeat what has been said before or would imply a fall in standard. There are flaws, but the bulk of the material is easily accessible and has been updated wherever possible. The directory is still the only one to have all the world's factories listed within its covers, and the price is not too high in these days of inflation.

* * *

Sugar year book 1974. ANON. 369 pp; 10 × 14 cm. (International Sugar Organization, 28 Haymarket, London, England SW1Y 4SP.) 1975. Price: £2.50.

The 28th edition of this pocket book, published by the ISO set up under the 1968 International Sugar Agreement, gives statistics relating to world centrifugal sugar production, consumption and trading. The data have been obtained from member countries of the ISA under the rules of the Agreement or, in the case of non-member countries, have been supplied by the respective governments, extracted from statistical pulications or estimated. Except where otherwise stated, the details are given on a calendar year basis and are expressed in metric tons of 96° raw sugar. (Where the information is available, the trade figures are broken down into raw and refined sugar.) The book comprises an authoritative set of statistics which are neatly printed and set out.

* * *

***Commemorative* brochure of the Experiment Station of the South African Sugar Association.** ANON. 39 pp; 25 × 25 cm. (South African Sugar Association, Sugar Experiment Station, Mount Edgecombe 4300 Natal, South Africa.) 1975.

Produced to commemorate the Golden Jubilee of the Mount Edgecombe Experiment Station, first set up in 1925 under the directorship of H. H. DODDS, this brochure gives an illustrated history of the Station and then briefly reviews the work done on cane breeding, diseases, pests, soils, nutrition, husbandry, weeds, irrigation, mechanization, growth studies, extension service work, soil conservation, dissemination of information, the history behind the name of Edgecombe (derived from Mount Edgcumbe in Plymouth, England) and the principal functions of the Experiment Station today.

Egypt sugar statistics[1].—Production of sugar fell from 571,909 metric tons, raw value, to 535,000 tons in 1974. Imports rose from 61,650 tons to 103,000 tons while exports were nil, as against 42,215 tons in 1973. Consumption rose from 600,800 tons to 637,400 tons and the end-year stocks were almost the same at 54,600 tons against 55,000 tons in 1973.

* * *

New Mexican sugar factory[2].—The Unión Nacional de Productores de Azúcar S.A. (UNPASA) is to set up a sugar factory at Alvaro Obregón (Tlaxcala) with a daily processing capacity of 6000 tons of cane.

* * *

Togo sugar project[3].—A Chinese delegation arrived in Togo in August to conduct a feasibility study into the possible construction of a sugar factory. In September 1974 China and Togo concluded an agreement on economic and technical cooperation. The factory will have an annual capacity of 6000 tons, to be increased later to 7000 tons.

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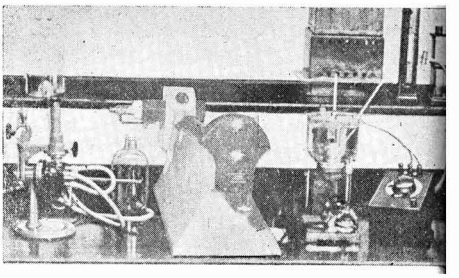
[1] *I.S.O. Stat .Bull.*, 1975, **34**, (8/9), 41.
[2] *Bank of London & S. America Review*, 1975, **9**, 600.
[3] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (28), 11.

Laboratory methods & Chemical reports



Balance of the metals in five sugar factories during the 1973-1974 campaign. Forecasts of purities and yields from beet. P. DEVILLERS, P. GORY and M. LOILIER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Beet and molasses were analysed for sugar, potassium, sodium and amino-N. The K and Na balance was compared with the sugar balance, revealing the considerable quantities of Na added during deliming or by addition of NaOH. The molasses sugar:metals ratio (assuming one equivalent each for K, Na, Ca and Mg) was found to be constant for a given factory and for a specific campaign. It alters slightly from factory to factory, thereby distorting predictions of juice purity and sugar yield based on beet composition. However, these forecasts are sufficiently good for carbonatation juice purity based on the WIENINGER & KUBADINOW formula, but for sugar yield the accuracy is governed by the process used in the factory and particularly molasses sugar extraction.

* * *

Behaviour of quality-determining components in sugar beet during frozen brei preparation and storage. M. BURBA, W. HAUFE and W. KRÜGER. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The procedure used at the Plant Breeding Institute of Kleinwanzlebener Saatzucht AG in the preparation of frozen brei for analytical purposes is described. Determination of the effect of preparation and storage for varying periods showed that the differences in sugar and in other components (K, Na and amino-N) between the frozen and fresh brei did not exceed $\pm 1\%$ and $\pm 6\%$, respectively, and the deviations occurred relatively early in the storage process, after which the contents remained constant.

* * *

Decomposition kinetics of sucrose and pH- and temperature-dependent hexoses. A. R. SAPRONOV and R. A. KOLCHEVA. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—Investigations showed that sucrose, glucose and invert sugar decomposition conforms to the acid-base catalysis theory of DAWSON, hydrogen and hydroxy ions being the main catalysts. Sugar decomposition rate constants have been plotted as a function of pH, the graphs indicating minimum values obtained for each temperature in the range 60–140°C. Equations have been derived for calculation of the rate constants, and a nomogram developed for calculation of the rate constant for sucrose. A method for calculation of activation energy and temperature coefficients in acid and alkaline media is described. A procedure for calculation of sugar losses is proposed and some practical examples presented.

* * *

Some colour formation reactions and their inhibition in sugar manufacture. A. R. SAPRONOV, L. P. KOTEL'NIKOVA and L. D. BOBROVNIK. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The various chemical reactions involving colour formation, and inhibition of colour formation during alkaline decomposition of reducing sugar are examined. Dihydroxyacetone solution heated in the presence and absence of sodium sulphite decomposed more quickly than did a glyceraldehyde solution under the same conditions, from which a possible explanation for colorant inhibition reactions is deduced. It is assumed that the formation of mono- and disulphonates of monosaccharide carbonyl decomposition products is the main factor in colorant inhibition by sulphites.

* * *

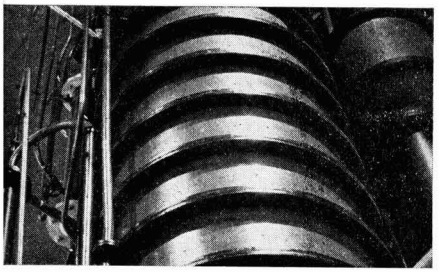
Microbiological determination of sucrose with the aid of heterogeneous cultures of *Bacillus stearothermophilus*. G. POLLACH. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—A method for determining sucrose with cultures of sucrose-selective *B.stearothermophilus* is described which permits 50 analyses to be carried out per hour. Use of saccharase eliminates the sensitivity of the micro-organisms to glucose and fructose. The effect of monosaccharides, formed from raffinose and kestose by the action of the saccharase, on the analytical results was found to be negligible even with beet molasses. At a sucrose content of 200 ppm, accuracy of the method is 0·44%, and as little as 5 ppm can be determined.

* * *

A method for determining uronic acid to establish the content of pectin fragments in sugar factory products. F. PERSCHAK. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—A photometric method for determination of *d*-galacturonic acid, a decomposition product of pectin, is described and results for beet, juices, molasses and press water are discussed.

* * *

The behaviour of free amino-acids during juice purification. N. KUBADINOW and W. HAMPEL. *Paper presented to the 15th Gen. Assembly CITS*, 1975.—The behaviour of amino-acids during juice purification was studied by automatic analysis. Results, for the 1973 and 1974 campaigns, showed that almost all amino-acids are subject to changes, so that not all those found in raw juice will be found in the same form in molasses. The greatest changes were to glutamine and asparagine; both are subject to saponification, which is considerable in the case of glutamine, while it proceeds very much more slowly in the case of asparagine. Increase in the concentration of glycine is attributed to threonine and serine decomposition and not to albumin degradation. Decrease in the arginine or histidine concentration is most probably associated with a Maillard reaction. Apart from chemical reactions, adsorption on calcium carbonate also causes a reduction in amino-acid concentration.



By-products

Utilization of sugar cane molasses for purposes other than the conventional ones. D. SRIDHARAN. *Indian Sugar*, 1974, **24**, 677–680.—The use of molasses to produce alcohol which could be blended with petrol is discussed and the economic advantages examined.

* * *

New route to alcohol via fermentation. A. RAMALINGAM and R. K. FINN. *Chem. Eng. News*, 1974, **52**, (37), 20; through *S.I.A.*, 1975, **37**, Abs. 75-325. Vacuferm is a new process in which the alcohol is distilled off under reduced pressure as fast as it is formed by yeast, allowing higher concentrations of reactants to be used in the fermentation mixture. In laboratory tests, an 18% sugar solution was fermented completely in 12 hours at 30°C and 30–35 mm Hg. It is proposed to use as substrate clarified molasses containing up to 50% sugar.

* * *

Levulinic acid from sucrose using acidic ion exchange resins. R. A. SCHRAUFNAGEL and H. F. RASE. *Ind. Eng. Chem., Prod. Res. Dev.*, 1975, **14**, (1), 40–44. Glucose and fructose produced by acid hydrolysis of sucrose can be reacted by parallel and apparently 1st-order mechanisms to produce 5-hydroxymethyl (5-HMF) as an intermediate product which is further degraded by an acid catalyst to levulinic and formic acids. Experiments were conducted on treatment of sucrose solution with one of four highly acidic ion exchange resins, details of which are given, at 100°C. It was found that resin pore size affected selectivity, a large pore resin allowing the 5-HMF to diffuse out more rapidly so that there was less chance for it to form levulinic acid. However, the glucose and fructose reactions are the controlling steps for levulinic acid formation, and a temperature of 100°C was found to be too low, since the glucose rate was considerably lower than the fructose rate and could only be very much increased by raising the temperature to e.g. 140°C. Hence, the process would be viable only if small pore resins could be developed which could be used at temperatures above 100°C for prolonged periods. The possibility of using waste sources of hexoses, such as bagasse, as feed material is suggested.

* * *

Culturing carotene-forming yeasts on molasses media. E. V. STABNIKOVA, T. P. SLYUSARENKO and T. A. GRINBERG. *Izv. Vuzov, Pishch. Tekh.*, 1975, (1), 85–89. After establishing that a molasses dry solids content of 9% (4–5% sucrose) was optimum for biomass and carotenoid yield, further tests were conducted in which *Rhodotorula glutinis* M-214 was cultured on a molasses of pH 5·0 for up to 10 days. Maximum biomass and carotenoid yield was obtained within 6 days, after which it started to fall, although by the 6th day the β-carotene proportion of the total carotenoids was only about half of the initial proportion.

Dependence of the degree of vibropacking of dry beet pulp on vibration amplitude and frequency. M. G. PARFENOPULO amd N. E. KARAULOV. *Izv. Vuzov, Pishch. Tekh.*, 1975, (1), 105–107.—Since dry beet pulp will pack down or loosen up under the effects of vibrations during transportation or dosing, tests were conducted in order to obtain mathematical relationships of value in calculating volumetric capacities of storage bins and transport used for pulp. The tests and results are discussed.

* * *

TSC's intensive feedlot system for cow-calf and beef production programme. S. C. MAI and T. H. WU. *Taiwan Sugar*, 1974, **21**, 198–211.—Incentives for a concentrated beef production programme as set up by the Taiwan Sugar Corporation include the considerable demand for beef in Taiwan, the need to make better use of molasses, cane tops and bagasse pith as animal fodder, and the requirement for more economical use of marginal land (of 12,000 ha) which is unsuitable for cane growing. The various factors involved in the setting up of beef farming are discussed and information given on the production of cane top silage. Diagrams and illustrations indicate the progress already made in beef production by TSC.

* * *

High molasses, bagasse and bagasse pith rations without grass for beef cattle on finishing. Y. CHEN, Y. Y. HUANG, T. C. SHIEH, Y. C. CHANG and Y. CHENG. *Taiwan Sugar*, 1974, **21**, 212.—Feeding trials lasting 180 days showed that experimental rations containing molasses, bagasse and bagasse pith gave an average daily weight gain of 1·07 kg, compared with 0·73 kg when silage was added and with 0·74 kg with cattle fed on control diets plus cane tops. The cattle fed on the molasses-bagasse ration yielded more boneless cuts and a greater percentage of lean meat than did the cattle fed on the other rations.

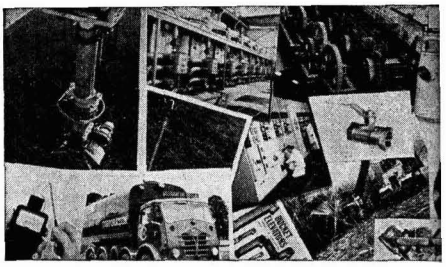
* * *

Technological scheme for producing granules of amido-mineral additive on a dry pulp base. L. E. DOLGORUCHENKO. *Sakhar. Prom.*, 1975, (3), 30–32.—Details are given of a scheme for producing animal fodder containing 77% dry beet pulp, 9·5% molasses, 6% urea, 1·5% sodium sulphate, 6% defluorinated phosphate or monocalcium phosphate and traces of cobalt chloride, zinc sulphate and copper sulphate.

* * *

Total nutrient value of your beet crop. L. THOMPSON. *Sugar Beet J.*, 1975, **38**, (2), 10.—The total nutrient value of a 20-ton per acre beet crop (expressed in US dollars), i.e. the value of beet tops, pulp and molasses used for animal fodder, is compared with that of a corn crop. The author emphasizes that pulp should be regarded as a well-digested roughage rather than a concentrate, while molasses, because of its laxative effect, must be fed at restricted rates, although it is valuable in inducing livestock to consume more feed.

Trade notices



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

PUBLICATIONS RECEIVED

"AIDS TO GOOD PACKAGING". The Thames Packaging Equipment Co., Senate House, Tyssen St., London, E8 2ND England.

A recently published brochure illustrates the various pieces of equipment available from Thames Packaging Equipment for heat sealing and stitching bags, as well as miscellaneous associated items including devices for bag tying and opening, and a sample extractor.

* * *

DUST MEASUREMENT. Sartorius-Membranfilter GmbH, 34 Göttingen, Postfach 142, Germany.

Sartorius-Membranfilter GmbH, manufacturers of membrane filters, industrial filters, dust measuring devices and special equipment for pharmaceutical and medical research, have issued three brochures concerning dust samplers EM 100 Cat. No. SM 267 34 and SM 267 35 and their aerosol photometer S, Cat. No. SM 167 19. Each brochure gives information on the method of application of the particular equipment as well as complete technical data, demonstrating how dust immission and emission can easily be monitored in the case of dust extractors, dryers, rooms, exhaust shafts, etc.

* * *

WATER AND EFFLUENT TREATMENT. Serck Water Processing, Hucclecote, Gloucester, England GL3 2XF.

A 4-page brochure outlines the activities of Serck Water Processing in supplying complete projects or individual pieces of equipment, or acting as design consultants, for treatment of effluent, boiler feed water and process water.

* * *

CHEMICALS INFORMATION HANDBOOK 1975-6. Shell International Chemical Co. Ltd., Shell Centre, London, England SE1 7PG.

This 111-page booklet provides latest information on the chemical industry and chemical business of the Royal Dutch Shell Group. It also includes details of important chemical manufacturers, including a number well known in the sugar industry as producers of chemicals for use in beet and cane agriculture and of chemicals and commodities such as ion exchange resins for use in factories and refineries.

* * *

INDUSTRIAL BOILERS. Babcock, 165 Great Dover St., London, England SE1 4YB.

The latest leaflet from Babcock, a member of Babcock & Wilcox Ltd., outlines the various types of industrial boilers available, with an indication of their evaporation capacities.

* * *

ALUMINIUM SULPHATE. The Alumina Co. Ltd., Ditton Road Works, Widnes, Cheshire, England.

The Alumina Co. Ltd., part of The British Aluminium Co. Ltd., has produced a 6-page booklet on aluminium sulphate and its availability and uses in a number of fields, including water and effluent treatment. As readers will know, the use of $Al_2(SO_4)_3$ for the treatment of beet diffusion water has been the subject of a number of articles abstracted in the *International Sugar Journal*.

FILTER PRESSES. Poly Filters Inc., Route 6 and Maple Rd., Dalton, Pa., 18414 USA.

The latest brochure from Poly Filters describes their automatic filter presses in both side bar and overhead rail configurations available in plate sizes from 6 inches square (for laboratory purposes) up to 56 inches square. The advantages of filter presses are listed as well as outstanding features of Poly Filter presses.

* * *

"UNIGRATED". Unice Machine Co., 1275 Columbus Ave., San Francisco, Calif., 94133 USA.

A 4-page leaflet from Unice describes the chief features of the "Unigrator" cane shredder[1] and presents a review of thoughts on cane preparation expressed by various authors.

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MAGNETIC EQUIPMENT AND TOOLS. Kanetsu Kogyo Co. Ltd., 15–4, 2 chome Uchikanda, Chiyoda-ku, Tokyo, Japan.

A 46-page booklet gives details of magnetic equipment and tools available from Kanetsu. Of particular interest to our readers are the various types of magnetic separators manufactured by Kanetsu. Separate brochures give more specific information on suspended magnetic separators and magnetic separators for cane sugar; the latter brochure describes three main types of magnet installation in a sugar factory, viz. a suspended magnet over the conveyor belts, cane elevators or chute; a grate-type permanent magnet (comprising a grid of magnetic rods which attract iron when material passes over); and KER electro-magnetic pulleys. The electric suspended magnet is particularly suitable for tramp iron removal from cane and bagasse, while the permanent magnet is intended for use where space is limited or where there is thin flow of material. Also described is the permanent plate magnetic separator, available in hinged or rotary form.

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WYSSMONT "TURBO-DRYER". Wyssmont Co. Inc., 1470 Bergen Blvd., Fort Lee, N.J., 07024 USA.

The Wyssmont "Turbo-Dryer" is a vertical-axis rotary dryer (available with a diameter up to 35 ft and a height of 60 ft) in which the material rotates on circular trays within a fixed housing. During rotation, the material is wiped off into trays below by stationary elements, and the pile which forms is then levelled to increase its surface area. This periodic mixing improves the drying rate and product quality. Air is injected from special horizontal "Turbo" fans over the trays. The "Turbo-Dryer" can handle all types of material from beads to sludges, irrespective of the particular characteristics, i.e. whether dusty, fragile, flammable, heat-sensitive, etc. A new brochure describes the operation and features of the "Turbo-Dryer" as well as of other "Turbo" units for various operations including heating, cooling, agglomerating, etc. Other Wyssmont equipment briefly described includes a rotary valve feeder, a vane-rotor airlock, a lump breaker, a multi-screw feeder, and a sight window which is simply slid in and out over the port for cleaning without breaking vacuum or pressure.

* * *

GEARS FOR THE SUGAR INDUSTRY. David Brown Gear Industries Ltd., Park Gear Works, Huddersfield, Yorks., England HD4 5DD.

Featured in the Autumn 1975 issue of "Contact" is an illustration of a massive gear wheel being cut for final installation as part of a cane mill transmission in an East African sugar factory. Each transmission will be driven by a steam turbine connecting to a David Brown primary triple reduction helical gear unit of 20 × 30 × 45 inch centres, with a 75:1 ratio to provide a speed of 14·7 rpm at the secondary pinion. This meshes with a 14-ft diameter final spur gear wheel providing 3·5 rpm at the 30-inch roll mill.

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[1] *I.S.J.*, 1975, **77**, 140–142.

Uruguay sugar statistics[1]

	1974/75	1973/74	1962/73
Production from beet and cane, metric tons white value	102,031	73,595	67,182
Production from imported raws, metric tons, white value	0	37,454	38,781
Total production	102,031	111,049	105,963
Consumption, metric tons, white value	95,080	110,522	108,625
Imports, metric tons, raw value	0	39,978	41,294
Beet sugar			
Sown area, hectares	22,239	14,373	15,079
Harvested area, hectares.....	21,713	13,544	14,649
Beets harvested, metric tons..	570,970	428,237	370,531
Beet yield, metric tons.ha^{-1} ..	25·70	29·79	22·30
Beet sugar production, metric tons, white value	77,845	52,496	37,763
Cane sugar			
Harvested area, hectares.....	5,272	4,976	5,388
Cane yield, metric tons.ha^{-1}..	39·0	39·5	50·0
Sugar production, metric tons white value	20,898	21,270	26,110
Sugar yield % cane	10·79	11·49	20·35

Taylor control for world's largest sugar factory.—Through their associate company in Holland, Taylor Instrument Cos. (Europe) Ltd. of Stevenage, Herts., England, have won a £165,000 order for the control instrumentation for the largest sugar factory in the world. Destined for Iran, the equipment has been ordered by Stork-Werkspoor Sugar B.V. of Hengelo, Holland, who are currently building the factory for the Karun Agro-Industrial Cane Sugar Company. Scheduled for completion in the Spring of 1977, the new plant, to be called Karun II, will be capable of producing 20,000 metric tons of sugar per day, sufficient for all Iran's requirements and providing a surplus for export. Based on Taylor's "Quick-Scan" 1400 Series pneumatic controllers, recorders and indicators, the instrumentation system will comprise some twenty-five site-mounted control panels located throughout the factory. The Taylor equipment will control the entire process.

* * *

Sucrochemistry seminar[2].—The 2nd seminar on sucrochemistry sponsored by the International Sugar Research Foundation was held during the 20th–21st November at the Tate & Lyle Group Research & Development Centre in Reading, England. The objective was to review sucrochemical research having the aim of technological exploitation of sucrose in the chemicals industry. Papers were presented on studies of selective substitution of sucrose hydroxyls and conversion of chlorosucroses into potentially useful products (Prof. L. HOUGH, England); selective esterification of sucrose via chelates to give stereo-specific derivatives in high yield (Prof. E. AVELA, Finland); benzylation of sucrose (Dr. P. A. FINAN, Ireland); sucrose ethers (Dr. A. H. HAINES, England); sucrose organotin derivatives (Dr. R. C. POLLER, England); sucrochemistry in the paint and allied fields (R. N. FAULKNER, England); sucrose esters in textile preparation and finishing (Dr. J. R. HOLKER, England); opportunities for sucrose in industry (Dr. K. J. PARKER, England); successful recent developments in the exploration of sucrose derivatives (Dr. R. KHAN, England); and the use of oxyalkylated sucroses as internal plasticizers of epoxy resins (Dr. J. LEBLANC, Belgium).

* * *

New Brazil sugar factory[3].—It is reported that the Sugar and Alcohol Institute is scrutinizing a project for the erection of a modern sugar factory in the district of Kariri in the state of Ceara.

* * *

French West Indies sugar production.[4]—Owing to drought, the 1975 cane crop reached only 924,000 metric tons against 1,082,000 tons in 1974 and 1,272,000 tons in 1973. The yield of sugar % cane at 9·36 was higher than the 8·91 obtained in 1974 but not as good as the 9·49% of 1973. As a result, sugar production was reduced to only 86,500 tons in 1975 as against 96,471 tons in 1974 and 120,754 tons in 1973, and represented only about half the island's quota. A similar situation was found in Martinique; the cane crop amounted to 235,149 tons as against 242,625 tons in 1974 and 288,616 tons in 1973 and, while the sugar yield was higher at 8·84% on cane than the 8·14% of 1974 and the 8·11% of 1973, sugar outturn reached 15,996 tons, somewhat better than the 14,231 tons of 1974 but not as much as the 22,944 tons made in 1973.

Brevities

Cuba-Philippines technical cooperation agreement[5].—Cuba and the Philippines have agreed to exchange information and technical cooperation in sugar, including construction of factories and the use of new cane varieties.

* * *

EEC Commission fines on refiners annulled[6].—Further to the reductions made earlier[7], the European Court of Justice has annulled or reduced fines imposed on the 16 EEC sugar refining companies as a result of the Community's anti-trust legislation. The companies successfully claimed that the absence of free competition arose from the way the Community's sugar market had been organized by the Governments of the member states, and their fines were reduced from a total of nine million units of account (about £4·5 million) to 1·6 million u.a. (about £800,000), the latter in respect of distortion of free competition in export tenders.

* * *

China purchases of sugar from Guyana[8].—Agreement has been reached under which China is to purchase 30,000 tons of sugar from Guyana in 1976 and 500,000 tons in each of the following three years.

* * *

Cuban sugar expansion[9].—The Cuban Prime Minister, Dr. CASTRO, told the first Congress of the Cuban Communist Party that sugar production had registered a continuous increase over the past three years, in spite of drought conditions, with a 1975 sugar production higher than the 5·9 million metric tons of 1974. No figure was given for the 1975 crop but it was stated that the aim of the 1976–1980 plan was to increase production by between 35 and 40% to between 8 and 8·7 million tons.

* * *

New Honduras sugar factory[10].—The Banco Centraomericano de Integración Económica has authorized a loan of US$6 million to Azucarera Central to finance the installation of a sugar factory in Choluteca with a milling capacity of 5000 tons of cane per day.

* * *

Guyana cane land expansion[11].—Bookers Sugar Estates Ltd. in Guyana will expand sugar cane cultivation by another 5500 acres at two of its nine factories by the end of 1976. The cultivation projects will cost well over G$15 million, expanding sugar production further. Bookers have brought 20,000 acres of new land under cultivation during the past eight years, realising the production of some 60,000 tons of sugar annually.

* * *

New sugar factory in Indonesia[12].—A sugar factory operated by a state-owned sugar cane plantation in Bone, South Sulawesi, will start commercial production soon. Rated milling capacity is 2400 t.c.d.

* * *

Turkish sugar factory plans[13].—Now that the new Afyon sugar factory is nearly complete, plans are being made for a further new factory at Kahramanmaras which will slice 300,000 tons of beet per year.

* * *

Indonesia sugar factory plans[14].—Plans have been made to erect a sugar factory in the area of Lawang Tiga Banlai, where there is said to be 5500 hectares of land available for cane.

[1] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (35), ix.
[2] *ISRF Bulletin*, 1975, **6**, (6), 1–2.
[3] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (30), 11.
[4] *Le Betteravier Français*, 1975, (285), 30.
[5] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (33), 9.
[6] *The Times*, 17th December 1975.
[7] *I.S.J.*, 1975, **77**, 352.
[8] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (33), 10.
[9] *Public Ledger*, 20th December 1975.
[10] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (24), 11.
[11] *W. I. Chron. News*, Dec. 1975/Jan. 1976.
[12] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (30), 12.
[13] *Zeitsch. Zuckerind.*, 1975, **100**, 587.
[14] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (24), 12.

Brevities

Thailand cane variety[1].—The Sugar Institute of the Thailand Ministry of Industry has succeeded in its research into and development of a new variety of sugar cane highly resistant to white leaf disease. This disease causes damage of approximately 100 million Baht (£2,500,000) per year.

* * *

Italy sugar imports[2].—Imports of sugar by Italy in 1974 amounted to 716,181 metric tons, of which 143,217 were of raw sugar and 572,964 tons white sugar. The total was 208,255 tons or 36·43% higher than imports during 1973, and the main suppliers were France with 457,830 tons and West Germany with 213,563 tons.

* * *

East German beet variety[3].—After only two years from its introduction to the list of varieties, 230,000 hectares or 85% of the 1975 area of 270,600 ha was planted with "Hymona", a new variety developed by the Klein-Wanzleben Institute for Beet Research. It gives a 0·3% higher sugar yield than the previous main variety "Plenta" and will also allow manual labour to be halved.

* * *

Egypt sugar production[4].—According to official sources, sugar production in 1974/75 reached 521,994 metric tons, tel quel, which represents a decrease of 4·21% or 22,930 tons against last year.

* * *

New bagasse paper plant in Mexico[5].—NAFINSA is to establish Mexicana de Papel Periódico, with an investment of 2800 million pesos ($225 million), to produce 220,000 tons of newsprint a year from bagasse. The plant is to be installed at Tres Valles, near the Papaloapan basin, with Mexican technology, and is due to become operational at the beginning of 1978.

* * *

Indonesia sugar expansion[6].—According to press reports, twelve sugar factories are to be set up in Indonesia, six of them on the island of Java. The factories are to start operation in 1978 and will be able to produce a quantity of 270,000 tons of crystal sugar per year.

* * *

Bulk storage facilities expansion in Australia[7].—The Chairman of the Queensland Sugar Board, Mr. L. C. Harris, has announced that contracts worth $A 3,000,000 have been let as a first step in a major expansion of bulk sugar storage facilities at Bundaberg. The work is part of a Sugar Board plan to spend $A 50 million on expanding bulk loading and port facilities at Bundaberg and Lucinda. The expansion at Bundaberg will raise its sugar storage by 98,000 metric tons to 296,000 tons, extend the sugar wharf and boost conveyor loading systems to 1400 tons per hour capacity.

* * *

EEC refiners' margin[8].—The EEC farm ministers have agreed to set the differential margin for cane sugar refineries at 1·20 units of account per 100 kg to 30th June 1976. This amount is far below the 1·97 units of account originally requested by the British Ministry of Agriculture in order to ensure that British refineries are able to compete against beet sugar factories working out of season.

* * *

Japanese sugar company rationalization[9].—Nippon Tensai Seito K. K. plans to close its Obihiro beet sugar factory (2000 tons/day) and expand its Memuro factory (3600 tons/day) to take the combined beet supply. At 5600 tons per day Memuro will become the largest beet sugar factory in Japan. It is also planned to introduce thick juice storage at Memuro which will be the first to use this technique in the country.

* * *

Japan-South African trade agreement[10].—Japanese sugar refineries and importers have signed a three-year agreement with the South African Sugar Association for the supply of at least 350,000 tons of sugar annually beginning in 1976. Japan has already concluded similar long-term contracts with Australia, Brazil and Thailand.

Thailand sugar exports[11]

	1974*	1973	1972*
	(*metric tons, tel quel*)		
France	0	0	13,400
Hong Kong	0	0	15,985
Indonesia	0	32,351	0
Iran	71,625	11,990	0
Iraq	34,087	10,581	0
Japan	221,966	0	34,961
Jordan	0	0	21,598
Lebanon	12,272	0	0
Malaysia	33,924	101,263	74,292
Nepal	0	0	6,466
Pakistan	0	0	45,336
Saudi Arabia	0	0	21,831
Singapore	10,999	0	2,194
Sri Lanka	11,974	23,571	76,532
Sudan	0	0	30,242
USA	23,394	17,180	16,806
Vietnam, South	0	61,358	68,918
Yugoslavia	0	0	10,260
Other countries	143,705	0	0
Total	563,946	258,294	438,861

* Raw value.

Sugar handling terminals in Cuba[12].—It has been announced that seven sugar loading terminals are to be built in Cuba, four of them for bulk loading and three for mechanized bagging and loading. The first terminal was to start operations in November 1975 and the others are to be completed for the 1977 crop.

* * *

Bagasse fire in Taiwan[13].—Lightning started a fire in a 200,000 metric tons stack of baled bagasse at Hsinying, Taiwan, which measured 10 metres high by 20 metres wide and 100 metres long. Fire-fighting equipment was not able to get into the stacks and all was destroyed, representing a year's supply of raw material for the paper pulp plant.

* * *

Floods in Colombia[14].—Sugar cane cutting and transport operations in Northern Colombia have been noticeably slowed by flooding of 20,000–30,000 hectares planted to cane (out of the total area of 126,000 ha in the country), according to the President of the Colombian Sugar Cane Growers' Association. The flooding is expected to have detrimental effects on the industry in both the long and short term.

* * *

New sugar factory for Syria[15].—Ente Nazionale Idrocarburi (ENI) of Italy has announced that a subsidiary company has signed a contract to supply a sugar factory with a daily capacity of 4000 tons of beets, to be built at Ghab in Northern Syria at a cost of over $30,000,000.

* * *

New Rumanian sugar factories[16].—Building of new sugar factories is proposed in the provinces of Tandarei and Urziceni.

* * *

New sugar factory for Yugoslavia[17].—A new sugar factory, with a processing capacity of 300,000 tons per year, is to be set up in Kovacica, near Belgrade, by the end of 1977. The sugar beets to be processed by this factory are to be supplied by agricultural cooperatives as well as by private farmers in the region. It has also been announced that two further sugar factories are to be built at Bac and Zabari.

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[1] *Standard Chartered Review*, November 1975, 31.
[2] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (32), 7.
[3] *Zeitsch. Zuckerind.*, 1975, **100**, 647.
[4] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (23), 9.
[5] *Bank of London & S. America Review*, 1975, **9**, 601.
[6] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (32), 10.
[7] *Queensland Newsletter*, 2nd October 1975.
[8] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (29), 7.
[9] *Zeitsch. Zuckerind.*, 1975, **100**, 587.
[10] F. O. Licht, *International Sugar Rpt.*, 1965, **107**, (30), 12.
[11] *I.S.O. Stat. Bull.*, 1975, **34**, (7), 104.
[12] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (29), 12.
[13] *S. African Sugar J.*, 1975, **59**, 560.
[14] *Public Ledger*, 20th December 1975.
[15] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (25), 11.
[16] *Zeitsch. Zuckerind.*, 1975, **100**, 647.
[17] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (35), 12.

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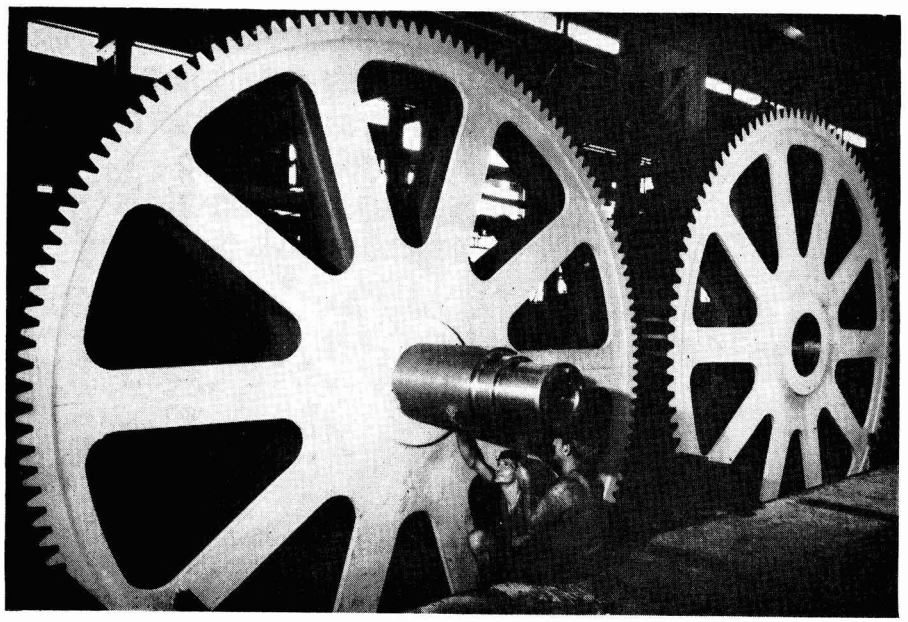

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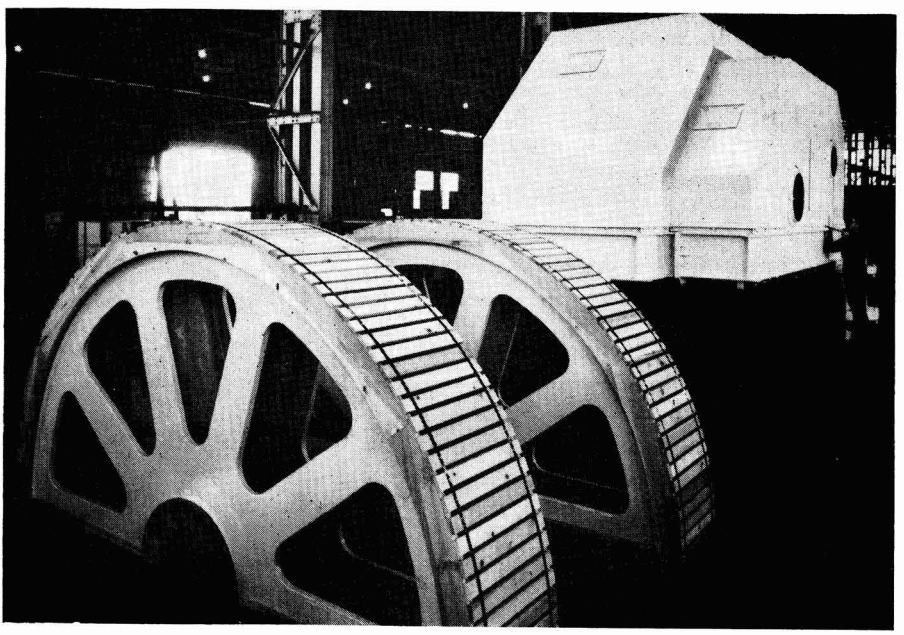

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