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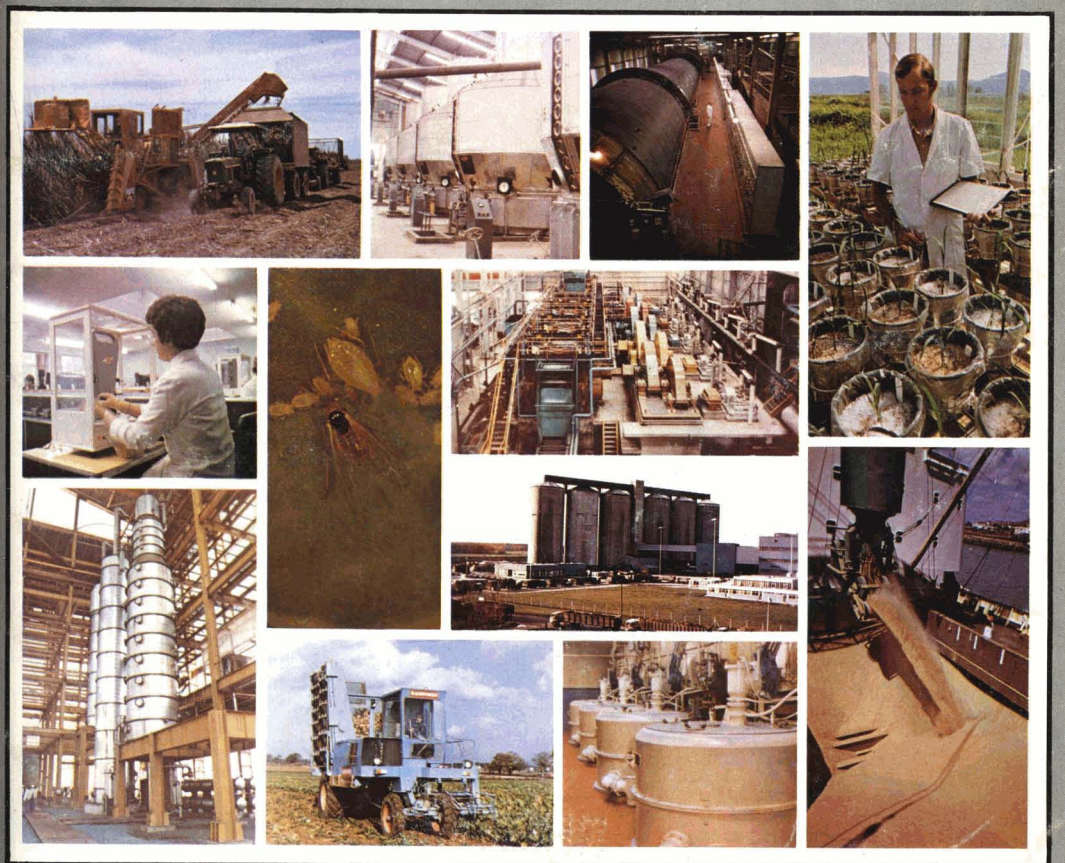

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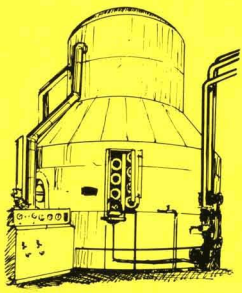

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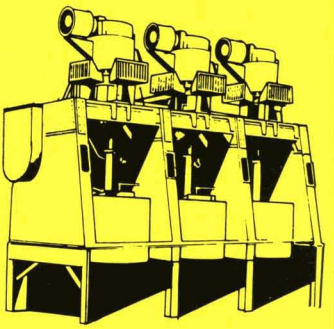

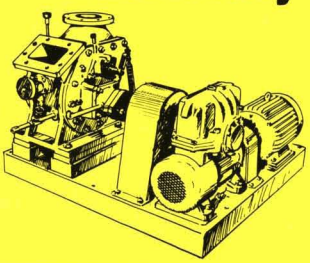

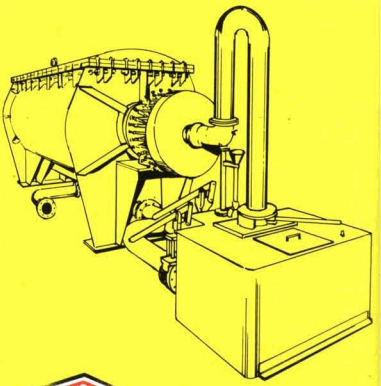

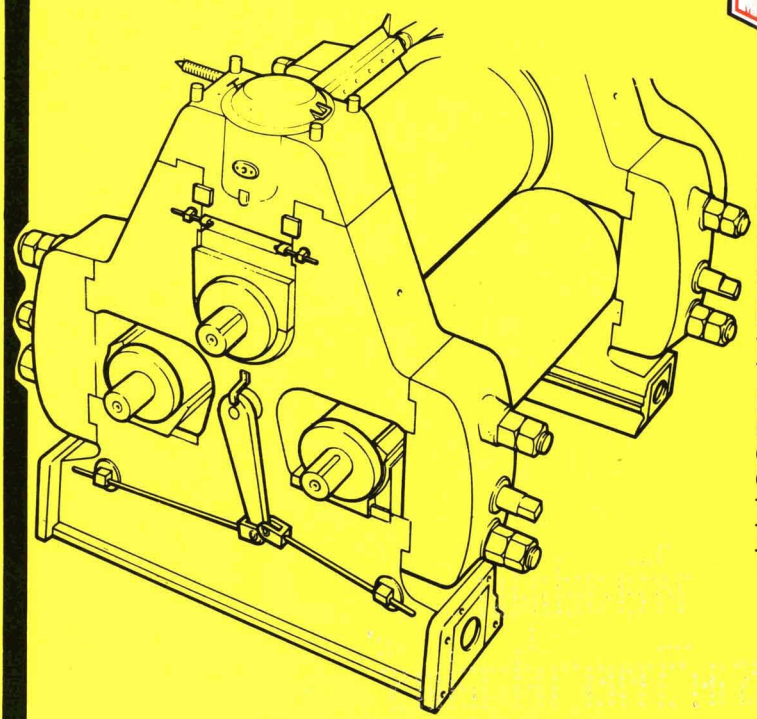

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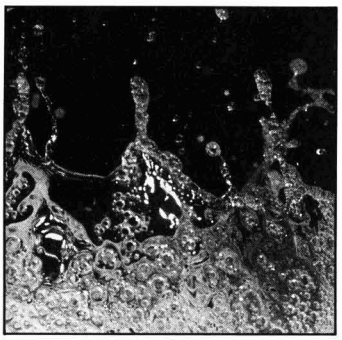

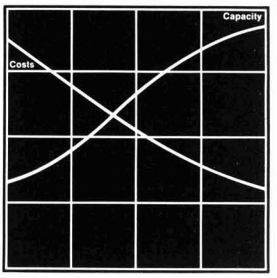

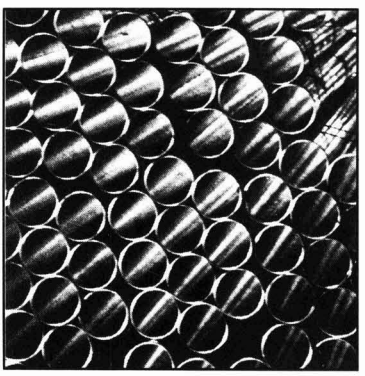

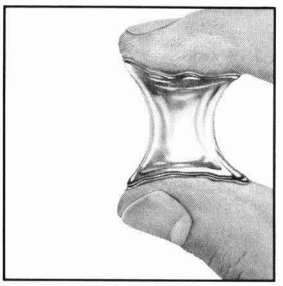

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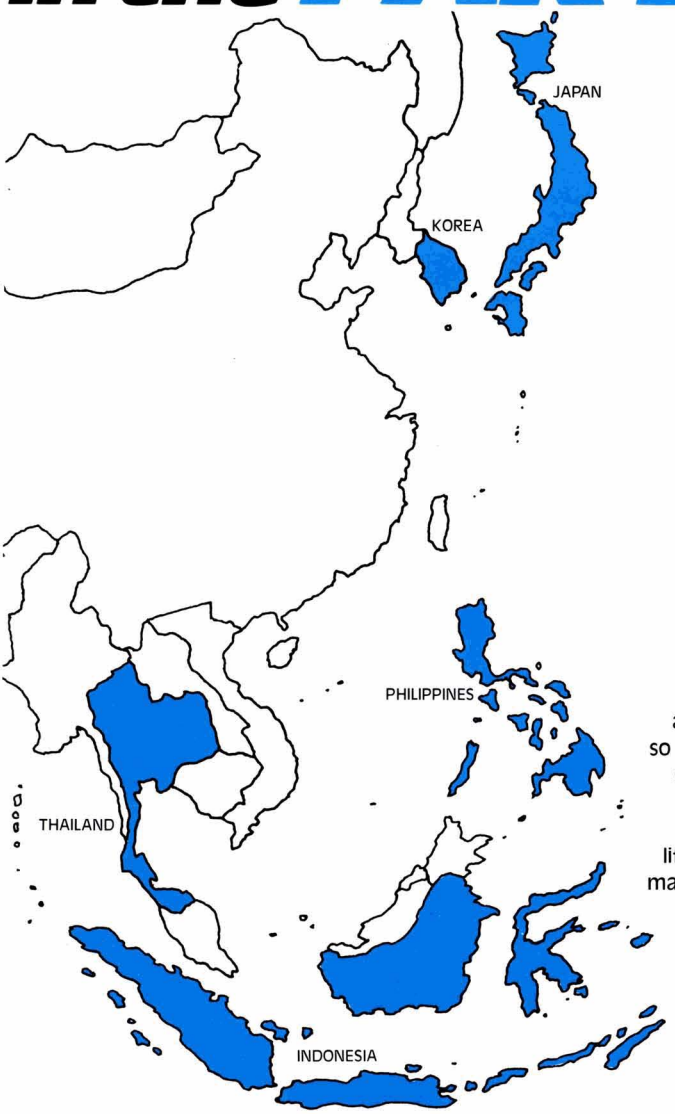

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NOTES AND COMMENTS

World sugar prices

The market was dominated during the month of January by political developments following the movement of Soviet troops into Afghanistan. There was a drop in the LDP from £179 on January 2 with the announcement of a 10% increase in quotas but when it was appreciated how little extra sugar would be forthcoming as a result, the market started to rise and the LDP climbed with scarcely any effect when quotas were removed entirely on January 10. The end of the month saw a level of £214 per tonne, its highest since April 1975.

White sugar prices have followed those of raws but have not been so firm so that on two occasions the premium of the LDP(W) over the raw sugar price has fallen to nil. Nevertheless, from a value of £193 on January 2, the LDP(W) had reached £216 by the end of the month.

CCST Commodities Ltd., in an analysis of prospects for 1980, consider that raw sugar prices could be up to £300-£350 by the end of the year[1]; they consider that US ratification of the ISA and EEC resolve to reduce beet acreage could take prices above £300 early in the year before expected bigger Soviet and Chinese plantings cause a £100 downward correction. However, with both these countries requiring more internally and heavy Middle East buying, a third quarter high of £500 could be achieved, they believe.

International Sugar Agreement

The meeting of the ISO Executive Committee on January 3-4 decided that, with effect from January 7, the global quota for 1980 would be increased by 1.3 million tonnes, bringing it to 14,209,000 tonnes, raw value. This resulted in increases in individual quotas of about 7.5% of basic export tonnages. In spite of this, sugar prices continued to rise and it became evident that conditions were approaching where it would be mandatory to abolish quotas. The Committee therefore decided at its meeting on January 10 to remove all quotas and limits to exports with effect from January 11.

This did not affect exporting members' obligations to hold the special stocks, and quotas can be reimposed if the prevailing price falls again below 15 cents; they must be reimposed if the prevailing price falls below 14 cents/lb. The South African Sugar Association has 50,000 – 100,000 tonnes of sugar that it can now export, but the Australian Sugar Board said that the suspension of quotas would have no effect on sales from the 1979 crop. In Argentina, sugar industry sources claimed that no sugar is available for export as stocks are only sufficient for domestic needs until the new crop begins in July or August. Brazil also has contracted to sell around 2,000,000 tonnes and it would be difficult to find any extra. The Cuban authorities have been reporting additional difficulties in their current crop and Soviet Union purchases leave little extra sugar for the world market. Mauritius has suffered from the effects of cyclone damage the extent of which is a matter of conflicting reports. The Dominican Republic could supply a further 230,000 tonnes, however.

Not surprisingly, therefore the suspension of quotas had little effect on sugar prices which have continued to rise. The special stocks are due to be released in three equal amounts when the prevailing price exceeds 19, 20 and 21 cents/lb, respectively, at present trigger points. The Council is to meet in the second half of March to consider, among other matters, adjustment of these trigger points to take into consideration the fall in the value of the US dollar since they were established in 1977.

The Price Review Committee was to meet on February 26 and its recommendations considered by the Executive Committee on February 29, for submission with its own recommendations to the Council. If it is decided to raise the various price levels serving as trigger points this could affect the prices at which quotas are restored and at which special stocks are released. However, the London Daily Price reached 19 cents on January 23, 20 cents a day later and 21 cents/lb on February 4. It may well be, therefore, that the prevailing price will have been such that the stocks, currently totalling almost 2,000,000 tonnes, will have been released under the current rules before the Council meets to amend them.

US ratification of the ISO[2]

The US Administration has decided not to wait for Congress to pass enabling legislation and instruments ratifying the ISA have now been formally deposited with the United Nations. A proviso has been added to the effect that the USA is as yet unable to implement the provisions of the Agreement under which importers are obliged to assume the responsibility for ensuring that ISA stock fee payments have been made on all sugar entering the country. US customs will not be empowered to do this until enabling legislation has been passed by Congress and this was not expected before late February.

Cuban sugar production problems

In addition to the effects of rust disease which has been reported from Cuba to have caused a fall in the cane crop, further problems have emerged. Resources which should have been applied to the new crop last May, June and July were instead used for extending the 1979 crop to about 8,000,000 tonnes. As a result, the 1980 crop had a poor start and the area planted was smaller than it should have been. Weed control has been inadequate, and harvesting has been reduced by a shortage of machinery spares and a lack of volunteers to cut cane manually. Unofficial forecasts put the crop as low as 35% down from last year.

Pakistan sugar situation[3]

The area devoted to sugar cane in 1978/79 was 1,822,000 acres with an average yield of 14.9 tonnes of cane per acre. This yielded a cane production of 27,147,000 tonnes. The thirty sugar factories in the country crushed 6,174,000 tonnes of cane (22.74%) while about 3,400,000 tonnes was used as seed cane. This leaves a balance of 17,573,000 tonnes of cane (64.73%) which was used for gur production. Gur has an average pol of 70-75 and gives a lower recovery rate than that achieved in a white sugar factory; it takes 12 tonnes of cane to produce 1 tonne of gur. It is

[1] *Public Ledger Commodity Week*, January 19, 1980.
[2] C. Czarnikow Ltd., *Sugar Review*, 1980, (1474), 6.
[3] F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 717-718.

estimated that gur production in 1978/79 was at least 1,464,000 tonnes while, during the same year, total white sugar production was 609,000 tonnes, comprising 578,000 tonnes of cane sugar and 31,000 tonnes of beet sugar. Per caput consumption of centrifugal sugar was 8.12 kg while that of gur was 19.53 kg. Gur thus accounts for some 70% of total consumption.

In view of the fact that less than a quarter of the cane crop is used for production in sugar factories while, at the same time, the country has to import sugar, the question arises as to why gur production is not reduced or banned altogether and white sugar production increased accordingly. Although this would seem to be logical there would be enormous distribution problems and, moreover, the existing capacity of the factories is not sufficient to crush all the cane produced. Total daily crushing capacity is estimated at 55,000 tonnes.

The sugar industry in Pakistan faces substantial difficulties. First of all, the cane yield per acre is not more than 14.9 tonnes while the sugar yield is only 1.42 tonnes. Moreover, processing of stale cane in the factories accounts for big losses in recovery; the polarization of cane in the field is around 13, but the factories only extract 11.5%. This can be explained by the fact that cane deliveries to the factory take a very long time which necessarily causes losses in sugar content.

Current estimates indicate that sugar production in 1979/80 will reach the previous season's level. The production outlook is somewhat uncertain, however, because the government has revised upwards the price of sugar cane and of sugar to enable the industry to compete with gur. The effects of this step will be seen in due course; however, even if production should be in excess of 600,000 tonnes, white value, it will not be enough to cover domestic consumption which is forecast at 845,000 tonnes for the period.

In the past the government has resisted imports in view of the tight foreign exchange situation and shortages were met by reducing rations and by consuming a large carry-over stock from the previous year. This option no longer applies and the government will have to import sugar to bridge the gap of 200-250,000 tonnes if demand is to be satisfied.

Mexico sugar situation[1]

At the end of 1979 the Mexican Government authorized the importation of 400,000 tonnes of sugar during this year although up to the end of November it had maintained that only 14,875 tonnes had been authorized to cover industrial demand and that sufficient new crop sugar would be available to meet domestic needs in all parts of the country. In fact, shortages had existed through the second half of 1979 and was officially attributed to "speculation" by wholesalers and retailers. New laws provide for stiff fines and imprisonment for those found guilty of such speculation.

Production in the new season is expected to be poor, however, owing to drought in six states, and the mills have insufficient crushing capacity to process a full crop in spite of repairs and renovations which are considered inadequate. Internal demand continues to grow at between 6 and 10% (a phenomenal 18% increase was recorded in 1979 but this might have been partly due to hoarding) while sugar prices are maintained at low, subsidized levels.

Mexico exported only between 40 and 44,000 tonnes in 1979 against the 70,000 tonnes quota under the ISA (and exports of 577,956 tonnes in 1970 and 161,017 tonnes in 1975) and there are unlikely to be any exports in 1980 and 1981. Mexico has thus moved from being an important world market exporter to an importer. Cane growers and economists consider the growing state interest in the industry to be responsible for the situation.

In 1970 the cane crop came to 34.6 million tonnes but, as the state acquired mills and built new ones, the crop fell, reaching 30 million tonnes in 1978. The area devoted to cane, 547,000 ha in 1970, had fallen to 480,000 ha by 1978, while yields had also fallen off. The cane price has been increased to US $17.60 per tonne, with $1.37 per point for sucrose content higher than standard. But growers claim that costs have risen by 150% and further difficulties with cane supply may result.

World sugar balance, 1979/80

F. O. Licht GmbH recently published their first estimate[2] of the world sugar balance for the period September 1979/August 1980 as follows:

	1979/80	1978/79	1977/78
		tonnes, raw value	
Initial Stocks	30,412,000	30,065,000	24,900,000
Production	88,054,000	91,196,000	90,935,000
Imports	28,738,000	27,079,000	28,220,000
	147,204,000	148,340,000	144,055,000
Exports	28,779,000	27,545,000	28,247,000
Consumption	91,580,000	90,383,000	85,743,000
Final stocks	26,845,000	30,412,000	30,065,000
" " % consumption	29.31	33.65	35.06

The increasing consumption, combined with falling production, results in a drop of 4.34% in stocks on consumption; and since Licht considers commercial stocks of 24% as normal, this means that surplus stocks are almost halved compared with 1978/79 (no account is taken of the special stocks withheld from the market under the ISA). But Licht believes the marked fall of 1979/80 to be due to special circumstances and does not anticipate that the same rate of fall will be achieved in 1980/81.

US loan sugar sales

The Commodity Credit Corporation offered 54,000 short tons of the forfeited loan programme sugar for sale and announced the sale of 44,000 tons on December 14. The CCC is reviewing its method of selling and is considering sales at 7-10 day intervals rather than monthly and also selling for forward delivery up to 6 months instead of 30-45 days. Another tender of 330,000 tons was offered on December 27 and a total of 156,889 tons was sold, mainly to one trade house. No date was announced for the next tender.

Bulk handling seminar. — A seminar was held during the week-end of February 1-3 at the HTS Management Centre, Lane End, High Wycombe, in which representatives of leading UK manufacturers of mechanical handling systems and components delivered lectures and led discussions on the latest developments in the field of handling loose bulk materials, including high speed conveying, headshaft drives and backstops, ship loading and unloading, aerial ropeways, cable belt conveying, high-capacity ship unloading, digital control systems, screw conveying, etc. Information may be obtained from the Mechanical Handling Engineers' Association, 16 Dartmouth Street, London SW1 9BL, England.

[1] *Public Ledger Commodity Week*, January 5, 1980.
[2] *International Sugar Rpt.*, 1979, **111**, 720.

Sub-surface irrigation for the Australian sugar industry

By L. S. CHAPMAN (Senior Agronomist, Bureau of Sugar Experiment Stations, Mackay, Queensland)

Sugar cane is grown in Australia in a discontinuous strip along the north-east coast between 16° and 29° South latitudes.

There are four natural divisions with regard to irrigation requirements.

The northern cane-growing area from Ingham to Cairns receives reliable rainfall (1800 to 3000 mm/year) and practically all cane is rain-grown, although there could be a need for irrigation in the dry spring and early summer months.

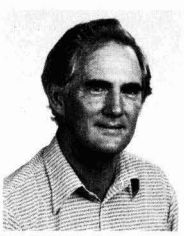
The Burdekin district is in a lower rainfall area (1000 mm/year), and all farms depend on irrigation from shallow aquifers or from surface streams to maintain high yielding crops. A few farmers with sandy soils use travelling irrigators, but water is freely available and flood irrigation is mainly used. Cane-growing land has been extensively graded, and lay-flat plastic fluming is used for water distribution. Natural recharge of the aquifer is augmented by a ground water replenishment scheme which operates when the river flows.

The Mackay, Proserpine area has a less reliable wet season (1800 mm/year) than the far north, and 40% of farms are irrigated by portable spray line or travelling irrigators. The water supply is generally inadequate for flood irrigation. Ground water resources are completely exploited, but there are still some opportunities for small surface storage schemes.

The Bundaberg and southern areas are in an unreliable rainfall belt (1100 mm/year). At Bundaberg, approximately 80% of farms can be irrigated, while less irrigation development has occurred in other mill areas in the southern cane-growing region. Water is pumped from streams, dams and from aquifers up to 80 m deep. Irrigation is applied from portable spray lines, travelling irrigators and surface furrows depending on the water supply and terrain. Major capital works on water storage and reticulation are in progress in Bundaberg district to relieve the demand on an over-developed aquifer and to improve the reliability of the irrigation water supply. Some intrusion of sea water has been experienced at the margins of the Bundaberg aquifer as a result of irrigation usage during low rainfall periods.

Sub-surface irrigation in Australia

The principle of drip irrigation is to supply the water requirements of plants at a low moisture tension by frequent irrigations. Drip irrigation was adopted for cane-growing in Hawaii in 1970. There, thin-walled, perforated irrigation pipes, similar to the soaking hoses used in gardens, are used on the soil surface. At the biennial cane harvest in Hawaii the infield drip irrigation system is destroyed.



Mr. L.S. Chapman

In Australia, cane is generally harvested annually, and in developing drip irrigation for sugar cane, all the infield drip irrigation equipment was installed below the surface to protect the equipment from destruction at each harvest. It is usual in Australia to grow from two to five ratoon crops, and if the drip system could be maintained for three to six crops then sub-surface irrigation could be economical in some cane-growing districts.

The possible benefits from drip irrigation in the three cane-growing areas, where irrigation is widely used, are:-

* yield responses due to lower moisture stress
* improved efficiency of water use on sandy soils
* better water penetration on silty soils where flood irrigation causes sealing of the soil surface after cultivation has ceased
* improved yields by using small water supplies more effectively on a limited area.

Trials with sub-surface irrigation systems have been conducted on BSES experiment stations at Ayr, Mackay and Bundaberg. Details of these trials follow.

Ayr irrigation systems trial

An irrigation system trial was conducted at Ayr by Ham who reported that there were no significant yield differences between methods of irrigation until the second ratoon crop when drip irrigation was inferior to other methods of irrigation[1]. The yield decline from drip irrigation resulted from the plugging of orifices due to iron precipitates which affected the water distribution pattern as well as the total water application. The level of iron in the irrigation water ranged from 4 to 7 ppm.

Results of this trial are presented in Table I.

Mackay drip irrigation experiment

An experiment to measure the yield responses from drip irrigation was commenced in Mackay in 1976[2]. Three levels of irrigation were used, and scheduling was based on replacing water deficit, calculated from Class "A" pan evaporation and a factor related to canopy development. Yields are presented in Table II.

Maximum cane and sugar yield responses were obtained from the highest water application rate (0.8 pan). These responses represent significant increases in yield compared with unirrigated cane.

The cane yield responses of 22 and 44 tonnes per hectare from drip irrigation for the plant and first ratoon crops were higher than the mean irrigation responses of seven and 18 tonnes per hectare from two sprinkler irrigation experiments irrigated at 0.9 pan factors in the same years at the Mackay Sugar Experiment Station. However, as drip experiments were watered on a daily schedule, more water was used than in sprinkler experiments where 10 to 15 day schedules (depending on crop water use) were employed. In the latter case,

[1] *Proc. Conf. Australian Soc. Sugar Cane Tech.*, 1979.
[2] Chapman: *Proc. 45th Conf. Queensland Soc. Sugar Cane Tech.*, 1978, 145-152.

there was a greater probability that a scheduled irrigation would be obviated by rainfall.

The lack of yield responses in the second ratoon crop was an unexpected result, and is attributed to the better-than-average rainfall in that year which could have caused some waterlogging. In addition, more damage occurred to the stool at harvest in the irrigated plots and this resulted in poor stool populations in the irrigated cane.

Bundaberg irrigation methods experiment

An experiment was initiated at Bundaberg in 1977 to evaluate sugar production and operation of drip irrigation and sprinkler irrigation systems[3]. Yield data are presented in Table III.

The large yield response to irrigation was a reflection of low and poorly distributed rainfall during the growing season. (Long-term average response to irrigation at Bundaberg is 22.2 tonnes cane, or 3.6 tonnes sugar/ha.) Results of this experiment complement the Ayr data. No differences in cane or sugar yields were apparent between sprinkler and drip irrigation treatments. Similar volumes of water were applied. Yields from plots, with drip tubes in alternate inter-spaces only, were significantly lower than those for plots with a drip tube beneath each cane row.

Table I. Yield of cane and sugar from Ayr irrigation systems trials (tonnes.ha^{-1})

Crop Class / Irrigation system	Plant		1st ratoon		2nd ratoon	
	cane	sugar	cane	sugar	cane	sugar
Solid set	181	27.7	140	22.3	112	17.3
Spray	181	28.1	147	23.8	109	17.0
Drip	183	27.0	142	23.1	89	14.4
Furrow	179	25.3	136	22.8	105	17.0
L.S.D. $p < 0.05$	ns	ns	ns	ns	ns	2.7

ns = not significant

Table II. Cane and sugar yield for Mackay drip irrigation trial (tonnes.ha^{-1})

Crop Class / Irrigation method	Plant		1st ratoon		2nd ratoon	
	cane	sugar	cane	sugar	cane	sugar
No irrigation	107	16.3	88	10.1	108	16.3
Drip, 0.4 pan	115	17.8	118	14.8	104	15.5
Drip, 0.6 pan	113	17.5	112	13.4	105	15.4
Drip, 0.8 pan	129	19.9	132	16.9	101	15.2
L.S.D. $p < 0.05$	15	2.2	15	2.3	24	4.4

Table III. Cane and sugar yields for irrigation methods experiments, Bundaberg (tonnes.ha^{-1})

Crop Class / Irrigation method	Plant	
	cane	sugar
No irrigation	57	7.6
Drip	119	17.3
Spray	115	17.2
L.S.D. $p < 0.05$	4	0.7

Assessment of sub-surface irrigation

The following assessment is based on results from three replicated trials and the experience of cane-growers who have installed small areas of sub-surface irrigation.

Design

The basic components of the sub-surface irrigation system are illustrated in Fig. 1. These include the pump, water filters, timers and control equipment, fertilizer injection equipment and the water distribution network. In the example two blocks are irrigated by sub-mains buried on the headland with drip laterals joined to the sub-mains by suitable adaptors. Laterals can be installed at planting or after cane has germinated. In most cases cane is planted in moist soil soon after the wet season and irrigation is not necessary to ensure germination. Installation after germination is preferred. However, if cane is being replanted immediately after the last crop is harvested and ploughed-out, irrigation is sometimes required to obtain a satisfactory germination and drip tubes must then be installed at planting.

Under Australian conditions long cane rows are preferred for mechanical harvesting, and restricting lateral tube length to 200 m for hydraulic reasons is a disadvantage. Positioning of sub-mains within blocks of cane can overcome this disability.

Lateral types

Only two lateral tube types have been used in Australia — monowall and biwall. Monowall is a single walled pipe with small orifices drilled at regular intervals. Biwall consists of two adjacent chambers of unequal diameter interconnected by orifices. The larger chamber conveys the irrigation water, while the smaller chamber has a larger number of orifices which emit the irrigation water.

Biwall has some advantages over monowall for use in undulating land, but as most irrigated cane is grown in Australia on land of minimum slope, both types of tube appear to be suitable. There have been problems with quality control in the biwall tubing, and stress cracking occurs where the tube has been weakened by faulty manufacture, thus causing leaks in the tubing when in use.

Lateral durability

The first commercial installation of sub-surface irrigation in the Australian cane industry is now five years old and is still functioning satisfactorily. The tubing is still pliable and does not appear to be degrading.

Durability is also affected in the field by damage from pests. *Rattus conatus*, a local species of rat which invades cane fields from adjacent natural harbourages, causes puncturing of laterals. The rats tunnel under the cane stools during nest building and inadvertently chew through the tubing. This damage causes minimum interruption to irrigation as it happens in mature cane during the latter part of the wet season, or when the cane is being dried-off prior to harvest. The damage has to be located and repaired before the next ratoon crop can be

[3] Personal communications, 1979.

irrigated. Rat bites to tubing have reached an intensity of 25 per hectare.

Ants have also been the cause of damage to buried laterals, by either enlarging the orifices or by chewing additional holes. The main species involved is the tramp ant, *Pheidole megacephala* Fabricius, which seems to be particularly troublesome when the tube is not in operation, either after installing and before commissioning or during the crop maturing period when irrigation is not required.

Roots entering the orifices have not been a problem.

Restriction of the water flow by cane stools growing adjacent to the laterals has been observed, but the problem was overcome by positioning the laterals 40 mm below or to one side of the sett.

Lateral placement

Sub-surface irrigation systems have been tried with several planting configurations. These include (1) placing the lateral adjacent to the sett at or soon after planting[4], (2) placing it in alternate inter-rows below cultivating depth or (3) burying it between the dual rows as in the Hawaiian dual-row or pineapple planting system.

The lateral placed adjacent to the sett with 1.4 m row inter-spaces has given the best yields and the least interruption to normal farming practices.

Placing the laterals in alternate inter-spaces was not successful, as it restricted cultivation and weed control and the yields obtained from this configuration were lower than where one lateral per row was used.

Dual-row planting has been tested extensively in Australia, but no yield advantage has resulted from this planting method. The advantages which would result from the reduction in cultivation costs with dual-row planting do not outweigh the disadvantages of converting present equipment. Where sub-surface irrigation and dual-row planting have been combined, results to date are not encouraging.

Water treatment and orifice plugging

Water filtering is essential for all drip irrigation systems. Where good quality irrigation water has been used 100 mesh screen filters have been successful. Sand filtering was beneficial in removing iron precipitates, but not on a long term basis. Gibson & Bui[5] found that chlorine treatment was essential with the use of surface water to prevent the growth of algae which plugged orifices in Hawaii. Chlorine has been necessary in Australia when surface water has been used, but where underground water is available, and all the irrigation system is sub-surface, chlorine treatment of water has not been necessary.

Injection of sodium polyphosphate or hydrochloric acid has not prevented precipitation of iron and subsequent blockage of orifices in trickle lines.

Orifice orientation and flushing of laterals

The orientation of orifices upwards is essential to prevent plugging even when good quality water is used. Any precipitates or sludges of colloidal material then collect on the bottom of the laterals where they can be flushed from the system at regular intervals. Gibson &

[4] Nicholson: *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 139-142.

[5] Personal communication, 1975.

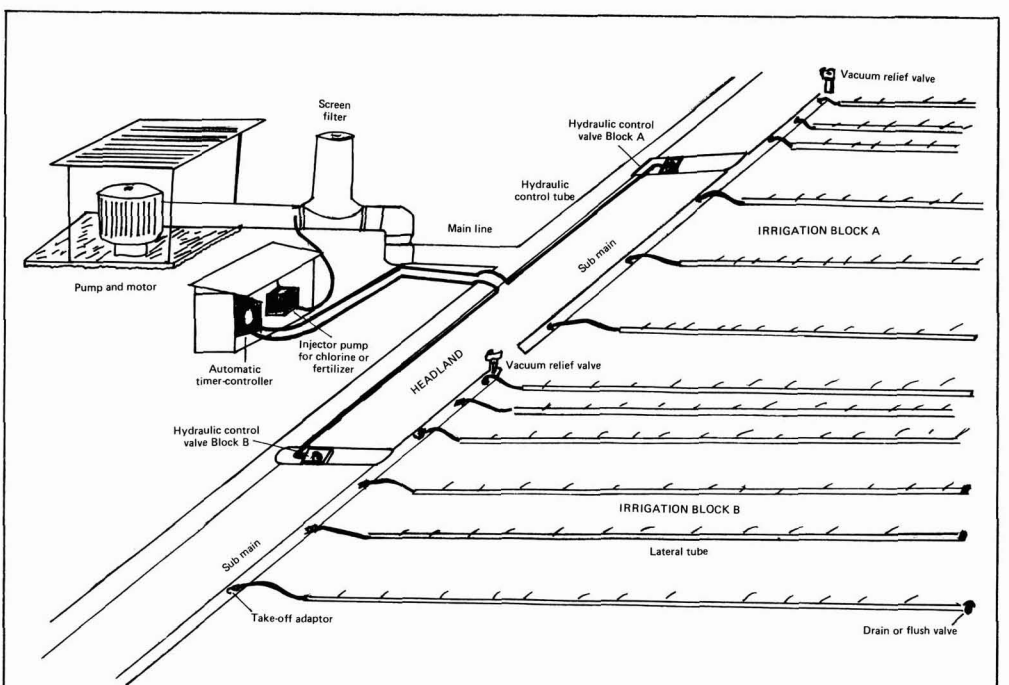


Fig. 1.

Bui[5] have stated that a flushing velocity of 0.3 m per second is necessary to remove precipitates and sludges. No automatic flushing system has operated satisfactorily in Australia, and all successful systems have been manually operated.

Fertilizers and insecticides

The efficiency of fertilizers has not improved when injected through drip irrigation systems. Urea and potassium chloride have been applied using this method. Phosphorus fertilizers could not be applied because calcium phosphate precipitates are formed when phosphorus fertilizers are mixed with most irrigation waters. Aqueous ammonia was not applied through drip irrigation systems because brass fittings which are an integral part of the irrigation system would be corroded by dilute ammonia solutions.

Some success has been achieved with insecticides for ant control applied through the drip irrigation system. A trial using a systemic insecticide to control the large moth borer *Bathytricha truncata* Wlk. was not successful.

Irrigation scheduling and water economy

Trial work has shown that scheduling of drip irrigation based on a Class "A" pan factor of 0.8 is satisfactory when the full canopy is developed. Similar cane growth resulted from both daily and twice weekly irrigation schedules.

Less frequent irrigation is desirable in the early stages of cane growth to allow fertilizer application, cultivations for weed control, and cultivation to shape the drill for efficient mechanical harvesting. Once cultivation is no longer necessary, irrigation scheduling based on Class "A" pan evaporation can be used. At the end of the growing season a drying-off period of approximately six weeks is required.

More efficient water use occurs with sub-surface irrigation than with flood or spray irrigation because of the even water distribution pattern.

Automation

The ability to automate drip irrigation is a desirable feature. The additional costs of automation are small compared with the full cost of installing a sub-surface irrigation system. Automatic control by either electrically or hydraulically controlled valves has been used successfully.

Conclusions

Sub-surface drip irrigation of sugar cane has been successfully demonstrated in Australia and the system as originally developed in Hawaii has been modified to suit local conditions.

Drip irrigation is unlikely to be adopted in the Burdekin as trial results are not promising and existing practices are satisfactory. Flood irrigation is the appropriate form of irrigation for most of the Burdekin area. Sprinkler irrigation has proven advantages in water distribution in sandy soil. Irrigation waters of the Burdekin area have iron concentrations as high as 17 ppm and the use of drip irrigation is not practical at present because of the orifice plugging problem.

At Mackay and Bundaberg, drip irrigation of cane has been shown to be a practical form of irrigation and good yields have been obtained. The responses from drip irrigation at Mackay appear to be slightly superior to responses from sprinkler irrigation, but at Bundaberg both drip irrigation and sprinkler irrigation gave similar yields.

The daily scheduling technique used for drip irrigation has resulted in more water being used than for sprinkler irrigation when the latter schedules were significantly modified by rainfall. This has offset any potential advantage due to greater water application efficiency. The cost of installing drip irrigation is high and equipment valued at more than $A1000 per hectare is destroyed after each crop cycle, as no technique is currently available to recover the subsurface drip irrigation tubes or to replant the next crop cycle without destroying the infield installations. The oldest operating drip irrigation system in cane has been in service for five crops, and the system is expected to operate for a full crop cycle.

Drip irrigation has a low labour requirement but this is partly offset by damage to lines during operation. Rats burrow to nest in the cane stools and accidently damage the buried drip tubes. Although the repair of this damage is not costly it is time consuming. Ant damage has also been recorded. Insecticides are currently available which will control ants but at additional cost.

The main disadvantage of drip irrigation at present is the high installation cost in a period of restricted production quotas in Australia. A drip system must be fully utilized for maximum production to be economical and farmers can meet present quotas without maximizing yields.

When additional sugar markets become available, drip irrigation could be used more widely, but in the meantime, flooding, portable spray lines and travelling irrigators will be used to irrigate cane.

Sub-surface drip irrigation is an excellent concept with many practical advantages. However, at its present stage of development the technology appears too specialized, and the material used in the systems too fragile for wide acceptance by Australian cane growers.

Summary

Experiences with drip irrigation in sugar cane agriculture in Australia are described.

Irrigation sous-surface pour l'industrie sucrière australienne

On décrit des expériences avec l'irrigation à goutte dans la culture de la canne à sucre en Australie.

Unterirdische Bewässerung in der australischen Zuckerindustrie

Man beschreibt einige Erfahrungen mit Tropfbewässerung beim Zuckerrohranbau in Australien.

Irrigación subterránea para la industria azucarera de Australia

Se describen experiencias con irrigación por goteo en agricultura de la caña de azúcar en Australia.

Guatemala sugar industry[1]. — The 1979/80 season in Guatemala has started early. The factories working include Ingenio Pantaleón (7500 tcd), Concepción (600), La Unión (4500), Palo Gordo (4000), Santa Ana (4000), Madre Tierra (3000), El Salto (3000), Los Tarros (2800), El Baúl (2000), San Diego (1600), Magdalena (1100), Tululá (600), Santa Teresa (300) and Mirandilla (100 tcd). In addition the two new mills Ingenio El Pilar, near the town of Cuyotenango, and Tierra Buena in the Nueva Concepción area, will start operations in the crop, with capacities of 3500 and 4000 tcd, respectively. The new Trinidad factory will also start up on a test basis during the latter part of the crop. The Guayacán, Azuvalle and La Sonrisa factories are not expected to operate during 1979/80.

[1] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 40.

The technology and profitability of drip irrigation in sugar beet cultivation

By FRANZ J. BRAUN

Agricultural basics

Things which seem to be plentiful are, in reality, only available in limited quantities. Everyone dependent on plant growth should consider this principle when working with the production factor, water. In this connexion, it must be remembered that in Central Europe sugar beets are grown, to a great extent, in areas where rainfalls are, on average, decreasing, so that one may speak of a permanent deficiency in moisture for use in agriculture. As regards a balanced yield pattern, it must be impressed on the beet farmer that there is need to make up this deficiency through economical application of the most modern irrigation techniques.

In addition to refined agricultural practices such as crop rotation, varietal selection, soil treatment, plant protection and fertilization, sugar beet yield is mainly influenced by heat, light and water. As the sugar beet is one of those crops where an optimum supply of water leads to improved yields, the following experiences and recommendations derived from tests carried out over a long period of time will form the basis of possible yield increases through specific irrigation techniques. Here it must be borne in mind that the correct timing of additional water applications creates difficulties, since the period of growth of the sugar beet does not pass through any phenologically distinctive phases. Because of this, it follows that prerequisite for the profitable use of various irrigation practices is knowledge of the extra yield attributable to each individual technique, whereby investment may only then be allowed when the value of the increase in crop yield exceeds the irrigation costs.

Crop-related use of irrigation

All technical practices in sugar beet agriculture must, more than ever before, be focused on the development of the young plant, as this is decisively reflected in the final yield. In this respect, it must be remembered that the high consumption of water during germination is usually provided by the natural moisture available in springtime. Should the effective groundwater capacity (nK) not fall below 30%, additional irrigation will not be needed until the leaf canopy stage (about 10-12 weeks after emergence). This recommendation is based on the fact that, with an excessive supply of water, leaf growth develops well in advance of the sugar beet root and would become a limiting factor with regard to solar irradiation, so that in the end it could hinder the growth of the beet itself. In addition, the excessive water supply leads to limited elongation of the root, so that nutrient uptake occurs exclusively in the upper soil layers, which again has an inevitable negative effect on the productive beet volume. On the other hand, a moderate water supply forces the crop to obtain water and nutrients from lower layers, resulting in a larger storage organ or beet volume.

Franz J. Braun

Irrigation tests over a long time have shown that the crop must be well supplied with water during the main period of water requirement (July/August). An effective groundwater capacity of 40-50% can be considered as ideal. Correspondingly, an increased capacity of 50-70% has a favourable effect on leaf growth but root yield is substantial with the lower capacity range. In Central European regions, dry periods may be suddenly interrupted by heavy rain showers, which, naturally, cannot be predicted; the dry periods can mostly be balanced to the extent of 40-50% by a constant supply of water, while a standard level of 50-70% would provide an excessive supply of water on the one hand, and a yield-reducing under-supply of soil air on the other. The logical conclusion to be drawn from this is the need for an absolutely constant supply of water, achieved wherever possible by daily balancing of the soil air:groundwater ratio to adjust it to the optimum.

Comparative cost-efficiency analysis

Based on average representative conditions, the results from which mainly agree with the views of various institutions, the actual study of sugar beet includes, *inter alia*, yield performances specific to a given practice as well as results from several years of trials. In addition to the popular practices of tube irrigation and irrigation by machine is the relatively new technique of drip irrigation. With regard to actual data and for matters of economy, flexible use of the system must be assumed with all irrigation practices. Starting from the multiplicity of soil types that occur in beet agriculture, an irrigation interval of at least 10 days must be maintained, as shown in the actual case study; this entailed rearranging the irrigation tubing twice a day in order to cover one-tenth of the 25 hectares, *i.e.* 2.5 ha per day. At the same output, the irrigation machine needed moving only once a day. Drip irrigation, through a series of parallel tubes laid on the soil surface, in a fixed position according to the original concept, needs only to be operated twice a day through a semi-automatic control unit by means of manual operation of a regulating valve in order to supply the entire area of 25 ha per day with the amount of water required by a given crop under given climatic conditions.

Items 1-10 in Table I show how drip irrigation requires about 18% less water than does tube irrigation and about 24% less water than does machine irrigation. This is mostly due to mainly loss-free emission of water in drip irrigation whereas, because of extremely high precipitation concentrations, the highest seepage losses are to be found with machine irrigation. As a result of low seepage, low evaporation and low surface water losses as well as low operating pressures, the energy costs (DM 0.18/kWh and DM 0.70/litre diesel fuel) are low in the case of drip irrigation, so that, according to practice, the water was available free of charge. In addition, with a wage level of about DM 10.00/hr, one

must consider the high cost of labour used in tube and machine irrigation in contrast to drip irrigation. In tube irrigation, 100 minutes has to be spent on work associated with the system per cm^3 of precipitation per ha, whereas the considerably more sophisticated machine irrigation requires 40 $min.cm^{-3}.ha^{-1}$; by comparison, drip irrigation requires only 2.5 $min.cm^{-3}.ha^{-1}$. Moreover, the possibilities of controlling the fixed drip irrigation system in accordance with crop and climatic conditions guarantee ideal conditions of growth, so that, despite the lowest consumption of water, it gives a beet yield which is about 11% higher than with the other types of irrigation compared, while the sugar yield per unit area is about 6% higher.

Items 10-34 in Table I show, besides the high investment costs of drip irrigation, the annual fixed and operating costs; when the increased crop yields are considered, drip irrigation seems an attractive proposition. Naturally, this new system only pays for itself later than do the other two types of irrigation, but this should not hide the fact that, after the writing-off period (usually 10 years) or after the expenses have been deducted (allowing for 3% interest), drip irrigation will be seen to be much more profitable. Because of its potential profitability, drip irrigation should be given greater consideration than before, from the point-of-view of new investment, since the system is not merely comparable to tube and machine irrigation but is far superior to them. In view of this, drip irrigation is explained in detail below.

Operating method and advantages of drip irrigation

The possibility of drip-wise irrigation with water application rates of 0.3-11 $litres.hr^{-1}$ and drip tubing available by the metre permits, for the first time, extensive constant maintenance of the moisture level necessary for the root zone of the crop, whereby the soil air content required for growth is also maintained. At the same time, the extremes of over- and under-supply of water are excluded, thus guaranteeing an optimum, balanced yield pattern.

Although, in drip irrigation, the water is only emitted from predetermined places in the drip tube (Fig.1), depending on crop, soil type and profile, an almost uniform supply of water to the soil is achieved. This is especially due to the capillary action of the soils. Lighter

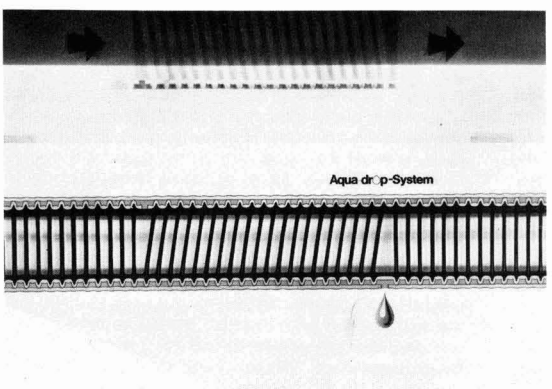


Fig. 1. Section along an Aqua-drop type homogeneous drip irrigation tube made of ultra-violet resistant polyethylene

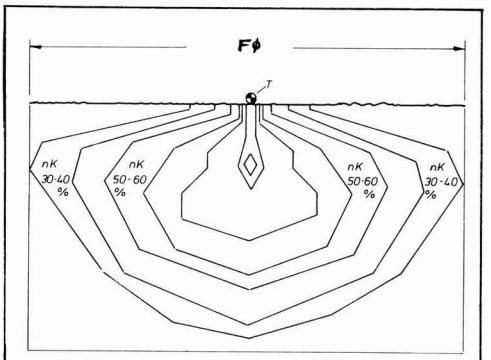


Fig. 2. Water distribution in soil around the drip point T. FØ = distance in cm, nK = groundwater capacity

Soil type	Deep soils	Shallow soils
	FØ, cm	
Sand	80	60
Loamy sand	140	100
Sandy loam	200	140
Loam	260	170
Clay	320	210

soils tend to have less capillarity than heavy soils; hence the water will spread more widely in the latter than in the former soils. The visible moisture zone at the surface (around the individual drip points) where the distribution is smaller, is no evidence, therefore, of the considerable onion-shaped spread of the water (Fig.2) below the surface. In the light of the demand (not to be underrated) of many producers for easing of the workload, the advantages of drip irrigation may be summed up as follows:

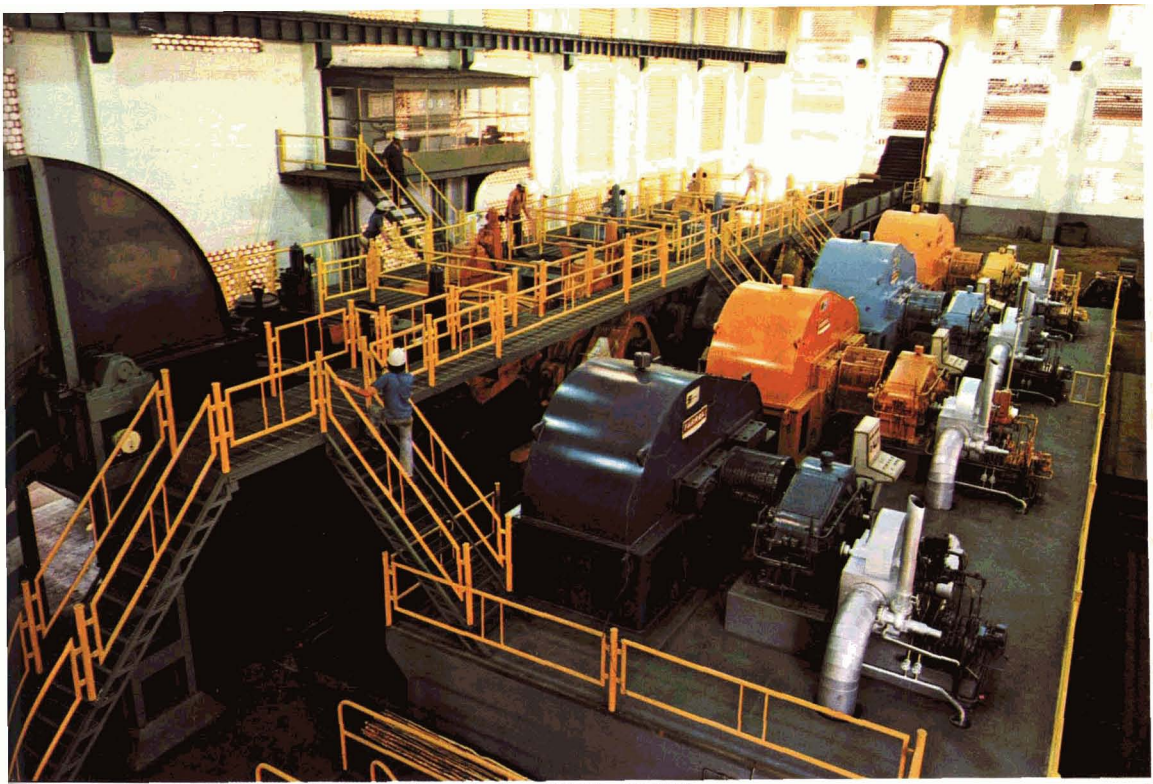
(a) Best possible use of water owing to low seepage, low evaporation and low water losses at the surface in contrast to conventional irrigation systems. As the root area of the crop is exclusively supplied with water, the saving under Central European conditions of sugar beet cultivation is between about 20% and 30%.

(b) Improved yields and increase in quality by comparison with conventional irrigation systems – about 11% higher beet yield and about 6% higher sugar yield. The reason for this is the constant optimum air:water:nutrient balance in the soil.

(c) Best possible use of fertilizers, since the system permits the nutrients to be fed directly to the beet crop without any distribution losses. In addition, when liquid nitrogen is applied, the drip tube spacing can be increased, which again reduces the investment costs.

(d) Saving in plant protection materials. The leaves remain dry, so that susceptibility to disease and pests is reduced. The relatively dry surface of the soil prevents germination of air-borne seeds, which again considerably reduces weed growth.

(e) Low application costs and other expenses as a result of the small amounts of water required and the low



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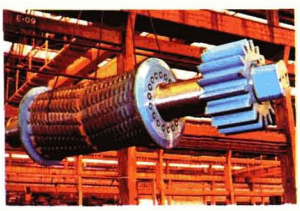
Fator

Solamente quien fabrica el mejor trapiche del mundo puede transformar su ingenio en un moderno central azucarero.



En el ramo azucarero, así como en cualquier otro, un buen equipo es de vital importancia para la obtención de un mejor resultado final. Cada pieza, cada equipo influye en el funcionamiento, pero sucede muy a menudo que un buen equipo no puede alcanzar los resultados deseados, debido a una falta de armonía del conjunto en general.

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Table I. Cost-effiency analysis based on existing water extraction point. More or less consumption of nutrients or plant protection chemicals resulting from the specific properties of the irrigation technique are not considered

Location:			
Terrain:	level — slope under 1%		
Type of soil:	loamy		
Soil layers:	deep		
Dimensions of area:	rectangle, ratio 1:2.66, total of approx. 25 ha		
Irrigation technique:	Tube Irrigation	Machine Irrigation	Drip Irrigation
Total area to be irrigated, ha	25	25	25
Capacity of irrigation unit per installation/switching operation, ha	1.25	2.5	12.5
Maximum area to be irrigated per day with 10 day cycle, ha	2.5	2.5	25
Conception of irrigation unit	flexible	flexible	fixed (stationary)
Consumption and Yield:			
1. Maximum water requirement of crop per day, mm	4.2	4.2	4.2
2. Water loss (evaporation, seepage, loss at surface, etc.), %	25	35	3
3. Average quantities of water to be used for irrigation per year, mm	213	230	175
4. Water required for irrigation per year, m^3	53,250	57,500	43,750
5. Precipitation density per operating hour, mm	6	57	0.375
6. Total water requirement per operating hour, m^3	75	89	47
7. Maximum operating time per day according to type of system, hr	17.5	16	23
8. Capacity of pumping unit required, kW	41	49	13
9. Required operator time per mm precipitation per ha, min	100	40	2.5
10. Total required operator time per year for irrigation, hr	887	383	182
11. Average crop yield, tonne.ha^{-1}	54	54	60
Without irrigation, tonne.ha^{-1}	44	44	44
Increased yield, %	23	23	37
Investment and Profit:			
12. (a) *Investment costs*			
13. Irrigation unit complete, DM	25,000	28,000	115,000
14. Pumping unit complete, DM	10,500	12,000	8,500
15. Total investment, DM	35,500	40,000	123,500
16. (b) *Fixed annual costs*			
17. Labour costs at DM 10.00 per working hour (Item 10 x DM 10), DM	8,870	3,830	1,820
18. Energy consumption at DM 0.18 per kWh or DM 0.70 per litre diesel fuel, DM	4,150	5,600	2,130
19. Maintenance + servicing, DM	800	2,480	1,200
20. Total fixed costs, DM	13,820	12,270	5,150
21. (c) *Annual running costs*			
22. Depreciation per year (Item 15/10 years), DM	3,550	4,000	12,350
23. Interest rate with total financing [(Item 15/2) x 3%)], DM	530	600	1,800
24. Fixed annual costs, DM	13,820	12,270	5,150
25. Total running costs, DM	17,900	16,870	19,300
26. (d) *Increased crop yield*			
27. Average price level per tonne of sugar beets, DM	100	100	100
28. = Total increased yield (yield irrigated less yield unirrigated) x Item 27, DM	25,000	25,000	40,000
29. (e) *Annual profit increase*			
30. (Item 28 minus Item 25), DM	7,100	8,130	20,700
31. (f) *Amortization period* (Item 15/Item 30), years	5	5	6
32. (g) *Profit increase after use over 10-year period* (3% interest relative to Item 30), DM	38,825	44,458	89,199

pressure; small pumps of reduced energy consumption. Because of the various possibilities of automatic control, there are hardly any maintenance and operating costs. Low water application rates prevent leaching, silting and crusting of the soil, so that the need for additional soil treatment is reduced. One can, of course, walk or drive over the irrigated areas at any time.

The Aqua-drop long-path system considers all these advantages. The product, consisting of a special homogeneous tube, obviates use of the usual appendages in the form of mounted or inserted drip elements. Thus, even in sugar beet agriculture, complete mechanization of the installation work is possible with reduced labour costs.

Concept and practical application of the system

It should be possible to assemble a drip irrigation system, as conceived in accordance with the present state of the art for use in agriculture, on the modular principle. Assuming a water connexion already exists, such a system can be divided into the following groups:
(i) water supply pipe, installed between pump and servicing unit, for supply of the required amount of water;
(ii) servicing unit, installed between the water supply pipe and the main distribution pipe, consisting of filter, control valves, automatic control set and fertilizer connexion;
(iii) fertilizer mixing unit, to be connected to the servicing unit for dosage of water-soluble nutrients into the water passing through it;

Fig. 3. The fully-mechanized tractor-mounted coiling unit has proved to be especially useful for agricultural areas with large drip irrigation installations

(iv) main distribution pipe to be connected to the servicing unit, for the distribution of a prepared quantity of water along the breadth of the field;
(v) pressure reducing valves between the main and secondary distribution pipes, with throttling means for automatic control and reduction of the water pressure in the drip tubes to 1.0 bar;
(vi) secondary distribution pipes between the pressure reducing valves and drip tubes to provide economical use of valve capacity through the coupling of more drip tubes;
(vii) drip irrigation tubes connected to the secondary distribution pipes with orifices at preselected intervals specific to a given crop and soil and providing low water emission per unit time.

In drip irrigation of sugar beet, it is recommended that the drip tubes be laid upon the soil surface, while the main and secondary distribution pipes and pressure reducing valves should be installed below the soil. For smooth operation of the water pressure reducing valves to make use of their isolating capacity, the valves should be installed in shafts where they are accessible at all times. The installation method described only requires unrolling and coiling of the drip tubes (before and after the crop period); fully mechanized tractor units equipped as coiling units can handle up to 12,000 running metres of drip tubing per working hour (Fig.3).

In order to suit the various soil types and profiles with their different capillarities and water retention capacities, the drip tubes should be installed in rows of greater or lesser distance from one another. The ideal band width along a drip tube row (as regards water supply) and the resultant maximum interval between the tubes is governed on the one hand by the plant roots and, on the other, by the soil, starting from a given drip interval. Since, with smaller inter-drip intervals considerably greater quantities of water are emitted, and frictional losses argue for the use of shorter rows, for beet irrigation on light soil one should normally use a drip interval of 60 cm (maximum length of rows with even terrain 100-180 m), and on moderately heavy to heavy soil, an interval of 100 cm (maximum length of rows with even terrain approx. 180-300 m).

Summary and discussion

Under the climatic conditions of Central Europe, fullest use cannot be made of sugar beet agricultural efficiency as regards yield potential without the help of irrigation. The permanent lack of water which limits plant growth below its potential is reason enough for the farmer to find out more about the subject of irrigation. Only maximum yields from the available areas will reduce unit costs.

Agricultural basics, use of crop-related irrigation and a comparative cost-efficiency analysis thus give the practical man reference values of fundamental importance, especially as these can be adjusted to the problems at other locations by various modifications. Compared with the usual sprinkler systems, drip irrigation has proved to be an attractive alternative fully suited to the tendency to water shortage and increasing cost of water as well as rising energy and labour costs. Hence, in the foreseeable future the term "profitability" will primarily apply to this system. More than 300,000 hectares of drip-irrigated land spread throughout the world are certainly a fact which bears out the points mentioned above.

Furthermore, with regard to the large number of drip irrigation systems on offer, it should be remembered that for the agricultural sector, including sugar beet cultivation, only homogeneous drip tubes without additional elements (which tend to cause disruption) should be used. Aqua-drop, a system of the Fränkische Rohrwerke, well meets the requirements mentioned, since it is especially intended for use over large areas, and was conceived on the modular principle. Thus, herein one can see a new generation of drip irrigation, which, with fully mechanized installation, meets the needs of the producer in every way. In conclusion, it should be pointed out that only expertly established irrigation techniques, no matter which type, used consistently, will bring optimum and economically attractive yields.

Bibliography

Bramm & Sommer: "Gedanken zur Optimierung der Wasserversorgung in Zuckerrüben". *Die Zuckerrübe*, 1978, **27**, (4), 17-19.

Braun: "Tropfbewässerung für den Praktiker". (Fränkische Rohrwerke, Königsberg), 1978.

Idem: "Rentabilität verschiedener Bewässerungsverfahren unter Einbeziehung kultur-spezifischer Belange". *Zeitsch. für Bewässerungswirtschaft*, 1978, (1).

Idem: "Versuche beweisen es: Mehr Ertrag durch Tropfbewässerung". *Taspo*, 1978, (18).

Idem: "Tropfbewässerung ist gleich 50% weniger Wasser". *Agrar-Übersicht*, 1978, (5).

Dambroth & Bramm: "Vier wichtige Regeln für den Beregnungseinsatz bei Zuckerrüben". *DLG-Mitteilungen*, 1978, (8).

Drip irrigation in sugar beet cultivation

Rosegger, Dambroth & Siegert: "Ergebnisse des Einsatzes der Tropfbewässerung in Reihenkulturen". *Landbauforschung Völkenrode*, 1977, (2).

Sourell: "Tropbewässerung in Ackerbau". *Hannoversche Land- und Forstwirtschaftliche Zeitung*, 1978, (February).

Summary

The advantages of drip irrigation in sugar beet agriculture are surveyed and the equipment used is described.

La technique et rentabilité de l'irrigation sous-surface dans la culture de betterave sucrière

On passe en revue les avantages d'irrigation à goutte dans la culture de la betterave sucrière et décrit les équipements employés.

Technik und Rentabilität der Tropfbewässerung beim Anbau von Zuckerrüben

Man bringt eine Übersicht über die Vorteile der Tropfbewässerung beim Zuckerrübenanbau und beschreibt die angewendeten Einrichtunge.

La tecnología y provecho de irrigación por goteo en el cultivo de remolacha azucarera

Los ventajes de irrigación por goteo en agricultura de la remolacha se examinan y se describe el equipo usado.

Man-made rain: recent developments in irrigation techniques

By C.J. COOTE

(Farrow Irrigation, Bromley Common, Kent, England)

Ever since man first attempted to grow his own food crops, he has been aware of the necessity of a regular application of water in order to achieve the best results. In those parts of the world blessed with seasonal rainfall, cropping patterns are based on the rainy season to get maximum benefit in the growth of the crop. Unfortunately, man over-cropped and over-grazed many areas of the world, creating a change in the climatic structure and resulting eventually in the formation of deserts. With increasing populations and a world-wide desire for improved standards of living, pressure on existing land and water resources has intensified and in recent years man has sought ways of developing food production from land which was not previously cultivated.

Early methods of irrigation

Irrigation in its simplest form has been practised in eastern countries and in the Nile Delta for thousands of years. Gravity or simple lifting devices were used to guide water into the fields and crops were grown in small basins, which were flooded periodically. These traditional methods are still used successfully in many countries in the Middle and Far East in rich fertile river valleys and on alluvial silts in the Sudan, Egypt and parts of West Africa; but the pressure on land and water resources has stimulated development of mechanized irrigation systems which have now reached a high degree of sophistication.

Mr. C.J. Coote

Apart from the obvious requirements of finance, all new land development projects require three basic resources, namely: land, labour and water, but, on examination of potential project areas, limitations in any or all of these resources soon become apparent. In many cases, water has to be lifted and conveyed by pipe or canal from its source to the nearest suitable land. By the time this water arrives at the development site it is already expensive and must be used as efficiently as possible. Virgin soils which are not the result of alluvial deposition are often shallow and the subsoil below them is often inadequately weathered and lacking organic matter and plant nutrients. Furthermore, most new development areas are sparsely populated and labour to cultivate the land must be brought in from more populous regions and provided with suitable housing and social amenities.

In circumstances such as these, overhead or sprinkler irrigation can prove to be preferable to surface methods. Land does not need to be graded so the fertile top soil is not disturbed or removed; water is carried in pipelines

right up to the sprinkler and, although there are some evaporation losses while spraying, the overall efficiency of water utilization with a sprinkler can be as high as 80% compared with efficiencies of 50% or less with many surface systems. This mechanized system of irrigation enables fields to be laid out in rectangular shapes with long uninterrupted rows facilitating maximum use of mechanized equipment for planting, weed control and harvesting. Thus, in situations where there is a limitation of available labour, overhead irrigation does permit a totally mechanized system of cultivation.

Sprinkler systems

Portable sprinkler systems using aluminium pipes were first developed in California over 50 years ago and, apart from refinements to the actual equipment, the basic principle remained unchanged for many years. It is only during the last dozen years or so that, with rapidly increasing labour costs and a demand for mechanical irrigation systems in many countries of the world, especially in Europe, Africa and the Middle East, the irrigation industry has seen a rapid acceleration of new developments designed to make irrigation a truly mechanized operation.

Development of the Dolphin sprinkler

In 1966 a farmer in the UK was faced with the problem of irrigating potatoes and sugar beet with only his family to help him. Being an inventive person he devised a machine which would apply water to the crops but at the same time use the water pressure to move itself across the field by means of a winch driven by a water motor. This system was then developed by Farrow Irrigation which became part of the Tate & Lyle Group in 1969 and is now a division of Tate & Lyle Agribusiness Ltd.

Aware of the need for a large scale irrigator for sugar cane, Farrow developed the original Dolphin to cover up to 4 ha at each run with up to 60 mm of water. There is now a range of 12 different self-propelled irrigators under the Dolphin brand name which can be equipped with sectoring rain guns or booms with sprinklers for fragile soils and row crop work. Farrow pioneered the use of self-propelled irrigation equipment in the UK, several European countries and many parts of Africa and the Middle East. Dolphins are now in use in more than 30 countries throughout the world and have proved to be reliable and suitable for the most arduous tropical conditions.

As the self-propelled machine pulls itself across the field it is supplied with water through a flexible hose which is easily coiled on to a tractor-mounted hose reel at the end of the irrigation run, for transport and laying out again in its next position. After each irrigation, nothing remains in the field to obstruct mechanical cultivation or harvesting operations, and the whole system can be operated by a tractor driver before and after his normal day's work. The irrigator can operate unattended for up to 23 hours per day.

Within Europe there is another type of machine which pulls a single rain gun mounted on a sledge across a field by coiling onto a huge drum a length of polyethylene piping. In tropical countries there are limitations to the suitability of this equipment and the sledge unit cannot be fitted with the boom and sprinkler alternatives.

The self-propelled irrigator is very flexible in its application and very easily transported from one crop area to another. However, for projects where there is a large uninterrupted land area free of obstacles and growing a single crop, one must look again to developments within the US where the areas irrigated by centre-pivot irrigators have expanded rapidly during the past seven years.

A 75 million gallons/day pumping station for an Ivory Coast cane estate

The centre-pivot is a large boom approximately 400 metres long which rotates around a central supply point using a series of wheeled towers supporting spans of piping which carry the sprinklers. It is usual to irrigate a circle of approximately 50 hectares and the rotation speed can be regulated to provide irrigation every day or at intervals of up to 10 days. Some smaller models can be moved from field to field but it is most convenient to leave the larger models in a fixed position throughout the growing period of the crop.

On new development projects the fact that a circle is irrigated is not a serious drawback, since the circles can be "nested" in a triangular pattern to minimize the loss of land between the circles. Some manufacturers are

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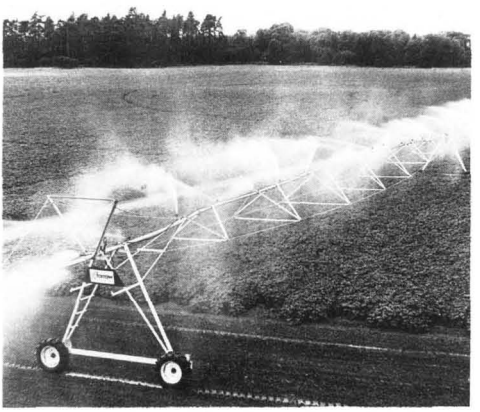
developing extensions to the booms which only operate in the corners, thereby achieving a shape nearer to a square.

It is estimated that approximately 2½ million hectares are already irrigated by centre-pivots in the USA, of which almost half are in the state of Nebraska. In the Pacific North-West states of Washington and Oregon, centre-pivots have enabled desert land to be brought under cultivation using water from the Columbia River. The Pringle centre-pivot irrigator, for which Farrow Irrigation is the world-wide marketing agent, has been developed for this area where it has to be capable of operating in conditions of blowing sand for up to 5000 hours per year. Pringle irrigators are offered in a range of systems suitable for any crop and any climate.



In sugar beet, towable units can be used so that the irrigation follows the beet crop in rotation around the farm. Centre-pivots have been used in sugar cane and are particularly appropriate where soils are shallow and frequent irrigation is desirable. Provided that good maintenance facilities are available on site, the labour requirement is virtually nil. Where the crop is expected to exceed 3.5 metres in height, a high-clearance model can be supplied and the pivot system is ideal for application of fertilizers and some plant protection chemicals.

Running costs

Energy costs, whether in the form of diesel fuel or electric power, now form a high proportion of the total operating costs of any overhead irrigation system. In the case of large rain gun systems, whether travelling or static, the saving in capital costs and labour could be offset by the extra power cost to achieve the required operating pressures. Some centre-pivot systems incorporate large sprinklers at the boom end which require all the water to be adequately pressurized for the largest sprinkler in the system but others, like the Pringle machine, are based on a number of small sprinklers closely spaced along the booms and requiring a lower operating pressure at the pivot point.

Solid-set sprinkler systems

In intensive vegetable production and for certain permanent fruit crops, vineyards, etc., a fixed sprinkler layout covering the entire land area, or "solid set" can be justified economically. By using small, low-pressure sprinklers at a low precipitation rate (less than 5 mm per hour), it is possible to maintain the crop in ideal growing conditions with the added benefit of cooling in high temperature periods. Portable solid-set equipment can also be a valuable tool in establishing seedlings of cereal or forage crops in arid conditions where soils have a fragile structure and are liable to erosion by wind or heavy applications of water.

A more economical variation on this theme is now being used in sugar cane plantations. Known as "semi-solid set", it involves a lateral pipe laid down a trace every 60 metres. Valved outlets are located every 18 metres along the lateral, and for every 4 outlets there is one sprinkler on a self-supporting tripod, with 20 metres of flexible hose. Thus each sprinkler operates from 3 positions out of each valved outlet, or 12 positions altogether. On shallow soils, sprinklers are moved every 6 hours, achieving a cycle every 3 days, and on deeper soils the set is for 12 hours, with a cycle of 6 days. The system will be appreciated from the diagram which shows a typical layout for a semi-solid set.

Much has been written about trickle or drip irrigation; if properly designed this system should apply to the crop only that quantity of water which it uses, with minimum losses by evaporation and by percolation. But, for sugar crops, the water used should be no different from that used by any other irrigation system. Certainly saline water has been used on certain crops through a trickle system but it is essential that adequate drainage is also provided and that the soil be leached frequently to prevent an accumulation of salts in the surface layers.

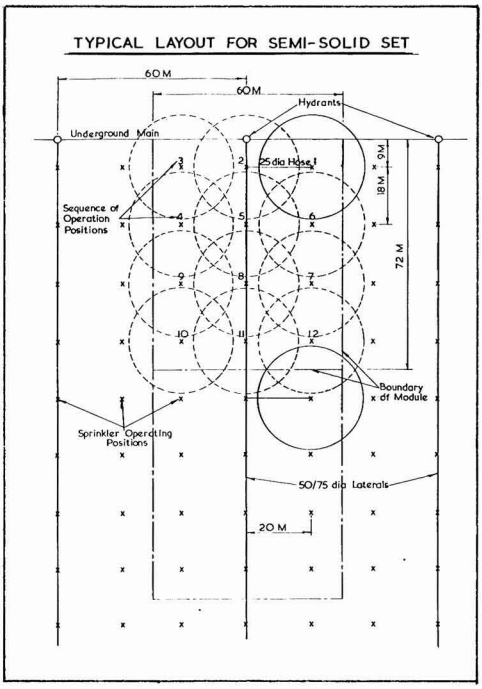
The capital cost of a trickle system depends primarily on the spacing between crop rows; the most economical costs apply to widely-spaced tree crops such as apples, oranges or palms. Since the water is applied through very

EXTRACT FROM A STUDY OF A TYPICAL NEW SUGAR CANE PROJECT IN AFRICA

Comparative costs of alternative irrigation systems in US Dollars

System	Capital cost per ha *	Annual costs/ha			
		Depreciation charge	Operating cost	Interest on capital	TOTAL
Single movable line 2 x 10 hours	4,275	160	492	192	844
Double movable line	3,000	131	285	134	550
Single movable line 1 x 22 hours	2,920	119	280	131	530
Travelling rain gun	2,640	144	249	119	512
Semi-solid set	3,055	166	222	137	525

* Includes cost of housing for operators.



small orifices at low pressure, adequate filtration is essential and allowances must be made for all rise and fall in land level. With sugar crops destruction of the tubing during harvesting operations must be accepted or the location of the tubing sufficiently deep that it is not damaged, when its capability of providing the required amount of water is affected.

Looking to the future in sugar crops, there is no doubt that irrigation systems will become more automated and related to the actual demand of the crop with a view to getting the maximum benefit from available land, water and people.

Summary

A survey is presented of new developments in irrigation of sugar beet and cane, and comparison is made of various techniques.

La pluie artificielle: récents développements dans la technique d'irrigation

On passe en revue des récents développements dans l'irrigation de la betterave sucrière et de la canne à sucre, et fait comparaison entre les méthodes variées.

Künstliches Regen: neue Entwicklungen auf dem Gebiet der Bewässerungstechnik

Ein Überblick über neue Entwicklungen auf dem Gebiet der Bewässerung von Zuckerrüben und -Rohr wird dargestellt, und verschiedene Methoden werden verglichen.

Lluvia fabricada: nuevos adelantos en técnicas de regadío

Se presenta un examen de desarrollo reciente en regadío de remolacha y caña de azúcar, y varias técnicas se comparan.

Correspondence

To the Editor,
International Sugar Journal

Dear Sir,

E.R.H. and ICUMSA

With the advent of bulk handling and storage of sugar in the late 1940's, troubles were experienced and it became evident that atmospheric humidity was a potent influence. In a paper read in 1950 I wrote "We have found the most convenient way of referring to these (vapour) pressures as the relative humidity of the air which is in equilibrium with the sugar or solution.....". I had emphasized that moisture changes were due to the influence of the difference in vapour pressure between the surface of the sugar in storage and the atmosphere in contact with that surface; only later did I realise that, by definition*, the term relative humidity, or R.H., long accepted as a measure of the moisture content of air or any gas, could not be applied to a solid.

In a paper published in 1951 I recorded my findings under the title "Introducing the equilibrium relative humidity of sugar". At the next ICUMSA meeting I learned that American friends were thinking on the same lines but were using the term Equivalent Relative Humidity. Fortunately the initials are the same and we agreed to adopt "E.R.H." and this term has been familiar for many years; for those who understand the physical facts it cannot be faulted.

It has been emphasized recently that ICUMSA is concerned with analytical aspects, and analytical methods of assessing the E.R.H. of a sugar all imply the separation of air from an adequate body of the sugar in question and assessing the R.H. *of that air*.

Relative humidity can only apply to a gas and only by ignoring standard definitions can it be applied to or adopted for any solid. To me, therefore, the first Recommendation†, adopted at the 1978 ICUMSA Session in Montreal[1], is totally unacceptable.

The Referee for any subject is chosen as one who has earned what is a responsible duty, namely, to formulate recommendations to be accepted world-wide. The scientist, even more than most, should ensure, to the best of his ability, that he adheres to correct terminology, and this is surely highly desirable in this, one of the world's major industries. I would request the International Committee to give thought to the desirability of retaining this erroneous term as part of ICUMSA's official vocabulary.

Yours faithfully
HAROLD E.C. POWERS

34 Wordsworth Ave.,
South Woodford,
London, E18 2HE,
England.

[*Perhaps Relative Humidity Equivalent or R.H.E. might meet the objection. – Ed.*]

* The Oxford Dictionary, also "Handbook of Chemistry & Physics", 21st Edition.

† "The relative humidity of air in contact with a sample of sugar shall be referred to as the sugar's Relative Humidity(RH)".

[1] *Proceedings 17th Session ICUMSA*, 1978, 328.

A fresh look at Rillieux's principles

By Dr. S. K. GHOSH
(National Sugar Institute, Kanpur, India)

Norbert Rillieux is credited with the enunciation of three broad principles that are generally referred to by his name and which govern the operation of multiple-effect evaporators. The first two principles relate to economy in the consumption of steam while the third is concerned with the extraction of incondensables.

The first of the principles lays down that, in a multiple-effect evaporator, the total evaporation remaining constant, the consumption of steam decreases as the number of effects in the series is increased. This is the basic reason for increasing the number of effects until an economically viable limit is reached. In other words, two underlying aspects are inherent in the first principle: the first, that the greater the number of effects the lower is the steam consumption – *i.e.* the greater is the steam economy – and the second, that the limit to the number of effects is set by the need for economic viability. The total annual cost (X) of operating the multiple-effect evaporator may be expressed in the form of an equation[1] as follows, the symbols used being recorded under "Nomenclature" at the end of this paper.

$$X = nPF + nM + \frac{Q}{n}DC + kT\left(n - 2 + \frac{2}{k}\right)\frac{D}{R} + Y \quad .. .. .. (1)$$

On differentiating with respect of n and equating to zero, to solve for minimum cost, equation (1) gives the following expression for the optimum number of effects beyond which the overall economy begins to decline:

$$n_{opt} = \sqrt{\frac{QDC}{PF + M + kTD/R}} \quad .. .. (2)$$

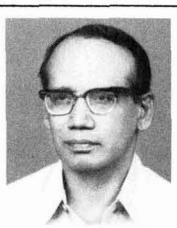
The second of the Rillieux principles stipulates that, when vapour is withdrawn from any effect in the evaporator set for use in place of steam in the process or in any other heating or boiling equipment, the resulting saving of steam is equal to the amount replaced multiplied by the location in sequence of the effect from which the vapour has been withdrawn and divided by the total number of effects in the set. This may be conveniently expressed in the form of equation (3).

$$\triangle S = \frac{m}{n}b \quad .. .. (3)$$

When $m = n$, *i.e.* bleeding is from the last effect,

$$\triangle S = b \quad .. .. (4)$$

This explains the effort of plant operators (a) to bleed the maximum quantity of vapour to replace steam in other equipment and (b) to bleed from the body closest to the last effect. Steam saving is maximum when the last body vapour is used in the process.



Dr. S. K. Ghosh

The two principles have been so universally accepted as the key to steam economy that the fact that they are relevant and true only for a particular system of working and cease to be applicable if the particular system is changed has seldom been appreciated. The principles are valid so long as the multiple-effect evaporator discharges its final vapours into a condensing system – say a barometric or multi-jet condenser – where the cooling water, after condensing the vapours, carries away the heat from the system. Alternatives to this particular system of operation are rare, so that, for plant technicians familiar mostly with the conventional set-up, the two principles as enunciated by Rillieux have ruled almost as axiomatic truth.

However, the two principles will not hold if, for example, the entire final vapour from the last body, instead of exhausting its heat content in the usual condensing apparatus, is led to other heating and boiling equipment for use there in place of steam. Although at present such a system is almost non-existent in the cane sugar industry, the possibility of its functioning has been examined earlier by the author[2].

The consumption of low-pressure steam in sugar manufacture, *i.e.* exhaust steam from the prime movers, supplemented by live steam, is mainly at the juice heaters, evaporators and pans. When the manufacturing process is arranged to follow a particular pattern, the heat demands of juice heaters and pans generally become stabilized at more or less constant values. The steam consumption of evaporators, on the other hand, varies over a wide range depending upon the particular set-up. It follows that an economy in process steam consumption can more readily be effected by the reduction of steam demand for the evaporation process. The variables that need to be considered in determining the steam consumption of the evaporators for a given evaporation load E and the number of effects n, the amount of bled vapour b, and the location m of the body from which vapour is bled.

The low pressure steam S for the process being consumed mainly in the evaporators (S_e), juice heaters (S_h) and pans (S_p), one can write

$$S = S_e + S_h + S_p \quad .. .. (5)$$

Putting $B = S_h + S_p$ since these are fairly constant, and since

$S_e = \frac{E}{n}$, we have

$$S = \frac{E}{n} + B \quad .. .. (6)$$

If b is the amount of vapour bled from body m for use in juice heaters and pans, equation (6) modifies to

$$S = f\ (m,n,b) = \left[\left(\frac{E}{n} - \frac{mb}{n}\right)\right] + b \quad + (B - b) \quad .. .. (7)$$

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[1] Ghosh: *Maharashtra Sugar*, 1979, **4**, (8), 17-20.
[2] Rao & Ghosh: *Proc. 16th Congr. ISSCT*, 1977, 2329-2346.

Steam economy is the primary objective of multiple-effect evaporation, so that it is necessary to obtain the critical values of the variables involved in function (7) for the minima/maxima by obtaining the first partial derivatives and equating them to zero; one then gets

$$f_n\ (m,b,n) = -\left(\frac{E - mb}{n^2}\right) = 0 \quad \ldots\ \ldots\ \ldots\ \ldots\ (8)$$

$$f_m\ (m,b,n) = -\ \frac{b}{n} = 0 \quad \ldots\ \ldots\ \ldots\ \ldots\ (9)$$

$$f_b\ (m,b,n) = -\ \frac{m}{n} + 1 - 1 = 0 \ldots\ \ldots\ \ldots\ \ldots\ (10)$$

From functions (8), (9) and (10) one obtains

$$-\frac{E}{n^2} + \frac{mb}{n^2} - \frac{b}{n} - \frac{m}{n} = 0$$

which can be grouped in two ways:

$$\left(\frac{E}{n^2} + \frac{m}{n}\right) + \left(\frac{b}{n} - \frac{mb}{n^2}\right) = 0 \quad \ldots\ \ldots\ \ldots\ (11a)$$

and $$\left(\frac{E}{n^2} - \frac{mb}{n^2}\right) + \left(\frac{b}{n} + \frac{m}{n}\right) = 0 \quad \ldots\ \ldots\ \ldots\ (11b)$$

The first leads to the critical relation

$$m = n \quad \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ (12a)$$

and the second to

$$E = mb \quad \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ (12b)$$

Combining both, we have

$$E = nb$$

or $$\frac{E}{b} = n \quad \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ (13)$$

The second order partial derivative of (8)

$$f_{nn}\ (m,b,n) = \frac{2\,(E - mb)}{n^3}$$

being positive and other derivatives not being negative, the critical values as at (12a) and (12b) are for minimum consumption of steam. Using these values of E and m in equation (7), one gets

$$S_{min} = \frac{(bn - bn)}{n} + b + (B - b)$$

$$= B \quad \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ \ldots\ (14)$$

In other words, the minimum level of steam consumption in the process works out to the constant value B (*i.e.* the steam demand of the juice heaters and pans), irrespective of the number of effects in the set or the amount of vapour bled or the location of the body in the set from which vapour is bled, so long as the critical conditions, as determined by (12a) and (12b), are obeyed. Thus, the minimum steam consumption S_{min}, which reduces to the constant value B, remains unaffected by any increase in the amount of bleeding b or change in the number of effects n or location m of the body from which bleeding occurs — all at complete variance with Rillieux's principles — so long as the critical relationships between E, b, m and n are maintained as stipulated by (12) and 13).

What do the critical relationships $m = n$ and $E = mb = nb$ signify? First, they indicate that evaporation E has to be entirely accounted for in the bleeding of vapours for use in the process and, since n also refers to the last body, there is no scope for any condenser as in the usual system. Second, the relation $m = n$ signifies that m and n lose their individual identity and m has no separate relevance. Under conditions set by the relationships (12) and (13), the body m from which vapour is bled becomes the last body for that portion of the cumulative evaporation which is involved in this particular arrangement. For example, if b_1, b_2, b_3 ... b_m, ... b_n are the amounts of vapour bled from effects 1, 2, 3, ... m, ... n, then the corresponding cumulative evaporations E_1, E_2, E_3, ..E_m, ..E_n for each of the aforesaid bleedings could be expressed as:

$$E_1 = b_1$$
$$E_2 = 2b_2$$
$$E_3 = 3b_3$$
$$\ldots\ldots\ldots$$
$$E_m = mb_m$$
$$\ldots\ldots\ldots$$

and $E = \Sigma E_1, E_2, E_3 \ldots E_m, \ldots E_n = \Sigma b_1, 2b_2, 3b_3 \ldots mb_m, \ldots nb_n$.

Since all the above are in accord individually with the critical relationships (12a) and (13) for minimum steam consumption, it is obvious that bleeding from any intermediate body, irrespective of its location in the set, will have no effect on the final result, expressed by equation (14), so long as the entire evaporation E is covered by the individual bleedings from all bodies including the last. This again is at variance with the generalized enunciation of Rillieux's principles.

But although b and n do not affect the minimum steam consumption B so long as they are bound by the critical relationships (12) and (13), they have a bearing on another aspect of the overall economy. In the relationship (13), $E/b = n$, with E remaining constant, n decreases as b increases. Larger values of b will then become conducive to lower first cost because, with Δt remaining the same, the size of heating surface of each effect remains invariable. Since the value of b can vary from a minimum of zero to a maximum of B, the condition for the minimum number of effects, and consequently the lowest capital cost without affecting achievement of minimum steam consumption, is given by

$$n = \frac{E}{b} \qquad (b \rightarrow B)$$

So long as n is obtained as a whole number, it indicates that the evaporations and consequently the heating surfaces of each effect are all equal and that the vapours are withdrawn entirely for process heating and only from the last effect, implying the set to be a straight, non-bleeding one. Where n is not a whole number, however, the evaporations, as also the heating surfaces, are not equally distributed among the effects and the fraction value refers to the evaporation and also the heating surface of the last effect. All these are suitably exemplified in Table I.

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Table I. Assumptions: E = 75% on cane, B = 30% on cane						
For b =	37.5	30	25	19	15	12.5
S_{min}	30	30	30	30	30	30
n	2	2.5	3	4	5	6

It is apparent that the first value for n is not possible because b cannot exceed B. Since the next value for n is not a whole number, this indicates unequal evaporation amounts and heating surfaces, and implies bleeding of vapours from intermediate effects (in this particular case 15% from the 2nd effect). The distribution of evaporation in this particular case could be 1st body – 30% on cane, 2nd body – 30%, 3rd (last) body – 15%. The lower first cost resulting from higher values of b also becomes obvious from this table.

A third principle may then be enunciated as an addendum to the two already discussed, in order to cover the entire spectrum of multiple-effect evaporation, as follows: "When the bleeding of vapours from the various effects, including the last, cumulatively accounts for the entire evaporation in the evaporator, the total steam consumption in the process, including that in the evaporator (reducing them to a minimum base value), becomes independent of the number of effects in the evaporator set, the amount of bled vapour, the location of the bleeding effects in the set and the fraction of the process steam that is replaced by vapour".

Nomenclature

B	Steam consumption in juice heaters and pans % cane
b	Amount of vapours bled % cane
C	Cost of steam per unit weight
D	Number of days worked per year
E	Evaporation load % cane
F	Depreciation plus interest on capital, %
k	Relative factor having values between 1.0 and 0.15
M	Annual cost of maintenance per body
m	Location in a set of evaporator bodies of that from which vapour is bled
n	Number of effects in the set
P	Price of each body
Q	Quantity of evaporation per day
R	Number of working days between consecutive cleanings
S	Total steam consumed in the process % cane
ΔS	Saving in steam consumption % cane
S_e	Steam consumption in the evaporator % cane
S_h	" " " " heaters % cane
S_p	" " " " pans % cane
T	Average cost per body of cleaning the last two bodies in a set
X	Total annual cost
Y	Labour and supervision cost

Summary

Rillieux's principles concerning multiple-effect evaporation have held sway ever since they were enunciated; they still do today. The merits of a greater number of effects, more extensive bleeding of vapours for process use and closer location of the bled body to the last effect, all for reducing the consumption of steam in the process, have been universally recognised; today they reign almost as axiomatic truths. The author examines in this paper if these principles are universally applicable. He finds that they hold true so long as the evaporator is discharging its final vapours to a condenser from which the heat escapes from the system. In a closed system, however, in which all vapours are inducted back into the system for complete re-use, and no heat is allowed to escape from the system, Rillieux's principles regarding the number of effects, amount of bleeding and location of the bled body are no longer directly applicable.

Un nouveau regard sur les principes de Rillieux

Les principes de Rillieux concernant l'évaporation en multiple effect se sont imposés dès leur énoncé; ils le font toujours. Les mérites d'un plus grand nombre d'effets, de prélèvements plus extensifs de vapeurs pour la fabrication et le prélèvement le plus près possible du dernier effet, tout cela pour réduire la consommation de vapeur en fabrication, ont été universellement reconnus; de nos jours ce sont devenus quasi des axiomes. Dans cet article l'auteur examine si ces principes sont d'application universelle. Il constate qu'ils restent vrais aussi longtemps que l'évaporation déverse ses vapeurs finales dans un condenseur d'où la chaleur quitte le système. Cependant, dans un système fermé, dans lequel toutes les vapeurs sont réintroduites dans le système pour etre complètement réutilisées tandis qu'on ne tolère pas de sortie de chaleur du système, les principes de Rillieux concernant le nombre d'effets, la qualité prélevée et la position du corps sur lequel on prélève ne sont plus directement applicables.

Bemerkungen zum Prinzip von Rillieux aus neuer Sicht

Das Prinzip der Mehrfachverdampfung von Rillieux wird überall angewandt, seitdem es aufgestellt wurde. Die Vorteile durch die große Anzahl von Stufen, die stärkere Entnahme der Brüden für Anwenden in Prozessen und das Stellen der Stufe, aus welcher die Brüden entnommen wird, näher der letzten Stufe dienen alle der Senkung des Dampfverbrauchs im Prozeß, was überall erkannt worden ist; heute wird dieses Prinzip fast als axiomatische Wahrheit angesehen. Der Autor prüft in diesem Artikel, ob dieses Prinzip überall anwendbar ist. Er findet, daß es so lange zutrifft, wie die Brüden der letzten Verdampfungsstufe in einen Kondensator geleitet wird, der die Wärme aus dem System abführt. Aber in einen geschlossenem System, in dem sämtliche Brüden wieder in das System für eine restlose Wiederverwendung zurückgenommen und keine Wärmeabfuhr zugelassen wird, ist das Prinzip von Rillieux in Bezug auf die Zahl der Stufen, die Höhe der Brüdenentnahme und die Stellung der Stufe, aus welcher die Brüden entnommen wird, nicht mehr direkt anwendbar.

Una mirada nueva a los principios de Rillieux

Los principios de Rillieux que conciernan evaporación a multiple-efecto han tenido dominio después de su enunciación; lo mismo es verdad hoy. Los méritos de un aumentado número de efectos, retirada más extensiva de vapor para uso en el proceso, y locación más cercana al último efecto del cuerpo de que el vapor se toma, todos para reducir el consumo de vapor en el proceso, se han reconecido universalmente; hoy se consideran como verdades axiomáticas. El autor examina en este artículo si estos principios se pueden aplicar universalmente. Establece que son válidos mientras que el evaporador descarga sus vapores finales a un condensador por que el calor escape de la sistema. Sin embargo, en una sistema cerrada, en que todos los vapores se re-inducen en la sistema para re-utilización completa y no permite escape de calor de la sistema, los principios de Rillieux respecto del número de efectos, grado de retirada y locación del cuerpo de que el vapor se retira, no son directament aplicable.

SUGAR CANE AGRONOMY

Effect of gibberellic acid on sugar cane yields. P.H. Moore. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 67-73. – While gibberellic acid (GA) generally increases cane yield, the differences in yield attributable to treatment are usually less than 10% and therefore difficult to determine accurately; either the yields of cane from 50-100 paired blocks have to be compared on a mill run basis, or the yields of individual stalks compared, although sampling of the correct tissues is necessary for the sake of accuracy. The magnitude of the increase in yield is governed by a number of factors, including variety; maximum response requires cool winter growth conditions and sufficient N and water for growth. Increase in growth resulting from treatment is not at the expense of sucrose stored in the stalk; the sucrose content in the older segments is unaffected, while that in the elongated segments is greater than in the non-elongated stalks. There is a loss in fresh weight for a few weeks after the period of GA-stimulated growth, the loss varying between tests and possibly being a major reason for variable results. Among aspects being studied further are application problems (the suggestion being that a more uniform application would improve results), the possible use of additives to increase GA effectiveness, and the possible establishment of optimum water and N applications for maximum GA effectiveness.

Effect of sugar cane plant and row spacing on growth and yield. A. Yamaguchi. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 76-80. – Experiments are reported which were aimed at developing optimum cane and sugar yields, through uniform stands and improved tillering, and reducing the amount of cane lost as a result of mechanical damage during growth, *e.g.* fractures and splits, and weak and broken tops. Orchard planting, based on a 2.25-ft row spacing and a 2-ft plant spacing, with staggered plant spacing within rows so that the plants were equidistant from one another, used the same number of setts as did conventional planting of rows 4.5 ft apart with plants 1 ft apart, but did not suffer from early plant competition as did the standard technique. However, while orchard planting increased the yield of hand-cut cane per acre by 14.6% and sugar yield by 8.4%, there were only 2.9% more stalks per acre than in plots planted by the conventional method; while tillering was increased and more stools survived mechanical damage, orchard planting did not prevent loss of cane as a result of the damage.

Tassel control in drip-irrigated fields at Wailuku Sugar Company. R. Smith. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 81-83. – A high degree of flowering occurs in the fields in question, but withholding of irrigation water and application of Diquat herbicide have proved effective as control means, although they have been restricted to only some of the fields for reasons which are stated. Tests were therefore conducted on control of flowering by withholding drip irrigation water. This reduced flowering to 2.3% of cane stalks, compared with 36.1% in the untreated control and 10.2% when Diquat was applied. The drying-off effect of water restriction gave a cane yield per acre which was slightly lower than the control, but the sugar yield was higher. While no major problems were encountered with the irrigation system during the experiments, at least one field showed signs of increased rodent damage which was probably attributable to the stopping of irrigation, while ant damage is known to be more severe when a drip irrigation system is unused for long periods of time.

Legumes and grasses for erosion control in sugar cane. R.J. Joy. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 95-98. – Erosion in cane fields is serious as a result of heavy rain between harvests and when the new cane crop is closing in, and the situation has been made worse by the introduction of drip irrigation, with the resulting conversion from furrow planting to flat soil culture. After preliminary trials on planting of legumes as a ground cover crop, four were selected for further testing, *viz. Biserrula pelecinus, Lotus tenuis, Medicago hispida* and *Trifolium hirtum.* Criteria applied were low growth, rapid emergence, fast spread, early seed production and freedom from insects and diseases. The choice of legumes was based on the belief that addition of N to the soil by the cover crop would offset the competition between the legume and cane. *B. pelecinus* caused the greatest increase in cane volume by comparison with the control, while *M. hispida* was intermediate between it and *L. tenuis* which caused only very slight increase; *T. hirtum* had a negative effect on cane volume. The soil N content ($lb.acre^{-1}$) was considerably greater as a result of the cover crops, being maximum at 535 $lb.acre^{-1}$ with *B. pelecinus* compared with only 50 $lb.acre^{-1}$ in the control. Mention is made of a grass, *Paspalum hieronymii*, which has proved of great value for erosion control along towpaths and waterways.

Spectacular cane yield responses in sub-surface drainage trials. D.R. Ridge. *Cane Growers' Quarterly Bull.*, 1978, **42**, 32-33. – Yield losses caused by waterlogging have become more evident in the northern wet belt of Queensland where poorly drained areas have been adopted for cane growing; these areas have water tables less than 0.5 m below the soil surface for up to 180 days between December and June. However, drainage experiments, with corrugated plastic piping placed at a depth of 1.2 m and leading to a sump from which water was pumped to a shallow surface drain to maintain the water table constant, have demonstrated the possibility of substantial increases in yield, even where only moderate waterlogging occurred. The results for three varieties were increases of 32.2, 22.3 and 19.00 tonnes. ha^{-1} on yields which, under undrained conditions, were 70.5, 76.8 and 82.8 $tonnes.ha^{-1}$, respectively. Where there are no natural outlets for the disposal of drainage water, the scheme mentioned above can be used, or group drainage schemes can be formed and underground pipes led into deep, open drains.

Underground drainage – an investment in wet districts. P. J. Nielsen. *Cane Growers' Quarterly Bull.*, 1978, **42**, 34-35. – The benefits of underground drainage in cane fields are indicated, and advice is given on installation of piping and devising a suitable drainage scheme. The costs are mentioned, and it is shown that typical results obtained with underground schemes will allow the value of the increased cane yield to outweigh the installation costs by a very wide margin. While open drains are

cheaper to build and have a larger capacity and usually a faster draining action than underground pipes, they must be kept free of weeds and can suffer from collapse of the banks, while also occupying land that cannot be used for anything else. A combination of underground pipes and open drains is often an economical answer.

Side effects of drought. P. R. Downs. *Cane Growers' Quarterly Bull.*, 1978, **42**, 36-37. — The main effect of drought on cane is a fall in yield, but there are secondary losses caused by the actions of pests and diseases which are greater as a result of the dry conditions. The author lists various pests and diseases and indicates how their activities can contribute to the already poor state of the cane. The effect of drought on certain soil and plant characteristics is also briefly mentioned.

New system lays drainage pipe in minutes. L. K. Izatt. *Cane Growers' Quarterly Bull.*, 1978, **42**, 38. — A brief description is given of the Sanko Pipe Master which can lay a 100-m length of plastic drainage piping in two minutes. The piping is supplied in a 100-m rolls of flat, perforated polyethylene sheet which is converted into 50-m lock-seamed piping as it is drawn through the machine by forward movement of a conventional mole plough fitted with a smear-wall bullet to which the pipe is attached by a pin-type connector.

Why risk soil erosion? D. V. Calcino. *Cane Growers' Quarterly Bull.*, 1978, **42**, 39. — Factors influencing soil erosion by rainfall are briefly indicated, and a list is presented of measures for erosion control.

The Woongoolba Flood Mitigation Scheme. G. R. Cullen and C. R. Henkel. *Cane Growers' Quarterly Bull.*, 1978, **42**, 40-45. — Photographs are presented of various aspects of the title scheme which has permitted development of 800 ha of new caneland in Queensland as well as improvement of quality and productive capacity of the existing assigned area. Some swamps that had previously held water for most of the year now produce cane crops yielding more than 95 tonnes.ha^{-1}

Poor water penetration — is it a problem? L. G. W. Tilley. *Cane Growers' Quarterly Bull.*, 1978, **42**, 51-52. — It is stated that many cane growers spend large sums of money on energy to pump irrigation water only to see much of the energy lost in the form of water flowing down drains as a result of poor water penetration. The problem is a complex one caused by a number of inter-related factors, the more common of which are discussed in turn, *viz.* soil type, organic matter content, soil crusting as a result of exposure to water (thus creating a seal), cultivation and water quality. Possible remedial measures are discussed.

Itch grass reappears in the Burdekin district. I. T. Freshwater. *Cane Growers' Quarterly Bull.*, 1978, **42**, 55. Itch grass *(Rottboellia exaltata)* is a vigorous annual, often reaching a height of 3 m or more; its long, brittle hairs on the leaf sheaths cause irritation to the human skin. In 1978, a number of cane fields in the Ayr district of Queensland were heavily infested with the weed; until suitable herbicides have been found, the best means of control are fallowing of heavily infested fields followed by regular cultivation to destroy the itch grass seedlings, and efficient cultivation of cane fields, with the last cultivation left as late as possible before the cane canopy closes in (to prevent new seedlings germinating), followed by regular inspection.

Studies on the effect of soil moisture regimes and fertilizer levels on spring-planted sugar cane grown pure and inter-cropped with moong. K. S. Parashar, C. S. Saraf and R. P. Sharma. *Indian Sugar*, 1978, **28**, 253-261. Trials were made with two soil moisture regimes for irrigation and four fertilizer programmes on cane grown alone and with moong as an intercrop. Highest yields of cane were obtained in the treatment with the highest amount of nitrogen (120 kg.ha^{-1}) irrespective of phosphate fertilizer level or intercropping. The more frequent irrigation at shallower depth was also beneficial to yield. Yield of moong was not affected by fertilizer or irrigation programme and usefully increased the cash return.

Deterioration of piled frost-affected cane. F. A. Fogliata and C. A. Gargiulo. *La Ind. Azuc.*, 1978, **85**, 276-279, 296-303 *(Spanish)*. — In 25 tables are presented data concerning the loss of sucrose or pol and increase in non-sucrose in two varieties over a period of up to 10 days from a frost, for two periods in 1975 when the post-freeze temperatures were low and high, respectively. Comparisons are made with cane processed immediately after the frost. The data quantify the loss of water by evaporation from the cut and piled cane and the increases in reducing sugars and soluble solids with decrease in the extracted juice. The resulting fall in cane quality and reduction in recoverable sugar is thus demonstrated.

Studies on the effect of different levels of press mud cake with various levels of nitrogen on yield and quality of sugar cane (Co 740). V. D. Patil, C. D. Salunkhe, J. P. Patil and A. G. Shinde. *Maharashtra Sugar*, 1978, **4**, (1), 187-189. — Results from trials with different levels of filter cake (5-20 tonnes.ha^{-1}) and nitrogen fertilizer (175-325 kg.ha^{-1} N) at Kolhapur, India, in 1971/74 are tabulated and show that 15 tonnes.ha^{-1} of filter cake plus 250 kg or 325 kg N per ha gave highest cane and ccs yields.

Sugar cane production in Uttar Pradesh: review of problems and prospects. H. L. Kulkarny. *Maharashtra Sugar*, 1978, **4**, (1), 211-214. — Sugar cane production in the 1977/78 season in Uttar Pradesh reached a record level, but this was through an uncontrolled extension of the cane area rather than by planned productivity increase. Instability of production and low yields are characteristic of the state, and causal factors for this, and their remedies, are discussed under the headings: seed, role of sugar cane varieties, use of adequate and balanced fertilizers, planting programmes and time of planting, management of ratoon cane, and water management. Adoption of the recommendations made would, it is suggested, raise yields from the present 53 to 70 tonnes.ha^{-1}.

Is earthing-up necessary for adsali sugar cane? J. D. Chougule and B. R. Patil. *Maharashtra Sugar*, 1978, **4**, (1), 215-218. — Trials were carried out in two seasons on the effects of earthing-up manually and by bullock-power of adsali cane (18-month crop planted in summer and harvested in winter). It was found that number, height and weight of millable canes were all reduced by earthing-up by comparison with the control.

Destun, Dual and Velpar — three new herbicides for the sugar industry. P. E. T. Turner. *S. African Sugar J.*, 1978, **62**, 463-469. — See *I.S.J.* 1979, **81**, 339.

Effect of post-harvest handling on the industrial quality of burnt cane. F. A. Fogliata and C. A. Gargiulo. *Bol. Est. Exp. Agríc. Tucumán*, 1978, (127), 1-23 *(Spanish)*. Burnt cane was treated in three ways: left standing, topped and windrowed, and windrowed without topping. The experiments were carried out in September over a 10-day period with a temperature around 17°C and then repeated in October at a temperature of about 23°. There was little difference between the two varieties studied, but the rates of deterioration were higher in October than in September. If it is not possible to crush the cane immediately after burning, it is better to leave it standing than to cut and windrow it.

Burnt cane: a revision on its behaviour and characteristics. F. A. Fogliata. *Bol. Est. Exp. Agríc. Tucumán*, 1978, (128), 1-32 *(Spanish)*. — Further trials on the deterioration of burnt cane (see previous abstract) were contradictory in that in one case it was found better to leave the cane standing and in another to cut and windrow. It is thus necessary to carry out trials in each area in order to determine the best procedure.

Tolerance to Dalapon (sodium 2,2-dichloropropionate) of different cane varieties cultivated in Argentina. R. P. Cossio, N. Vázquez R. and C. A. Gargiulo. *Rev. Ind. Agríc. Tucumán*, 1978, **55**, (1), 1-11 *(Spanish)*. Greenhouse and field trials were conducted on the resistance of cane varieties to Dalapon. After immersion in a 0.67% solution of an 85% preparation, the sprouting of buds of NA 56-62 cane was delayed while that of the other four varieties studied was almost completely inhibited. Analyses were made of the internode lengths, diameter and stalk weight of cane treated at a rate of 4 kg a.i. per ha, and sensitivity to the herbicide was greatest in the variety Tuc.68-18, followed by NA 56-79, Tuc.28-19, CP 48-103 and NA 56-62 in reducing order.

Effect of Cycocel on the "ripening" of sugar cane. N. Vega O. *Bol. Est. Exp. Occidente* (Venezuela), 1971, (93), 3-32 *(Spanish)*. — An account is given of trials on the application of Cycocel (2-chloroethyl trimethyl ammonium chloride) on sugar cane of varieties B 4362 and B 49119. Application of 8 litres.ha^{-1} of a 50% w/v solution was found to increase both juice purity and Brix in both varieties up to 61 days from application, after which the Brix started to fall. Application between 55 and 61 days before harvest appears to be optimum.

Effect of methyl 3,6-dichloro-*o*-anisoate on "ripening". N. Vega O. *Bol. Est. Exp. Occidente* (Venezuela), 1971, (93), 33-72 *(Spanish)*. — Application of 1.112 litres.ha^{-1} of the title chemical (sold as Racuza 4EC) at the start of ripening produced an increase in the purity and sugar content of cane juice. Application of 1.668 litres.ha^{-1} produced very low purities and sugar recovery figures. Treatment did not inhibit cane deterioration after harvest.

Deterioration of sugar cane after cutting. L. H. Sigala V. *Bol. Est. Exp. Occidente* (Venezuela), 1971, (93), 73-103 *(Spanish)*. — Studies have shown that the quality of cane before cutting is the most important factor in obtaining a good yield and that the supply of water is the factor most easily controlled in achieving this quality. Under the conditions studied, losses in cane weight were 1.20-1.50% per day after cutting, and this interval should be as short as possible to ensure the maximum quality which benefits both grower and miller. The sucrose:reducing sugars ratio appears to be a good index of cane ripeness.

Herbicide trials in sugar cane. N. Vega O. and L. A. Jiménez. *Bol. Est. Exp. Occidente* (Venezuela), 1971, (94), 3-37 *(Spanish)*. — In trials with a total of 14 herbicides it was found that post-emergence application of a mixture of 0.7 litre.ha^{-1} a.i. of Actril-D and 3.0 litres.ha^{-1} a.i. of Asulox gave acceptable control of weeds up to canopy establishment although higher rates affected the cane. Pesco C, however at 4.62 kg.ha^{-1} a.i. was not adequate. Afalon and Tunic were more effective with broad-leafed weeds than grasses, while no herbicide controlled *Cyperus rotundus, Ceratosanthes palmata* or *Portulaca oleracea.*

Action of sugar cane nutrients. G. Segura L. *Bol. Est. Exp. Occidente* (Venezuela), 1971, (94), 39-83 *(Spanish)*. Four levels of N, P and K were applied to a clay loam soil near Yaritagua having a high K but low N and P content. The P and N applications brought positive response as expected, but K was also effective in raising cane yield.

Effect of nitrogen, phosphorus and potassium on the yield of sugar cane. E. Martínez M., G. Seguro L. and J. J. Villasmil. *Bol. Est. Exp. Occidente* (Venezuela), 1972, (96), 3-28 *(Spanish)*. — An account is given of trials with nil and three levels each of N, P and K in three experiments on different soils, and preliminary results are reported, which require a more detailed economic analysis.

Effect of irrigation on the development and production of cane. L. H. Sigala V. *Bol. Est. Exp. Occidente* (Venezuela), 1972, (97), 3-28 *(Spanish)*. — An appreciable effect was found in irrigation studies, the greatest supply of water increasing cane tonnage without detriment to cane quality. Appropriate irrigation gives a longer cane with more internodes. Moderate drought reduces the size of the stalks of plant cane; with ratoons, the size and number of stalks are reduced, this effect continuing into the following ratoon crop. Ratoons are more sensitive to drought than plant cane. The best treatment used 7 mm of water daily during the dry period from January to April, equivalent to evaporation from a Class A pan.

Effect of three systems of planting on the development and production of sugar cane. L. H. Sigala V. *Bol. Est. Exp. Occidente* (Venezuela), 1973, (99), 3-14 *(Spanish)*. In Venezuela, cane is normally planted in furrows 1.4 m apart, and this was compared with planting in furrows 0.7 m apart and in double furrows 0.8 m apart and separated from the next double furrow by 2 m. Planting at furrow intervals of 0.7 m gave a higher cane and sugar yield for both varieties studied, yields from the other two systems being about the same. Other considerations affecting the economics of the system are also discussed.

Effect of the size and position of the bud on the germination of sugar cane. A. Segovia. *Bol. Est. Exp. Occidente* (Venezuela), 1974, (102), 3-21 *(Spanish)*. — The effects of the size of the cuttings and the position of the buds in relation to the furrow on the germination, budding and growth of sugar cane were studied. It was observed that the bigger cuttings with buds either uppermost or on the side gave better results. The billet should include at least half an internode per bud.

CANE SUGAR MANUFACTURE

Elements of optimization in the sugar house. R. Pouchayret. *Paper presented at 2nd Intern.Congr. ARTAS* (Réunion), 1978, 18 pp *(French).* – Optimization of sugar house processes by choice of boiling scheme suited to given conditions, by greater use of available laboratory instruments to obtain information on massecuite parameters and by promulgating such information, and by appropriate training of personnel is discussed.

On-line purity measurement in the sugar factory. J.C. Obert. *Paper presented at 2nd Intern.Congr.ARTAS* (Réunion), 12 pp *(French).* – The principles of on-line measurement of purity, based on the relationship between Brix and conductivity, are explained and details given of the system such as installed in Savanna sugar factory [1,2].

Concentration. Anon. *Paper presented at 2nd Intern, Congr.ARTAS* (Réunion), 1978, 7 pp *(French).* – While there are major advantages in concentrating cane processing in large, centrally situated factories rather than in a number of smaller factories, there is one serious drawback, *viz.* the increase in costs of cane transport resulting from the greater distances to be covered from the fields to the centralized unit. The economic pros and cons of concentration are discussed.

Sugar terminal of the port of Maceió. Anon. *Brasil Açuc.*, 1978, **92**, 14-19 *(Portuguese).* – An illustrated report is presented on the new Maceió bulk sugar terminal, giving details of its capacities and costs. Reception of bulk sugar is possible at 500 tonnes.hr^{-1} by rail and 500 tonnes.hr^{-1} by road, and 200,000 tonnes may be stored in the two sections of the warehouse. Sugar may be loaded at rates of 1000 tonnes.hr^{-1} for bulk sugar and 4000 bags of 60 kg per hour, with the possibility of simultaneous loading of bulk and bagged sugar.

Unquantified sugar losses. C.E. Monteiro. *Brasil Açuc.*, 1978, **92**, 90-93 *(Portuguese).* – The author calculates losses by entrainment in evaporators by means of the condensate quantities and analyses of their sugar contents; he arrives at a figure of 229 kg per day for one São Paulo factory. He also discusses losses in cane wash water and considers them to be some 2.5% of production, which would justify examination of methods of cane treatment to eliminate washing. The loss of sugar in condensates and wash water causes pollution equivalent to a population of 15,000,000 persons in the state of São Paulo and necessitates water treatment costing 15-45 cruzeiros per person.

A simple and inexpensive evaporator entrainment separator. R. Archibald and C. Mack. *S. African Sugar J.*, 1978, **62**, 480-481. – See *I.S.J.*, 1979, **81**, 374.

Plant milling test – a tool for optimizing productivity and reducing cost. T.R. Ancheta. *Sugarland* (Philippines), 1978, **15**, (2), 8-9, 13-15, 19. – The application of the Mittal formula for calculation of whole reduced extraction to cane mill performance evaluation is explained, and details are given of the wet milling test used. A typical example is appended.

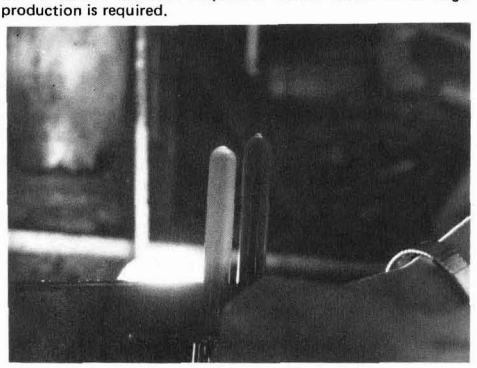
Recovery of energy from cane trash. J. Bersch. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 9-10. Reference is made to the inventory drawn up for the Hawaiian sugar industry[3], and the reasons for use of only a small proportion of the available trash are

[1] Ponant & Windal: *I.S.J.*, 1976, **78**, 375.
[2] Windal: *ibid.*
[3] Murata & Gibson: *ibid.*, 1979, **81**, 21.

The Juice Syrup Purification system

The Juice Syrup Purification (JSP) system developed by Fabcon Inc. incorporates juice pre-flocculation and syrup purification by air "micronization". Heated juice is recirculated for 60 sec with a high M.W. polymer in a specially designed combined flash tank and reaction chamber; the result is a clearer, lighter juice of higher purity. The juice enters the flash tank tangentially so that it is effectively degasified and its turbulent flow changed to laminar flow as it passes across deflecting baffles into the reaction chamber. The baffles create a swirling, rolling motion which allows the flocs to grow and come into contact with other, smaller, particles to form dense, compact units which remain intact because of the laminar flow. The juice is then drawn by syphon from the bottom of the tower and passes to the clarifier through a special loop which completely prevents turbulence or flash-back from the clarifier. (Internal baffling in the reaction chamber allows up to 20% of the clear juice to be drawn from the top and transferred directly to the evaporator supply tank.) Settling of the flocs is rapid, lime consumption is reduced, as is the pH drop from limed, mixed juice to clarified juice, while mud density is greater and more uniform. The resultant sugar has less ash, colour and moisture.

Fabfroth syrup purification is a patented process based on the fact that when air is mixed with syrup and processed so that the air particles are "pulverized" to below 1 micron, the particles are believed to take on negative surface charges similar to the negative charges of the colloidal non-sugar particles, so that both non-sugar and air particles become bridged together. Addition of high M.W. polyacrylamide polymer cements and increases the size of the particles to large agglomerates. The dilute polymer solution is dispersed in the syrup without breaking the growing agglomerates, and the resultant frothy syrup is passed into a specially designed circular clarifier where the froth floats to the top and is drawn off by vacuum pump. The froth contains about 75% of all suspended and colloidal solids in the syrup plus 5% or more soluble salts. At a retention of less than 20 minutes, a temperature of 180°F and 5-10 ppm polymer (on weight of syrup solids), decolorization is greater than with conventional means, while turbidity, viscosity and ash content are lower and the purity higher by *e.g.* more than 1 unit. For acceleration and increase of new floc formation in the syrup, up to 5 ppm Colorgone may be added as a dilute solution to the pre-flocculation tower, or 20-50 ppm (normally 30 ppm) may be added before the last evaporator effect where white sugar production is required.



discussed. The future prospects of a greater quantity being used to produce steam and power are considered in the light of increasing costs of imported oil.

Future prospects for energy from sugar cane. E.J. Lui. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 11-14. Various possible combinations of product manufacture from sugar cane are considered against the background of energy requirements and costs in Hawaii. While, at present prices of oil, electricity and yeast (as animal fodder), production of sugar and molasses plus surplus electricity for sale to the public grid is of greater value, (as expressed in equivalent barrels of oil), with a substantial increase in the cost of oil, gasoline and yeast, it would be economically more practical to produce alcohol, yeast and surplus electricity but not sugar from cane. However, it is admitted that there are a number of questions that need answering before investment in alcohol facilities is undertaken.

Planning in the face of adversity. P. E. Bouvet. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 15-17. Long-term planning in the sugar industry is discussed, with particular reference to the situation at Honokaa Sugar Co. The inadvisability of undertaking short-term panic measures when a crisis occurs is stressed; even emergency plans must be carefully thought out, even though they involve drastic steps.

Thermal principles of drying bagasse and trash. J.F.Mullen. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 21-23. – Calculation of the parameters involved in bagasse and trash drying shows that use of flue gas from a conventional boiler at a temperature below 500°F is unpractical, since such gas contains about 15% moisture by weight; at low temperatures the gas can absorb only a small quantity of extra water before it becomes completely saturated, whereas the operating, maintenance and capital costs will be disproportionately high, since the large volumes of gas needed plus the high quantities of moisture necessitate the use of large fans and motors to remove the original gas and its moisture plus the moisture added to the gas by evaporation from the bagasse. Drying with gas at 1200-1400° is extremely rapid. The moisture content is reduced to, say, 8-10%, and the dried material then mixed with wet material to reduce the overall moisture content of the mixture; since the temperature of the product does not exceed the wet bulb temperature of the gas, the product is not overheated provided some moisture remains. The cost of conveying the hot gas in special ducts has to be balanced against the reduced capital costs and costs of handling lower volumes of gas as well as reduced fan power.

Sulphitation at Puna Sugar Company. F. G. Kennedy. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 24-25. – After installation of a Silver Ring Diffuser at Puna Sugar Co. in 1969, raw sugar colour content gradually rose to a peak of 22.1 units in 1973, and thereafter continued to be much higher than the standard range. Reasons given include the processing of all the cane trash in the diffuser and high diffusion temperatures and residence times. The processing of trash was necessitated by the high fuel needs of newly installed power generation plant. After changes in boiling house practices had met with only partial success in remedying the situation and the factory had been heavily penalized for the high sugar colour, sulphitation tests were carried out; these were sufficiently encouraging to warrant installing a permanent liquid SO_2 station for sulphitation at the diffuser. Installation and operating costs are indicated. Problems of liquid SO_2 supply could be solved by installing a sulphur burner, but the capital costs of such equipment are high.

1977 juice sulphitation tests at Puna Sugar Company. K. Onna and G. E. Sloane. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 26-28. – In the tests, approx. half of the juice from the diffuser juice tank was pumped to one of two liming tanks and then recirculated to the diffuser tank; the other half passed directly to the boiling house. The smaller of the two liming tanks was used to adjust the pH to 7.5-8.0 with a 3:2 CaO:MgO mixture; the other tank was used for sulphitation to 9.5-10.0. Results showed that the raw sugar colour was reduced by 46% compared with the level when no sulphitation was used. The colour of refined sugar produced from the raw sugar at Crockett was about 35% lower than without sulphitation at Puna; raw sugar filtrability was also improved by sulphitation, which also reduced molasses purity and increased sugar recovery. Boiling was also improved.

Maintenance programme at Puunene mill. A. Coelho. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 29-30. – Information is given on the maintenance programme as well as the techniques and equipment used.

Electrical energy conservation in factories. W. H. Raupp. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 31-35. – A survey showed that of over 700 motors used at the two Hawaiian Commercial & Sugar Co. factories, about 100 were underloaded and could be replaced with ones more nearly matching the load, thus permitting energy savings. The monetary savings resulting from replacement of a bagasse conveyor 75-hp motor with a 40-hp motor are calculated. The possibility of eliminating certain motors altogether is considered; currently under study is the possibility of replacing a 350-hp motor with a turbine drive. Also discussed is the power saving resulting from replacement of incandescent lighting with a more efficient form. Eddy current coupling drives installed on conveyors for variable speed control are highly inefficient at low speeds, where most of the energy is wasted in the form of heat; installation of a variable-frequency drive on a conveyor during the 1978-79 off-season was expected to give marked energy savings and will also have other advantages.

Scope of higher pressure boilers in Indian sugar factories. S. K. Ghosh. *Maharashtra Sugar*, 1978, **4**, (1), 203-208. Changes in the pattern of steam conditions resulting from the adoption of turbines as prime movers in place of steam engines are considered and the importance of the efficiency of steam generation stations emphasized, with reference to the bagasse moisture content, reduction of excess air and use of economizers and air preheaters. The use of higher pressure boilers is only relevant in respect of reduction of steam consumption, *e.g.* for saving of bagasse for use other than as boiler fuel, or where it is intended to produce power for sale to the public grid. The former requires an established demand for bagasse since bagasse is a nuisance to handle and store and presents a fire hazard. In the latter case, considerable problems arise in regard to the specifications of machinery and plant to be installed, etc.

BEET SUGAR MANUFACTURE

The Jarmen-system molasses weigher. P. V. Schmidt and L. Kumpfert. *Lebensmittelind.*, 1978, **25**, 509-510 *(German)*. – Until now, establishment of an accurate factory balance in the East German sugar industry has been made difficult by the absence of a suitable molasses weigher; reliance has had to be placed on fortnightly determination of Brix from the dry solids content and tank levels. A new system, tested at Jarmen, is described which uses a load cell to measure the weight of molasses fed batchwise from a header tank. Valve controls linked to the load cell ensure a constant quantity of molasses based on a maximum weight for the filled weigher tank and a minimum weight for the tank when emptied. Weighing accuracy is ± 0.05% compared with a permissible ± 1.5%.

Use of the Remat 20 in examination of technical sucrose solutions. E. Junghans, H. G. Uhlitzsch and W. Graup. *Lebensmittelind.*, 1978, **25**, 511-513 *(German)*. Applications of the VEB Carl Zeiss Jena Remat 20 refractometer are described. At Klein Wanzleben sugar factory it was used during two successive campaigns for continuous measurement of thick juice Brix in evaporation. At a flow volume of 300 $cm^3.min^{-1}$, the refractive index is measured to within ± 1 x 10^{-3} over a measurement range of 100 x 10^{-3} and a response of 3 x 10^{-4}; a conversion scale has been worked out for the sucrose concentration range 0-85%. The only maintenance needed was essentially the cleaning of the K7 cell. For use in measurement of pressed beet juice at the Beet Research Institute, Klein Wanzleben, the refractometer was provided with a Fresnel cell, which has the advantages over the conventional K-series cells of smaller film thickness, smaller flow volume, the possibility of flow-through of a reference solution and temperature adjustability; the smaller film thickness is particularly valuable in investigations of highly coloured and turbid juices.

Protection of diffusers at sugar factories by means of spray metallization. W. Milewski. *Powloki Ochronne*, 1975, **3**, (13), 49-53; through *S.I.A.*, 1978, **40**, Abs. 78-1404. – In summer 1974, Instytut Mechaniki Precyzyjnej (IMP), CHZ Chemadex and an East German workforce cooperated to protect all internal surfaces (including scrolls and pulp wheels) of the DC-6 diffuser (1400 tonnes beet/day, total area 850 m^2) at Döbeln factory and the DC-4 diffusers (1100 tonnes beet/day, 750 m^2) at Elsnigk and Löbau. The method used is outlined, difficulties encountered are listed and results are reported with photographs. Surfaces exposed to the action of cossettes were given a 0.8 mm coating of Al, sprayed from Metal 63-A pistols, and other surfaces received 0.4 mm, thicknesses being verified with the SK-2 magnetic instrument made by IMP; total usage of Al was 4.5 tonnes. Before application of Al, surfaces were blasted with sand or corundum, with canvas protecting areas already coated. Even where severe corrosion had previously occurred, the coatings stood up well to harsh conditions in the subsequent campaign, with cossettes containing up to 30% sand; the area bared in each diffuser was < 1 m^2. It is recommended that new diffusers be metallized during manufacture.

Progress in low-grade work and application of the Genotell process at Mezohegyes sugar factory. F. Túri. *Cukoripar*, 1978, **31**, 220-224 *(Hungarian)*. – With introduction of the Genotelle low-grade crystallization process with pre-spinning of some of the massecuite before the crystallizers[1], there was reduction in the quantity of massecuite, but the other parameters were either no better than before or were even worse in some cases. The basic cause was the lower crystal content of 29.8% after boiling (compared with 31.1% before introduction of the process), whereas there was need for a greater crystal content. The problem was subsequently solved by introducing the Quentin ion exchange process for molasses treatment, whereupon both quantity and purity of the low-grade massecuite were reduced and the crystal content raised to 36.2%, thereby increasing exhaustion (and thus sugar recovery) and so making the process highly economical.

The heat balance of a sugar factory. I. Mass balance of juice purification. J. Cuel. *Sucr. Franç.*, 1978, **119**, 414-424. **II. Mass balance of crystallization.** *Idem ibid.*, 455-466. **III. The heat balance.** J. C. Giorgi. *ibid.*, 505-514 *(French)*.

I. As a necessary step in establishment of a sugar factory heat balance, the author describes the individual stages in calculating a mass balance for juice purification where both 1st and 2nd carbonatation mud is recycled. The entire balance is set out in a diagram, and brief notes are appended to draw attention to particular points.

II. Two approaches to calculation of a mass balance for the sugar house are described, where a 3-massecuite scheme and Quentin ion exchange treatment of molasses are used: (1) calculation of dry solids as a percentage of beet weight, and (2) calculation of a dry solids + water balance, which involves use of the values given in (1) and laboratory Brix data.

III. The fundamentals of establishing a heat balance are explained, followed by calculation of the balance for each factory process, reduction of formulae to simple forms, and notes on the measurements required, *viz.* temperature, pressure and Brix.

Thoughts on colour formation in juice purification. N. Kubadinow and L. Wieninger. *Zuckerind.*, 1978, **103**, 1015-1021 *(German)*. – Beet cossette samples from the six Austrian sugar factories were deep-frozen and then subjected to a standard purification procedure at the Austrian sugar research institute. The thin juice colour was measured at 420 or 560 nm and the values compared with those obtained at the corresponding factories. Closest agreement was found for two factories using conventional pre- and main liming, 1st and 2nd carbonatation, with muddy juice recycling to preliming; close agreement was also found for juice treated by a modification of the Novi Sad system (including preliming instead of the original juice stabilization stage, clarification of the juice between 2a and 2b carbonatation and thin juice filtration), while factory juice treated by simultaneous liming and carbonatation (with use of pre-carbonatation) deviated by up to 87% from the laboratory results (in all cases, the factory juice colour being higher than the institute value). While the conventional system used 80-100% CaO on non-sugars in raw juice, the Novi Sad system used 100-120% to obtain the same

[1] Genotelle *et al.*: *I.S.J.*, 1977, **79**, 64-67, 96-100.

juice colour, whereas use of 120% lime in the simultaneous process was unsuccessful in achieving the required colour reduction. Reasons for this are examined. Investigation of possible relationships between colour formation and the behaviour of dextrose, levulose, glutamine and amino-acids, using model juices, showed that glutamine had little effect on colour formation, while a mixture of alpha-amino-N and the two named monosaccharides provided at least half of the thin juice colour. However, because of lack of knowledge on other chromophore-bearing impurities which must be present in factory juice, optimization of juice colour can only be brought about by comparison with that of juice in the standard process.

Development of a pilot plant for extraction of beet cossettes. F. Zama, C. A. Accorsi, G. Vaccari and G. Mantovani. *Ind. Sacc. Ital.*, 1978, **71**, 121-125 *(Italian)*. — A stainless steel trough diffusion apparatus, operating with contra-rotating screws similarly to a DDS diffuser and capable of treating 250-300 kg of beet cossettes per hour, is described and illustrated. The unit is intended to produce juice which is more representative of factory material for research purposes than juice obtained in a laboratory extractor.

Prospects for the utilization of solar energy in the sugar factory. C. Di Camillo. *Ind. Sacc. Ital.*, 1978, **71**, 126-129 *(Italian)*. — Generalized aspects of the capture and utilization of solar energy are discussed, while possible applications mentioned for the sugar industry include the use of solar cells to derive the energy for operating aerators in the treatment of waste waters, the preheating of air to be further heated for supply to pulp dryers, and for conditioning of sugar.

Eps — a system of automation for chemical engineering processes. A new approach to process automation in the sugar industry. W. Hügle. *Zuckerind.*, 1978, **103**, 1022-1026 *(German)*. — An outline is given of the eps system for automatic control of chemical engineering processes; the programmable system is built around a mini-computer and has a storage scheme based on the floppy disc. The principle of direct digital control is explained, and the hardware and software components of the system are described. Possible applications are suggested.

The control of adiabatic and non-adiabatic dryers using the example of drum and steam-heated tube bundle dryers. H. A. Paschold. *Zuckerind.*, 1978, **103**, 1026-1030 *(German)*. — The Foxboro system of dryer control is based on a formula $(T_O - T_W) / (T_i - T_W) = R$, where T_O is the exhaust air temperature, T_W is the wet bulb temperature, T_i is the incoming air temperature and R is the ratio constant. For adiabatic dryers, $T_i = RT_i + b$, where b is the basic load adjustment; for non-adiabatic dryers, $P_O = Rh + b$, where P_O is the required steam pressure and h is the difference between the actual and required steam pressure. The system described compensates for variations in parameters by automatically changing the exhaust air temperature or steam pressure so as to maintain the required final moisture content of the product within narrow limits.

Low-grade processing with vertical crystallizers at Oreye sugar factory. J. Huberlant and W. Loop. *Zuckerind.*, 1978, **103**, 1031-1035 *(German)*. — Details are given of the Toury vertical low-grade crystallizer station at Oreye (Belgium), which is operated in conjunction with continuous low-grade centrifugals, a Quentin ion exchange plant and diluters[1]. Reasons for alterations to the crystallizer station, the advantages of vertical crystallizers and details of their performances are given. The major effect has been a drop in molasses purity from 62 to about 52, which is the minimum purity permitted in Belgium for molasses that is marketed. Because of this limitation, the Quentin ion exchange capacity is deliberately restricted.

Designing sugar factory evaporator stations with the help of computers. G. Bator and K. Urbaniec. *Zuckerind.*, 1978, **103**, 1035-1042 *(German)*. — The application of a digital computer program to the designing of evaporator arrangements is described. Two versions have been developed in Poland, one for use by the Chemadex organization and the other for the design office, Cukroprojekt. The program has been applied to the planning of a number of installations in various countries, and an example of its use is described.

Development of a rational scheme for raw juice liming. V. A. Kolesnikov, D. M. Leibovich and V. A. Maksyutov. *Sakhar. Prom.*, 1978, (12), 17-22 *(Russian)*. — Results are reported of investigations on reducing matter degradation in main liming as a function of time and temperature; these showed that for optimum thermal stability of the juice, the liming temperature should be raised by 10°C (from a base value of 60°C) for every 0.1% reducing matter, and liming carried out for at least 25 min. However, for achievement of low colour content and high heat stability, fractional liming (in which the juice is first exposed to a lower temperature and then to a higher one) has proved better than exposure to an intermediate temperature over a total time which is double that of the fractional periods. Hence, for a juice containing 0.2% reducing matter, 15 minutes at 50°C followed by 5 minutes at 80°C is recommended; for a reducing matter content of 0.4%, optimum conditions are as for the lower content, except that the period of exposure to 80°C is extended to 15 minutes. Comparison of the two systems shows that fractional liming gives higher juice purity, lower colour and lime salts contents, a higher 1st carbonatation juice settling rate and a slightly lower molasses sugar content.

Some questions involved in improving the performance of inclined diffusers. A. P. Parkhod'ko. *Sakhar. Prom.*, 1978, (12), 35-36 *(Russian)*. — Because of the need for regular repairs to the scrolls of DDS diffusers built under licence, suggestions have been made on ways in which the problems can be solved and the performances of the diffusers in Soviet sugar factories improved. The author describes the various modifications.

Experiment on storage of sugar beet using chemical preparations at Olymskii sugar factory in 1977. B. V. Zaichikov, O. Ya. Sergeeva, N. M. Sapronov and S. K. Mezentsev. *Sakhar. Prom.*, 1978, (12), 40-43 *(Russian)*. Tests are reported in which beets were sprayed with an aqueous solution of the sodium salt of maleic hydrazide (10% solution) or catechol (0.3% solution) before storage for 2½-2¾ months (October-December) in piles containing some 10,000 tonnes. Results showed that both chemicals were effective in reducing daily sugar losses by comparison with the control, catechol being slightly better (a 0.005% absolute reduction) than the hydrazide (0.003% reduction).

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[1] See also Genotelle *et al.*: *I.S.J.*, 1977, **79**, 64-67, 96-100.

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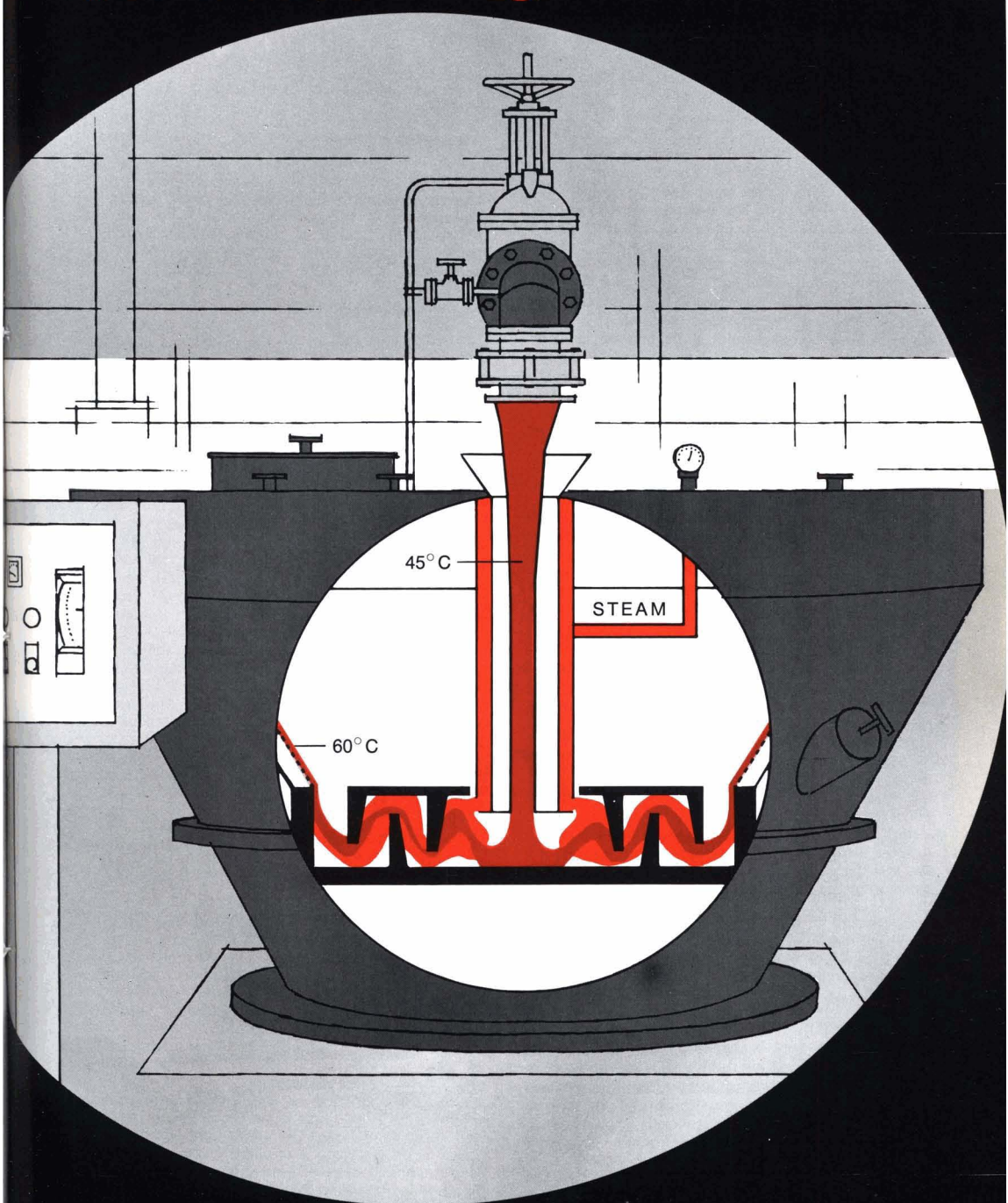

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NEW BOOKS

Proceedings of the 17th Session, International Commission for Uniform Methods of Sugar Analysis, Montreal, 1978. 448 pp; 15.0 x 29.0 cm. (ICUMSA, Publications Dept., P.O. Box 35, Wharf Road, Peterborough, England PE2 9PU.) 1979. Price: £20.00.

This book is an excellent example of the desirable characteristics of its type; it is well printed and not of unwieldy size, it provides a systematic account of the meeting concerned with lists of participants and their addresses, and gives both the texts of the reports presented and the discussions which ensued, as well as a useful index. The editors have followed a consistent style and the volume will be essential for maintenance of complete and up-to-date literature on the introduction, development, acceptance and sometimes discarding of methods for use in all aspects of analysis for chemical process control and international trading.

Defects arise not from the editing or presentation of the Proceedings or even from individual Reports of Referees but from the nature of the Commission's work. This has developed over the decades and, perhaps inevitably, there is often an overlap between one Subject and another, notably Subjects 5 and 11. It would be useful if ICUMSA, and indeed the whole sugar world, would decide whether "polarization" is a parameter which corresponds approximately to sucrose content, the level of that parameter, or its measurement. With practices and nomenclature established in different countries for so long it is probably unrealistic to look for establishment of a universally accepted system which would, for instance, distinguish consistently between polarization, sucrose and sugar. But ICUMSA would be the obvious source for such a system; perhaps a new Subject is called for.

Hawaiian sugar manual 1979. 43 pp; 15 x 23 cm. (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, HI 96701, USA.) 1979.

Described as a handbook of statistical information, this work is split into four sections, covering, respectively, the Hawaiian sugar industry, the US sugar industry, world sugar and terms used in the cane sugar industry. The Hawaiian section includes details of sugar-producing companies, cane and sugar production from 1908 to 1978, cane acreages, important historical dates in the industry (starting with 1825, when the first cane plantation was attempted on the island of Oahu), and an outline of the refining and marketing of Hawaiian sugar. In the section on the US beet and cane sugar industry, beet and sugar production figures are given as well as Florida and Louisiana cane and sugar production for 1940-78; data for Texas start from 1974, and for Puerto Rico from 1945. Various other data are included, such as sugar consumption and imports in 1975-78 and information on edible syrups. The third section gives details of the International Sugar Agreement and world centrifugal and non-centrifugal sugar production in the period 1974-78, white refined sugar prices in selected countries in 1975-77 and sugar supply and distribution by countries in 1977. The booklet represents a handy source of data, particularly of value for the information on Hawaii and the USA.

International sugar economic yearbook and directory 1979. Ed. H. Ahlfeld. 461 + 57 pp; 20 x 29 cm. (F.O.Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany). 1979. Price: DM 90.00

The latest edition of Licht's yearbook follows its well-established pattern, providing an enormous amount of information on the sugar industry in the form of facts and figures, addresses, texts, etc. Of the nine parts the first provides a contents list and index to advertisers (whose displays make up a substantial part of the volume), while the second part provides details of such international organizations as the ISO, CIBE, IIRB, etc. and gives the economic rules established under the International Sugar Agreement. The bulk of the book is taken up by the next two parts which provide information on the industries, organizations, companies and sugar factories for beet and cane sugar countries, respectively.

Technical and economic articles are featured subsequently; these include "Sugar and the Cuban economy" by G.B. Hagelberg, "New products from sugar" by A.J. Vlitos, "1985 sugar consumption: a revised outlook" by A. Viton, "Equipment and services for the sugar industry: a survey" by H.J. Delavier, "Intercropping sugar cane" by R. Antoine, "Agricultural implements for sugar beet growing" by H. Schafmayer and "The evolution of sugar beet harvesting techniques in Belgium" by M. Martens, as well as surveys on recent developments in cane irrigation and harvest mechanization and product reports from a number of suppliers to the sugar industry. A Buyers' Guide is included and a booklet of world sugar statistics fitted into a pocket at the back of the cover. We know of no other publication having the scope and detail of this remarkable and valuable book.

The industrial utilization of sugar and mill by-products (a literature survey). M. J. Kort. 201 pp; 21 x 29.5 cm. (Sugar Milling Research Institute, University of Natal, King George V Avenue, Durban 4001, South Africa.) 1979.

The seventeenth report in the series shows a continuing expansion of the literature on industrial utilization of refined sugar and by-products from sugar manufacture, as indicated by a 4.8% increase in the number of references given by comparison with the previous survey[1].

The book is separated into six major sections, *viz.* by-products from sugar manufacture, livestock feeding, industrial uses (food and non-food) of refined sugar, recent developments in sucrochemistry, nutrition and toxicology, and other sweeteners (natural and synthetic). The section on by-products is sub-divided into: factory and distillery waste water, filter mud, wax production, molasses, bagasse and chemicals from cane by-products (alcohol, yeast and protein, and acids).

Despite the expansion in the literature, there have been no startling new developments in by-products utilization, although, as is to be expected, there is great interest being shown in fermentation to produce ethanol for fuel use. No new major discovery has been made or is expected regarding industrial uses of refined sugar, nor have any new directions of research appeared in sucrochemistry; while there are many patents and publications on the use of sucrose ethers and esters, it is the esters which have attracted the greater attention,

[1] Kort: *I.S.J.*, 1979, **81**, 56.

while the interest in application of ethers in detergents and polyurethane foams seems to continue to decrease.

Obviously, the author has devoted a great deal of energy and time to this work, and he is to be congratulated on his achievement; certainly, there is call for a survey of this nature, and the result adequately fills the gap.

The South African sugar year book 1978-1979. Ed. M. Morgan. 200 pp; 21.5 x 28 cm. (The South African Journal, P.O. Box 1209, Durban, Natal, South Africa.) 1979. Price: R6.50.

The 49th edition of this well-known book is separated into four main sections, the first containing a number of special articles including items on cane smut and bagassosis, ethanol and work at the South African Sugar Association Experiment Station. The second section is a collection of industrial reviews and reports from cane and sugar organizations plus abstracts of papers presented at the 53rd Congress of the South African Sugar Technologists' Association, while the third section comprises the 1978 Annual Report of the Sugar Milling Research Institute and a review of the 1978-79 milling season in Southern Africa, with tables of performance data for individual factories. The fourth section is a directory of South African sugar organizations, with an outline of the present structure of the sugar industry, and a guide to sugar companies, factories and refineries in South African and neighbouring countries. The book is well printed with a wealth of information, and will prove of immense value to those readers interested in the sugar industries of Southern Africa.

Obshchaya tekhnologiya sakhara i sakharistykh veshchestv (General technology of sugars and sugar substances). A. R. Sapronov, A. I. Zhushman and V. A. Loseva. 464 pp; 15 x 22 cm. (Izd. "Pishchevaya promyshlennost' ". 1-i Kadashevskii per. 12, Moscow M-35, USSR 113035.) 1979. 1.30 rouble.

The work is intended as a handbook for advanced students specializing in the technology of sugar manufacture from beet and of starch manufacture from potato and corn (as well as starch syrup and glucose production); it is also designed to be used by technicians attending diploma courses. It is divided into four sections; the first (written by A. R. Sapronov) concerns the chemistry, agronomy and storage of the raw materials, the second (also by Sapronov) deals with sugar technology, the third (by V. A. Loseva) describes sugar refining processes, while the fourth (by A. I. Zhushman) deals with the manufacture of starch and its products.

The sections are arranged in a neat manner, the authors writing in a straightforward, unlaboured manner which befits a students' handbook. The starch section is interesting, in view of the significant inroads being made by corn syrups into what was traditional sugar territory, and for this part of the book the work is of some value to those able to read Russian.

Planalsucar relatório anual 1977. 100 pp; 21 x 28cm. (I.A.A. Planalsucar, Rue Boa Morte 1367, 13400 Piracicaba, São Paulo, Brazil.) 1978.

This beautifully prepared and printed book, in English and Portuguese, is the report by Paulo Tavares, General Superintendent, of the work of Brazil's experiment stations in the National Programme for Improvement of Sugar Cane or Planalsucar. It lists the Committee and staff of the Programme and discusses first the sugar cane growing areas of the country before turning to the work of the different groups of researchers. The main sections cover cane breeding and selection (with sub-sections on genetics, results of breeding and selection, research on sugar cane improvement and varietal experiments), plant pathology, entomology, agronomy (with sub-sections on nutrition and fertilization, agroclimatology, climatic requirements, chemical ripeners, herbicides, and mechanization), sugar processing and engineering (with sub-sections on analytical centres set up under the programme, and the industrial division which is concerned particularly with cane payment on a sucrose content basis as well as an advisory service for sugar factories), and the information centre. A list is included of the Planalsucar staff's contributions to the literature and at the 1977 ISSCT Congress. The wealth of results reported are evidence of the value of the Programme to the Brazilian sugar industry.

An annotated check list of the invertebrates (insects, mites, nematodes) of sugar cane in Mauritius. J. R. Williams. 22 pp; 18.5 x 24.7 cm. (Mauritius Sugar Industry Research Institute, Réduit, Mauritius.) 1978.

Lists of insects and other invertebrates of sugar cane in Mauritius were published in 1954 and 1962 and the latest has been published in the form of an annotated list of pests. The notes provided describe the pest status and give details of parasites and predators, indicating among these the ones which have been deliberately introduced. The cane-feeding invertebrates include 43 insects, 3 mites and 25 nematodes, while a total of 102 parasites and predators are listed.

Gasohol for energy production. N. P. Cheremisinoff. 140 pp; 15 x 13.5 cm (Ann Arbor Science Publishers Inc., P.O. Box 1425, Ann Arbor, MI 48106, USA.) 1979. Price: $16.45.

The history of the use of biomass principally vegetable material, as an energy source is reviewed, with considerable attention to the use and production of methanol as a fuel, particularly from wood waste. Although ethyl alcohol fermentation of grains and fruits has been practised from ancient times for use in beverages, its technology dates only from the mid 19th century. Up to 1945 industrial alcohol production was based largely on fermentation of carbohydrates from grain, sugar beet, potatoes, hydrolysed cellulose, etc., but after World War II the cheapness of ethanol from oil-based synthesis caused the replacement of fermentation as the principal source.

With the realization of limitations to oil supplies, and the higher prices demanded by the producing countries, the situation has changed again and in many countries the production of alcohol as fuel is being examined and pursued, most notably in Brazil, as well as the use of waste material combustion to reduce the need to burn oil.

Dr. Cheremisinoff describes the energy balance in alcohol production from sugar cane and describes large-scale usage in Brazil, before presenting information on the physical nature of alcohol *vs.* iso-octane and discussing legal implications of alcohol fuel use in the USA. He then goes on to discuss development of national programmes for the US of 5:95 methanol and ethanol-petrol blends, and the way that Government would have to participate in order for this to be possible. He also describes problems which would arise with alcohol which do not exist for petroleum products. The last chapter of this interesting book is a review of the opportunities for mass production of biomass in the USA for synthetic fuels.

LABORATORY STUDIES

Ionic impurities and habit modification in sucrose crystals. F. K. Mak. *Zuckerind.*, 1978, **103**, 947-950. The effects of chlorides of lithium, caesium, sodium, rubidium, barium and strontium, potassium iodide and potassium imidodisulphonate on the relative growth rates of sucrose crystal faces were determined by calculating the rates and comparing them with corresponding values for a reference crystal grown under identical conditions but without the impurities. All the salts, with the exception of KI, significantly reduced the growth rates of the a, c, r, d, q and o faces but did not have any significant effect on the p or p' faces. The action of the ionic impurities is related to adsorption at active growth sites on the sucrose crystal and crystallizing molecules, whereby the effectiveness of the sites for hydrogen bonding between the molecules is reduced. It has been suggested previously[1] that the active sites on the sucrose crystal are the polarized OH groups where the hydrogen and oxygen atoms correspond to the positive and negative growth sites, respectively, crystallization proceeding via the polar bonding of OH groups. Ions having small ionic radius and low electron affinity are probably more readily adsorbed and therefore more effective in modifying crystal shape.

Payment for sugar beet according to sugar content at Opava sugar factory. A. Kovařík, Z. Bialý, L. Schmidt, J. Rais and H. Pavlíčková. *Listy Cukr.*, 1978, **94**, 242-249 *(Czech)*. – Investigations conducted during 1971-77 at Opava on beet sampling and analysis for payment on sugar basis are reported, and three different approaches to beet evaluation are discussed. Determination of cossette sugar is simple, but does not distinguish between suppliers, gives no indication of grower efficiency, and does not allow for changes between beet reception and processing. The system as used in Western European countries (analysis of beet samples from individual loads) is considered technically and administratively too sophisticated and costly for use in Czechoslovakia. Instead, determination of beet sugar content in growing beets immediately before harvesting is considered the most suitable system.

Boiling point elevation of sugar solution. P. Kadlec, R. Bretschneider and A. Dandár. *Sucr. Belge*, 1978, **97**, 369-377. – The BPE of 20 sucrose solutions, 46 model sugar solutions of 65-95 purity and 60-80°Bx, and 38 molasses solutions of 2.0-2.4 non-sugar:water ratio, 57-63 purity and 60-80°Bx was determined by means of a special ebulliometer designed by Tuzhilkin. The results were processed by computer to give approximation equations relating BPE at normal pressure to solution composition. (See also Šárka *et al.: I.S.J.*, 1979, **81**, 251.)

Determination of the lubricant content in cube sugar. Á. Juhász and G. Visi. *Cukoripar*, 1978, **31**, 231-233 *(Hungarian)*. – The lubricant content in cube sugar is determined by filtering an aqueous solution through paper, which is then dried and its contents extracted in a Soxhlet apparatus with petroleum ether. Drops of the extract are applied to a thin film of Kieselgel G and fixed with 80:20:1 heptane:diethyl ether:glacial acetic acid; after development with 10% phosphoromolybdic acid, the colour intensity is compared with that of prepared standards. Full details are given of the method plus the quantities involved. A permissible maximum lubricant content of 50 ppm is suggested.

Deterioration of sugar cane: levels of dextran and total polysaccharides in process streams at two Louisiana sugar factories. E.E. Coll, E.J. Roberts and M.A. Clarke. *Sugar J.*, 1978, **41**, (5), 21-25. – A modification was devised of the Nicholson & Horsley "haze" method for dextran determination[2] whereby a standard curve was prepared using solutions of known Dextran 110 concentration. For dextran assay in raw cane juice samples, 60 cm^3 aliquots are shaken with a mixture of cation and anion exchange resins, screened and 10 cm^3 10% trichloroacetic acid solution added to 50 cm^3 of deionized juice, the mixture vacuum-filtered with the addition of 2% of diatomaceous earth, and 12.5 cm^3 of the filtrate treated with an equal volume of ethanol and the haze measured in terms of light absorbance after 20 min. For raw sugars, 50 cm^3 of a 40°Bx solution is mixed with 0.05 g Kleistase GM-16 enzyme and incubated for 1 hr at 55°C before deionization. Measurements were made by these techniques of dextran contents in juices, syrups, molasses and sugar from two Louisiana raw sugar factories, as well as total polysaccharides by the method of Roberts *et al.*[3]; the results are tabulated. Although there were no freezes during the period, wet weather persisted, and dextran in mixed juice ranged at one factory from 20 to 2910 ppm. Further study is warranted, but it is suggested that it would be more cost-effective for analyses of dextran to be made only when deteriorated cane was being processed.

Variations of non-sucrose solids in sugar cane. I. Potassium. J. E. Irvine. *Sugar J.*, 1978, **41**, (5), 28-30. – The role of potassium in plant growth and the effects of deficiency in sugar cane are briefly surveyed, as is the distribution of the element in the cane plant. A study was made of the variation of potassium in cane as a function of variety, location and time of harvest. The juice analyses showed that there were significant differences between varieties and highly significant differences between cane from different locations, although there was no clear association with soil type or geography. Average values for stalk samples from all varieties did not show significant changes for different harvest dates, although tops showed significant differences among harvest dates but not varieties, the K level declining as the season progressed. Implications in regard to K fertilization are discussed.

Rapid methods of calculating undetermined losses of sugar in diffusers, evaporator and the sugar house. A. Ya. Zagorul'ko, A. A. Lyashenko, D. M. Ishchenko, E. K. Ivanishenko and E. A. Trifonova. *Sakhar. Prom.*, 1978, (12), 48-53 *(Russian)*. – Details and requisite formulae are given of a system for determining unknown losses by passing the appropriate juices and syrups through cation exchange resin in H^+ form and establishing the resultant increase in acid radicals.

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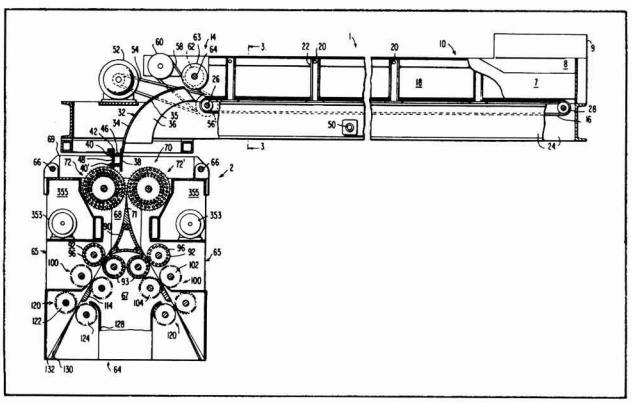
[1] Kelly & Mak: "The sucrose crystal and its solution" (Singapore University Press) 1975.
[2] *J. Agric. Food Chem.*, 1959, 7, 640-643.
[3] *Sugar J.*, 1978, **40**, (8), 21-23.

PATENTS

Sugar cane separation. Canadian Cane Equipment Ltd., of Edmonton, Alberta, Canada. **1,452,971.** October 30, 1973; October 20, 1976.

The cane handling equipment 1 incorporates an aligning and feeding zone 10 and delivery station 14. The alternately short and tall walls 7,8 cooperate with the base conveyor belt 16 to align cane dropped through chute 9 in a longitudinal direction along the belt. This is also assisted by vertical plates 18 suspended from transverse rods 20 carried by arms 22 mounted on the frame 24. The cane is delived into the arc-shaped chute 32, the alignment being maintained by longitudinal divider walls 36. It then passes down through the channels formed and past the yieldable guide plate 38 at the bottom of the chute. This plate is held by pins 40,40' which are provided with springs 46, and extends into the nip zone between the feed rolls 72,72' of the separator unit.



The splitting station 70 includes a cutting blade 71 secured to the base 64 against which the cane is brought by rotation of the synthetic rubber or rubber-clad rolls 72,72'. The cane stalks are split longitudinally, the aligned grip being more secure by virtue of the increased resiliency of the rolls which results from the provision of apertures in their ends, and by the axially spaced circumferential grooves and tines in the outer peripheral surfaces of the rolls. Each stalk half is gripped at the lower end by guide rolls 92,93 and conducted to the milling station 100 where it passes between a gripping roll 102 and a milling roll 104, the ridges on the latter scraping away the pith owing to the higher speed of roll 104 relative to that of roll 102. The convergence of the two rolls flattens the half-stalk between them so providing a flat surface from which the pith is scraped ensuring the completeness of its removal. The depithed cane continues over guide plates 114 to between the rolls 122,124, the outer rolls 122 having grooves to strip away the epidermis from the remainder of the rind.

Hatching agent for sugar beet nematode. Research Corporation, of New York, NY, USA. **1,457,098.** February 14, 1975; December 1, 1976. — See US Patent 3,956,485[1].

Production of levulose and syrups containing levulose and dextrose. Snamprogetti S.p.A., of Milan, Italy. **1,457,177.** March 18, 1974; December 1, 1976. — A glucose isomerase is produced by aerobic cultivation (for 16 - 24 hr) at 45° - 70°C (55° - 60°C) of cells of a heat resisting *Bacillus* micro-organism (*B. stearothermophilus*) [at pH 6 - 8 (7)] in a culture medium containing inorganic salts (Mg^{++} and/or Co^{++} ions) and assimilable sources of carbon (dextrose, peptone or meat extract) and nitrogen ($NaNO_3$, KNO_3, NH_4 salts, hydrolysates of meat, casein or soya). Xylose may be added initially to the medium. The glucose isomerase is recovered from the cells and used to isomerize dextrose in a buffered (pH 7.5) solution at 30° - 70°C (60° - 70°C) containing Mg^{++} and Co^{++} ions.

Beet harvester. J. D. Dyson, of Peterborough, England, and C. R. Dyson, of Bourne, Lincs., England. **1,457,735.** August 4, 1975; December 8, 1976.

Sugar containing foodstuff. L. A. W. Hayward, of London, England. **1,459,313.** January 7, 1974; December 22, 1976. — Cane or beet juice is evaporated (in the presence of an anti-foam agent and $NaHCO_3$ to control its acidity) optionally after removal of protein but no other component, to produce a syrup (of at least 70% sugar) which is incorporated into a foodstuff [confectionery (toffees, caramels, fudge, etc.)].

Production of α-galactosidase. Hokkaido Sugar Co., of Tokyo, Japan. **1,459,364.** January 21, 1975; December 22, 1976. — The title enzyme is produced by cultivation of a mould (a species of *Circinella* or *Absidia*) on a basal medium to which is added 0.2 - 1% of citric, lactic, glycolic, fumaric, glutaric, malic, tartaric, succinic, pyruvic, galacturonic, malonic or maleic acid.

Beet harvester conveyor. Deere & Co., of Moline, IL, USA. **1,459,938.** May 20, 1974; December 31, 1976[1].

Production of crystalline sugar. Tate & Lyle Ltd., of London, England. **1,460,614.** April 16, 1974; January 6, 1977. — See US Patent 3,972,725[2].

Centrifugal. Salzgitter Maschinen AG, of Salzgitter, Germany. **1,460,778.** June 25, 1974; January 6, 1977. See US Patent 3,961,746[3].

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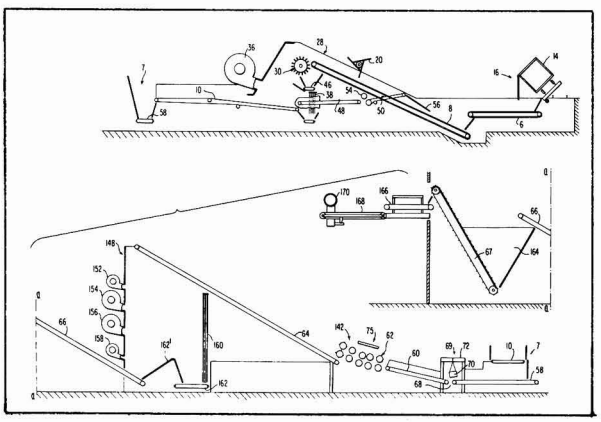
[1] *I.S.J.*, 1979, **81**, 283.
[2] *ibid.*, 1980, **82**, 33.
[3] *ibid.*, 1979, **81**, 283.

Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.25 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

Increasing the sugar content of (cane) plants. Monsanto Co., of St. Louis, MO, USA. **1,461,040.** March 3, 1975; January 13, 1977. —The sucrose content of cane is increased by application, 2-8 (3-7) weeks before harvest, as a dust or solution or suspension in water or non-toxic oil or an emulsion, of 0.1 - 5 lb.acre^{-1} of an amino-di (methyl phosphonic acid) compound having a formula $R\text{-}N(CH_2PO_3H_2)_2$, where R represents methyl, ethyl, chloromethyl or chloroethyl, or an alkali metal (Na,K), ammonium or lower (C_1 - C_4) alkyl (*iso*-propyl) amine salt of the compound. The compound is applied in the presence of 0.1 - 2% w/w of a surfactant.

Preparing cane stalks for subsequent processing. Canadian Cane Equipment Ltd., of Edmonton, Alta., Canada. **1,462,466.** April 22, 1974; January 26, 1977.

A tangled mass of cane is delivered e.g. from a rail truck 14 onto a conveyor 6 which carries it to a faster moving inclined conveyor 8. The change of speed tends to help alignment of the stalks in the direction of movement and this is further aided by the tines 20 on the shaft which rotates against the flow of cane. The cane is carried over the transfer wheel 30 and falls onto the conveyor 10. As the cane falls, a blast of air passes through it from fan 36, and light particles of trash are blown through the curtain of cane to meet the freely hanging rods 38. These trap the trash which falls onto the transverse conveyor below and is carried away. Dirt, stones and pieces of cane fall through the gap between the belt 8 and transfer wheel 30 and so onto transverse conveyor 46. This discharges onto a faster moving conveyor 48, which helps to align the pieces of cane stalk on it. The cane pieces pass onto the conveyor 50, aided by rotating drum 54, while dirt and stones fall through the gap between the two conveyors. The cane pieces are then delivered onto the distribution plate and so onto the cane blanket on conveyor 8.



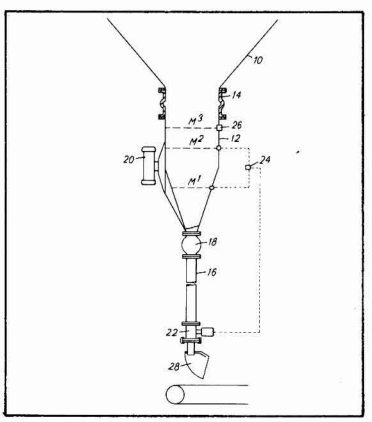
Cane on conveyor 10 is discharged onto conveyor 58 moving at right angles to its former motion. The speed of conveyor 58 is higher than that of 10, so aiding alignment of the stalks which pass under the magnet 70 for separation of metallic contaminants. The cane is fed to conveyor 60 which carries it to a series of four pairs of rollers 62 which have their gaps arranged so that the cane is deflected upwards. The long stalks are held at the rear end while the fore end is nipped by the rollers and the direction of motion changed. Smaller pieces of trash are not held, however, and are brought against the later pair of rollers and deflected downwards instead of being nipped and conveyed further. The stalks pass through another pair of rollers 142 with cutting blades which chop the cane into billets. The billets pass up conveyor 64 and fall down to the bottom of conveyor 66. Air blasts from fans 152, 154, 156 and 158 serve to carry away any remaining trash which passes onto the other side of ramp 162', is trapped by rods 160 and falls onto conveyor 162. The clean billets are taken by conveyor 66 to the hopper 164 from which they are reclaimed by conveyor 67, delivered to conveyor 166, weighing conveyor 168 and pass to process.

Beet knife sharpening machine. Raffinerie Tirlemontoise S.A., of Brussels, Belgium. **1,466,039.** April 14, 1975; March 2, 1977.

Beet harvester. Deere & Co., of Moline, IL, USA. **1,467,034.** May 20, 1974; March 16, 1977.

Continuous centrifugal discharge system. Fives-Cail Babcock, of Paris, France. **1,468,300.** September 20, 1974; March 23, 1977.

In UK Patent 1,416,093[1], a continuous centrifugal was claimed which is enclosed in an air-tight housing filled with compressed air to slow down the crystals discharged over the rim of the conical basket and thereby reduce breakage. The improved discharge system for such a centrifugal comprises a vibratable hopper 12 connected to the housing through flexible sleeve 14 and to the conduit 16 via valve 18. Flow through conduit 16 is controlled by valve 22 which is regulated by device 24 so that the level of sugar in hopper 12 remains between levels M^1 and M^2; if it reaches M^3 the detector 26 operates an alarm. Sugar from conduit 26 is directed by deflector 28 onto the conveyor below.



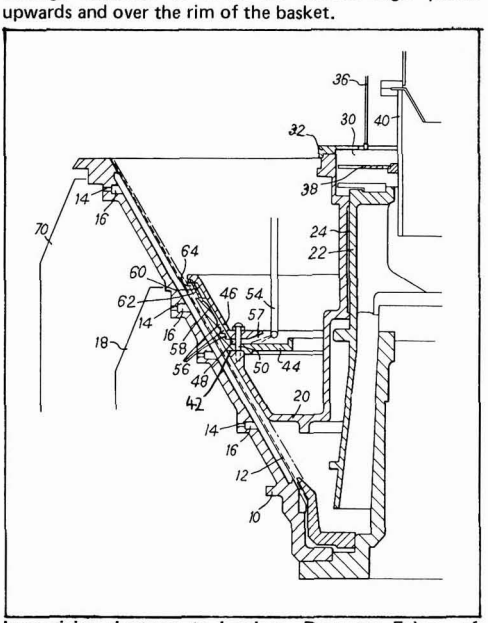
Crystallization of sugar. British Food Manufacturing Industries Research Association, of Leatherhead, Surrey, England. **1,467,433.** April 26, 1973; March 16, 1977. A crystalline sucrose, comprising non-aggregated and unfractured crystals, 5 - 60 μm in size, which do not aggregate on exposure to the atmosphere and which contains up to 5% (2%) of lactose (but $\geq$ 3% of invert sugar) is prepared by agitating a supersaturated solution of sugar (obtained by concentrating a refined sugar liquor) [having a boiling point of 117 - 128°C (122°C) at atmospheric pressure] in a vessel at at least 90°C (100°C) until a transition from solution to unagglomerated solid

[1] *I.S.J.*, 1978, **80**, 317.

crystalline material is achieved [within 5 (3) min], the degree of supersaturation and temperature being so adjusted that the latent heat of crystallization is such as to evaporate the water content giving a substantially dry product. The process may be operated with a continuous feed of solution to the vessel and a continuous withdrawal of dry product which is suitable for incorporating in confectionery.

Continuous centrifugal. Fives-Cail Babcock, of Paris, France. **1,469,467.** September 27, 1974; April 6, 1977.

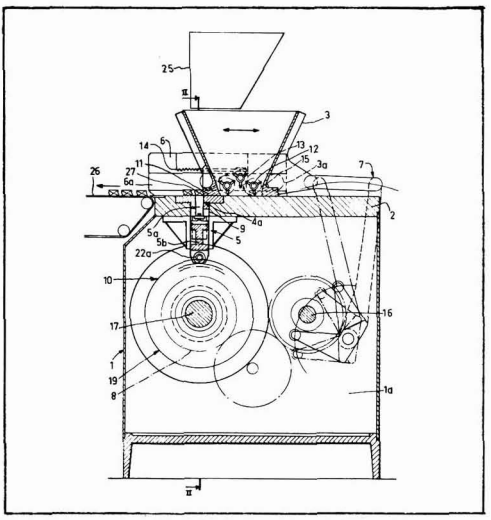
Mounted on the centre shaft of the conical centrifugal is a closure member 20 able to slide coaxially with the shaft and having a frustro-conical surface which rests on the surface of the product and may be rotated with it by friction or by keying to the shaft. This carries a pair of annular cross-section rings 44, 46, separated from each other by notches 48, and slightly separated from the surface of the product on the screen 12. Wash liquid supplied through pipe 54 falls onto ring 44 and is driven by centrifugal force through the openings, and so meets the product surface at about the same rotational speed and is therefore not appreciably dispersed and does not have a great impact. It washes the sugar and passes through the screen to be collected and discharged through channels 16 while the washed sugar passes upwards and over the rim of the basket.



Isomerizing dextrose to levulose. Roquette Frères, of Lestrem, France. **1,471,062.** April 10, 1974; April 21, 1977. — Dextrose is isomerized enzymatically by contact with mycelium from a strain of *Streptomyces violaceoniger* CBS 409-73 or a mutant of this strain. The micro-organism is cultivated (over 24-48 hr) under aerobic conditions in a medium containing 5-15 g xylose and 5-50 g nitrogenous substances (yeast, soya, maize extracts, etc.) per litre, the pH being 5.0-8.5 (5.5 - 7.5) and temperature 25-40°C (30-35°C). The mycelium is then collected and washed before use for isomerizing the dextrose.

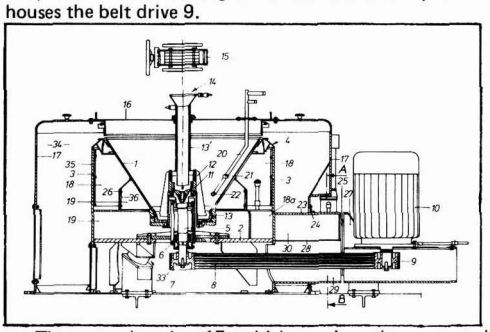
Moulding lumps of sugar. Chambon Ltd., of London, England. **1,471,705.** October 24, 1974; April 27, 1977.

The frame 1 supports a horizontal fixed table 2 on which hopper 3 can slide horizontally on rollers 3a over a moulding box in the upper surface of table 2 which has in it moulding recesses 4a. In each recess is a piston 5a moved by a compression jack 5 operated by driving means 10. The sole plate 11 of hopper 3 covers the recesses 4a during most of the sliding movement of the hopper and also acts as a counter plate to the piston 5a during the moulding of tablets inside the recess. The movements of the pistons and hopper are interconnected so that feed enters the recesses, is compressed into tablets, pushed above the surface of table 2 and then along its surface and onto conveyor 26.



Continuous centrifugal. Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **1,474,158.** July 24, 1975; May 18, 1977.

The continuous centrifugal is constructed in two separate parts; the conical basket[1], acceleration pot, drive, liquid collection chambers 18, 19 formed by annular walls 3, 26 and base 2 are resiliently mounted on four supports 33 which absorb the vibration. The liquid collection chambers are connected to the upper chambers 30a, 30b of the ducting 23 while the lower portion houses the belt drive 9.



The outer housing 17, which receives the separated sugar, carries the feed and washing devices 14, 20 and, because it is separate from the vibrating part of the machine, need not be so robustly constructed as if construction were as one unit.

BREVITIES

New Tanzanian sugar factory[1]. — According to radio reports, Tanzania is building a new $48 million sugar factory to enter production in 1981 with an initial production of 20,000 tonnes/year, rising to between 55,000 and 65,000 tonnes when it is fully operational.

Fiji sugar situation[2]. — The production of sugar, which dominates the agricultural sector in Fiji, declined sharply after independence, from 361,000 tonnes of raw sugar in 1970 to 272,000 tonnes in 1975. The government accordingly introduced the Seaqaqa Development Scheme to put new land under cane and also provided some security of tenure for the mainly Indian cane farmers. Production subsequently recovered and in 1979 was expected to amount to a record 460,000 tonnes, well in excess of Fiji's contractual obligations and its quota allocated under the International Sugar Agreement. Because of storage problems Fiji has been granted an additional allocation of 130,000 tonnes under the Hardship Reserve arrangements of the ISA. With a further substantial crop expected in 1980, the Fiji Sugar Corporation is preparing its case for a substantial increase in its basic export tonnage allocation when the ISA arrangements come up for renegotiation later this year. Meanwhile increases in crushing capacity are being achieved and bulk loading has speeded up the handling of the bigger crop at the ports. A distillation plant is to be constructed in the coming months and a feasibility study on the production of alcohol from sugar cane has been commissioned.

New Kenya sugar factory[3]. — Kenya is to have another sugar factory, to be built in Teso. Total investment cost is said to be 80 million shillings and annual production capacity will be 20,000 tonnes of sugar. No start-up date has been announced.

New Mexican sugar factories[4]. — The Comisión Nacional de la Industria Azucarera is to finance two new sugar factories in San Luís Potosí at a cost of 3000 million pesos ($131 million), to operate by 1980/81 with a total capacity of 180,000 tonnes of sugar per year.

Peru sugar study commission[5]. — A special commission was established in September 1979 to study the structure of the sugar cane cooperatives and to recommend measures for improvement. The commission is made up of twelve members from the Ministries of Agriculture & Food (3), Economy & Finance (1), and Labour (1), the National Planning Institute (1), CECOAAP (1), the sugar cane cooperatives (4) and the National Committee of Sugar Cane Producers (1). The problems of the industry, in the meantime, are worsening: production in 1979/80 is expected to decline to 815,000 tonnes compared with 856,000 tonnes in 1978/79 and 900,000 tonnes in 1977/78. Apart from drought conditions and low sugar prices, it is now generally acknowledged that the industry suffers from fundamental structural problems. There are 12 cooperatives in Peru with a total population of about 218,000 of whom about 41,000 work for the cooperatives. The daily crushing capacity ranges from 300 tonnes to 8500 tonnes and the national total is 35,850 tonnes. In 1978/79 the planted cane area amounted to 92,871 hectares and the harvested area to 53,771 hectares (much of the cane in Peru is grown over a 24-month season). Cane yields in Peru are around 150 tonnes per hectare.

Government take-over of Tanzania sugar factory[6]. — The Tanzanian Government has formally taken possession of the Arusha Chini sugar factory. In accordance with an agreement between the Government and TPC, a Danish-owned company, Tanzania will be given a loan of 87 million shillings, repayable over five years, to enable it to buy all the shares in the company. Under the agreement TPC will let its skilled workers continue working in the factory until the new management acquires its own skilled workers.

Alcohol from sugar beets[7]. — Dr. John J. Gallian of the University of Idaho told a "gasohol" conference in San Antonio in early December that "more alcohol can be produced from sugar beets per acre than any other crop". He said beets were a logical choice for alcohol production since all their energy was stored as sucrose. Beets currently have the capacity to convert to 450-500 gallons of alcohol per acre while fodder beets could convert to as much as 750-1000 gallons per acre.

HFCS producers compensation claim rejected[8]. — The European Court of Justice has rejected claims from three EEC producers of high fructose corn syrup for compensation for damage caused by the Community's production levy on HFCS. Amylum of Brussels, Tunnel Refineries Ltd. of London and Koninklijke Scholten Honig N.V. of Amsterdam all had claimed damages following the Court's decision in October 1978 that the levy of 5 units of account per 100 kg imposed in 1977 was too high[9]. The Court ruled that serious misconduct must be proved to get compensation; the EEC had introduced a regulation implying political choice and it could only be held liable if it had clearly violated laws which protected the interest of individuals.

New Moroccan sugar factory[10]. — According to industry sources, Morocco has signed a contract with a French company for the construction of a cane sugar factory with a capacity of 45,000 tonnes of white sugar a year. The new plant is due to start production in May 1981 and operate at full capacity in 1983. The plant will be built in the Gharb Valley north of Rabat and will cost 230 million Dirham. Total Moroccan sugar production capacity will thus be brought to 420,000 tonnes a year, which is about two-thirds of domestic requirements. Morocco produces both beet and cane sugar, the former being the major part of sugar production.

Animal fodder production in Cuba[11]. — The 16 plants in Havana province produced 100,000 tonnes of animal fodder from bagasse, molasses and urea in 1978 and this was increased to more than 140,000 tonnes in 1979. Production first started in the 1974/75 season with 18,000 tonnes.

Chile sugar factories for sale[12]. — The state-owned national sugar industry, IANSA, has put up for domestic and international bids two of its plants, located at Linares and Los Angeles in southern Chile. The Board of Directors took this measure because of a critical financial situation, the company having lost US$27 million in 1978 and $18 million in 1979. This particular moment was chosen to put the factories up for sale because of the improved price of raw sugar on the world market. The company will retain its other three plants which are also being considered for denationalization in the long term. Linares and Los Angeles beet sugar factories have a maximum annual capacity of 75,000 and 51,000 tonnes, respectively. Total IANSA capacity has fluctuated around 500,000 tonnes per year but the company only produced 172,000 tonnes in 1978 and will reach a similar level in 1979. Bids will be received up to April 2, 1980, and the value of the Los Angeles plant is estimated at around $15 million and of Linares around $23-24 million.

US 1980 sugar import fee[13]. — The US Secretary of Agriculture announced on December 21 that the import fee on raw sugar for the quarter beginning January 1 would remain at zero, while the refined sugar fee would also be unchanged at 0.52 cents per pound. The Secretary is required to determine the import fees each quarter according to a prescribed formula relating the fee to the world sugar price; the refined sugar fee has to be 0.52 cents/lb higher than that for raw sugar under the present legislation.

Chinese sugar expansion[14]. — A total of 22 new sugar factories have gone into operation in China during the past year, increasing the country's sugar production capacity by 170,000 tonnes, the New China news agency reports.

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1 F.O. Licht, *International Sugar Rpt.*, 1979, **111**, 610.
2 *Abercor Country Rpt.*, November 13, 1979.
3 F. O. Licht, *International Sugar Rpt.*, 1979, **111**, 691.
4 *Bank of London & S. America Review*, 1979, **13**, 739.
5 *World Sugar J.*, 1979, **2**, (6), 29.
6 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 58.
7 *Public Ledger Commodity Week*, December 8, 1979.
8 F. O Licht, *International Sugar Rpt.*, 1979, **111**, 707.
9 *I.S.J.*, 1978, **80**, 384.
10 F. O. Licht, *International Sugar Rpt.*, 1979, **111**, 715.
11 *Cuba Economic News*, 1979, **15**, (95), 4.
12 F O. Licht, *International Sugar Rpt.*, 1980, **112**, 16.
13 *Lamborn*, 1979, **57**, 208.
14 *Reuters Sugar Rpt.*, December 27, 1979.

BREVITIES

Cuban-Mexican technical cooperation in sugar[1]. — A scientific and technical agreement between Cuba and Mexico, signed in 1979, provides for technical assistance, transfer of technology, supply of equipment and components, joint enterprises and production, training and the exchange of documentation and experience, and visits and joint research projects. Cuba will be supplying KPT-1 cane harvesters to Mexico, two cane collecting and cleaning centres and two more such centres minus the parts Cuba has to import, and assistance in putting them in operation and the organization of agricultural work, etc. Mexico will provide Cuba with the basic engineering and details of facilities such as a furfural plant which exists in Mexico. Experts will also be sent to Cuba to determine areas for cooperation.

French sugar factory closure[2]. — After the 1979 campaign, Générale Sucrière is to close its factory at Montereau, south-west of Paris. The factory has a slicing capacity of 3500 tonnes of beet per day. Its closure completes the company's programme of production concentration begun with the closure of Fismes factory after the 1978/79 campaign and cessation of loaf sugar production at the Marseilles refinery.

International symposium on energy and the food industry.— The Commission Internationale des Industries Agricoles et Alimentaires is organizing an international symposium on "Energy and the Food Industry" to be held in Madrid, Spain, during October 6-8, 1980, under the patronage of the Spanish Ministry of Agriculture, and in cooperation with the International Union of Food Science and Technology. Information may be obtained by readers in Spanish-speaking countries from Dirección General de Industrias Agrarias (Simposio 80), Ministerio de Agricultura, Paseo Infanta Isabel 1, Madrid 7, while readers in other countries should write to the C.I.I.A., B.P. 470-08, 75366 Paris Cedex 08, France.

Uganda sugar industry rehabilitation. — A Booker Agriculture International team has recently completed a reconnaisance survey to determine the priority areas and basic requirements for rehabilitation of the Kinyala and Sango Bay sugar estates in Uganda. The team's report was to be submitted to the Uganda Government in February 1980.

Sugar Industry Technologists Inc. — John Lopez-Oña, Chairman of the SIT Meade Award Committee, has announced that the recipient for the award for the best paper presented at the 1979 Annual Meeting in Boston is W. A. Reed. Mr. Reed is Chief Chemist of the Revere Sugar Refinery in Charlestown, Massachusetts. His paper, "Low temperature regeneration of granular carbon", was outstanding among the excellent papers presented at the 38th Annual Meeting of SIT.

Dutch 1979/80 campaign[3]. — The 1979/80 campaign in Holland yielded 852,000 tonnes of white sugar against 952,000 tonnes in 1978/79, according to trade sources. The sugar content was 16.22% against 16.1% last year and the campaign was a long one. This was partly due to production trouble in some of the factories of Suiker Unie, which produces about 60% of the Dutch national total. A spokesman for the company said processing would have been simpler if EEC sugar regulations had not prevented Suiker Unie working together with the second largest producer, N. V. Centrale Suiker Mij., as had been the case in 1978/79.

West Germany campaign report, 1979[4]. — The campaign in the West German sugar factories was generally terminated by the end of December 1979. The final figures for beet processed and sugar produced show that results exceeded the earlier forecasts. The factories sliced 18,544,290 tonnes of beet, producing 2,380,197 tonnes of white sugar and 441,649 tonnes of raw sugar (giving a total of 3,067,224 tonnes, raw value). The increase of 90,000 tonnes over the 1978/79 outturn was due to a better extraction rate which averaged 16.54% against 15.80% in the previous campaign.

Increased Brazilian alcohol production[5]. — The President of the Instituto do Açúcar e do Alcool has announced that studies are being undertaken on increasing output of alcohol from sugar from 10,700 million litres a year in 1985 to 14,000 Ml in 1986 and 16,000 Ml in 1987. A rise is expected in the area sown to sugar cane from 2.5 million at present to 3.7-4.0 million hectares in 1985. It is proposed to maintain sugar output at present levels and use the increase in cane production to manufacture alcohol.

Finland sugar production, 1979/80[6]. — The four Finnish sugar factories sliced 696,565 tonnes of beet to produce 71,423 tonnes of white sugar, 16,296 tonnes of raw sugar, 24,932 tonnes of molasses and 53,019 tonnes of dried pulp.

Thailand exports deferment[7]. — Thailand recently asked two major trade houses to accept deferment to 1981 of sugar contracted for delivery in 1980, according to Reuter. About 90,000 tonnes is involved and another 50,000 tonnes could also be deferred. Dry conditions have restricted Thai cane development and cut yields in the current harvest which started in January. Production should continue to around April or May but the crop is expected to total only 1.1 million tonnes against 1.8 million tonnes in 1978/79. With domestic demand at 600,000 tonnes Thailand could fall short of its 1,000,000-tonne ISA quota. Export contracts for 1980 are believed to total 700,000 tonnes.

New power alcohol plant for Kenya[8]. — A new gasohol plant is being built at Kisumu, Kenya, and will take up all the molasses produced by the sugar factories. The plant, managed by the Kenya Chemical and Food Corporation, is expected to need more than the 180,000 tonnes of molasses a year to be produced by 1982 and is to produce about 20 million litres of alcohol a year to be used initially in blending with petrol.

Australia-China sugar contract[9]. — In the largest single sugar sale negotiated since trade between the two countries began in 1972, a contract has been signed under which 130,000 tonnes of Australian sugar, worth about $40 million, will be shipped to China between March and August 1980. Last year, Australia sold a total of 140,000 tonnes of sugar to China.

Zimbabwe-Rhodesia sugar situation[10]. — Owing to the UN trade embargo, little statistical information has been forthcoming from Zimbabwe-Rhodesia over the past few years. Figures supplied by the Zimbabwe-Rhodesia Sugar Association show, however, that sugar production increased from 284,118 tonnes in 1976 to 310,459 tonnes in 1978 and fell back to 299,108 tonnes in 1979. Consumption, on the other hand, has remained fairly stable at between 116,724 and 111,100 tonnes. The export surplus over the past four years has ranged from 167,394 tonnes to 197,005 tonnes. The country's sugar industry comprises two factories with a combined production capacity of 340,000 tonnes per year, so that it has not been working at full capacity since 1976. In 1980 it is probable that production will be about 295,000 tonnes, the balance of the capacity being used for the production of alcohol as motor fuel. In the short and medium term it is likely that any expansion of the industry will also be for the production of alcohol and it is not envisaged that production of sugar will be increased to any substantial degree. However, in view of the recent upsurge in world sugar prices, it could well be that the present policy will be reviewed.

PERSONAL NOTES

Herr **Heinrich Ahlers** has been appointed a deputy member of the Board of Süddeutsche Zucker-AG of Mannheim, Germany. He joined the company in 1961, serving first as a works assistant at Worms and then as works manager at Stuttgart and Regensburg. Since the end of 1977 he has been in charge of the main production department at the Mannheim head office.

Mr. E. T. S. Pearce, who recently retired after 32 years as General Secretary of the Australian Sugar Producers' Association, has died in Brisbane after a short illness. Mr. Pearce was well known in Australia and international sugar circles, having been a member of Australian delegations to almost every negotiation of conference from 1945 to 1977. He was made a Companion of the Order of St. Michael and St. George in 1959.

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1 *Cuba Economic News,* 1979, **15**, (95), 7.
2 *Sucr. Belge,* 1979, **98**, 417.
3 *Public Ledger Commodity Week,* January 5, 1980.
4 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 53.
5 *Bank of London & S. America Review*, 1980, **14**, 15.
6 *Zuckerind.* 1980, **105**, 101.
7 *Public Ledger Commodity Week*, January 5, 1980.
8 F.O. Licht, *International Sugar Rpt.,* 1980, **112**, 41.
9 *Queensland Newsletter,* January 9, 1980.
10 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 58.

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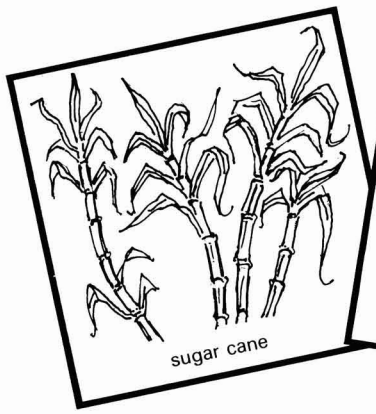

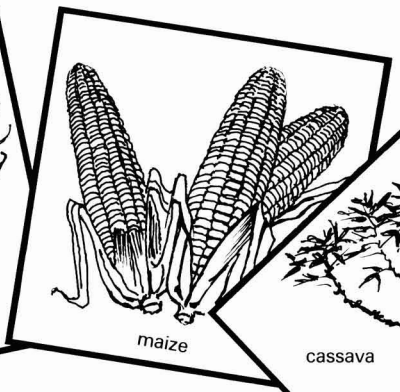

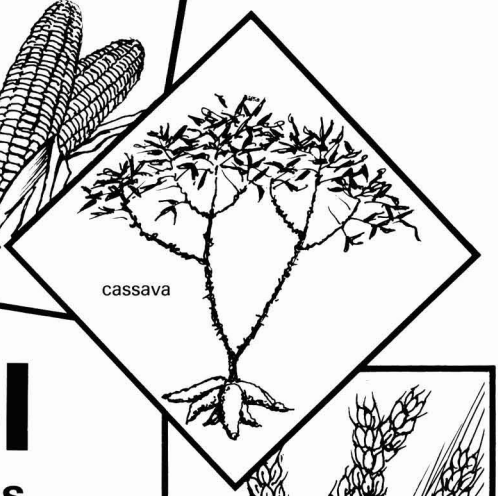

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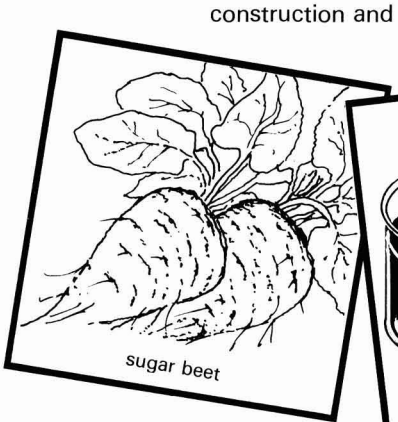

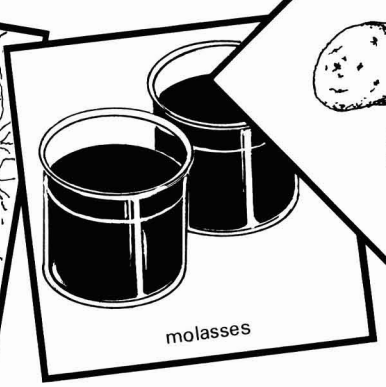

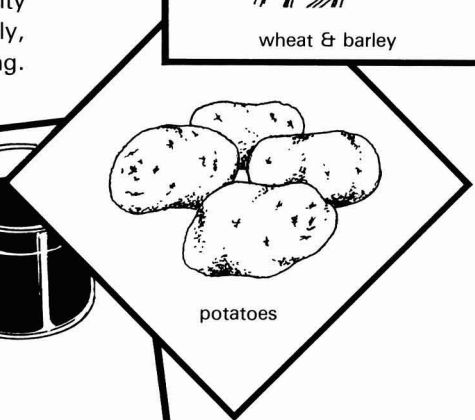

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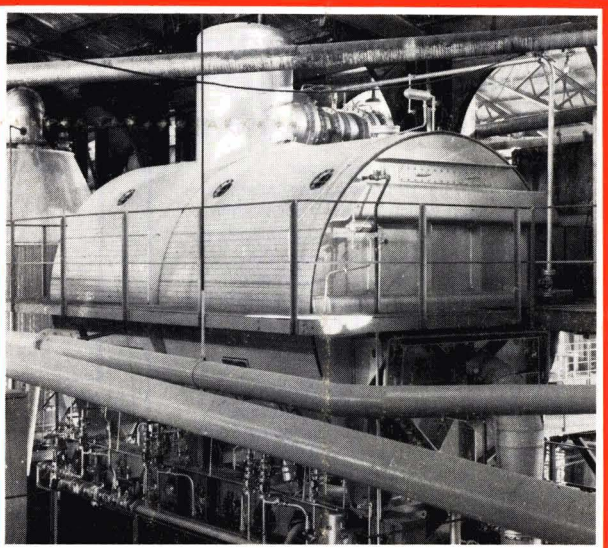

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