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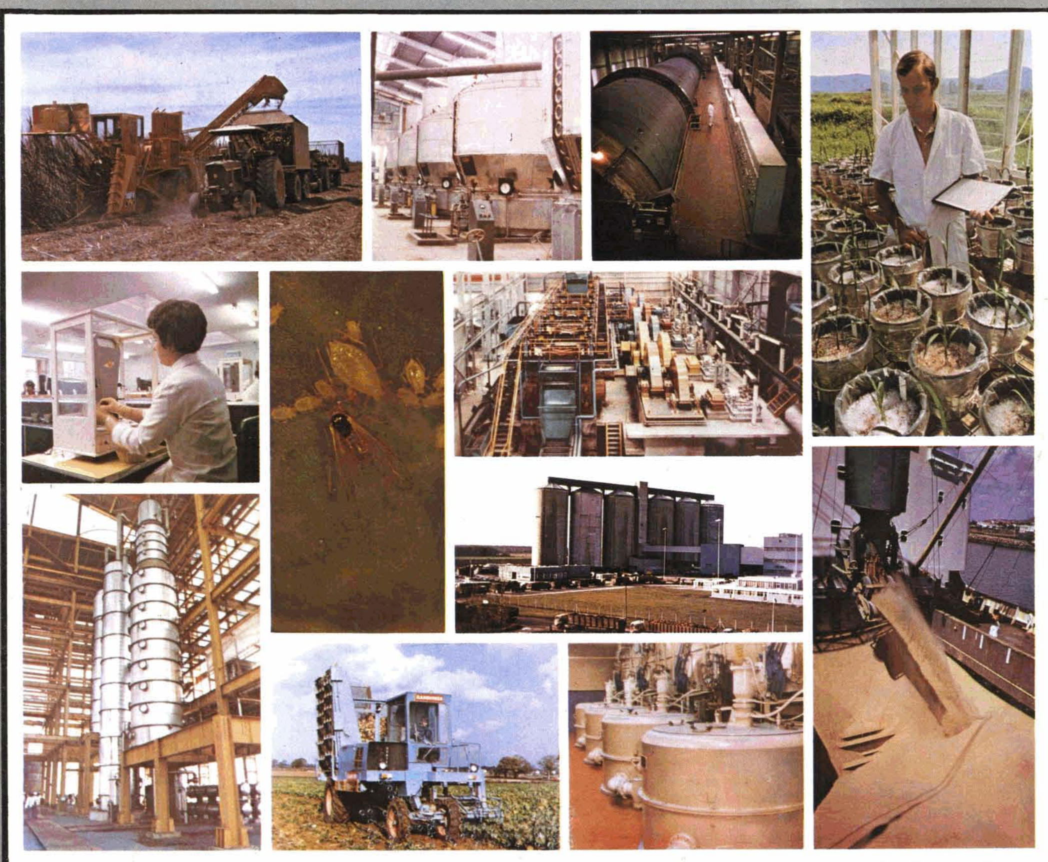

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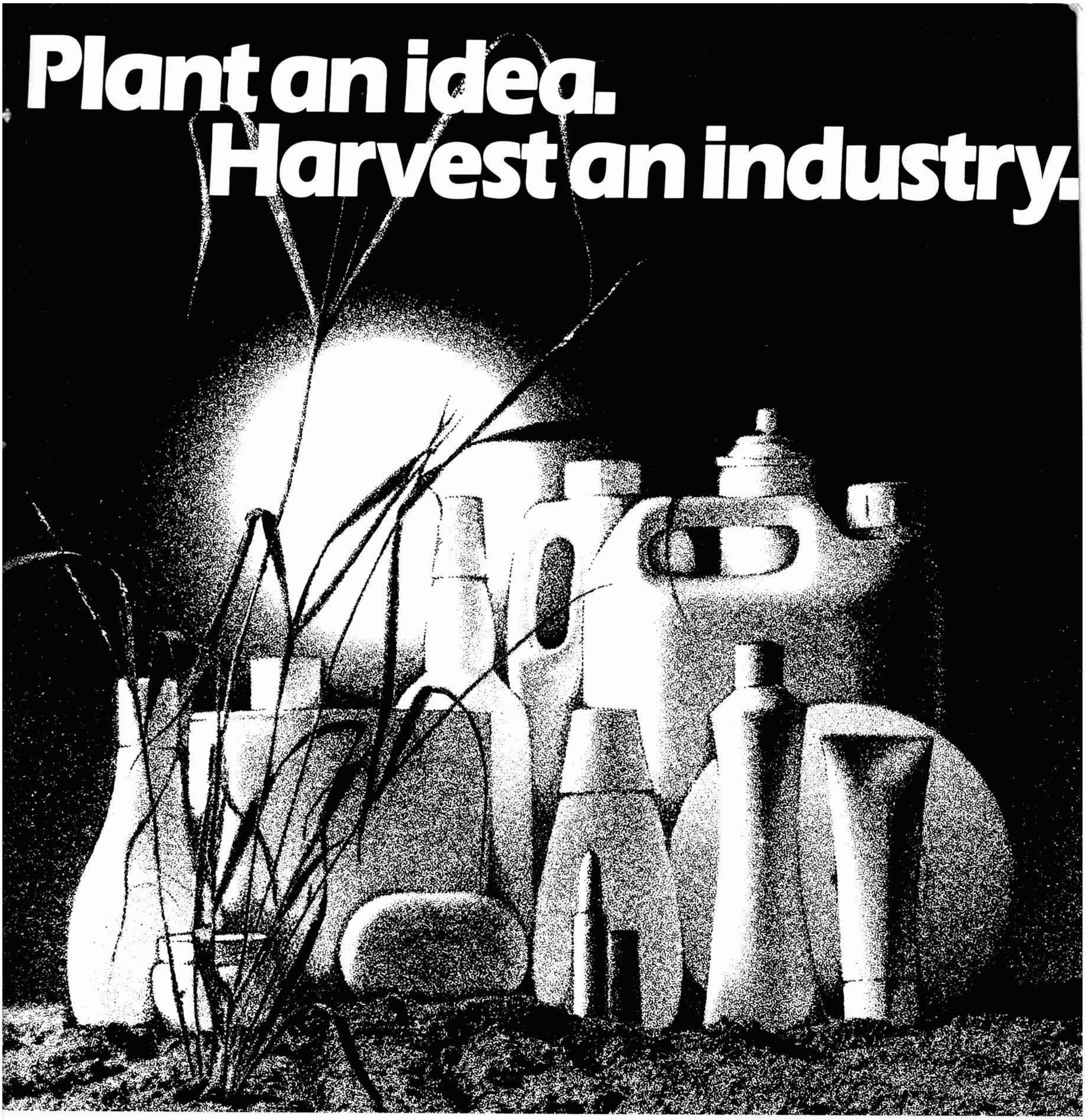

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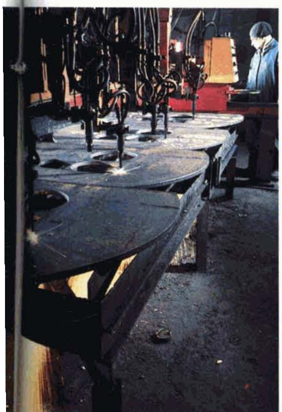


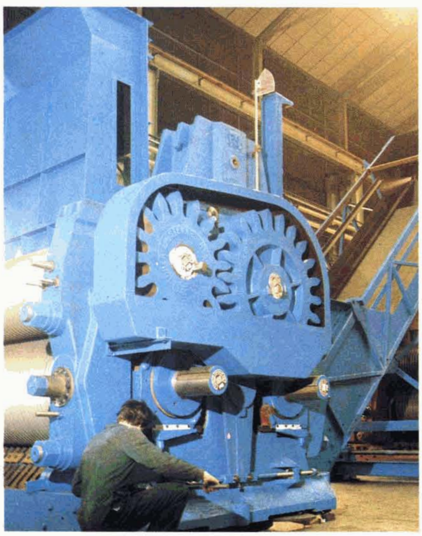




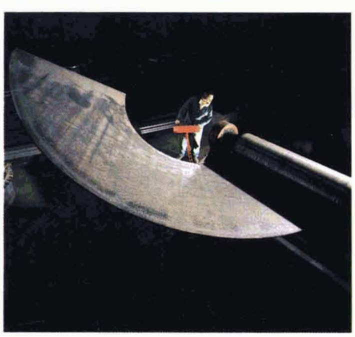

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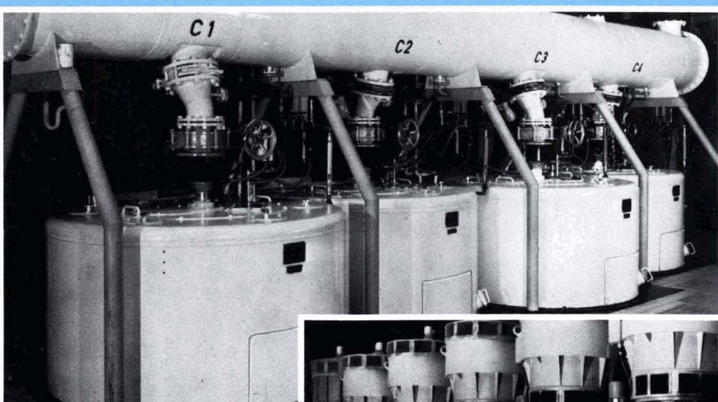

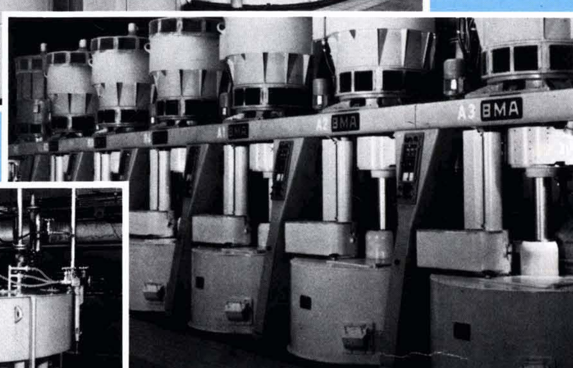

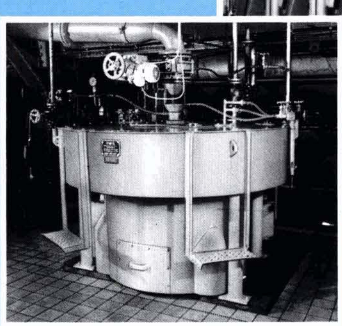

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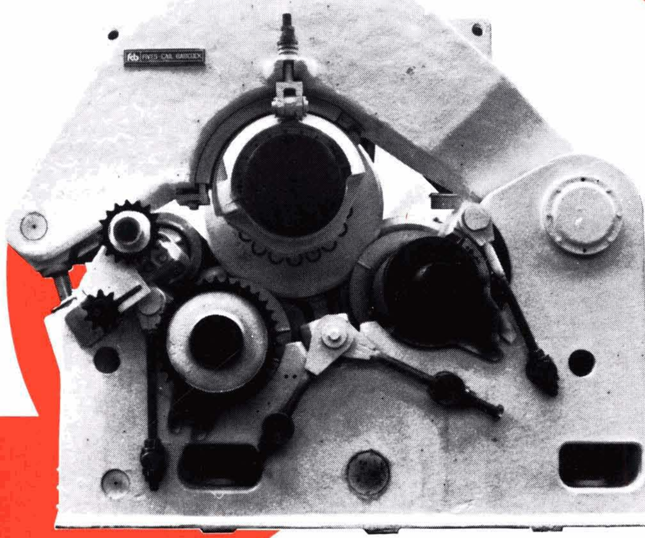
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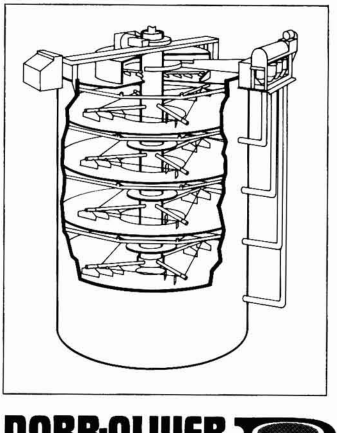

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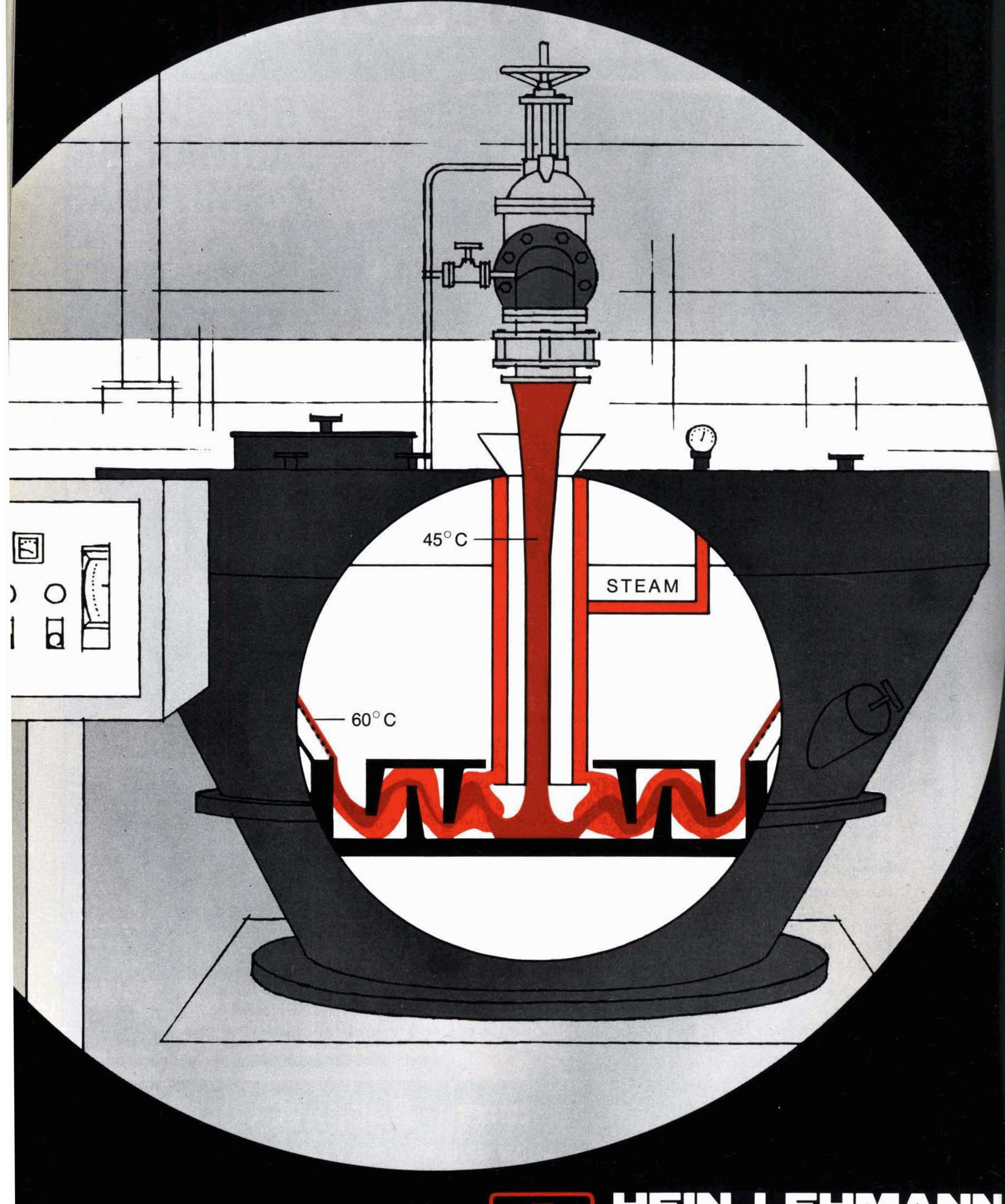

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NOTES AND COMMENTS

World sugar prices

During March there was a decline in the London Daily Price for raw sugar from £250 to £202 per tonne, while the LDP(W) fell from £283 to £216 in the same period. The levels at the beginning of the month had shown increases over the end-February prices, generally as a consequence of the official announcement of severe crop problems in Cuba. An announcement by Pepsi Cola that, like Coca Cola Co., it would permit formulation of its soft drinks with high fructose corn syrup instead of refined sugar brought an initial small reduction but the decision had been expected and prices rose again as it was realized that there would be little effect on the market supply and demand balance.

On March 7, however, the market suddenly collapsed and the LDP slid to £190 over the next two weeks. Values then started to improve and rose to £221 before falling again towards the end of the month. The possibility of the US dollar's becoming more stable after President Carter's proposed economic measures was one factor as was Licht's estimate of increased European beet areas, but the activity of speculators was considered to be the major influence.

White sugar values tended to follow fluctuations in the LDP, but the premium of the LDP(W) over raw sugar fell from £33 at the beginning of March to only £10 at the middle of the month and stayed at just over this for the rest.

In April, worsening of tension in the Middle East and reports of large purchases by the USSR and China, and smaller quantities by Pakistan and rumours of sales to India, together with news of crop difficulties caused by drought in Australia and South Africa and disease in Cuba and the Dominican Republic, all had a strengthening effect on prices. As a consequence, the LDP recovered to £248 per tonne by the end of April, while the LDP(W) reached £257.

Discussing the future statistical position, E.D. & F. Man, who have just published[1] their forecast of world crops showing a reduction in production from 90,555,000 tonnes, raw value in 1978/79 to 83,971,000 tonnes in 1979/80, quote drought in Asia, rust in Cuba and the Dominican Republic and weather stress in the USSR as the immediate causes of the decline, though the root causes are the preceeding four years of depressed world prices.

"The result of the decline in production will be an unexpectedly large draw down on stocks. With consumption in 1979/80 likely to exceed 91 million tonnes, raw value, final stocks will fall from around 30.5 million tonnes at August 31, 1979 to 23.5 million at August 31, 1980. The areas where this huge fall off in stocks are most visible are the United States, India, the Philippines, South Africa and the Comecon countries. The swing from surplus to deficit has also turned a string of former exporters into significant importers, including India, Pakistan, Peru, Mexico, Trinidad and Turkey.

"Next season's consumption, at present world price levels, will almost certainly exceed 93.5 million tonnes. A real danger now exists for the market that production will probably recover by no more than 4.5 million tonnes, in which case stocks will fall to an impossibly low level of 18-19 million tonnes by the end of August 1981.

"It is obviously too early to talk in detail of the new season or to identify where the pressure points will come, but almost certainly 1980/81 will be a very difficult and hazardous season for the sugar trade. Our conclusion can be only that we have now entered a period of recurring deficits, which will be broken only by a rise in prices to levels where consumption can be slowed, production encouraged, and equilibrium restored."

World sugar balance 1979/80

At the end of February, F. O. Licht GmbH published their second estimate of the world sugar balance for the period September 1979/August 1980[2]. This took into account the information which has become available since the first estimate of December 1979[3], in particular the reduced crops in Cuba, India, Thailand and the USSR, so that a further reduction of about 1.6 million tonnes in world production is forecast for the period. Following the large increase in consumption in India in 1978/79 and the subsequent shortage of sugar, the Government seems to be intending to restrict consumption rather than authorize sugar imports, and the likely fall in consumption in that country results in a net world sugar consumption increase of only 660,000 tonnes for the year, or 0.73%, against 5.59% in 1978/79 and 4.76% in 1977/78.

	1979/80	1978/79	1977/78
		tonnes, raw value	
Initial stocks	30,650,000	30,055,000	24,802,000
Production	86,423,000	91,438,000	90,958,000
Imports	29,089,000	27,130,000	28,209,000
	146,162,000	148,623,000	143,969,000
Exports	29,212,000	27,508,000	28,235,000
Consumption	91,124,000	90,465,000	85,679,000
Final stocks	25,826,000	30,650,000	30,055,000
% consumption	28.34	33.88	35.08

The combination of a fall of over 5 million tonnes in production and 660,000 tonnes expected higher consumption results in a deficit of 4.7 million tonnes in production against consumption by comparison with a million tonnes surplus in 1978/79. The stock figure is reduced further as a proportion of consumption and is thought likely to reach not very much more than the three months' supply or 25% traditionally considered desirable for normal trading purposes.

International Sugar Agreement[4]

The provisions limiting imports of sugar by ISA members from non-members were reinstated in mid-April, the prevailing price having been below 20.00 cents per pound for five consecutive days. The only imports from non-members which will not count against members' limitations are those quantities imported while the provision was inoperative, i.e. between February 19 and April 10, or purchased during that period for shipment within 90 days thereafter.

1 *The Sugar Situation*, 1980, (347).
2 *International Sugar Rpt.*, 1980, **112**, 117.
3 *I.S.J.*, 1980, **82**, 70.
4 C. Czarnikow Ltd., *Sugar Review*, 1980, (1488), 78.

The Soviet Union has requested a waiver from its obligations in respect of the quantity of some 600,000 tonnes of EEC white sugar purchased for import this year but it is not yet known what decision has been reached by the Executive Committee in this respect.

The ISO has issued revised details of basic export tonnages for 1980. These are shown below, together with the corresponding tonnages for 1979.

Member	1979	1980
	tonnes, raw value	
Argentina	450,000	447,201
Australia	2,350,000	2,375,287
Austria	80,000	80,000
Bolivia	90,000	100,832
Brazil	2,350,000	2,375,311
Costa Rica	105,000	103,227
Cuba	2,500,000	2,524,317
Dominican Republic	1,100,000	1,200,000
Ecuador	80,000	70,154
Fiji	125,000	211,834
Guatemala	300,000	256,920
Guyana	145,000	151,357
India	825,000	832,828
Jamaica	130,000	130,000
Mauritius	175,000	177,950
Mexico	75,000	70,000
Mozambique	100,000	85,797
Nicaragua	125,000	127,166
Panama	90,000	134,629
Peru	350,000	330,000
Philippines	1,400,000	1,413,880
El Salvador	145,000	172,848
South Africa	875,000	885,367
Swaziland	105,000	118,562
Thailand	1,200,000	1,214,435
Trinidad	85,000	70,000
	15,355,000	15,659,902

It will be noted that Colombia does not appear on the schedule; presumably this reflects the fact that there are still some formalities to be completed before that country is a member of the Agreement with a basic export tonnage of 280,000 tonnes for 1980.

On April 22, President Carter signed legislation which enables the USA to implement its obligations under the Agreement, and it will now be possible to introduce from July 1 the system of fee payment on world market transactions which was intended to finance the special stocks. Concerning the level at which the fee is to be set, C. Czarnikow Ltd. point out[5] that, even though there must be a back-log of administrative expenses and presumably claims by previous stockholders to meet, the fact that all special stocks have now been released means that the lower fee set down in the Agreement of 0.28 cents/lb would generate far more income than would be required to meet anticipated outgoings for this year.

South African sugar crop[6]

The South African harvesting season ended on February 2, 1980 with a total of 2,079,379 tonnes, tel quel, of sugar produced, only 2561 tonnes less than the previous season which was the second highest on record at 2,081,940 tonnes. The total amount of cane harvested was 18,411,616 tonnes, compared with 18,926,099 tonnes in 1978/79. Although the tonnage of cane crushed and sugar produced were lower than in the previous season, the cane quality was much higher, recoverable sugar being 11.22% cane in 1979/80 against the previous 10.84%.

The cane:sugar ratio improved from 9.09 in 1978/79 to 8.85 in 1979/80 and the factories performed well with an average of 234.75 t.c.h. against 233.60 and a very high extraction rate of 96.92% against the previous 96.63%. Early estimates of the 1980/81 crop are that it will be once again in the region of two million tonnes, but there are fears of a drought.

Indian sugar import possibility

The Indian Government is reported[7] to be exploring the possibility of importing sugar as a measure to tide over the current difficult situation, with probings to secure supplies, preferably on a barter basis, against the export of some other commodity. This is because the price of sugar on the world market is high at present so that the landed price would be about the present open market price in India. Such imports would mean a turnround from India's status as an exporter in recent years. With quotas no longer in effect the Government is not thinking in terms of exporting the 625,000 tonnes previous allotted to India under the ISA, although exports might be resumed at the end of the year if supplies come quickly from the new season.

Argentina sugar production[8]

Total sugar production in 1979, at 1,410,849 tonnes, raw value, was slightly higher than the previous year's figure of 1,396,860 tonnes and compares with the 1,666,184 tonnes produced in 1977 before restrictions were imposed to conform with the International Sugar Agreement. The 1979 target had originally been set at 1,315,000 tonnes, since the quota in effect at the end of 1979 was 359,000 tonnes. Sugar statistics for the past three years appear below:

	1979	1978	1977
		tonnes, raw value	
Initial stocks	649,627	592,087	851,415
Production	1,410,849	1,396,860	1,666,184
	2,060,476	1,988,947	2,517,599
Consumption	1,087,030	965,190	974,458
Exports	352,201	366,815	939,959
Difference	0	7,315	11,095
Final stocks	621,245	649,627	592,087

According to industry sources, production by 1980 is expected to reach approximately the same level as last year while domestic consumption is also forecast at about the same level, at 1.1 million tonnes. With a lower initial stock, the balance of sugar available for export is not more than 300,000 tonnes. However, actual exports could be higher if the country's stocks are reduced from the 57% of consumption in 1979 (which compares with 67% in 1978 and 86% in 1977).

The Government has authorized exports up to 70,000 tonnes, raw value, from current stocks which should be possible since the balance should cover a consumption level even higher than forecast in the period up to the start of the new crop in June.

Fiji sugar exports 1979[9]. — Exports of sugar from Fiji totalled 420,069.48 tonnes, tel quel, in 1979 of which 189,759.19 tonnes were to the UK, 118,837.39 tonnes to the USA, 60,972.90 tonnes to New Zealand, 24,000 tonnes to Malaysia, 16,000 tonnes to Singapore, and 10,500 tonnes to Japan.

5 *ibid.*, (1489,), 82.
6 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 133.
7 *Public Ledger Commodity Week*, March 29, 1980.
8 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 85-86.
9 *Fiji Sugar*, 1980, **5**, (1), 43.

Sugar Industry Technologists Inc.

39th Annual Meeting 1980

The 1980 meeting of S.I.T. was held in Chicago at the Continental Plaza Hotel during May 11 - 14. Members assembled during May 11 and, after the Mixer, were entertained to dinner by Revere Sugar Company.

A full program of technical papers was arranged for the next three days, beginning with the Address of Welcome by R. Stuart Patterson, President of S.I.T., and continuing as follows:

United States polarization allowances, by J. V. Lopez-Oña (National Sugar Refining Co., Philadelphia, PA)

Raw sugar sample cans, by M. K. Faviell (BC Sugar, Vancouver, Canada)

Air oxidation of unburned bone char and granular carbon, by V. R. Deitz (Naval Research Laboratory, Washington, DC)

Is "tunnel vision" a factory in your energy conservation program?, by J. D. Lewis (Westcane Sugar Ltd., Oshawa, Ont., Canada)

Economic considerations for conversion to coal burning, by O. Brannen (Savannah Sugar Refinery, Savannah, GA)

The effect of high dextran content raw sugars on refinery performance, by K. R. Hanson (Amstar Corporation, New York, NY)

Raw sugar quality standards – a producer's comments, by P. Carreno (Gulf & Western Food Products Inc., Vero Beach, FL)

The importance of flavour in brown sugar for consumer goods application, by G. Christianson (General Mills Inc., Minneapolis, MN) and L. A. Anhaiser (Imperial Sugar Co., Sugarland, TX)

Inline ultra violet sterilizer unit for liquid sugar, by M. K. Faviell (BC Sugar, Vancouver, Canada)

Entrainment separators for vacuum pans and evaporators, by D. M. Humm (California & Hawaiian Sugar Co., Crockett, CA)

Computer controlled evaporator on refined syrups in the Tirlemont refinery, by M. Braekman (Raffinerie Tirlemontoise S.A., Tienen, Belgium)

The new recovery plant at Thames Refinery, by J. O. Smith and H. Wheeler (Tate & Lyle Ltd., London, England)

Use of colour monitoring in beet sugar processing, by M. K. Faviell (BC Sugar, Vancouver, Canada)

A symposium on alcohol and the cane sugar refiner was chaired by John E. Morton (Redpath Sugars Ltd., Montreal, Canada) and included as panellists Dr. M. C. Bennett (Tate & Lyle Agribusiness Ltd., Bromley, Kent, England), Dr. F. G. Carpenter (Cane Sugar Refining Research Project, New Orleans, LA) and J. A. Harrison (Supreme Sugar Co., Supreme, LA).

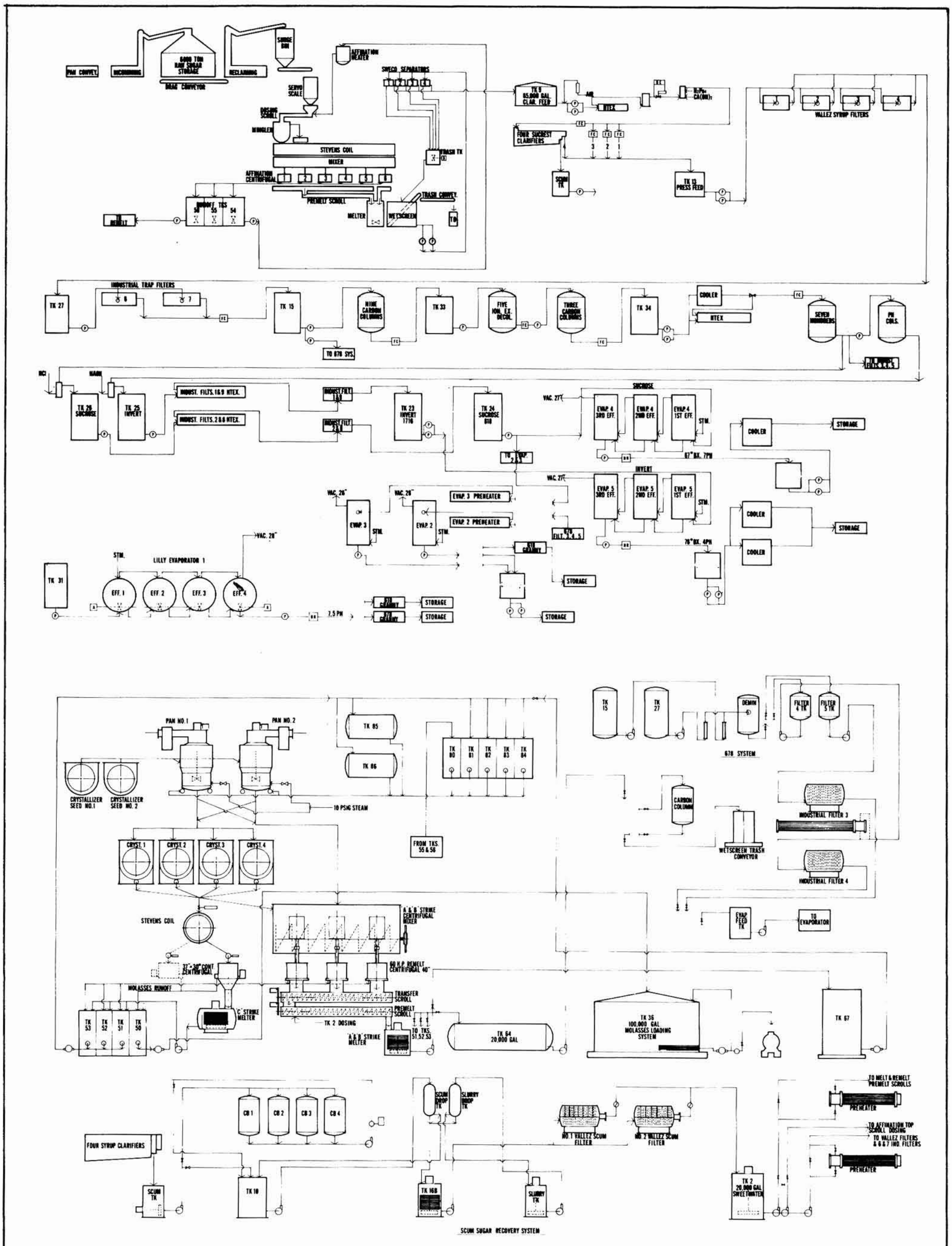
Dr. J. D. Brooke of the University of Guelph, Ontario, Canada, presented a colour film on sugar and nutrition, with an accompanying talk.

The Annual Banquet was held on the evening of Monday May 12 during which the ceremony of passing the gavel to the incoming President was held, as well as the presentation of awards including the George and Eleanore Meade Award to W. L. Reed for his 1979 paper on "Low temperature regeneration of granular carbon".

Revere Sugar Corporation, Chicago

During their meeting, SIT members were able to visit Revere's liquid sugar refinery operation in Chicago. The production of liquid sugar in this plant began in 1938. Prior to this the Chicago operation was limited to a molasses blending operation. In 1938 pressure leaf presses were installed to produce a finished liquid product from turbinado type raw sugars. This operation consisted of melting the raws and treating the resulting liquor with powdered carbon, then removing the carbon on pressure leaf filters. The polished liquor was sent to storage and sold directly. Invert syrups were produced by adding acid during the carbon treatment. This operation was limited to a few hundredweights of product per day.

In the mid-1940's when high-capacity synthetic organic resin became available, Revere (then known as SuCrest) installed a six-bed series-type ion exchange system. This system permitted the Company to increase the plant's output and upgrade the output product. This was still on a small scale and the plant output was



limited to 25 short tons per day. However, there was a more important point in this operation for it represented the first commercially successful use of ion exchange in the sugar refining industry. The simple system used in this operation, namely melting, filtering, ion exchange and evaporating to density, limited the input to high-grade raws or turbinados. The resulting purification, although a great improvement over the original carbon treatment system, still did not turn out the higher grade products demanded by industry in the latter part of the 1940's.

So, when the more efficient "mixed bed" (also known as the "monobed") resin system was invented in the early 1950's, Revere decided to install such a system in the Chicago plant. Simultaneously, it was decided to increase the plant output to more than 300 tons per day and to free the plant of the necessity of using high test raws as a starting material. To accomplish this a full scale refinery was designed. This installation was completed in the early 1950's. One of the outstanding features of the design was the elimination of crystallization as the final step in purification of the products. In place of this costly energy consuming step, mixed beds were installed and the resulting refined liquors from these beds were concentrated to their final densities by energy-efficient triple-effect evaporators. The design also incorporated other unique features such as the use of deep flotation clarifiers, multistage granular carbon units, and the then newly-discovered decolorizing beds.

With the exception of the additional equipment to increase the output of the refinery and other minor changes to improve the efficiency of the process, this is essentially the system used in the Chicago operation at the present time. Over the years the output has been increased to where, at the present time, the plant is capable of producing 800 to 850 tons of high quality products per day using any type of raw sugar as a starting material. A description of the actual plant operation is given in the flow diagrams and the paragraphs that follow.

Raw sugar for the Chicago plant operation is unloaded from ships in the port of New Orleans where the sugar is transferred to barges. After journeying up the Mississippi River the barges are unloaded at the Chicago plant dock by the use of a land-based crane. Sugar coming from the barges is custom-weighed then sent to a circular raw sugar storage bin. Sugar is then retrieved for production via a central drag conveyor running through the centre of the raw sugar bin.

A Servo-Balans scale is used to measure the sugar going into production and is also used to control the amount of affination water that is co-mingled with the sugar. Both an affination heater and a Stevens coil are used to warm up the magma formed by the mingling of affination water and raw sugar.

Automatic Western States batch centrifugals are used to produce affined sugar. Run-off from this operation is sent to the remelt station. The affined sugar is automatically dosed with sweetwater in the premelter scrolls to the desired density and the mixture is sent to a single-stage melter. A coarse inclined screen is used to remove heavy trash from the melt liquor. A second set of screens is used to remove finer trash and fine bagasse.

Melt liquor from the melt storage is heated to a set temperature and air, phosphoric acid and lime saccharate are automatically added to the melt prior to its entering the clarifiers. After passing through the clarifiers, the liquor is sent to the primary press station where filter aid is automatically added to the liquor. A second set of presses are used as the trap filters for the once-filtered liquor. The resulting clear liquor is then sent to the first pass granular carbon columns; liquor from these columns is sent to the decolorizer resin columns, and liquor from the decolorizer resin system is then sent over a second pass of granular carbon columns.

The resulting liquor from this decolorizing operation is cooled and passed over the mixed beds where the liquor is de-ashed and the final vestiges of colour are removed. At this point the liquor stream is split into a sucrose stream and an invert stream. The invert stream is then treated to produce the desired amount of invert.

Both streams are trap-filtered prior to evaporation to remove any suspended solids. The evaporation of filtered liquors to the desired density is accomplished by passing each stream through triple-effect evaporators. The finished liquors are then sent to final storage where final adjustments are made to fit each customer's needs.

Scums resulting from the clarification system are automatically mixed with sluicings from the primary presses. This mixture is then sent to scum presses where the cake and muds are sweetened off to recover the sugar in the cake. Affination syrup resulting from the affining of the raw sugar in the Western States centrifugals is boiled in remelt pans using a seed footing. A three-boiling system consisting of *A*, *B* and *C*-strikes is used to recover sugar from the affination syrup.

The *A* and *B*-strikes are sent directly to a remelt mixer where automatic Western States batch remelt centrifugals are used to separate the syrup from the crystals. The *A*-strike sugar is melted and sent back to join the raw sugar melt stream. The *B*-strike sugar is melted and sent back to join virgin affination syrup for *A*-boilings. The *C*-strikes are sent to crystallizers where they are cooled down to extract as much sugar as possible. After an appropriate period of time the magma in the crystallizers is sent to a Western States continuous centrifugal (via a Stevens Coil). The resulting sugar from the continuous centrifugal is melted and sent back to join virgin affination syrup. The resulting syrup from the continuous centrifugals is sent out as Refiners Final Molasses.

Great Western Sugar Co., Chicago

The facilities of the Chicago terminal of Great Western Sugar Co. were constructed to provide truck deliveries of bulk dry and liquid sugars to customers in that area. The plant is located at Brookfield, about 12 miles southwest of downtown Chicago and can receive over 50,000 short tons of bulk sugar a year by rail. Sugar is unloaded from air-slide or hopper rail cars on two tracks and conveyed to a bulk storage bin by conventional scrolls and bucket elevator, passing under a magnetic separator en route. A remote-controlled conveyor system delivers the sugar to any of the four bins, three of which are used to load road tankers for bulk granulated sugar. Trucks are loaded from overhead while the tanker is on the scale, and the proper amount is thus carefully loaded into each compartment so as to ensure that individual axle loads are not exceeded.

Sugar is weighed from the fourth bin in batches of approximately 7 tons and conveyed to one of two dissolving tanks to which 900 US gallons of ion exchange-demineralized water and carbon slurry are added. The

Great Western Sugar Co., Chicago

mixture is circulated through a stainless steel heater and brought to 75° - 80°C. The complete cycle is automated and controlled by a timer. The syrup produced is passed to a 150 ft^2 horizontal plate cartridge-type filter pre-coated with filter aid and the filtered syrup discharged to a stainless steel receiving tank from which it is pumped to a plate-type heat exchanger, where the temperature is brought to 38°C, and thence to storage. Two tanks of 15,000 gallons capacity are used for liquid sucrose and are fitted with ultra-violet lamps and a double-filtered air circulation system, while being designed to avoid sites for stagnation and contamination.

Two more 15,000-gallon tanks are also provided for liquid invert sugar which is prepared on site by dissolving granulated sugar to a 73° Brix syrup in one of the dissolving tanks and pumping it to one of four glass-lined inversion tanks with steam jackets where the temperature is raised to 80° - 83°C, hydrochloric acid added to bring the pH to about 2.3 and the solution held for 40 minutes (sufficient to achieve 55% inversion) before sodium carbonate solution is added to neutralize the acid. The syrup is then passed in 1,000-gallon batches through the cooler to storage.

Bulk road tankers are loaded directly from the liquid sugar and invert syrup storage tanks and a sanitation system operated on a schedule for both tankers and tanks.

International Sweetener and Alcohol Conference

From 35 countries, 235 people attended the London Conference organized and jointly sponsored by *World Sugar Journal* and the *Financial Times* during April 1-3, 1980. Details of the intended program were published in our October 1979 issue[1] but there were a number of changes in the interim.

Sir George Bishop presided, as originally announced, and the opening address was given by Lord Godber who contrasted the supply and demand status of the industry in 1980 with that at the time of the last similar conference in 1975. He spoke of questions for the industry – the balance between beet and cane sugar, the future of consumption, the influences of HFCS and fuel alcohol production, etc. – and hoped the Conference would contribute to better understanding of such matters.

Barry Newton of Fletcher and Stewart Ltd. and Ian Carmichael of Smith/Mirrlees presented a joint paper on the cost economics of factory production capacity expansion, now about £7000 per tcd against £1500 in 1970. The areas most likely for expansion were the developing countries, while agricultural costs were rising more than industrial costs because of the need to bring marginal land into cultivation. Instead of contracts with private companies or individuals, most new work was for state-owned or -financed corporations so that socio-political factors were now much more prominent in sugar developments, and business now lay much more with turnkey projects which included training of staff, infrastructure, management and often an investment in the equity.

William K. Miller, Executive Director of the International Sugar Organization, told the Conference that it had just been agreed to raise the trigger points of the Agreement by 1 cent/lb and that, as a result of failure to agree on new basic export tonnages, the fall-back formula of the Agreement would be used for establishing new B.E.T.'s although these were not in effect. The stock financing fund start had again been postponed, to July 1. He surveyed the working of the Agreement and discussed implications of a recent F.A.O. report which projected a rise in consumption of 2.6% annually to 1985.

Nick Osman, editor of *World Sugar Journal,* discussed the validity of his method of evaluation of sugar statistics on a crop year basis and then described his statistical techniques for assessment of world sugar production, consumption and prices up to 1984. He forecast that production would increase to 100.2 million tonnes, raw value, by 1983/84 and then fall again to 98.25 million tonnes in 1984/85, against production of 86.06 million tonnes in 1979/80. He considers that demand will fall in 1980/81 by 2,250,000 tonnes from 1979/80 but that it will then increase to a level of 98,868,000 tonnes by 1984/85.

Jose Lago, Assistant Secretary, Marketing and Statistics of GEPLACEA, discussed what producers required from the market, while Nicholas Kominius, President of the US Cane Sugar Refiners' Association, described sugar legislation in the USA and its international implications. Dr. Miklos Szabo-Pelsoczi of Bache Halsey Stuart Shields Inc. spoke on the impact of foreign exchange fluctuations on sugar trading and T. P. J. Dyke, Agriculture Director of the British Sugar Corporation, described new agricultural techniques in

1 *I.S.J.,* 1979, **81**, 320.

relation to productivity in the sugar beet industry, particularly mentioning the use of monogerm seed and planting to stand.

On the second day, Thomas Earley, formerly senior staff economist to the US President's Council of Economic Advisers, discussed the impact of high fructose corn syrup in the USA, Canada, Europe and Japan and the factors which would affect this, including the competitiveness of sugar prices, demand and facilities for syrups as against granular sweeteners, and the supply and price of maize. In the US, HFCS is likely to displace imported raws at first but also domestic sugar in the early 1980's. While world consumption is not likely to exceed 8.2% of world sweetener consumption by 1990 it may nevertheless exert a large effect on sugar prices.

The higher growth rate of HFCS consumption was also mentioned by Dr. Wilson Nicol of Tate & Lyle Ltd. but his main theme was the potential for natural and low calorie sweeteners. Sucrose consumption tends to decline in affluent societies but increasing consumption in developing countries indicates a bright future for the commodity. He described the nature of a number of alternative high-intensity sweeteners, including saccharin, cyclamate, aspartame and TGS.

Dr. R. Alan Yates referred to three crops which provided potential for alcohol production with the criterion of providing energy-selfsufficiency in processing, viz. sugar cane, sorghum and cassava. All can be grown under a range of conditions but only in Brazil are there conditions to allow cultivation of sufficient to yield enough alcohol to replace petrol by the end of the century, although Australia, Hawaii, the Philippines and Taiwan might be able to replace between 5 and 20% of their needs. In the mainland USA, less than 1% of petrol requirements were likely to be replaced by fuel alcohol from carbohydrate crops.

Production of alcohol in Brazil from sugar cane should reach 38 million hl in 1979/80 against 24.9 million hl in 1978/79, according to the President-Director of Coperbo, Romeo B. Dantas. The present official target for 1985 is 107 million hl with 140 million planned for in 1987 and 200 million hl at a future date. Current production capacity is 58.2 million hl. Brazil is also continuing with programs for other forms of energy including solar energy, coal, shale oil, hydroelectricity and nuclear energy, while other crops are being studied for conversion of carbohydrate to alcohol.

Roger Eden, of Shell International, discussed the possible blending and marketing of alcohols as petrol extenders; he expected such use to grow, particularly in countries with a balance of payments problem. However, alcohol is more expensive to produce and will require Government subsidy, while other costs arise in the storage and use of alcohol as a fuel.

Jeffrey R. Box emphasized the importance of the freight market when studying trends in sugar values, while Dr. Kenneth J. Parker, Chief Scientist of Tate & Lyle Ltd., provided a survey of chemicals from sucrose and evaluated its potential as a chemical feedstock. The potential for sugar imports into the US market in 1985 was discussed by Nicholas Rivero, Commodity Group Chief of the O.A.S., who assessed demand at three million tonnes or 10.9% less than the low level of 1979. This loss of an outlet for Latin American producers together with increasing oil costs, would force development of cane as an alcohol source and such an integrated alcohol-sugar production system could give acceptable output levels of both.

On the third day, Emiliano Lezcano, President of Cubazúcar, announced that Cuban sugar production from the current crop should be between 6.7 and 7.0 million tonnes although this was subject to the vagaries of the weather before the end of the crop. The reduction from 1978/79 production was the result of disease. He referred to Cuba's modest expansion and renovation program for sugar factories, ports and roads. He discussed the diversion of cane to alcohol production and considered that sugar exports could decline generally in a period of low sugar prices but high oil costs. He referred to the EEC's overloading the market with subsidized sugar and causing serious upheavals in the past few years (this was contested in a statement from the floor by John Eaton, an EEC official), and believed that the future of the sugar market and of the ISA would depend on the renegotiation of the EEC's common agricultural policy.

Arthur B. Calcagnini, Vice-President-Commodities of Paine Webber Inc., discussed the changing role of the sugar market in today's economy. He considered that the next upward movement might well be led by demand for physical sugar but that, because of high interest rates, it was unlikely to go to a premium over futures unless there was an extreme shortage. In the short term these high interest rates would therefore depress sugar prices but in the long term, their inhibition of investment in production facilities would result in shortages and therefore higher prices. The increased use of computer trading, which eliminated the "sentiment" effect in market operations, was likely to bring about wider and more unpredictable fluctuations in prices. He discussed commodity markets as places for trading in risks and explained the reasons for the CFTC seeking disclosure of brokers' principals as a measure to control risk transfer.

Michael J. C. Stone, Chairman of E.D. & F. Man, and Lucien Renier, Director-General of Jean Lion & Cie., gave trade views of the raw and white sugar markets, respectively. Mr. Stone emphasized that only 18-20 million tonnes out of 90 million were traded and half of this was at prices geared to the world market so that the world price of sugar was set in terms of only 9-10 million tonnes traded, of which about half was now raw and half white sugar. He thought that world sugar stocks were likely to fall to critical levels by end-1981 and predicted that there could be another price explosion in the not too distant future and that there would be little the ISA could do about it.

Mr. Renier pointed out that 85% of EEC white sugar exports had gone to non-ISA-member countries in 1978 and that the Community had proved itself a reliable producer. He considered that EEC sugar production should not be reduced since other white sugar producers such as India, Peru and Thailand were struggling to produce their ISA commitments and a world shortage is forecast for 1981. This would hit poorer white sugar importers such as Algeria, Indonesia and the Sudan, and would cause reduced sugar consumption and perhaps greater use of non-sucrose sweeteners. It would also not be easy to reduce French sugar production and exports because of the importance of the rural vote in a pre-electoral year, and the recent improvement in prices had made the financial burden of the EEC's sugar policy almost negligible.

At a lunch given by the *Financial Times*, World Commodity Publishing Inc. and Tate & Lyle Ltd., Michael Attfield, Tate & Lyle's Director in charge of sugar trading, spoke on the EEC's sugar policy and said that he considered that the Commission's proposals should be accepted and the way paved to EEC membership of the ISA. He referred to the benefits of aid given to developing countries but said this was undermined by the inaction of the Community with respect to the Agreement and deprivation of the developing countries of the markets they might otherwise have supplied. He said that only by stabilizing sugar prices at a high enough level can consumers be protected against runaway prices caused by lack of investment in production facilities.

In the final paper of the Conference, Simon Harris, of the trade house S. & W. Berisford Ltd., agreed that the EEC should reduce its production of sugar which had expanded as an over-reaction to high world prices in 1974, although this would involve political problems. The EEC sugar industry could be given compensation as direct income payments, however, similarly to the 1969 Deutschmark revaluation.

The Chairman then brought the Conference to a close, thanking all who had taken part.

Cost control factors in the production of ethanol from sugar cane*

By F. H. C. KELLY

Introduction

This study is concerned essentially with the production of ethanol from sugar cane itself and not from molasses, and results from a feasibility study carried out by the author in the Department of Chemical Engineering at the University of Queensland in 1977. It was observed then that molasses could only be considered a satisfactory raw material for ethanol production if one or more of the following conditions operated:

(a) The sugar factory was very large (≮ 15,000 tcd).
(b) The relative production of molasses was very high owing to low quality cane or for some other reason.
(c) Transport costs for centralized collection were very favourable.
(d) Fuel costs for processing were very favourable.

A close study of the situation in Queensland as then prevailing revealed only limited prospects from this source which would not be considered as a prospective contributor to the national requirements of liquid fuel on a significant scale.

The prospect of using whole sugar cane for this purpose was examined in detail and under Queensland conditions revealed very interesting possibilities for development on a scale compatible with over-all national consumption of light liquid fuels and chemical feedstock (14 Gl/year in 1976).

Although a wide range of technical aspects was included in the feasibility study, the present submission is restricted to identification of cost controlling factors with some elaboration on directions for possible development.

Raw material

In any study of ethanol production the cost of raw material features prominently. If "world price" of raw sugar as a possible source of ethanol is compared with "world price" of crude oil, present-day costs display a relationship which is very favourable to sugar as an alternative raw material. However, it is well known that the "world price" of raw sugar bears only a marginal relationship to the real cost of production. It soon became evident that it would be unwise to tamper in any way with the structure of the present Queensland sugar industry for the purpose of obtaining low-cost ethanol, although full advantage should be taken of experience in growing sugar cane, the control of pests and diseases and the extraction of juice. Sugar cane grown in *new* areas specifically for ethanol production would, however, appear to have better prospects for lower cost development, but would require the parallel development of an entirely new social and economic structure suited to its own needs. This includes such very important requirements as new contracts between management and employees based on the merits of the ethanol industry rather than existing practices in the sugar production industry, although such can form a useful basis for discussion. For example a mechanical harvester is a mechanical harvester whether cane is cut for crystal sugar or ethanol production, but in Australia whereas cutting is currently restricted to daylight hours and to five days a week the prospective employment of the high capital cost machines for 24 hours a day and 7 days a week needs to be envisaged and appropriate adjustments sought.

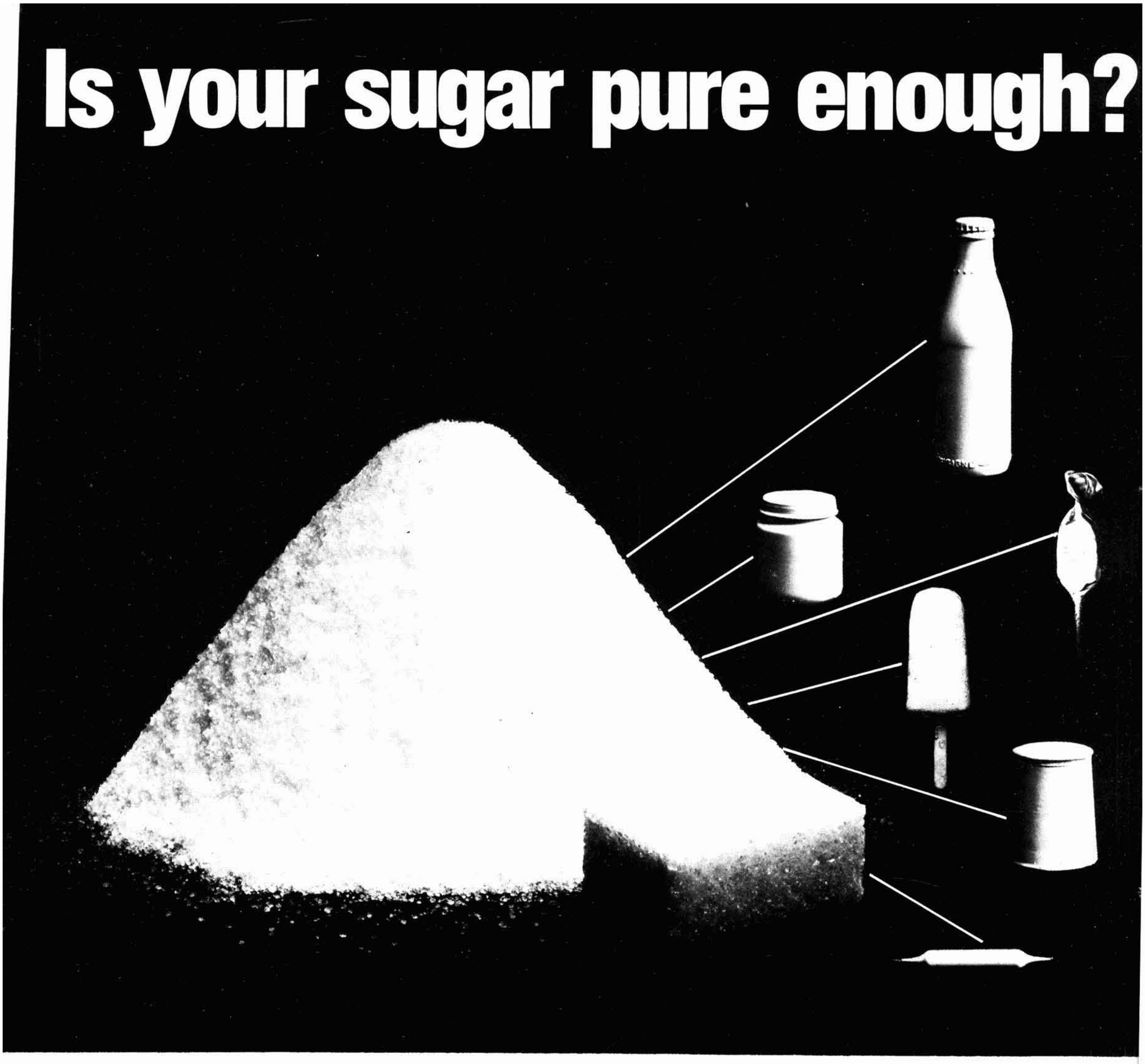
Diversion of cane from sugar to ethanol production is unlikely to be satisfactory economically and at the best to be only a short-term palliative. Whereas a community may tolerate certain high-cost aspects of production for a semi-luxury product such as sugar it is unlikely to be so tolerant towards an industry producing large quantities of liquid fuel the costs for which would permeate every aspect of daily living.

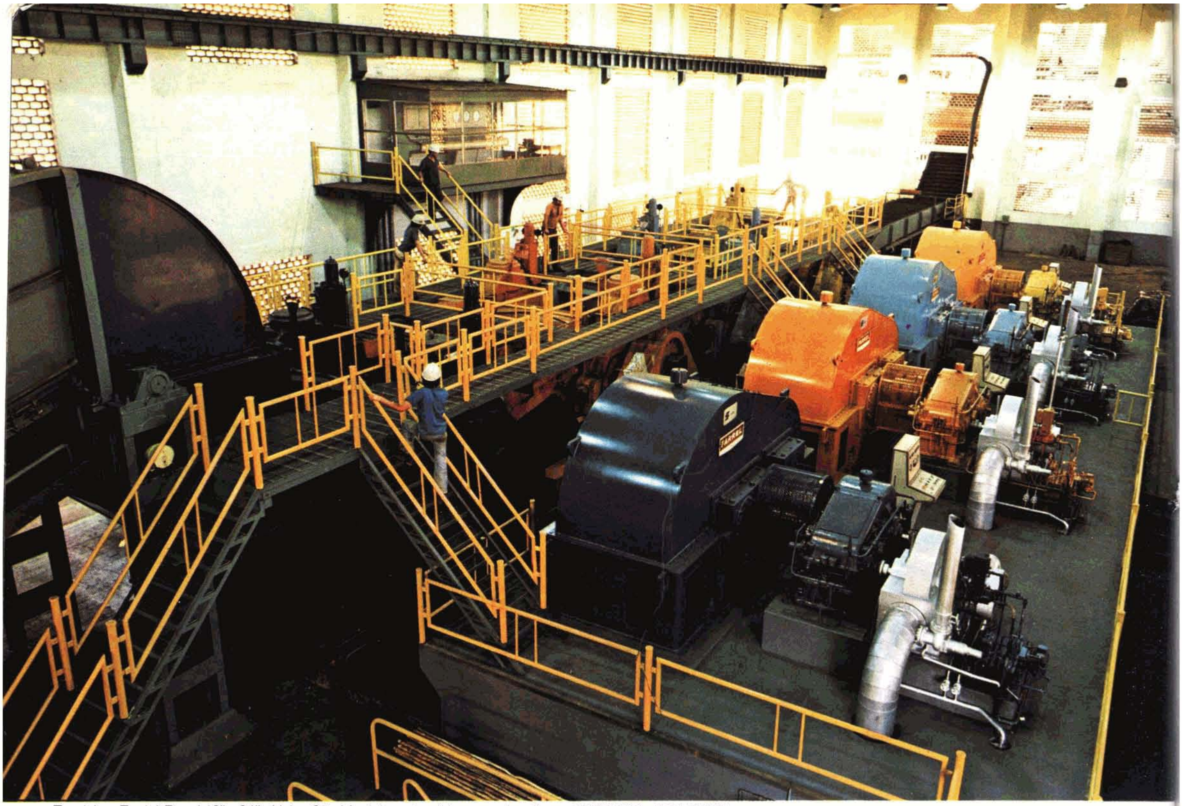
In order to be able to identify high-cost components in the production cycle the overall flow sheet for this study has been divided into 11 sub-units as far as the storage of ethanol at the distillery site. To this needs to be added transportation and other distribution costs. This procedure also has the advantage that variations of even ± 50% with respect to individual items only marginally affect the overall cost, and the possible scope of such variations in each sector can be individually examined.

Whilst sugar cane itself has been specified as the desirable raw material for this study it is necessary from a global or national point of view also to examine other possible sources of liquid fuel. It is not the purpose of this particular paper to do this, but it is pointed out that when making such comparison each source has both favourable and unfavourable conditions and it is necessary to be quite specific when dealing with such situations. The emphasis here is to define the most favourable conditions from all points of view for the production of ethanol from sugar cane. However, there is no unique solution to the problem of overall optimization, and the author will not attempt here to define such effects in detail but will draw attention to some of the situations which develop. For example, it is not uncommon to compare best productivity

* Workshop on Fermentation Alcohol for Use as Fuel and Chemical Feedstock in Developing Countries, Vienna, 1979.

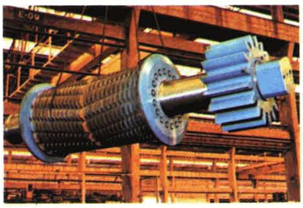
† Prof. of Industrial Chemistry, Science University, Minden, Pulau Penang, Malaysia.


Is your sugar pure enough?



Trapiches Zanini-Farrel 42" x 84" - Usina São Martinho - trapiches con 4 molinos - 8 000 TCD - 12% FIBRA

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



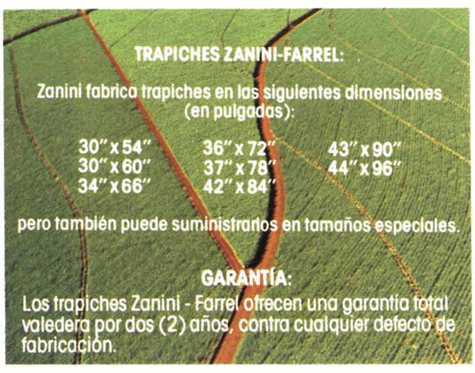
En el ramo azucarero, así como en cualquier otro, un buen equipo es de vital importancia para la obtención de un mejor resultado final. Cada pieza, cada equipo influye en el funcionamiento, pero sucede muy a menudo que un buen equipo no puede alcanzar los resultados deseados, debido a una falta de armonía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

Es por eso que Zanini no solamente fabrica el mejor trapiche del mundo, como también ejecuta proyectos completos para centrales azucareros. La calidad Zanini está siempre presente, para mejor seguridad del central azucarero y mayor tranquilidad del cliente, desde la fabricación del equipo hasta la indispensable asistencia técnica después de la instalación.

Y esta eficiencia es garantizada por el alto nivel tecnológico conseguido

a través de una asoci ción que reunió en una única fuente, la experiencia, la tradición y el "know-how" de Zanini y Farrel.

Por lo tanto, cuando Ud. piense e trapiches o en un gra proyecto de producción de azúcar, diríjase a aquel que tenga condiciones de suministrar no sólo el mejor equip como también la mejor solución para la coordinación global de su proyecto. Diríjase a Zanini.



conditions for a new crop with average conditions for sugar cane without examining the possibilities for best conditions for sugar cane or the likelihood of the new crop achieving less than best conditions under real-life large-scale situations.

To expound on this example for sugar cane, we may examine average yields on a world basis and find that best country yields are at least twice as much as the average and the best area within the best country may yield twice as much as the average for that particular country and the best farm within the best area may yield twice as much as the average for that area or eight times as much as world average. Queensland is a country where very high productivity values for sugar cane have been achieved but the author estimates that the average yield of stalk cane per hectare is still only about 34% of the known achievable under optimum growing conditions, which means that many countries are probably operating at not better than 20% of achievable yield and some as low as 10%. The author has estimated the maximum achievable photosynthetic efficiency for sugar cane, when grown as an economical crop under currently known conditions of technology, to be around 8%.

For successful economic development of an agro-based ethanol industry it is considered essential to apply the best 20th century technology at each of the agricultural, harvester, transportation and processing stages. The industry would not provide a panacea for unemployment, the minimum skill being that of the driver of a heavy duty tractor or truck or the general supervision of computer-controller processing.

Cost component items

In applying the principle of multi-component subdivisions for cost analysis the author categorized 55 subject areas for study, examined in detail 25 favourable combinations of conditions for cost estimations and required 35 sub-headings to summarize the findings effectively and tabulated under 20 sets of conditions recommendations related to areas of research and development considered to be important. The study was comprehensive but not necessarily exhaustive. The following costing sub-divisions were actually used:

1. Development of land including net capital cost, drainage and irrigation development.
2. Cultivation costs.
3. Fertilizers and chemicals.
4. Irrigation application.
5. Harvesting.
6. Management of plantations or farms.
   A = total growing costs.
7. Transportation of cane from field to factory.
8. Capital cost of factory.
9. Maintenance.
10. Labour and chemicals.
11. Management of factory.
    B = total processing costs.
    C = total cost of ethanol ex-distillery.

There is room for differences of opinion or custom within this subdivision and adjustments are permissible to accommodate personal preferences but this subdivision is adopted here as a primary basis for consideration of the problems.

All agricultural operations have become very highly mechanized and the sugar cane industry has shared in these developments. One very important requirement for the economical application of these developments is *continuity of use of equipment.* This requires, first, that a high standard of mechanical maintenance be achieved and, second, that the items of equipment be used for as large a proportion of available time as possible. The seasonal nature of agricultural operations reduces the time available for use in any one year and anything which can be done to extend seasonal operations must be of benefit from this point of view. Agricultural machinery is generally not distinguished for the standard of maintenance achieved, perhaps more so when small-scale units are employed. The most costly and physically largest mechanical unit employed on the sugar cane plantation is the present-day chopper-type harvester. At present practically every stick of cane in Queensland is mechanically harvested, but a study of the statistical records indicates that these very costly machines are being used to only about 13% of their potential capacity. There lies within this segment a factor of 5 to 7 by which the capital cost component could be reduced. An analysis of lost time due to mechanical failures for agricultural equipment in general reveals maintenance standards close to one-tenth of those achieved within the factory. Continuity of operation of other agricultural operations (including irrigation) also has important economic benefit and optimization is required at all stages *e.g.* cost/benefit of 24 hr/day ploughing and planting.

Sugar cane will grow in practically any type of soil, and those soils which are often classed as unsuitable can generally be suitably modified albeit at some cost. Water supply, fertilizer and sunshine are the three important requirements for satisfactory growth. The cost of developing land includes grading and draining as well as the storage and reticulation of water for irrigation. It has been preferred here to consider under a separate item the cost of applying the irrigation. The earlier items are considered to be part of the capital cost of land development which is a quite significant item in the list of costs and special attention has been given to amortization techniques. The period for repayment of capital plus interest with respect to total land development costs can be spread over a much longer period of time than for machinery, and for these studies a period of 75 years has been preferred with 20 years for processing plant and 5 years for agricultural machinery.

At the present time high interest rates are being charged for loan funds and are believed by economists to represent one antidote for high rates of inflation. This places a very heavy burden on amortization even if repayment is spread over a period as long as 75 years. One way of meeting this problem is to apply a system of indexation to repayments designed to keep the ratio of periodical repayments to sale price of product constant. It is of course difficult to predict the likely sale price for any commodity in 50 or 75 years time but it is not without interest in this context to look back for 50 or 75 years and to see just how the net prices of such commodities as petrol, ethanol, sugar and sugar cane have changed; an exercise which is rather more satisfying than a corresponding study of short-term changes. For example for every $100 initial capital investment at 5% an equal annual repayment of $5.13 would be required for each of 75 years, whereas if an indexation increment of 3% per annum is used then the median payment for the first 5 years would be only $1.55 although the payment in the 75th year would be $12.96. History seems to indicate that over long time spans annual inflation rates tend to average around 5%; hence an indexation of 3% could be expected to have a reasonable margin of safety. Correspondingly an 11% loan fund interest rate indexed at 3% p.a. would require payments of $11.00, $3.31 and $27.79. The mathematical relationships are itemized in Appendix 1.

Whilst an indexed system of amortization is of considerable benefit for debts repaid over long periods such as 50 to 75 years it is of only marginal value for a 20-year period and of no significant value for 5 years.

The money spent on primary land development has a very strong influence on productivity in later years; hence there is real value in enabling a thorough job to be done at this stage including the important items of flood prevention, drainage and adequate irrigation supplies.

Size of farm or plantation

This, more than any other single item, seems to have a dominating influence on the ultimate cost of ethanol, and the development of sugar cane culture for ethanol production as a new industry affords an opportunity to examine this aspect *ab initio*. The overall magnitude of full-scale development to provide in full Australia's present requirements of 14 Gl p.a. of liquid fuel would require an expansion 4 to 7 times the size of the present Queensland sugar industry which totals approximately 3250 km^2 subdivided into 7300 units averaging 44.5 ha. Development on this scale would afford substantial scope for study.

Whilst increased scale of operation offers bright prospects for reduction in management and operating costs, it is recognised that productivity tends to be lower as scale increases. A general relationship between productivity and unit area of growing, which has been found useful, in the author's experience, with respect to sugar cane growing, is evaluated in Appendix II.

Anticipating the overall picture of the final cost of ethanol, two complex exponential relationships became evident relating the estimated price of ethanol ex-distillery to the log of the log of the size of unit farm or plantation area. For this a gross area of 350 km^2 per factory unit has been employed, the effect of variations from which were separately considered.

When considering economic optimization of the size of a single plantation-factory unit in this situation, two factors are prominent: (1) the logistics of maintaining a continuous supply of fresh cane to the factory and (2) the absolute maximum size of a distillation column. A figure around 10,000 tcd seems best to satisfy these two requirements and for high productivity cane production corresponds to an area of approximately 350 km^2 if the season can be operated for as long as about 270 days.

The proposal to extend the season to around 39 weeks from the present practice of approximately 28 weeks assumes that the total sugar content of the cane has a less well defined peak value than for recoverable crystal sugar. The practical limits then become more specifically the end and beginning of the wet season.

Changing these parameters plus that of the working week-end introduces a step change into the relationship between the size of farm or plantation unit and the cost of ethanol.

Figure 1 illustrates in summarized form general relationships between the estimated cost of ethanol (ex-distillery) and the size of individual farm or plantation units incorporating also the direction and approximate magnitude of the influences of a range of additional variables.

The net result of these studies was to prefer plantation units of 1600 hectare area although managing the whole 350 km^2 as a single plantation unit could have some financial advantages. There is a tendency in the present Queensland sugar industry for some amalgamation of farm activities perhaps up to 150 or 250 ha, and two factory-owned plantations still remain. Within the global picture a plantation of 300 km^2 (net) supplies a factory in Argentina at the rate of 18,000 tcd, and comparable sized complexes operate in Mexico and the Sudan.

Processing cane

For producing crystal sugar only stalk juice is used and even this is required to be as fresh as possible. When ethanol is the end-product deterioration, which results in the formation of fermentable hexose at the expense of sucrose, is immaterial and juice from the tops carrying a higher proportion of such hexoses should be quite acceptable. Furthermore a useful proportion of the fibre is fermentable after hydrolysis. It was estimated that under Queensland conditions, whereas 96 litres of ethanol could be expected from 1000 kg of juice extracted from the cane stalk this could be increased to as much as 164.5 litres (71% increase in yield) if the tops were also processed and the cellulose component of the fibre hydrolysed and fermented.

Harvesting, transportation and milling of tops together with the stalk of the cane should present no particularly difficult problems. However, cellulose represents only about 53% of the total dry fibre weight and is the only component hydrolysable to fermentable hexose (glucose). The steps involved in these conversions still require much detailed study as any one of several routes is possible. The route preferred by the author is to minimize capital and operating expenditure at the milling stage by employing only a three-roll crusher and a single three-roller mill with appropriate pressure feeder device. Two preliminary sets of

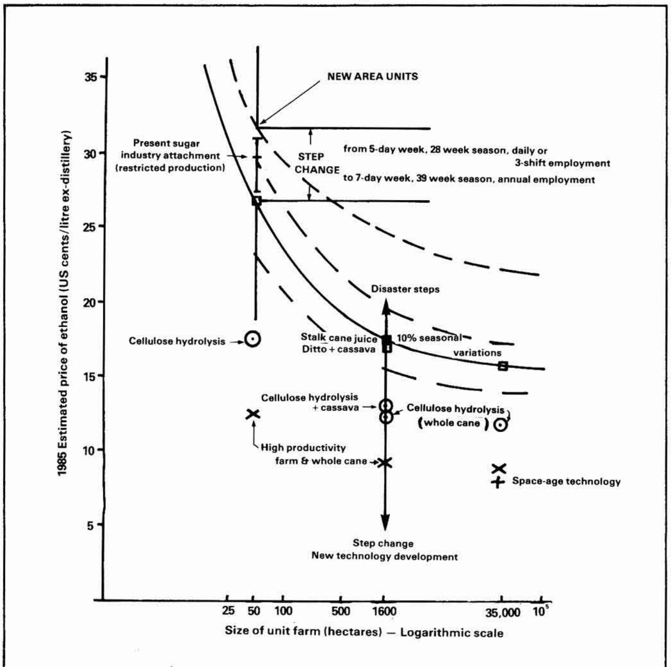


Fig. 1

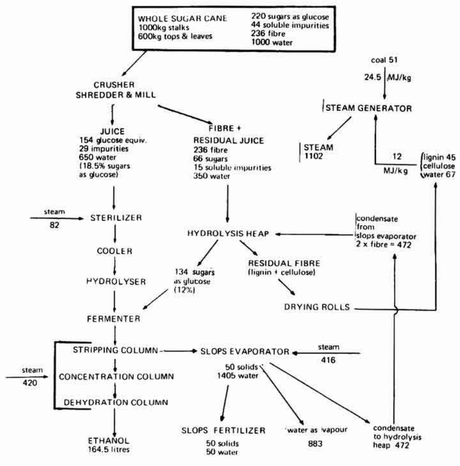


Fig. 2. Simplified flow sheet for whole cane processing with cellulose hydrolysis. Steam Usage: Power 40, Sterilizer 82, Distilltn. 420, Slops. evap. 360, Miscell. 200. Total steam 1102

knives are preferred and a shredder between the crusher and mill. The juice stream can then be processed through hydrolysis, fermentation and distillation. The fibre containing some 25% of residual juice would be subject to treatment in a separate stream.

For fibre processing the author expresses a preference for employing a "heap" technique comparable to that of the Ritter system developed actually for bacterial preservation of fibre. The percolation of biological fluids through large heaps is also practised on tailings dumps in the metallurgical industry. The author has observed the Ritter process in large-scale operation and is of the opinion that there should be no significant technical difficulties in converting its operation to use with a cellulase-rich percolating liquid phase. Fibre hydrolysis is difficult and slow, but any thermal technique aimed at accelerating the kinetics invariably results in loss of fermentable hexose. The Ritter bagasse storage system is ideally suited to slow treatment of large quantities of fibre at ambient temperatures. The residual fibrous material can be separated by passing it through perhaps two sets of standard 3-roller mills with pressure feeders, the extracted fluid joining the main stream of fluids passing to the fermenter.

The dried residual fibre would consist of a mixture of lignin and unhydrolysed cellulose — possibly 25% of the original amount. This lignin-cellulose mixture dried to a moisture content of 47% should be a very satisfactory fuel for those who are expert in burning bagasse. The fate of the pentosans forming some 23% of the dry fibre is uncertain; if hydrolysed (xylan) they would go out with the distillery slops as pentose, whereas any non-hydrolysed fraction (araban) might well go forward with the lignin-cellulose stream as fuel. It is unlikely that the lignin-cellulose residue would provide sufficient fuel for the whole process but supplementation (probably with coal) still leaves the hydrolysis of cellulose an economically viable route. Careful costing is called for at this stage to determine whether some lesser efficiency of hydrolysis would be justified but it is a low-cost route for converting coal into ethanol.

Fermentation

This is an important stage in the processing flow sheet and well worthy of careful cost-benefit as well as technical study. Important parameters are hexose concentration, non-hexose solute influences and effective application of continuous fermentation techniques.

Distillation

This is also an important step for maximizing thermal efficiency by multiple-effect type operations attending also to the need for a high recovery of ethanol. It is anticipated at this stage that anhydrous ethanol would be the preferred product but the possibility exists of some or all of the product being more economically marketed as 95% ethanol.

Slops disposal

The residue from the distillery becomes a very important and quite substantial by-product of the ethanol recovery. Disposal procedures which might prove satisfactory for a distillery processing only relatively small quantities of molasses become unacceptable for operations on the scale envisaged for whole-cane processing. They do contain materials valuable as plant nutrients and in fact contain probably 90% of the nutrients removed from the field with the plant. If these can be effectively recycled they can result in a very substantial reduction in consumption of chemical fertilizers. There may be difficulties in justifying the economics entirely on the basis of present-day costs of chemical fertilizers but it is close enough to make it a worthwhile undertaking from the point of view of conservation of energy and material resources.

Whilst recognising that there are technical difficulties, the author believes that these are by no means insoluble and that concentration of slops by multiple-effect evaporation is likely to afford the most satisfactory means for dealing with this problem.

Labour-saving expedients

For agro-ethanol to be economically viable it would be reasonable to expect the standard of technology to be comparable to that of an oil refinery or a petrochemical industry; correspondingly, a R & D effort comparable in magnitude and expertise would be expected to have benefits of much greater magnitude than we could envisage today.

Perhaps the most obvious labour-saving applications appear to be in the processing plant where the installation of automatic control instrumentation, micro-processor programming and overall computer monitoring would be logical expectations for any new installation.

However there is an even greater potential for labour conservation in the agricultural area if the energy at the disposal of an individual operator can approach that which an operator is a modern sugar factory has at his command. This means bigger tractors, double-row harvesters, double or multiple-row planters as well as mechanized irrigation and fertilizer application.

The possibilities of applying space-age technology for remote control of either agricultural operations or factory processing is a topic of imminent interest. Whereas one man may drive one tractor during the 20th century, there are now no technical reasons why one man should not drive 10 tractors.

The master-minds of the industry could activate controls from a centre through satellite transmission and closed-circuit television observation requiring essentially only a maintenance team on site.

Government charges

It should be superfluous in a discussion of this character to point out the very important and significant component of petrol prices which incorporates government charges in the form of a tax or taxes. When considering overall relative economic benefits of agro-ethanol it is necessary to take cognisance of government charges althougn the nature and magnitude of their imposition will be largely determined by politico-economic considerations. The point may well be made that instead of imposing restrictive taxes on ethanol production or consumption as a motor fuel or chemical feedstock from agricultural sources it may be considered in the best interests of the nation actually to subsidise the industry with financial incentives for development, as benefits accrue within a country which also result in minimizing the need for external payments.

Summary of cost estimates

Whilst the author has examined a very large number of possible combinations of production and processing variables from the point of view of probable cost contributions Table I represents the lowest cost conditions envisaged from these calculations and may serve as an indication of the nature of the problems with which the industry would be concerned.

TABLE I. Estimated costs in US cents (1977/78) per litre of ethanol produced in 1985 using reasonable maximum productivity of cane, whole-cane harvesting, cellulose hydrolysis and fermentation, with application of space-age technology.

Items	*35,000 ha estate at 160 tonnes cane/ha*
Total annual production of ethanol	690 Ml
Capital cost of factory	US$100 m
Property development	0.83 ¢/litre
Cultivation costs	0.08
Fertilizer and chemicals	0.11
Irrigation application	0.27
Harvesting	0.06
Local management	0.08
Total agricultural cost	1.43
Transportation of cane	0.44
Capital assessment for factory	2.98
Maintenance	0.72
Labour and chemicals	0.11
Local management	0.06
Cost of coal	1.67
Total processing cost	5.98
Proportion of control centre cost (20% at 20 years for US$560 m and and 14 Gl/annum of ethanol)	
Capital assessment	0.81 ¢/litre
Management and operation $22 m/yr)	0.16 ¢/litre
Cost of space age technology application	0.97 ¢/litre
Total cost of ethanol ex-distillery	8.38 ¢/litre

It is interesting to note that whereas the price of sugar cane in the sugar industry is commonly assessed at around two-thirds of the price of raw sugar or perhaps half of the price of refined sugar, the largest component in the above list of cost items for ethanol production under space-age conditions of technology is the capital assessment for the processing plant with the total agricultural cost being only 17% of the ex-distillery figure. This proportion becomes progressively smaller as we pass from around 30 ¢/litre when associated with even the best of present-day sugar production as agro-technology is oriented more towards the ethanol problem itself and incorporating all of the developments related to the problem and known at the present day to minimize around 8.4 ¢/litre, a figure which could justifiably be considered to compare more than favourably with petroleum-based fuels of corresponding quality. Property development costs in this table relate to an indexed amortization (on 11% interest) and would rise to 1.29 ¢/litre (on 5% interest) for equal annual payments.

Appendixes

I Indexed Amortization Formulae:

R = (C * i)/(1 − (1 + i)↑ − n) . . . . (a)

$Y_1 = (R*n*(1+r))/(\sum_{o}^{n}(1+r)\uparrow n)$

$Y_n = Y_1 * (1+r)\uparrow n$

I = R * n − C where

R = repayment in equal amounts for equal time intervals

C = capital debt

i = interest rate (uniform throughout period)

n = number of time intervals

Y_n = repayment for specific year n

I = total interest repaid to year n.

II. Productivity—Area Relationship

Productivity New = {[(AREA OLD)/(AREA NEW)]↑ 0.0184} * PRODUCTIVITY OLD

III. Cost-Area Relationships—equations to full line curves in Figure 1.

(a) for 5 day week, 28 week season and daily or 3 shift seasonal employment with short-term living/firing

$K = 41.74 - 8.21 * \log_e(\log_e A)$

(b) for 7 day week, 39 week season, daily or 4 shift roster employment system but with annual retainment

$K_L = 50.37 - 17.36 * \log_e(\log_e A)$
(for 10 to 100 ha unit area)

$K_H = 19.2 - 1.35 * \log_e(\log_e A)$
(for 1000 to 100,000 ha unit area)

where

K = estimated cost of ethanol ex-distillery in US cents/litre

K_L = ditto for low area farm units

K_H = ditto for high area farm units

A = unit area of farm or plantation in hectares.

Summary

A detailed economic analysis is based on the most advantageous present-day circumstances for alcohol manufacture from sugar cane. This shows that it would be practicable to produce alcohol at a cost comparable to that of petroleum-based fuels.

Facteurs en contrôle de frais chez la production d'éthanol à partir de canne à sucre

Une analyse économique detaillé se base sur les circonstances les plus avantageuses d'aujourd'hui pour la production d'alcool à partir de la canne à sucre. L'analyse montre qu'il serait praticable de produire l'alcool à un frais comparable au coût de combustible sur base de petroléum.

Kostenregelungsfaktoren bei der Herstellung von Äthanol aus Zuckerrohr

Eine detaillierte wirtschaftliche Analyse beruht auf den heutigen, vorteilhaftesten Vorraussetzungen für Alkoholherstellung aus Zuckerrohr. Die Analyse zeigt, dass es möglich sein würde, Alkohol auf denselben Kosten wie auf Erdöl basierte Brennstoffe herzustellen.

Factores en el control de costos en la producción de etanol de caña de azúcar

Se base un análisis económico detallado sobre las circunstancias actuales las más ventajosas para la fabricación de alcohol de caña de azúcar. Este demuestra ques es practicable producir alcohol a un costo comparable con ello de combustible basado en petróleo.

Eradication of a major pest of sugar cane

By R. A. AGARWAL

Sugar cane is damaged by about a dozen species of tissue borers in India. Some of them are ubiquitous and occur year after year all over the country. Amongst them the Gurdaspur borer (*Bissetia steniellus* Hmpsn.) is undoubtedly one of the most destructive pests. It has defied all known chemicals so far. However, an effective technique to eradicate it was evolved from the affected states in the sub-tropics. The results of the work are presented below.

General behaviour and biology

Until 1923 the pest was confined to a small area in North-Western India. It has assumed serious proportions in three Northern States in about 40 years. Its attack starts in July i.e. with the onset of rains after the cane formation has set in and tillering has practically ceased.

The newly hatched larvae enter the upper portion of the cane through a common hole. The entrance hole is generally made through the bud point in the nodal region nearest to the egg cluster and thus the larvae feed gregariously up to the second moult and move upwards in a spiral manner making minute punctures on the rind from within. On closer examination they appear as a dark spiral streak which is made up of a series of punctures lying side by side as short holes. Later, they bore deeper into the stalk and feed in a single straight tunnel moving upwards. As a result of this attack the side leaves turn pale in the beginning and, as the attack proceeds further, the entire whirl of leaves at the top dries up. Such plants can be easily spotted from a distance.

The larvae come out of the infested cane in about 8-10 days. The primary infested stalks not only fail to grow. They break at the point of entry when shaken by wind or by passing animals. The larvae after emerging enter a solitary phase and disperse to individual canes and move downwards. The pupation takes place in a specially constructed pupal cell in the attacked shoot.

The pest remains active from July to October, with two to three generations completed in a year. During this period all stages of the pests are encountered and a tremendous amount of overlapping of generations takes place. With the approach of winter the larvae migrate to the lower portions of the stalk and finally travel to underground portions into the stubble, where they ultimately enter into diapause till the next rainy season.

The damage caused by this pest varies from 5 to 50%. The loss is particularly heavy in the early stages of attack as most of the canes attacked dry up and are thus a total loss to the cane grower.

The eradication of the pest was undertaken at two stages of the crop, viz., in the standing crop, i.e. during the active phase of the pest, and at harvest, i.e. at the inactive phase of the pest.

Eradication in the standing crop

To take advantage of the gregarious habit of the freshly hatched larvae and identification of affected cane by drying of the crown, the tops showing such symptoms were removed before the larvae could disperse to the adjoining shoots or canes. Large scale campaigns, involving a team of workers equipped with knives and gunny bags, were launched simultaneously in the entire sugar cane area. Daily records were maintained of all the shoots removed. Data from one zone were analysed for assessing the efficacy of the eradication programme (Table I).

Table I. Number of affected tops removed per ha

Month	Week	Year 1st	2nd	3rd	4th	5th	6th	7th
July	I	X	X	X	X	X	X	X
	II	X	X	X	X	37	44	X
	III	X	X	X	420	X	X	X
	IV	X	X	X	1149	221	287	42
	Total	X	X	X	1569	259	331	42
August	I	X	X	6452	X	1294	X	X
	II	X	X		X		736	X
	III	657	114	3176	X	X	X	X
	IV	1141	1270	2574	2050	625	734	262
	Total	1798	1384	12202	2050	1919	1470	262
September	I	1119	1082	2366	X	X	X	X
	II	1003	1013	1618	1828	557	X	X
	III	1228	1010	1517	X	X	X	X
	IV	1119	1082	1561	1440	353	687	212
	Total	4469	4187	5501	3268	910	687	212
October	I	981	1005	1492	X	X	X	X
	II	976	906	1326	1097	546	X	X
	III	963	763	1447	X	X	X	X
	IV	825	X	X	X	X	425	X
	Total	3745	2674	4265	1097	546	425	X
Total		10012	8245	21968	7984	3634	2913	516

X – No tops removed

The campaign was mainly aimed at removal of affected tops at weekly intervals from the last week of July onwards from the entire area except in cases when weather did not permit the workers to enter into the field or there was a shortage of labour during the week. The volunteers were directed to inspect every clump every week in their zones. The campaign started in 1958 and operated every year thereafter till 1964.

The entire area was divided into zones and again into blocks of 65 ha each. Each block was under the charge of a supervisor assisted by volunteers. The affected tops collected during the day were buried deep in the soil every evening. The time schedule for starting the campaign was from the first week of July until October, when the larvae started migrating downwards into the stubbles.

Results

The data collected showed that during the first year of the campaign 10,012 affected tops were removed per ha whereas in the 2nd, 3rd and 4th years 8245, 21968 and 7984 tops per ha, respectively, were removed. The high number (21968) during the third year was due to the late start of the campaign coupled with early monsoons. The early rains seems to have stimulated the early emergence of the over-wintered generation. This was reflected by the large number (12202) of affected tops in August itself. However, from the 5th year onwards the number of attacked tops continuously decreased every year, so much so that in the 7th year the number of tops damaged were only 516 per ha. The average number of tops removed per year during the first five years worked out to 10567 per ha compared with 1714 for the 6th and 7th years. Each affected top is believed to harbour 15 to 25 gregarious-stage larvae.

The economics of the treatment work out as a net saving of about 43 quintals of cane per ha and the cost benefit ration works to 1:14. The results of the campaign were still more rewarding in subsequent years as the borer was considerably reduced in the treated area.

Eradication at harvest

The larvae of the Gurdaspur borer migrate into the root zone after October. (Table II). The canes harbouring diapausing larvae can be easily recognised by a straight streak in the cane when cut at ground level. Such canes were treated by injecting 0.5% Endrin or by spiking a pointed wire into the roots.

Table II. Migration of larvae from stalk to root zone

Month	Larvae above ground, %	Larvae below ground, %
July	100.0	0.0
August	100.0	0.0
September	83.8	16.2
October	38.8	61.2
November	11.5	88.5
December	23.6	76.4
January	11.6	88.4
February	12.7	87.5
March	14.5	85.5
April	10.5	89.5

Materials and methods

A plot of 2000 ha was selected in a severely infested area for spiking and Endrin treatments. To facilitate checking of treated stubbles blue ink was added to the Endrin emulsion. The treatments were done within 48 hours of harvesting the crop as locating of infested stubbles become difficult after this interval.

Observations on mortality of larvae were made after 3, 24, 48, 72 and 168 hrs of operations. For assessment of results three plots of 20 ha each were demarcated viz., (i) one from the central portion of the treated area (ii) one at the periphery and (iii) one in the untreated area situated far beyond the treated area. (Fig. 1)

Results

An assessment of the proportions of live and dead larvae in the stubbles was made from December to March, *i.e.* at a time when the larvae were hiding in the root zone. It was shown that 3.6% canes were infested, *i.e.* nearly 3557 larvae per ha were hidden in the stubble during the winter in the 7th year of the campaign. It was also noted that about 89% of the larvae survived in spite of extreme cold and other adverse weather conditions. About 9.0% were found dead and 0.61% were parasitized by *Apanteles flavipes* Cam. and 0.91% by an unidentified fungus.

It was noted that during July and August all the larvae were present in the stalks (Fig. 1) whereas, from

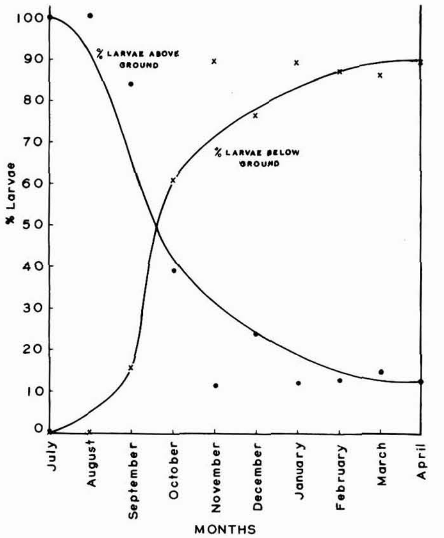


Fig. 1. Migration of *B. steniellus* larvae

September onwards, they started migrating to the root zone and about 90% of them were lodged in the root-stock. The population in stalks above the ground largely perish at harvest or are crushed in the sugar factory. However, a negligible population of about 1.3 to 3.9% may still remain in the left-over stalks.

Eight hundred stubbles suspected of harbouring the Gurdaspur borer larvae were injected with 0.5% Endrin emulsion. These stubbles were examined by splitting them in lots of 50 each. The data demonstrated (Table III) that Endrin emulsion killed 40.0, 54.0, 66.5 and 81.5% larvae after 24, 48, 72 and 168 hours, respectively. It was observed that 80% of the larvae were either dead or in a moribund condition after 72 hours and 92% 168 hours after treatment.

Table III. Effect of injecting Endrin 0.5% emulsion into stubbles

Condition of larvae	Hours after treatment 24	48	72	168
	%			
Alive	10.0	10.0	6.0	3.5
Moribund	43.6	30.5	23.0	10.5
Dead	40.0	54.0	66.5	81.5
Stubbles without larvae	4.0	5.5	4.5	4.5

In spiked stubbles mortality of about 86% larvae was observed (Table IV). It was found that the larvae lodged in the bent portion of roots escaped the hits of the spike. The mortality of larvae being immediate greatly convinced the farmers of the value of the measure.

Table IV. % Mortality of Gurdaspur borer larvae in stubbles 3 hours after spiking

Sample	Stubbles bearing larvae	% Mortality
1	100	91.5
2	100	86.8
3	100	85.2
4	100	86.0
5	100	84.6
6	100	83.3
7	100	83.5
Average		86.2

However, in areas affected by red rot or other diseases spiking of stubbles was not recommended, in order to avoid infection.

Effect of stubble treatment on larvae population during the next year

On an average 10 weekly cuttings of the affected tops were done from July to October for 7 years. The average number of tops removed during the first two years were compared with those of the previous year. This showed significant reduction in the number of affected tops. Evidently the population of the larvae was considerably reduced confirming the efficacy of the weekly removal of tops affected by the Gurdaspur borer.

The comparison of data for the last year in which stubble treatments were done showed that there was a reduction of 85% in the number of affected tops in the central portion of the treated area (Table V). Both Endrin injection and spiking were equally effective. A reduction of 61% in number of affected tops was recorded at the periphery (Fig. 2) and about 12.5% reduction at the outside of the treated area was noted. These observations indicated that the stubble treatment reduced the carryover population of the larvae. It thus significantly affected the initial population during the next year. The cost of insecticidal treatment comes to about ten rupees per hectare.

Table V. % Reduction in number of infested tops (in the succeeding active season) after the stubble treatment

No. of shoot	Number of affected tops in area			
	Central (Nachraun)	Middle (Radaur)	Periphery (Barshami)	Outside (Lakhmari)
Average of penultimate + last (7th) year	361	1987	958	684
Succeeding Year (9th year)	53	278	269	855
% reduction in damaged shoots	85.2	86.1	61.5	12.5

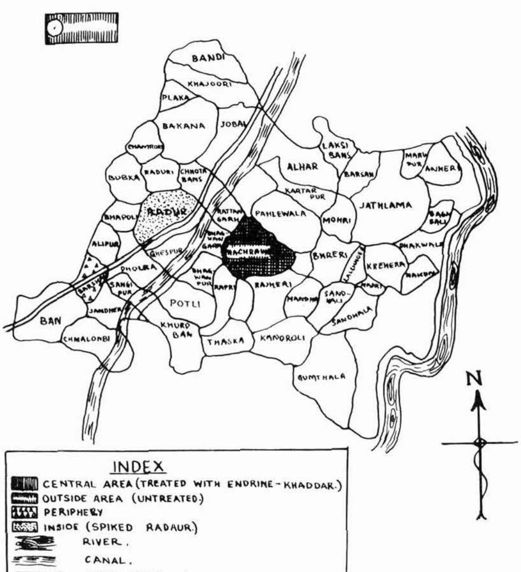


Fig. 2

Conclusions

A mechanical method, involving the weekly removal of primary infested tops, followed by injecting of 0.5% Endrin or other insecticide such as gamma-BHC or spiking the roots suspected to harbour the diapausing larvae at harvest is likely to eradicate the Gurdaspur borer. However, to achieve results it is necessary that the campaign of cutting the tops must be started soon after the first shower of rains and continued until October, when the larvae enter into diapause. This treatment must be done simultaneously over the entire area infested by this pest.

Summary

The Gurdaspur borer has defied all chemicals known so far. However, mechanical control, *i.e.* cutting of infested tops from the entire area at weekly intervals commencing soon after the first rains (from some time in July to the end of October), until the larvae enter into diapause, has shown spectacular control of the pest. The application of 0.5% Endrin or gamma-BHC, or spiking the stubbles harbouring larvae at harvest, will considerably reduce the carry-over population.

Eradication d'un des principaux ennemis de la canne à sucre

Le borer Gurdaspur a résiste tous les produits chimiques connus jusqu'à présent. Cependant, un contrôle mécanique, c.à.d. la coupe hebdomadaire des bouts infestés sur tout le champ commençant peu après les premières pluies (d'un certain moment en juillet jusqu'à fin octobre), jusqu'à ce que les larves entrent en diapause, a permis une maîtrise spectaculaire de cet insecte. L'application de 0,5%d'Endrin ou de gamma-BHC, ou l'étêtage des chaumes qui hébergent les larves lors de la récolte réduit considérablement la population gestante.

Ausrottung eines bedeutenden Zuckerrohrschädlings

Bisher sind alle gegen den Gurdaspur-Bohrer bekannten Chemikalien wirkungslos. Jedoch hat die mechanische Bekämpfung, d.h. das Abschneiden der befallenen Spitzen im ganzen Gebiet in wöchentlichen Intervallen bald nach den ersten Regenfällen (von einer Zeit in Juli bis Ende Oktober), bis die Larven in die Diapause eintreten, eine spektakuläre Kontrolle dieser Schädlinge ergeben. Die Anwendung von 0,5% Endrin oder gamma-HCH oder das Aufspießen der die Larven enthaltenden Stoppeln, reduziert die überlebende Population beträchtlich.

Extirpación de un mayor plaga de caña de azúcar

El barrenador Gurdaspur ha desafiado todas químicas conocidas hasta el presente. Sin embargo, control mecánico, es decir, corta de cogollos infestados en la área entera, en intervales de una semana, empezando poco después de las primeras lluvias, es decir, de algún día en julio al fin octubre, hasta las larvas entran en diapausa, ha dado control espectacular de esta plaga. Aplicación de 0,5% Endrin o gama-BHC, o tratamiento con un pincho de los rastrojos que abrigan larvas a la cosecha, ocasionara una caída considerable en la población superviviente.

SUGAR BEET AGRONOMY

Lime ensures maximum tops and root yield. J. Blades. *British Sugar Beet Rev.*, 1979, **47**, (1), 49-50. – Filter cake applied on fields in Lincolnshire raised the pH from 4.7-6.2 to 6.8-8.0 and provides nutrients in addition. This reduces expenditure on fertilizer while improving yields of beet and tops used as animal fodder.

How to load a 21-tonne truck in seven minutes. W. Hollowell. *British Sugar Beet Rev.*, 1979, **47**, (1), 52. A cleaner-loader designed by a haulage contractor in the UK is briefly described and illustrated. It can handle 5 tonnes of beet per hour and gave very little trouble in the 1977 campaign.

Good sugar beet quality – profitable for the farmer. Even in spring something can be done to achieve it. W. C. von Kessel. *Die Zuckerrübe*, 1979, **28**, (2), 10, 12-13 *(German)*. – Aspects of spring work which are of importance for a final crop of high-quality beet are examined, including sowing to achieve good emergence, balanced fertilization, and control of weeds, pests and diseases.

The effect of plant population on sugar beet performance criteria. E. Bornscheuer. *Die Zuckerrübe*, 1979, **28**, (2), 14-15 *(German)*. – Results of 15 tests at one location showed that, while a final plant population of 65-75,000 gave a high beet and sugar yield, 80-90,000 gave slightly lower beet yield but a somewhat higher sugar yield; 50-55,000 gave very low beet and sugar yields. The point is made that root quality will react more rapidly and to a greater extent than will root yield when the population is reduced. The effect of type of seed and use or non-use of thinning on emergence and final population is also examined.

Nitrogen application to sugar beet – helping to decide with the N_{min} method. H. C. Scharpf and J. Wehrmann. *Die Zuckerrübe*, 1979, **28**, (2), 16, 18 *(German)*. – The N_{min} method involves analysis of the soil, e.g. down to 90 cm, for available N at the start of the growing period or prior to fertilization. The amount to apply to the crop is then found by deducting the available quantity from a value established for a given region to give an optimum yield. There is a transitional range of values of N_{min}, below which a top dressing will be necessary and above which a top dressing will have an adverse effect, while within the range it will have no effect. It is considered better to analyse the soil in March rather than May, since it has been found that the values given later may be abnormally high, probably as a result of high temperatures and warming of the soil samples in plastic bags. The method has been officially recommended for use in Holland, where soil analysis is carrried out in March to a depth of 100 cm.

Liquid fertilization in sugar beet agriculture. D. Schneider. *Die Zuckerrübe*, 1979, **28**, (2), 19-20 *(German)*. Advantages of liquid fertilizer for the beet crop are examined and advice is given on application of two nitrogen formulations (one including phosphate) available in West Germany. The relative costs of solid and liquid fertilizers are discussed. The need for pH adjustment by liming after liquid fertilizer has been applied to crops within the rotation is underlined.

Control of rapeseed intrusion. H. Horning. *Die Zuckerrübe*, 1979, **28**, (2), 21-23 *(German)*. – The growth of rapeseed in sugar beet crops is proving a problem in Schleswig-Holstein, particularly in view of the expanding cultivation of rapeseed within the rotation. The plants in the beet fields grow from residual rapeseed after harvest, and prove troublesome because of their competition with the beet and difficulties they create in harvesting. They may also act as hosts for pests. The difficulties of tackling them are increased by the reduction in manual work in the beet field. Various chemical treatments have given some control, but less than hoped for; apart from the recommendation to omit rapeseed from the rotation, it is advised to intensify soil treatment and manually chop the intruders. Herbicide application is also advocated where mechanization is used for the beet crop, but the limited success of this is stressed.

Weed control. Anon. *Die Zuckerrübe*, 1979, **28**, (2), 24-26 *(German)*. – Advice is given on chemical treatment for control of grasses and other weeds. Recommended herbicide dosages and special remarks are given for each herbicide and herbicide combination.

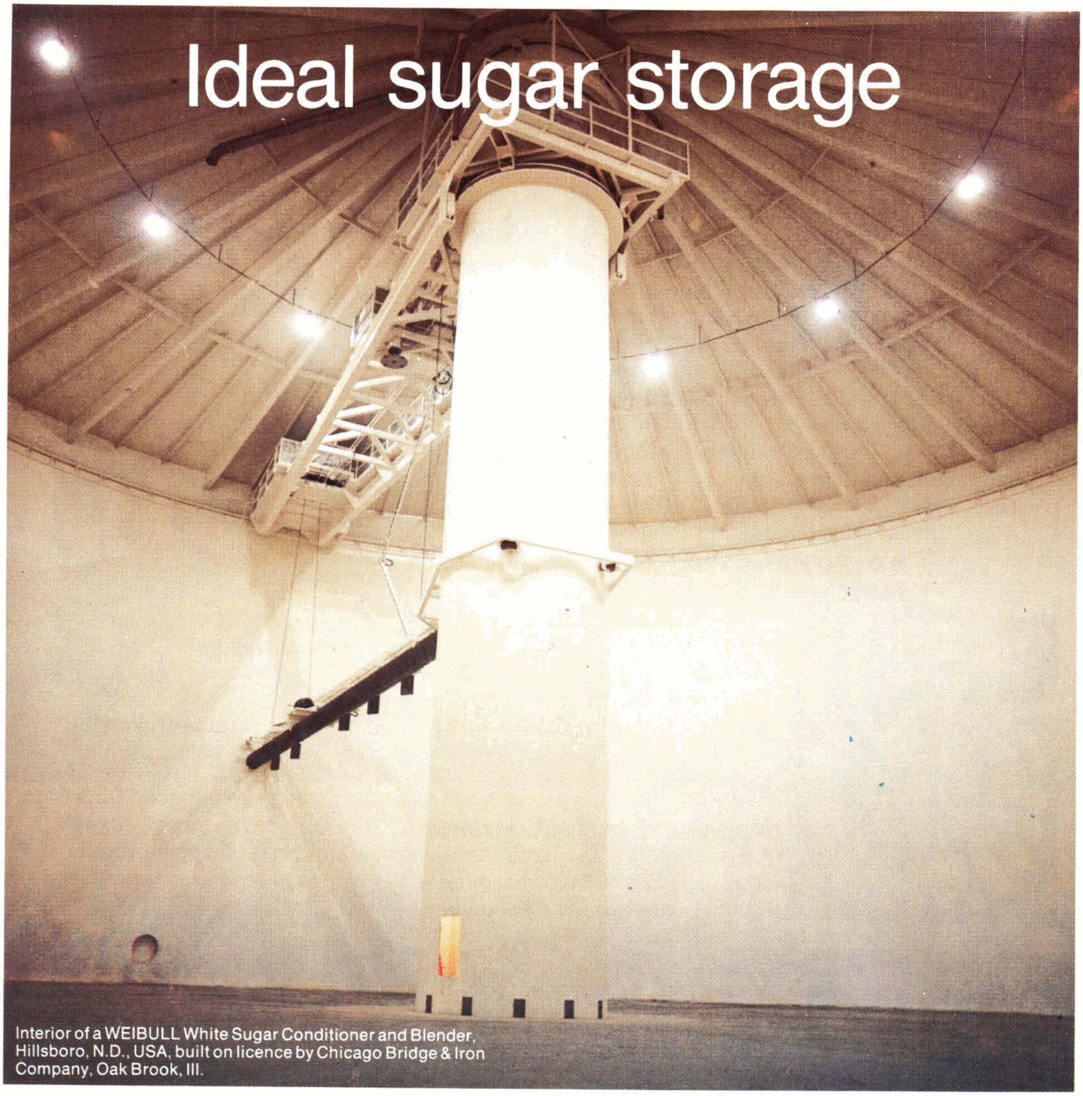
Recognise your weeds. Anon. *Die Zuckerrübe*, 1979, **28**, (2), 28 *(German)*. – Photographs are given of six weeds, with notes on means of eradicating them (where their elimination is possible).

Herbicide application for beet protection. Anon. *Die Zuckerrübe*, 1979, **28**, (2), 34 *(German)*. – Descriptions are given of three herbicide spraying techniques: (i) where the soil is moist and there is rainfall at regular intervals, (ii) where the soil is dry and no rain is expected for six weeks after spraying, and (iii) minimum herbicide application in three separate sprayings to allow for adverse conditions and thereby minimize harm to the crop.

Under-leaf spraying in the beet crop. -. Bartels and -. Ripke. *Die Zuckerrübe*, 1979, **28**, (2), 38-40 *(German)*. Guidance is given on under-leaf spraying of weeds, with descriptions of machinery and most suitable practices. It is stressed that under-leaf spraying demands great precision.

Sugar beet sowing and cultivation techniques in Hungary in 1978. G. Éliás and L. Forrai. *Cukoripar*, 1979, **32**, 6-11 *(Hungarian)*. – A survey is presented of the 1978 sugar beet growing season in Hungary, with details of area planted, leading varieties grown, chemical weed control and fertilization, and particularly the types of drills used and their performances in terms of seed spacing.

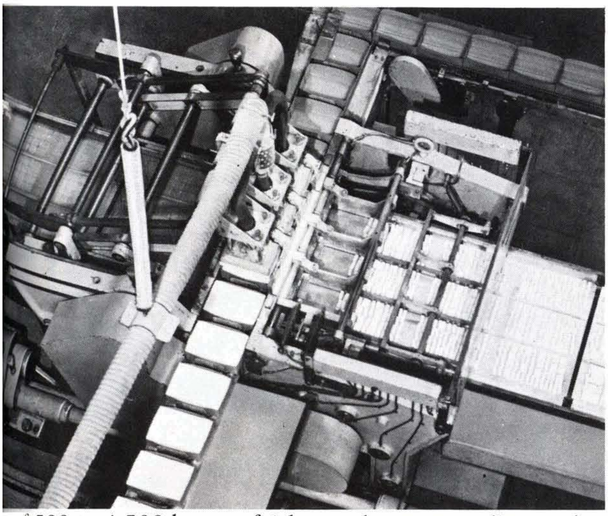
Recommendations on nitrogenous fertilizer for sugar beet. R. Vanstallen and A. Jardin. *Le Betteravier*, 1979, **13**, (129), 13, 16 *(French)*. – The question of optimum N application rate is discussed. While the best approach to determination of the optimum is soil analysis, it is conceded that there is need for proper organization of soil sampling and rapid analysis in the short period just preceding sowing.


Ideal sugar storage

simple product.

Automatic conditioning.

On leaving the drying units, the lumps are gathered and deposited by pneumatic fingers in three successive layers in the boxes, which are formed on a connected machine and automatically supplied to the conditioning line.
The full box is conveyed to the closing machine, which forms and glues the lid of the box.



A well-designed production unit.

A moulding and conditioning unit comprises certain basic inseparable elements synchronised with each other, all the functions of which are automatic, and optional elements (such as the machine for printing and forming the lids or the one-piece boxes, and the machine for parcelling in packets of 5 or 10 boxes).
Entirely automatic, it allows the production of 500 to 4,500 boxes of 1 kg per hour, according to the unit, without any manual intervention.
Four persons are sufficient to supervise all the operations.

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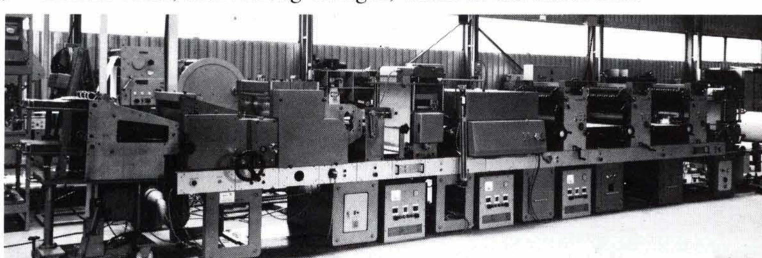

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CANE SUGAR MANUFACTURE

Raw sugar *vs.* refined sugar: a real confrontation? E. David. *ATAC*, 1978, **37**, (2), 11-15 *(Spanish)*. – The differences in characteristics between raw and refined sugar are discussed and it is suggested that the refining process removes desirable constituents which should be retained as part of the diet. Instead of refining to white sugar, with the consequent expense involved, a raw sugar could be prepared which would retain the desirable constituents and yet meet health requirements by adjusting the manufacturing process in ways which are briefly listed.

Evaluation of surface-active agents with samples in parallel and in series. J. Lodos, I. Díaz and O. Gomez. *ATAC*, 1978, **37**, (2), 26-31 *(Spanish)*. – Work on the assessment of the effects of surface-active materials in pan boiling reported in the literature is quoted and an account given of tests carried out in Cuba with a material, Espumol. Comparison between trials in which the test and control boiling were carried out in parallel with trials where a single pan was used and test and control boilings alternated showed that the results obtained were similar and the latter is therefore recommended as being more economical and efficient.

A mechanical sugar distributor. V. S. Bagi. *Maharashtra Sugar*, 1979, **4**, (3), 63-64. – Separation of sugar into fractions of different grist is unsatisfactory in most Indian sugar factories because the sugar is not distributed uniformly over the wire meshes used. Devices such as rotary feeders and inverted cones have been introduced to overcome the problem but are not effective. At Shree Datta Shetkari S.S.K. Ltd. the sugar elevator discharges onto a chute which oscillates under the action of an eccentric driving unit and discharges the sugar over the full width of the screens, giving improved capacity without crystal damage. The unit is inexpensive and requires no adjustments.

Cane yard survey. M. R. Kedian. *Comm. Sugar Milling Research Inst.*, 1978, (116), 30 pp. – The cane handling systems at seven sugar factories, representing all the types employed in South Africa, were examined to compare capital, maintenance and labour costs and power requirements. The two most important observations were the degree of excess capacity at most factories and the very high cost of using chained bundles. The most effective use of equipment is made by a yard receiving cane continuously and using only one system; combinations of systems lead to excessive labour requirement and inefficient yard operation. Further work is necessary to establish the relationship between higher milling rate and the yard equipment maintenance requirements, and also the relationship between the cane yard and transfer stations, *i.e.* whether cutting yard costs by switching to all loose cane will adversely affect costs at the transfer stations.

Technique of boiler feed condensate balance. M. Mangru. *Sugar J.*, 1978, **41**, (7), 9-12. – The author describes the relationship between boiler feed water, condensates and steam quantities and, using measurements made at Wales sugar factory, Guyana, shows how a balance may be drawn up which may be of use where a sugar factory suffers from a lack of steam.

Considerations on final molasses. E. David. *ATAC*, 1978, **37**, (3), 12-15 *(Spanish)*. – It is pointed out that, while sucrose in molasses is considered a loss for process calculations, it is not such a true loss as in bagasse where sucrose has no value but can even be a nuisance when pulp or paper is to be made. In molasses, its value is reckoned in terms of the sucrose and invert content whether it is to be used for fermentation or for animal fodder. The nature of molasses and melassigenesis is discussed as is the market for molasses. The aim of the sugar producer remains, however, to isolate as much of the juice sucrose content as possible in the form of crystal sugar and to minimize molasses formation.

New ideas in the design of heaters. E. P. Díaz G. and A. Santiago L. *ATAC*, 1978, **37**, (3), 37-44 *(Spanish)*. Juice heaters are robust and inexpensive, with long working lives, so that it is difficult to justify replacement of one design by another solely on the grounds of improved performance. They generally fall into two categories – parallel flow and counter-current flow of juice and vapour – and the characteristics of these are discussed. A new design is described; it is a variable-pass unit designed at Ingenio Oriente in the form of a welded steel cylinder with axial tubes and a series of axial baffles between them to provide multiple passes. Comparison with a standard unit during two seasons has shown its heat transfer coefficient to be about double.

Cane milling. A. Pavan. *Brasil Açuc.*, 1978, **92**, 360-373 *(Portuguese)*. – The development of milling equipment at Usina São Martinho between 1952 and 1978 is described, a single Farrel three-mill tandem now being replaced by three tandems, one of four mills and two of six, all with pressure feeding devices. Capacity is 20,000 tcd and, with addition of two more mills to the *C*-tandem, was expected to rise to 24,000 tcd in 1979. The theoretical capacity of mills is discussed, with reference to the work of Murry & Holt. Aspects of milling are mentioned, based on São Martinho experience, including power supply, maintenance, feeding, imbibition, etc., and data from South Africa and Australia are reproduced, as well as a system of imbibition proposed for Brazil and the "integral" imbibition system described by Hugot.

Influence of two systems of sugar cane harvesting on factory sucrose losses. H. G. Ayala, D. Bravo L. and A. Delfini. *La Ind. Azuc.*, 1978, **85**, 341-343 *(Spanish)*. Trials were carried out in a factory receiving both manual and mechanically cut cane from the same area and chemical control data for both types compared. The pol lost in bagasse was greater when milling mechanically harvested cane, although the pol % bagasse was approximately the same in both cases. Pol % cane and pol in mixed juice were higher with manually cut cane. Acidity and reducing sugars were greater in mixed and clear juice from mechanically cut cane and a similar tendency was observed with gums. Each 1% of trash produced a drop in sucrose extraction % sucrose in cane of between 0.234 and 0.434, and an increase of 0.521–0.908 in bagasse % cane.

BEET SUGAR MANUFACTURE

Improving beet quality. M. Loilier. *Sucr. Franç.*, 1979, **120**, 91-97 *(French)*. — Reference is made to trials with 25 beet varieties at seven sites in France, in which the gross income to the farmer per ha and the % extractable sugar were used as criteria. It is mentioned that the two most popular varieties throughout France carry high values for both criteria. Nitrogen trials in 1977 showed that the officially recommended dosage rate of 87 $kg.ha^{-1}$ gave generally better results, in terms of extractable sugar per ha, than no nitrogen or 158 $kg.ha^{-1}$, the latter being the average application rate recommended to farmers in the absence of information on soil N content and calculation of a nitrogen balance for the crop. Tests on reduction of losses in stored beet by treatment with fungicides to prevent mould growth, particularly after injury had been sustained, are reported; best results (268 g CO_2 liberated per tonne of beet per day) were obtained by soaking the beets (previously washed and then deliberately dropped 2 m onto concrete) in a solution containing Mancozeb + Carbendazime + propionic acid (16 + 2 + 15 $g.litre^{-1}$), while Benlate + propionic acid (2 + 15 $g.litre^{-1}$) gave 278 g $CO_2.tonne^{-1}.day^{-1}$, compared with 428 $g.tonne^{-1}.day^{-1}$ for the control. Treatment with propionic acid alone (sufficient to give a solution pH of 4) or with 3.5 $g.litre^{-1}$ thiabendazole gave only very slight reduction in losses. Prediction of sugar recovery in the factory on the basis of weekly beet samples taken at each of 52 factories gave values below the true recoveries because of the exceptionally favourable weather conditions in the autumn of 1978, although an empirical formula derived for the period August 1-15 proved better than one obtained in the previous year, and allowed for actual rainfalls; it is thought possible to effect still further improvement by making better use of autumn rainfall figures.

Waste water treatment. J. P. Lescure and P. Bourlet. *Sucr. Franç.*, 1979, **120**, 99-105 *(French)*. — Details are given of the scheme for effluent treatment by anaerobic fermentation at Vauciennes[1]. At a throughput averaging 27.4 $m^3.hr^{-1}$, the BOD_5 was reduced from an average of 3983 to 720 $mg.litre^{-1}$, the COD from 5896 to 1107 $mg.litre^{-1}$ and the total organic carbon content from 1956 to 414 $mg.litre^{-1}$ (after centrifuging). The methane, of 82.41% average purity, is burnt off. Power consumption (including that for the propeller-type mixer used for homogenization) is 0.055 kWh per kg of COD. The system is also used to treat the effluent from the factory during post-campaign refining.

A study of accelerated anaerobic fermentation, using miniaturized laboratory equipment (allowing a considerable increase in the number of tests carried out), concerned the problem of effluent treatment where sugar is not degraded before bacterial treatment. While acid salts, in pure solution, degraded at a constant rate, it has been found that these same acids (major constituents of sugar factory effluent) in mixtures degrade at preferential rates, although sludge can easily be acclimatized to bring the degradation rates to the same level, except in the case of lactic acid, which is thought to inhibit fermentation. Anaerobic degradation of sucrose was accompanied by marked changes in pH, even when the acids formed were neutralized with sodium bicarbonate. It is recommended to "ripen" sugar-containing effluent to obtain complete acidification before bacterial treatment.

While chlorination is the conventional method of reducing the odour from treated waste water used to wash beet, this method carries the risk of corrosion of the washer; tests were therefore conducted on odour elimination by aeration and addition of pure oxygen at 5 bar pressure or of 35% hydrogen peroxide. Sulphides were determined after 4 minutes' contact, although these do not constitute the sole source of odour, which also emanates from organic acids formed by sugar degradation — recycled water contained 1116 and 772 $mg.litre^{-1}$ of butyric and valeric acids, respectively, as well as 2660, 2040 and 19 $mg.litre^{-1}$, respectively, of acetic, propionic and *iso*-butyric acids. While aeration alone reduced the sulphide content by up to 70%, H_2O_2 reduced the content after aeration by 46-51% and was comparable in reaction time to hypochlorite; pure oxygen gave different results between factory and laboratory tests.

New electric massecuite reheater. J. C. Giorgi and B. Richard. *Sucr. Franç.*, 1979, **120**, 111-112 *(French)*. Tests are reported on the massecuite reheater described earlier[2]. It took only 30 sec to raise the massecuite temperature from 53 to 60°C (in the case of a refinery massecuite) and from 57.4 to 65°C with a factory massecuite; at a throughput of 6 $tonnes.hr^{-1}$ it consumed 12-36 W to raise the temperature by 4-12°C, giving a mother liquor purity difference before and after heating of <0.1. Comparison with an unheated massecuite showed that heating gave a lower molasses purity at a slightly lower sugar purity.

Industrial results of boiling control by micro-computer. G. Windal and A. Deleurence. *Sucr. Franç.*, 1979, **120**, 121-122 *(French)*. — Observations on the automatic boiling systems at Toury and Guignicourt factories are presented[3,4]. The basic system available to other factories is indicated, with the supplementary options existing at the two factories named. Documentation available for help in installing and operating the system is mentioned, and the advantages of the scheme are set out. At Toury, principal benefits from the system have been improvement in exhaustion and regularity of the boiling process; at Guignicourt there has been a saving in steam and improvement in sugar quality. The C.V. has been reduced to 24-26% for a M.A. of 0.5 mm despite the omission of water drinks.

The technical possibility of using laminates on baskets of sugar centrifugals. H. Dabrowski and E. Grozik. *Gaz. Cukr.*, 1979, **86**, 31-33 *(Polish)*. — The possibility of replacing metal with laminated plastics for centrifugal basket construction is discussed and reference made to experiments conducted by certain centrifugal manufacturers. The problems associated with the use of laminates are discussed. Comparison of the performances

[1] See Lescure & Bourlet: *I.S.J.*, 1979, **81**, 121.
[2] Giorgi & Richard: *ibid.*, 89.
[3] Windal: *ibid.*, 1977, **79**, 322; 1978, **80**, 375.
[4] Windal & Deleurence: *ibid.*, 1979, **81**, 121.

of two centrifugals, one with an epoxy resin basket and the other with a metal basket, showed that use of the plastic had no adverse effect on the quality of the white sugar.

The 1977/78 campaign and technical advancement at Strzelin sugar factory. M. Maciński. *Gaz. Cukr.*, 1979, **86**, 33-36 *(Polish)*. — Details are given of the 1977/78 campaign at this Polish sugar factory, some performance data being tabulated, and modifications to existing equipment and installation of new machinery are reported.

Treatment of sugar factory waste waters. L. Huss. *Sugar J.*, 1979, **41**, (8), 9-11. — A high-efficiency two-stage process has been developed by AB Sorigona and Svenska Sockerfabriks AB which is capable of a 99% reduction in the BOD of beet sugar factory waste water. The process involves an anaerobic followed by an aerobic process, with recycling of excess aerobic sludge to the anaerobic stage. The waste (flume-wash water) is pumped through a heat exchanger and its temperature raised to 35-40°C. It is then pumped to an anaerobic reactor — normally a steel tank, but possibly an open pond if weather and odour are not problems. The reactor is provided with a mechanical mixer and temperature and pH controls. Activated sludge is added from the aerobic stage, and the resultant fermentation converts waste organic matter (mostly sugar) to organic acids and finally methane plus CO_2, reducing the BOD_5 by 70-90%. The gas mixture produced can be burned in a steam boiler or pulp dryer, saving purchased fuel, and the accumulated sludge pumped to a mud pond at the end of the campaign. The treated waste then passes to a concrete tank with submerged aerators in the presence of active sludge, and the remaining organic material (mostly organic acids) removed.

Sand removal from raw juice. M. Cuer. *Ind. Alim. Agric.*, 1979, **96**, 5-6 *(French)*. — The system used at Pithiviers sugar factory in France for sand removal from raw juice leaving a RT4 diffuser is described. The juice flows down into a circulation tank having a conical bottom and is discharged into it from a tangential pipe so that the concentration of sand is greatest in the proximity of the sloping wall. Within the tank is a smaller conical-based tank from which some of the juice is pumped to preliming and some to reheaters for subsequent use as carrier for the cossettes fed into the diffuser. The remainder of the juice in the larger tank is pumped to a hydrocyclone (the amount must be greater than 30% of the average quantity withdrawn from the smaller tank for the sake of maximum sand removal), from which the overlow returns to the circulation tank, while the underflow is pumped to a milk-of-lime treatment tank. The system permits an average of 2000-2500 kg of sand to be separated from 8-10 m^3 of juice per day.

The requirements of feed water for high-pressure boilers in sugar factories. M. Manasse. *Hellenic Sugar Ind. Quarterly Bull.*, 1979, (36), 366-392 *(Greek)*. — The recommended composition of water used for boiler feed is indicated and that of raw water and feedwater used at Serrae factory is shown for the years 1972-77. The results achieved with degasification and blowdown are discussed; the former treatment reduces the CO_2 content by 60% and the ammonia content by 90%. Oxygen is almost completely eliminated, while corrosion through caustic embrittlement is very slight. At Platy sugar factory, X-ray analysis of the scale on the steam

turbine blades has been carried out, and the possible sources of the various components found are discussed: sodium chloride, carbonate and bicarbonate are attributed to the softening plant, while carbon is considered to emanate from decomposition of organic substances catalysed by iron from the steam pipes. Means of reducing the level of organic substances are described.

Assisted management of the first massecuite pan house. G. Windal and A. Deleurence. *Sucr. Franç.*, 1979, **120**, 123-126 *(French)*. — The automatic control scheme described earlier[1] has been applied to 1st massecuite boiling house operation at Villenoy sugar factory. The scheme is centred on a micro-computer using Farandole software. Advantages of the system are analysed and problem areas indicated. The economics are also briefly examined.

Effect of impact damage on sucrose loss in sugar beets during storage. W. R. Akeson and E. L. Stout. *J. Amer. Soc. Sugar Beet Tech.*, 1978, **20**, 167-173. — Freshly harvested beets were dropped from heights of 1.5, 3 and 6 feet onto surfaces of steel, hard rubber over steel and spring rubber over steel. Impacts from 3- and 6-ft falls caused bruising and increased respiration losses, although those from 1.5-ft falls did not significantly affect losses. Cushioning the steel surfaces with rubber reduced but did not eliminate losses from impact damage.

Alternating- and direct-current centrifugal drives with automatic controls. U. König. *Zuckerind.*, 1979, **104**, 212-216 *(German)*. — Information is given on the latest Siemens 1SH5 pole-change A.C. motor and on D.C. motors for batch centrifugals, with details of automatic controls.

Design and operation of the SL 1400 continuous centrifugal. S. Matusch. *Zuckerind.*, 1979, **104**, 216-218 *(German)*. — A description is given of the Selwig & Lange SL 1400 centrifugal, the prototype of which is being used for low-grade work at a West Geman factory.

Increasing the capacity of continuous centrifugals by new screen construction. E. Heidborn. *Zuckerind.*, 1979, **104**, 218-221 *(German)*. — Stages in the production of centrifugal screens are briefly described, starting with photographic reproduction of the screen design and ending with screen quality control. Aspects of screen design and manufacture where improvements could be made in view of modern technical and technological requirements in sugar factories are discussed, and results achieved with the new Balco B 1000 screen of 9.5% open space and slots 60 µm wide are compared with those obtained using older screens of 6.5% space and the same slot width, showing that the newer screens are of advantage in increasing massecuite throughput ($tonnes.hr^{-1}$) by 35% while maintaining the same processing quality and having the same service life as the older screens.

Investigation of the beet lifting process in a hydropneumatic lift. N. D. Khomenko, V. G. Yarmilko, V. P. Yares'ko and N. M. Datsenko. *Sakhar. Prom.*, 1979, (4), 27-30 *(Russian)*. — Equations are developed for calculation of a number of parameters concerning the beet lift described earlier[2]. These permit operation of the lift under various conditions to be evaluated.

[1] Giorgi & Windal: *I.S.J.*, 1978, **80**, 376.
[2] Khomenko *et al.*: *ibid.*, 1979, **81**, 277.

SUGAR REFINING

A new centrifugal feeder for tablet refined sugar to automatic wrapping machines. M. E. Balyasnyi, A. F. Lifshits and M. S. Konstantinovskii. *Sakhar. Prom.*, 1978, (12), 28-32 *(Russian)*. – Details are given of a prototype tablet sugar feeder of Soviet design which is planned for mass production. The tablets pass from a hopper to a spinning disc forming the bottom of, but separate from, a rotary drum; as the disc revolves, the tablets are thrown outwards and gain access to a spiral chute forming the perimeter of the drum. The tablets are finally ejected, at 180 per minute, onto the conveyor of the wrapping machine.

Automatic weighing and recording of cane raw sugar. N. F. Bondarenko, I. P. Zharko, A. P. Koval and L. A. Lutsenko. *Sakhar. Prom.*, 1978, (12), 32-34 *(Russian)*. The automatic weighing plant for raw sugar at Gorodishche refinery is described with the aid of an electrical circuit diagram.

Determination of some characteristics important for bulk sugar storage. J. T. Jorge. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 385-396; through *S.I.A.*, 1978, **40**, Abs. 78-1522. – Data relevant to the design of sugar silos are presented on the basis of tests done with apparatus made at Faculdade de Engenharia de Alimentos e Agricola. Equations are given for the vertical and horizontal forces exerted by a sugar layer of known height. The angle of repose of amorphous refined sugar varied from 30 to 37°, averaging 34.7° with standard deviation of 1.351°; corresponding values for white cane sugar were 30-35, 33.0 and 0.837. The coefficient of internal friction was 0.67 for refined sugar, 0.86 for white sugar. Coefficients of friction against six materials are shown for both sugars; those for stainless steel and aluminium were lower than those for wood and galvanized iron. The times for 25 kg of sugar to discharge from a model silo through five different apertures were measured; graphs of flow rate *vs.* area were linear, exhibiting a critical area for flow to occur. White sugar usually flowed about twice as fast as refined sugar through a given aperture, and showed lower critical area.

Migration of colouring matter at Tula refinery. V. A. Loseva, S. Z. Ivanov, N. T. Shtandarova and S. M. Kovernega. *Sakhar. Prom.*, 1979, (1), 19-21 *(Russian)*. The colour of various intermediate products in the granulated and recovery houses of Tula refinery as well as the raw material and final product is discussed. The colour content is expressed in both °St and weight of fuscasinic acid (both on 100 g dry solids) and covers three refined sugar boilings and three recovery boilings. The data are tabulated. The raw sugar was of low quality, with a high non-sugars content, and under these circumstances it is urged that close attention be paid to the vacuum level in the pans and boiling carried out at 60-70°C. While ion exchange treatment of the syrup reduced the subsequent massecuite colour content considerably, colour rose again with boiling, the greatest rise occurring in the 1st recovery boiling.

Liquid sugar and its application. R. Štengl and Z. Frimlová. *Listy Cukr.*, 1978, **94**, 273-276 *(Czech)*. – A review is presented of liquid sugar manufacture in various countries, with information on types produced and their uses, and the processes adopted by different refineries. The possibility of liquid sugar manufacture in Czechoslovakia is discussed, and reference made to storage tests in which quality remained virtually unchanged over a period of up to 9 months when the liquid sugar of at least 61% concentration was treated with 0.001-0.002% formalin, the pH adjusted to $\nless 9$ by means of NaOH, the surface protected with a layer of oil or oil + iodine and the temperature maintained at $\ngtr 40$°C. The manufacture of dextrose and fructose syrups is also discussed, with particular mention of the value of ion exchange, either for invert sugar separation or for sucrose inversion.

The activation of bone charcoal by thermal and chemical treatment. II. The effects of chemical treatment. J. C. Abram and M. C. Bennett. *Proc. Tech. Session Cane Sugar Refining Res.*, 1978, 1-16. – Previous studies had examined the effects of high temperature on the physical structure of bone char and the consequent influence on decolorization of raw sugar liquor. New studies have examined the influence of the carbon and hydroxyapatite constituents of the char by treatment of liquor with a stock char which had been progressively decarbonized. Extrapolating to zero carbon, the hydroxyapatite surface was capable of removing 40-45% of the original colour (the strongly charged anionic colorants) while increasing carbon content raised colour removal to nearly 90% at 7% C. Exposure of char to the atmosphere results in CO_2 adsorption; this reduces the capacity for adsorption of other anions than HCO_3^- but activates the colour adsorption of the carbon surface. Sodium phosphate treatment reduced the colour removal capacity of char; the phosphate ions were strongly adsorbed and greatly increased the ash removal capacity, this increase being largely retained after kilning. After exposure to CO_2 during cooling, however, the colour removal capacity was restored. New char loaded with Ca^{++} and SO_4^{--} ions was found to have its ash removal capacity markedly reduced, but decolorization was not affected.

Thermal regeneration of granular activated carbon. H. R. Johnson and B. H. Kornegay. *Proc. Tech. Session Cane Sugar Refining Res.*, 1978, 17-32. – A new fluidized-bed carbon regeneration system has been developed by Westvaco Corp. and is described. Advantages, compared with multiple-hearth and rotary kilns, include improved fuel economy, lower maintenance requirements, a uniform high-quality product, quick start-up and shut-down, and operation flexibility. Initial tests have been made on regeneration of granular carbon at lower temperatures (900°C) than the usual 1500°C and results indicate that it is feasible; long-term effects are to be studied.

Microcrystalline sugar: production, characteristics and applications. C. C. Chou and C. Graham. *Proc. Tech. Session Cane Sugar Refining Res.*, 1978, 183-190. – A survey is given of patents held by Amstar Corporation and their experience over more than 20 years in the production of speciality dry micro-crystalline white and brown sugars.

NEW BOOKS

Pnevmotransport sakhara v pishchevoi promyshlennosti (Pneumatic conveying of sugar in the food industry). A.F. Zaborsin and T.K. Vasil'eva. 279 pp; 13.5 x 20.5 cm. (Izd. "Pishchevaya promyshlennost" 113035, Moscow M-35, 1-i Kadashevskii per.12, USSR.) 1979. Price: 1.10 rouble.

The subject of pneumatic conveying of white sugar is discussed in eight chapters, covering the design features of equipment, performance, sugar requirements for pneumatic conveying and the effect of the conveying on the sugar, selection of equipment, including feeders, the hydrodynamics of high-pressure pneumatic systems, and possible future developments (including sugar tankers having pneumatic discharging means, pneumatic conveying of sugar solutions, and multi-ducted systems). Obviously the contents are based on practices and research in the USSR, although many references are given to work in other countries. The work is limited, however, to those readers able to read Russian; no matter how well-written a work is, the fact that it is in a language which is not understood by many people outside the country of origin is restricting.

Developments in food carbohydrate – 2. Ed. C. K. Lee. 397 pp; 14.5 x 23 cm. (Applied Science Publishers Ltd., Ripple Rd., Barking, Essex IG11 0SA, England.) 1980. Price: £30.00.

This book represents an attempt to bring together recent developments in the chemistry, potential chemical utilization and techniques of analysis (particularly nuclear magnetic resonance spectroscopy) of several readily available di- and trisaccharides. The first chapter, written by C. K. Lee, concerns trehalose, a non-reducing disaccharide which is a storage sugar of fungi, algae and pteridophytes and accounts for up to 15% of the dry weight in mushrooms and yeast. Chapter 2, by M. R. Jenner, is about sucrose, while Chapter 3, by E. B. Rathbone, concerns raffinose and melezitose (a trisaccharide found in the sweet exudation of many plants). E. Tarelli takes maltose as the theme for Chapter 4, while cellobiose (with maltose, a basic structural element of starch and cellulose) is the subject of Chapter 5, which is written by R. G. Edwards. Chapter 6, by L. A. W. Thelwall, is concerned with lactose, while Chapter 7, by J. M. Hurford, is entitled "Surface-active agents derived from some selected disaccharides" and Chapter 8, by B. Coxon, has as its title "Carbon-13 nuclear magnetic resonance spectroscopy of food-related disaccharides and trisaccharides". Most of the authors have been closely involved in research on the respective saccharides over the last few years. Because of interest in the possible use of the sugars covered in the book as chemical raw materials and the desire to have a greater understanding of their fundamental chemistry arising from their presence in biologically active compounds such as antibiotics, it was decided to accumulate what information exists, such knowledge being otherwise very widespread and often difficult to obtain.

The book is well printed with a subject index. However, while it will undoubtedly be of value for those chemists involved in research on the sugars in question, for most chemists in the sugar industry it will probably be of only academic interest.

Nitratreduktase-Aktivität am Beispiel Zuckerrübe (Nitrate reductase activity in sugar beet). A. Messler. 148 pp; 14.5 x 20.5 cm. (Verlag Verband der wissenschaftlichen Gesellschaften Österreichs, A-1070 Vienna, Lindengasse 37, Austria.) 1979.

The work, No. 38 in the series of Dissertations of the Technical University, Vienna, is a report on glasshouse investigations of nitrate reductase activity (NRA) in three beet varieties grown under controlled conditions in two dilute nutrient solutions, qualitatively the same but differing quantitatively, containing calcium nitrate. Since it proved impossible to store leaf samples from the young plants (generally 11 weeks old) without loss of NRA, even by using refrigeration, only fresh leaves could be used for analysis. Marked fluctuations in the values of NRA were mainly attributable to the effect of daylight and could be calculated by regression equations incorporating total radiation during the 15-hour day. The values of NRA were also found to be dependent on variety as well as nitrate supply. From the results and study of the daily pattern of enzyme activity and nitrate content in the leaves, various mechanisms for the uptake and reduction of nitrate are suggested; since a 75% increase in the nitrate supply led to only 20% increase in NRA, it is concluded that, with the solution of lower Ca nitrate concentration, the quantity of nitrate at the location where reduction took place was the limiting factor for NRA, while with the other solution light was the limiting factor. Analysis of the beets after a 175-day growth period clearly indicated the negative effects of the higher nitrate supply on beet quality. Since the NRA pattern agreed with the known behaviour of the three varieities, it is suggested that the method can be applied to varietal performance prediction in terms of N accumulation and hence serve as a useful tool in selection. The results are given in the form of 34 tables at the back of the book, followed by a list of references.

New developments 1979. 35 pp; 21 x 29.5 cm. (Tate & Lyle Trading & Developments Ltd., Sugar Quay, Lower Thames St., London EC3R 6DQ, England.) 1979.

This is a colourful presentation of the work being conducted by the Tate & Lyle Group outside its normal refining operations. It describes the Knowsley plants for polysaccharide gum and surfactant manufacture operated by Talres Development (in the case of the polysaccharide plant in collaboration with Hercules Powder Co. Ltd.), development of the Talin sweetner, and operations at the Group Research & Development Laboratories at Reading University, including production of derivatives of sucrose and other carbohydrates for use as chemical feedstock and fuel, fermentation alcohol production from biomass and agricultural raw material, and effluent treatment by a yeast process which reduces the COD by 70-75% and provides 1-1.5 tonnes of dried yeast daily from an hourly throughput of 5-6 m^3 effluent. Immobilized enzyme applications, crop protection with micro-organisms, and aquaculture (in which waste water from fish ponds is transformed into algal protein and subsequently returned to the pond for fish feeding) are also among other interesting projects.

LABORATORY STUDIES

Topography of the chemical composition of the sugar beet root. II. Investigation of changes in the topochemistry of the sugar beet root during storage. J. Zahradníček, Z. Hnátko, M. Ondráček and O. Šebíková. *Listy Cukr.*, 1979, **95**, 25-29 *(Czech)*. — The changes in distribution of sucrose and non-sugars resulting from 34 and 32 days' storage were investigated in two roots, differing in their general shape — one long and thin, the other short and thick. The long root was divided into 16 zones, while the short root was divided into 15 zones. In the long root, storage caused a fall in the sucrose content in all zones except the epicotyl, where it rose by 0.8-1.4% absolute; this shift to the crown from the lower zones was also observed in the case of α-amino-N and, to a lesser extent, in ash. In the short roots, the only well-defined pattern was in the conductimetric ash which rose in the bottom two zones and in part of the zone immediately above them and fell in all the other zones; the pattern of change in sucrose and α-amino-N was haphazard. In both types of root, invert sugar increased in all zones.

Granulometry and classification of sugar. I. Theory and sieve analysis. J. Gebler. *Listy Cukr.*, 1979, **95**, 37-44 *(Czech)*. — The fundamentals of sieve analysis of sugar are described and factors affecting it examined (with the exclusion of the screens themselves and screen systems). Methods used to process the analytical data are described, including Powers' M.A. and C.V. method.

The physico-chemical properties of saturated solutions of sucrose in the ternary mixture H_2O-NaCl-NH_4Cl. A. I. Gnezdilova, G. P. Remizov and V. M. Perelygin. *Izv. Vuzov, Pishch. Tekh.*, 1978, (6), 25-28 *(Russian)*. The solubility of sucrose in the title system was determined at 40°C and measurements made of viscosity, density and electrical conductance. It was found that, at low chloride concentrations, the Cl^- ions are apparently sited in the spaces between the sucrose molecules; sucrose solubility falls as a result of hydration of the ions. Since, it is assumed, Na^+ and Cl^- ions do not alter the volume of the spaces between the sucrose molecules in a saturated solution, with increase in the NaCl concentration the degree of hydration of the sucrose molecule falls as a result of ion salting-out, association takes place and viscosity increases. On the other hand, the NH_4^+ ion breaks up the structure of aqueous solutions of sugar by increasing the volume of the spaces between the sucrose molecules, thus reducing viscosity and density and helping to counter the melassigenic effect of chlorides. The disintegrating effect of the NH_4^+ ion is increased in the presence of the Na^+ ion. However, at high NaCl and NH_4Cl concentrations, break-up of the structure of the solution is accompanied by liberation of some water from the spaces between the sucrose molecules, so that both viscosity and sucrose solubility increase.

Conglomeration of crystals during massecuite boiling. N. I. Shtangeeva, N. A. Arkhipovich, I. G. Bazhal and L. I. Trebin. *Izv. Vuzov, Pishch. Tekh.*, 1978, (6), 71-73 *(Russian)*. — A special laboratory unit was used in investigations of "massecuite" boiling under carefully controlled conditions. In experiments under non-isohydric conditions, a saturated sucrose solution was taken to 1.19 supersaturation and then injected with a predetermined quantity of seed crystals measuring 0.05-0.063 mm; for experiments under isohydric conditions, the amount of initial solution was approx. half that in the first experiments, but boiling temperature, time, seed crystals and final "massecuite" crystal content were identical. Whereas in the first experiments no compensation was made for the amount of water evaporated, in the second series of experiments the vapour was condensed and its quantity measured to permit a balancing quantity of saturated solution to be fed at a rate corresponding to that of evaporation. Under these conditions the quantity of conglomerates was 7.4% of the total crystal mass, whereas under non-isohydric conditions all of the crystals became conglomerated. Further experiments under isohydric conditions but with varying massecuite levels showed that the degree of conglomeration rose with massecuite level, although the overriding factor was the initial amount of solution and the establishment of isohydric conditions. The significance of these findings for the design of continuous pans is noted.

High pressure liquid chromatographic determination of sugars in various food products. D. L. Dunmire and S. E. Otto. *J.A.O.A.C.*, 1979, **62**, 176. — A HPLC method has been developed which is fast, simple, specific and reliable over a wide range of sugar concentrations in a variety of food products including molasses. With few exceptions, sample preparation is simple, requiring only extraction with 1:1 aqueous ethanol, followed by a rapid mini-column clean-up before injection into the HPLC system. The majority of samples can be prepared for analysis within 1-1½ hr and the following sugars are separated in less than 45 min: levulose, dextrose, sucrose, maltose, lactose, melibiose, raffinose and stachyose. For molasses, levulose values were obtained of 19.9 and 19.5% on the same day, and 21.5 and 21.8% on the next; dextrose values were 19.2 and 19.1%, and 19.7 and 19.5% the next day; sucrose values were 32.3 and 33.8% and 32.0 and 30.9% the next day. Recovery of added sucrose was 90.0 and 90.5% the next day.

Possible use of mass spectrometry in the sugar industry. H. Gruszecka. *Gaz. Cukr.*, 1979, **86**, 28-31 *(Polish)*. The theory of mass spectrometry is explained and the basic components and operation of a mass spectrometer described. The technique was used in conjunction with gas chromatography to analyse beet brei from long-stored beet for sucrose at various intervals after preparation. Results showed the considerable fall in sucrose content with brei retention at 20°C for 24, 72 and 144 hours and increase in the contents of levulose, dextrose and galactose. The quantitative effect of each of these non-sucrose sugars on polarimetric measurement is indicated.

Preservation of pure sugar syrups by ultra-violet irradiation. J. C. Giorgi and R. Gontier. *Sucr. Franç.*, 1979, **120**, 107-109 *(French)*. — Sucrose solution of 65°Bx with 1% added reducing sugars (equal parts of dextrose and levulose) was stored for 6 months in a 50 mm i.d. x 5 m high stainless steel column provided with a lateral tube communicating with both top and bottom of the column; the lateral tube, hosing a resistance heater, permitted circulation of the syrup (if required) to simulate the action of convection currents in an industrial-scale storage tank. Parallel tests were conducted with four columns in which the syrup had an initial pH of 6.5 and 8.0, and the lateral tube was heated and unheated. An ultra-violet lamp, rated at 400 μW.cm^{-2}, emitted rays of 2537 Å wavelength, onto the surface of the syrup. Graphed results showed that, in most cases, the sucrose concentration increased slightly as a result of evaporation (caused by heat from the lamp as well as the air in the room); the colour of syrups having the lower initial pH remained constant or even fell slightly, whereas it rose in the case of the syrups of initial pH 8. pH fell by 1-1.5 units over the 6 months, the fall being marked at the start of storage and attributed to the U.V. light. With one exception, there was no increase in dextrose concentration, and even in the exceptional case the increase was only slight. In the first month, there was almost complete elimination of all micro-organisms determined initially in the syrup, and no subsequent microbial development was observed.

Methods of analysis. R. Detavernier, M. Groult and J. Roger. *Sucr. Franç.*, 1979, **120**, 113-119 *(French)*. No corrosion was found in the evaporators at 23 factories during 1978, the iron content difference between incoming and outgoing juice being less than 1 ppm; at the only factory where there was a steady increase in the corrosion rate (8 g iron dissolved per tonne of dry solids treated in the evaporator), addition of sodium carbonate to the juice some hours before evaporation to give a pH of 11.5, coupled with omission of deliming, had an immediate inhibitory effect. Evaporator scaling was monitored at 15 factories; regular use of anti-scalants was generally successful in preventing scale formation from lime salts, although three factories exhibited marked differences between incoming and outgoing juice lime salts contents, from which scaling was assumed to have taken place. As regards silicon, nine factories showed significant differences between thin and thick juice, indicating possible deposition, but of only a very small amount (an average of 3.15 mg out of an initial 22.34 mg) and not enough to create problems. The low thin juice Si content was attributed to high juice filtrability and maintenance of a high 1st carbonatation pH. Differences between sucrose determined enzymatically and the pol of raw juice and molasses were monitored at 18 factories, and the findings are briefly reported. The use of chloride as tracer for sugar loss determination was investigated, and a modification of the ferric thiocyanate method used for physiological tests was employed with an auto-analyser to give successive values for the same beet juice with a C.V. of ± 0.2%, which was considered sufficiently precise. Results obtained at factories in 1978 are discussed. The ferric chloride method for diffusion juice organic acids determination as lactic acid (as a measure of losses)[1] had the disadvantage of requiring precise measurement of the reaction time, but an automatic version has overcome the problem. Results showed marked differences between types of diffuser as regards losses, hot diffusion giving a lower value (averaging 1.28 kg white sugar lost per tonne of beet) than diffusion where points of lower temperature occurred (2.17 kg. tonne^{-1}). The ratio between lactic acid determined by the chloride method and enzymatically diminished as the lactic acid content rose.

The functional properties of carbohydrates. R. Zimmermann. *Lebensmittelind.*, 1979, **26**, 57-62 *(German)*. Functional properties of carbohydrates examined include rheological properties, osmotic properties, sweetening power, hygroscopicity, chemical reactivity and resorbability. The sugars and other carbohydrates concerned are indicated, and the effects of the various properties on industrial uses of the carbohydrates are mentioned. Functional properties of polysaccharides alone are also described, *viz.* gelling capacity, film formation capacity and the ability to bind aroma substances and other low-molecular compounds.

Instrument-specific influences on the effective wavelength of photoelectric quartz-wedge saccharimeters and their effects on measured results. K. Zander and H. Melle. *Zuckerind.*, 1979, **104**, 195-198 *(German)*. The principle on which the photoelectric quartz-wedge saccharimeter operates is described and compared with that of the visual instrument. The effective wavelength λ_e of the standard quartz-wedge saccharimeter, established by Bünnagel *et al.*[2] as 587 ± 3 nm, permits saccharimeter manufacturers freedom in the choice of light source, filter and detector, using quartz control plates for calibration. Investigations were carried out on the possible effect of spectral properties of specific photoelectric saccharimeter components on the value of λ_e. The beam intensity $L_{e\lambda}$ from an Osram 8026 lamp, at 4700 Å, corresponds to that of a Planck irradiator at a temperature of 2672 ± 10°K. The investigations showed that, while the radiation temperature can vary as a result of change in operating characteristics, differences between lamps and aging of the lamp, change in its value by as much as ± 400°K causes only a ± 1 nm change in λ_e. On the other hand, the edge angle of the light filter was found to have appreciable effect on λ_e, and data for a Schott OG 570 filter 1.8 mm thick indicate a manufacturing tolerance equivalent to ± 6 nm, while the scatter of values tabulated for different filters was found to be equivalent to ± 5nm variation in λ_e. Loss of sensitivity to red light by the detector may occur as a result of aging and/or manufacturing tolerances, but the overall effect is equivalent to a difference in λ_e of $< \pm$ 4 nm. However, the total effect of the parameters studied is to limit the measuring precision of a photoelectric saccharimeter to ± 10 nm, which is equivalent to 0.04°S, without special precautions.

Fractionation and analysis of invert sugar alkaline degradation products by sorption and spectral methods. V. F. Selemenev and G. A. Chikin. *Sakhar. Prom.*, 1979, (4), 35-38 *(Russian)*. — A solution of invert sugar alkaline degradation products was added in three equal portions to a column of anion exchange resin in OH^- form and each portion allowed 30 minutes' contact with the resin, leading to formation of a layer of colouring matter in the top of the column. This was eluted by successive passage of distilled water, NaOH, HCl and NaCl. The fractions were then subjected to electrophoresis and paper chromatography, and the I.R. and U.V. spectra of the individual components established. R_f values and migration distances are tabulated for the three zones of each of the four eluates, and the spectra are interpreted.

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[1] Detavernier *et al.*: *I.S.J.*, 1979, **81**, 123.
[2] *ibid.*, 1973, **75**, 356.

BY-PRODUCTS

Separation and characteristics of albumin concentrate from sugar beet leaves. L. V. Kaprel'yants, M. S. Dudkin and E. F. Selich. *Izv. Vuzov, Pishch. Tekh.*, 1978, (5), 25-28 *(Russian)*. — Fresh beet leaves were minced and the resulting pulp pressed. The juice was then heated at 75-80°C and the coagulated protein separated by centrifuging, followed by washing with alcohol and drying at 25-30°C, yielding a green powder which was soluble in weak alkali. Analysis gave the following composition: 48.44% crude protein, 35% carotene, 29.64% non-nitrogenous extractives, 13.15% water, 8.77% ash and 3.98% readily hydrolysed polysaccharides. The yield was 13.5-15% on leaf dry solids. Optimum conditions for extraction of the albumin were established as: NaOH concentration 0.6-0.8%, time 4-4.5 hours, temperature of 35-40°C and number of extraction runs — two; yield under these conditions was 35-40%.

Torula yeast developed in final molasses and dried for broiler fattening. V. Pelletization or not of the rations. M. Valdivié and A. Elías. *Cuban J. Agric. Sci.*, 1978, **12**, 161-167. — Trials showed that pelletization eliminated incrustations in beaks and mouth mucous provoked by wheat + 20% yeast diets. The pelleted feed increased consumption by 25.6% and live weight gain by 40%. In maize + 30% yeast diets, pelletization increased intake by 22.3% and live weight of birds by 27%.

Rice broken and final molasses for pig fattening. C. P. Díaz and L. Marrero. *Cuban J. Agric. Sci.*, 1978, **12**, 177-184. — Addition of 30, 40 and 50% molasses in a rice feed did not achieve the weight gains obtained with maize feeding, but the cost per unit carcass weight was comparable and use of indigenous materials saved foreign exchange expenditure.

Concentration of vinasse. P. Chenu. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 123-125; through *S.I.A.*, 1978, **40**, Abs. 78-1470. — Flue gases from a bagasse-fired boiler can supply enough heat to concentrate all the vinasse from a corresponding molasses-based distillery to about 40°Bx, giving a fertilizer base containing approx. 8 g N and 50 g K per litre. When circulated through a gas scrubber, the vinasse cools the gases to 100°C and removes all the smuts; a strainer in the circuit separates most of the smuts, which may be useful as a K supplement for filter cake in fertilizers. It is recommended that the pH of concentrated vinasse be increased from approx. 5 to 5.5-7 by adding filter cake or chalk + lime.

Industrialization of bagasse paper, by-product of the sugar factory. G. Abadia. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 397-410; through *S.I.A.*, 1978, **40**, Abs. 78-1421. — Predictions are made about the world consumption of cellulose and paper and the increasing Brazilian share of the market, and the activities of Agro-Industrial Amália S.A. are outlined. Data on bagasse cell dimensions and properties of newsprints are included; notes are made about the processes and equipment used to make cellulose and paper from bagasse.

Values and optimum utilization of different farm by-products in the feeding of ruminants. A. Deswysen. *Le Betteravier*, 1979, **13**, (127), 11-12, 16 *(French)*. — A survey is presented of various beet by-products which are of value as cattle fodder, and a table is presented showing dry solids contents, feed value and recommended daily amounts.

Use of vinasse in sugar cane in Usina da Pedra — Serrana. J. A. Magro. *Brasil Açuc.*, 1978, **92**, 232-240 *(Portuguese)*. Application of vinasse to the soil as a fertilizer is discussed with mention of its composition, the effects of utilization in irrigation on the soil and on the plant, application of vinasse from road tankers and experimental results of trials which show that the vinasse produced higher yields than mineral fertilizers, although the juice ash content was higher as a result. Commercial application of vinasse and the costs involved are briefly discussed.

Grassland application. B. James. *British Sugar Beet Rev.*, 1979, **47**, (1), 50. — Application of filter cake to grassland soil at one farm in the UK has raised the pH and also provided copper, a trace element which had previously needed supplying separately.

Utilization of a deionization plant waste regenerant stream to produce a valuable granular fertilizer as by-product. R. F. Olsen, A. M. Sandre and S. E. Bichsel. *Sucr. Belge*, 1979, **98**, 11-16. — Details are given of the process and plant for manufacture of a mixture of ammonium sulphate and potassium sulphate from ion exchange waste regenerant at the Moorhead, Minnesota, factory of American Crystal Sugar Co. The spent regenerants are concentrated to 45-48°Bx by evaporation and pumped to a storage tank provided with agitator and heat exchanger. From this the feed stock is pumped to a batch mixing tank, where the Brix is adjusted to 60° by water addition or remelting of the coarse fraction recycled from later screens; each batch (of 5 short tons) is adjusted to pH 6-7 with ammonia and heated to 80°C, pumped through a basket strainer to a feed tank, and thence to a spray dryer. The powder from this passes via a cyclone to a hopper where it is mixed with fines from the screens, and from this is transferred to a spiral path-type, vertical agglomerator where liquid from the feed tank is sprayed to produce homogeneous granules which then pass through a fluidized bed dryer to the screens. Daily maximum capacity of the plant is 50 tons. Typical analysis of the product is 17% N, 5% K_2O, 23% S and 0.5-1.0% moisture.

Influence of lack of aeration of molasses solutions in the initial period of development of the mould *Aspergillus niger* on the course of submerged fermentation. J. Kovats and L. Gackowska. *Przemysl Fermentacyjny i Rolny*, 1977, **21**, (4), 16-18; through *S.I.A.*, 1979, **41**, Abs. 79-49. — Experiments on 6-day citric fermentations in 10-litre vessels are reported with tabulated results. Delaying aeration for 8-16 hr after inoculation of dry conidia had little effect; indeed, less oxalic acid was formed and less residual sugar remained. Fermentation

[1] See Valdivié & Elías: *I.S.J.*, 1980, **82**, 128.

was impaired by a delay of 24 or 30 hr, and was completely suppressed by one of 40 hr.

Dissolving pulps from Egyptian bagasse. IV. Influence of sulphidity on the viscose solution. A. Abou-State and S. A. Helmy. *Faserforschung u. Textiltechnik*, 1974, **25**, (2), 54-56; through *S.I.A.*, 1979, **41**, Abs. 79-77. Viscose pulps were prepared from bagasse by the pre-hydrolysis-sulphate process with sulphidity of 0, 20, 30 or 40%. Chemical and physical properties of the resulting pulps are tabulated; their sub-microscopic structure was examined. Use of 20% sulphidity is recommended, since it gave the best degree of pulping, lowest bleach requirements, a more open and accessible inner structure and the highest reactivity towards xanthation, although 40% sulphidity gave the maximum yield and α-cellulose content. In multi-stage chlorine bleaching, use of 16% NaOH (on pulp) in the second stage gave better results than 8% or 24%.

Studies on the rapid treatment of the yeast waste stream. I. The optimal conditions for mould cultivation. Y. T. Chuang, P. T. Hwang, L. H. Wang and S. L. Sang. *Rpt. Taiwan Sugar Research Inst.*, 1978, (81), 35-45 *(Chinese)*. — Application of a fungal strain designated A-188 for treatment of waste water from a yeast plant was examined and optimal conditions established as initial pH 6.0, incubation temperature 30°C, cell concentration 6 $mg.cm^{-3}$ (dry basis) and BOD:N:P = 100:5:1. The optimal oxygen transfer coefficient requirement was 2.6 min^{-1}. The strain rapidly and effectively reduced the waste water BOD from 10/20,000 to about 2000 ppm and sterilization of the waste was unnecessary for effective treatment. BOD removal efficiency did not decrease significantly with fall in BOD. Trials with a 14-litre fermenter (working volume 6 litres), with ½ vol. $vol^{-1}.min^{-1}$ and agitation with a 400 rpm stirrer effected 87.8% BOD removal after 30 hr and 93.6% after 48 hr. The mycelium could easily be separated with a 100-200 mesh sieve and was obtained in a yield of 10-16 $g.litre^{-1}$ of waste.

Alcohol as an automobile fuel. P. A. Hanks. *Producers' Rev.*, 1978, **68**, (12), 31-35. — The need for petroleum import substitution in Australia and the possible means to effect this are discussed. The two most likely are production of liquid fuels from coal — which would require new technology — and the well established production of alcohol by fermentation. At current consumption levels, a 15% blend of alcohol with petrol would require about 350,000 ha of land for cane growing which does, in fact, exist, within economical hauling distance from the sugar factories processing cane grown on the 300,000 ha which provides Australian sugar. A feasibility study was made into growing of cane for direct juice fermentation to alcohol in the Ord river area of Western Australia; this envisaged the erection of a producing plant typical of what would be required, since the existing fermentation alcohol industry has only a small fraction of the capacity that would be needed. Such a project would be one of 14 required in total and its cost would be $A 123 million at March 1978 prices plus infrastructure costs, a total of $A 2660 million. It is considered unlikely that such a venture could be profitable at present-day prices. Studies carried out in other countries and in respect of cassava growing for fermentation are reported. If use of alcohol as a blend in petrol became accepted, the industry would have to be established on a wide scale and strong government support would be needed.

The use of fibrous cane by-products by ruminants. V. White muscle disease (WMD) of bulls fed with alkaline treated bagasse pith unsupplemented with selenium or vitamin E. T. Verdura and P. C. Martin. *Cuban J. Agric. Sci.*, 1978, **12**, 241-247. — Animals fed with unsupplemented bagasse pith were found to develop muscular lesions causing some deaths; supplementation of the diet with Se and/or vitamin E is suggested.

Performance of pigs fed final molasses diets supplemented with vitamin E and/or selenium. M. Castro and A. Elías. *Cuban J. Agric. Sci.*, 1978, **12**, 249-255. — Compared with diets of maize and unsupplemented molasses + yeast, addition of Se alone gave significant weight gains in pigs in the 38-65 kg stage and overall, but not in the 65-100 kg stage. Addition of vitamin E improved back-fat quality. Use of 0.5 ppm of Se in diets is recommended.

Overdoses of niacin in final molasses diets for chicken fattening. C. T. González and R. S. Ibáñez. *Cuban J. Agric. Sci.*, 1978, **12**, 263-270. — Maize diets gave higher weight increases than those containing final molasses, but 30% of the difference could be made up by supplementation of the molasses diet with niacin (nicotinamide).

Energy balance with high molasses diet. Calorimetric studies in a sheep. C. M. Geerken. *Cuban J. Agric. Sci.*, 1978, **12**, 277-285. — An account is given of calorimetric studies on a sheep to determine energy balance in molasses feeding.

Production of volatile fatty acids in the rumen of goats fed molasses. C. M. Geerken. *Cuban J. Agric. Sci.*, 1978, **12**, 287-300. — Dry matter intake, rumen pH and rumen concentration of volatile fatty acids were similar, irrespective of diet, but feeding of molasses reduced acetic acid and increased butyric and propionic acid contents.

Interaction of molasses carbohydrates, orthophosphoric acid and urea. M. S. Dudkin, S. I. Grinshpun, N.A. Lemle, I. G. Bozhko and S. P. Korchevnaya. *Izv. Vuzov, Pishch. Tekh.*, 1978, (6), 29-33 *(Russian)*. — OTI-3 is an animal fodder preparation containing molasses, urea and orthophosphoric acid. A study was made of the chemical reactions taking place after initial mixing of the constituents, including sucrose hydrolysis and formation of glucosyl urea. The intensity of the reactions increases with temperature and retention time. Steeping cellulose in orthophosphoric acid in the presence of urea followed by drying led to formation of urea phosphate. Cellulose added to OTI-3 adsorbs the glucosyl urea, urea phosphate and other components.

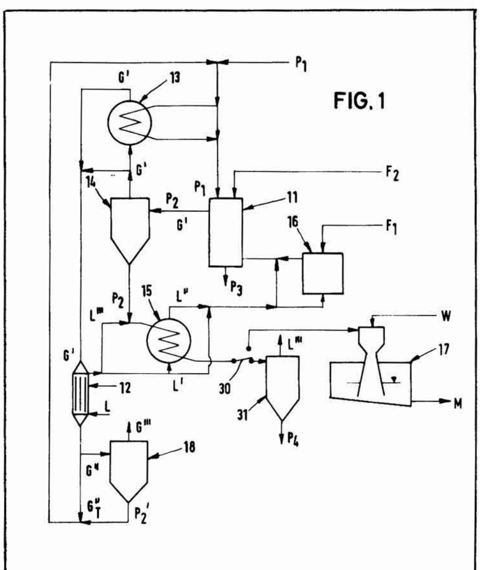
Determination of the angle of repose of beet pulp. V. D. Orlov. *Sakhar. Prom.*, 1979, (4), 39-40 *(Russian)*. A method is described for determination of the angle of repose of beet pulp; both wet pulp (of 510-515% moisture on dry solids weight) and dry pulp (10-12% moisture) were tested, the dry pulp also being divided into three particle size fractions. Tabulated values indicate that the angle falls with decrease in moisture content and with reduction in the mean particle size.

PATENTS

UNITED KINGDOM

Production of calcined lime. F. Schoppe, of Ebenhausen/Isartal, Germany. **1,476,963.** May 31, 1974; June 16, 1977.

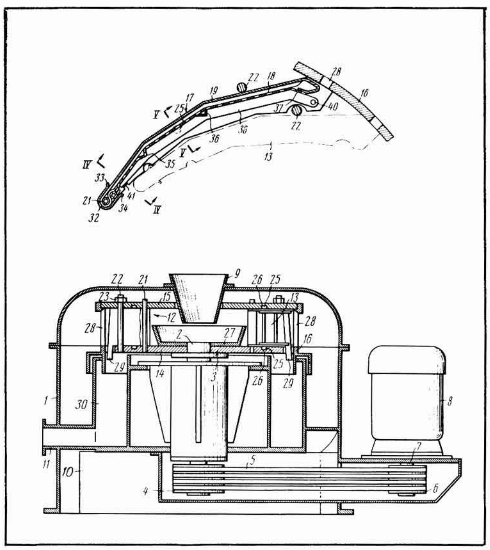
Carbonatation sludge from a sugar factory is pre-dried and calcined in such a manner that all the organic content is oxidized and the calcium carbonate converted to active calcium oxide in a fine particulate form which aggregates and can be separated from the hot gases produced in the kiln. Combustion air L (having an oxygen ratio of 1.6-2 of stoichiometric requirements) is heated to a specified temperature (1000 - 1400°C) in heat exchanger 12 against exhaust gases G′ from the dust separator 14. If necessary the air is also passed through a preheater 15 where it receives heat from the agglomerated CaO particles P_2 from the separator 14. The once (L′) or twice (L″) preheated air may be further heated by passage through a combustion chamber 16 in which fuel F_1 is burnt. The air is introduced with fuel F_2 and material P_1 to be treated into the calcining chamber 11, the material P_1 having been preheated [to 400 - 800°C (500 - 600°C)] in heat exchanger 13 against the hot gas flow G′ from dust separator 14.



Large particles P_3 which cannot be entrained by the upward flow of gases fall to the bottom of chamber 11 while smaller particles P_2 are discharged in the gas stream and enter the dust separator where they are collected and are cooled if necessary in heat exchanger 15 before passing via the change-over device 30 either to cyclone separator 31 or to the device 17 for production of milk of lime M by addition of water W. The cooled gases G″ from heat exchanger 12 pass through a fine dust separator 18 to give a cooled gas G‴ which is discharged and a particle product which is entrained in part of gas G″ (G''_T) and recycled.

Continuous centrifugal. Krasnodarsky Politekhnichesky Institut, of Krasnodar, USSR, and Penzensky Zavod Khimicheskogo Mashinostroenia, of Penza, USSR. **1,477,417.** April 22, 1975; June 22, 1977.

The central shaft 2 of the centrifugal is driven by electric motor 8 via belts 5 and pulleys 4, 6 and carries a rotor 3 in the form of a drum 12. This drum is formed by a bottom disc 14, a top disc 15 and a circumferential wall 16. Within the drum are a series of vane elements 13 of arcuate form and having an inner screen surface 18 separated from a solid outer surface 17. The inner end is threaded by its eye on a vertical shaft 21 which fits between the discs 14 and 15, while the outer end rests on the wall 16.

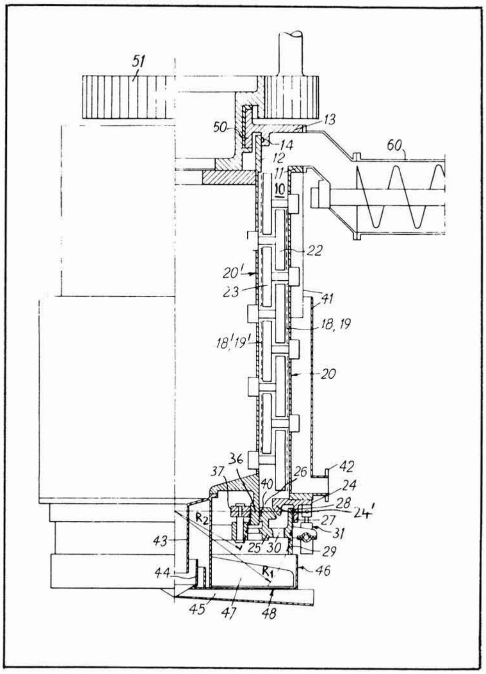


The vanes are supported by pins 22 and 25 between the discs, the former passing through the upper disc and being held by nuts 23. Sugar separated from massecuite passes along the screen surface and is discharged through the slots 28 in wall 16 and so into the casing 1 for discharge through outlet 10. Molasses passes through a drain 29 from the outer end of the space between the screen 18 and solid surface 17; the drains pass through holes in disc 14 and discharge into the chamber 30 from which molasses leaves by pipe 11. Massecuite is admitted to the machine through funnel 9 and distributed onto the vanes by the bowl 27 mounted on the bottom disc 14.

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 specification are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

Beet pulp press. Fives-Cail Babcock, of Paris, France. **1,477,702.** July 10, 1974; June 22, 1977.

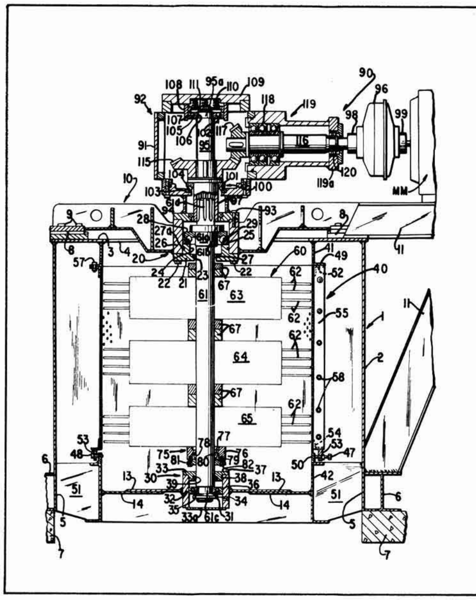
Pulp is delivered by a twin-screw pump 60 to the top of the press which includes a fixed outer cylinder 11 and a co-axial inner cylinder 12 which rotates by the action of gear 51. On the inner surface of cylinder 11 and the outer surface of cylinder 12 are grids and screen surfaces 18, 19, 18′, 19′ while there are short radial arms projecting inwardly and outwardly, respectively, from the cylinders and carrying blades 23, 22 spaced very close to the screen surfaces. The sizes of the arms and blades are such that the blades overlap.



At the base of the cylinder 11 is an annular flange 24 having a corresponding flange 25 mounted on the rotary cylinder 11 such as to maintain a small gap 26 between the two flanges. This gap is closed by the action of hydraulic jacks 31 on flange 25 which is moveable, and the pressure within the space between the two cylinders is thus governed by these jacks. Pulp delivered by pump 60 passes down the space between the cylinders and is squeezed between the leading surfaces of fixed blades 23 and rotating screen surface 19′ and between the leading surfaces of rotary blades 22 and the fixed screen surfaces 19. Liquid is expressed through the screens and collects in chambers feeding the outlets 42, 45 while pressed pulp drops into trough 46 from which it is directed by blades 47 to an outlet.

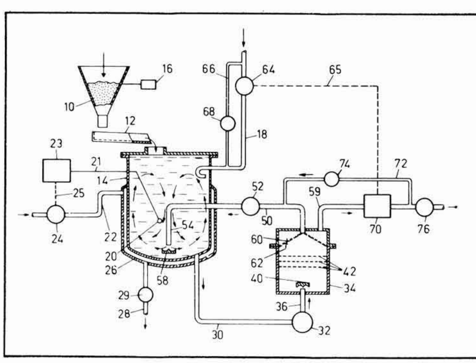
Bagasse depithing. The Western States Machine Co., of Hamilton, OH, USA. **1,478,725.** August 27, 1975; July 6, 1977.

The cylindrical casing 1 has a vertical side wall 2 between an upper disc 3, having a central opening 4, and a lower base 5. The base is secured to a framework 6 while a rigid frame 10, mounted across the opening 4, is positioned by mounting pads 8 to the top disc 3 and connected to the framework 6 by brackets 11 which also support motor MM. This operates through the drive mechanism 92 and rotates the vertical coaxial shaft 61 which carries a rotary hammer assembly 60. The shaft 61 hangs centrally under gravity but is guided by bearing 32 at its lower end.



The hammers are horizontally spaced bars which can swivel about vertical pins located around and near the edge of the fixed plate assemblies 63, 64, 65. They rotate within a perforated cylindrical basket formed from four sections joined together and extending between the upper and lower annular partitions 41 and 42. The pins about which the hammers can swivel are adjustable to vary the clearance between the hammer tips and the inner surface of the screen. Bagasse delivered by chutes is beaten by the hammers and the fibres and pith separated; the latter passes through the perforations in the screen and so into the outer casing from which it is removed, while the larger fibre particles remain within the inner zone and discharge to a separate conveyor.

Dissolving of sugar. Frebar Holding AG, of Zug, Switzerland. **1,480,911.** September 5, 1974; July 27, 1977.



Sugar from hopper 10 is delivered by a vibratory trough or belt conveyor 12 to a first dissolving vessel 14 into which water is also delivered by inlet 18. A temperature sensing probe 20 is connected to a control unit 23 to govern steam flow through valve 24 to the jacket 26 surrounding the vessel 14. Part of the contents of the vessel is withdrawn through conduit 30 and delivered by pump 32 into a second dissolving vessel 34 where a plate 40 is arranged to provide turbulence to aid dissolution. Turbulence is decreased in the upper part of vessel 34, however, by perforated plates 42.

A conduit 50 is provided from the top of vessel 34 and delivers into vessel 14 against a baffle plate 58 to produce turbulence. The amount of recycling is governed by valve 52 between 50 and 99%, the balance being withdrawn from the upper part 62 of vessel 34 after passing through screen 60 and leaving as product through pipe 59. The concentration is sensed by control unit 70 which governs the valve 64 and so the water feed. During start-up, valve 76 is closed, valve 74 opened and the syrup recycled until the product reaches the correct concentration which may be 60°Bx or higher, held within ± 0.3°Bx.

Harvesting of sugar cane. F. W. McConnel Ltd. and J. C. Hudson. (A) **1,481,955.** August 13, 1974; August 3, 1977. (B) **1,481,956.** September 9, 1974; August 3, 1977. — (A) Cane topped and harvested and laid in a swath on the ground by a suitable harvester is picked up by a machine which gathers the canes lengthwise, removes the trash and deposits the clean cane in a bin. (B) The cane is topped in the machine instead of before harvesting.

Extraction of sugar from molasses. Bayer AG and Süddeutsche Zucker-AG. **1,483,327.** April 21, 1976; August 17, 1977. — Molasses is separated into sugars and non-sugar constituents by ion exclusion or liquid distribution chromatography on two types of (strong) acid cation exchangers (in the Ca form) based on cross-linked copolymers of mono-vinyl and divinyl compounds. Flow is successively through one type, a macroporous cation exchanger containing 8-20% [10 - 16% (12-15%)] polyvinyl compounds and an inner surface area of 5-150 [30 - 100 (30 - 50)] $m^2.g^{-1}$ and then through the other type, a gel-type resin containing 2-6% (2-5%) of polyvinyl compounds. The first type accounts for 5-35% (10-25%) of the total resin and contains 30-50% (35 - 40%) of swelling water, while the second type contains 55-65% of swelling water. The resins may be arranged in a series of columns.

UNITED STATES

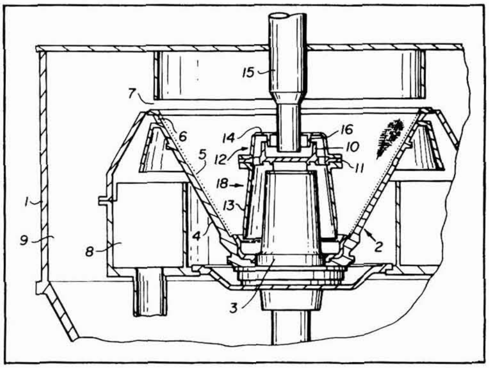
Purification of sugar juice. K. W. R. Schoenrock, A. Gupta and H. G. Rounds, of Ogden, Utah, USA, *assrs.* The Amalgamated Sugar Co. **3,982,956.** September 26, 1975; September 28, 1976. — Beet juice after second carbonatation is treated with a carboxylic-type cation exchange resin in H^+ form in a column to remove the Ca^{++} content, and then through a weakly basic anion exchange resin having a tertiary amine functionality in the OH^- form. The anion exchanger is first stripped with the acidic regenerant waste from the cation exchanger before regeneration with aqueous ammonia. The ammonia is recovered from the regeneration waste from the anion exchanger by treating with an approximately stoichiometric quantity of lime and distilling, collecting and condensing the ammonia vapours.

Fertilizer and animal fodder from molasses fermentation residue. H. H. Bass, of Potts Point, Australia, *assr.* Unisearch Ltd. **3,983,255.** September 20, 1974; September 18, 1976. — Vinasse is concentrated to 60 — 80% solids and heated to about its boiling point to induce thickening. It is then cooled to about 80°C, mixed with about 15% w/w of a soluble phosphate [phosphoric acid or ammonium phosphate or (single, double or triple) superphosphate (monoammonium phosphate)], the mixture heated to 105 — 120°C until coagulation takes place, and the coagulation product recovered, dried and ground to a powder or granulated to give a product which may be incorporated in animal fodder or fertilizer.

Solidified (food) product from molasses and wheat flour. E. F. Glabe, P. W. Anderson and S. Laftsidis, *assrs.* Food Technology Inc., of Chicago, IL, USA. **3,985,912.** December 31, 1975; October 12, 1976. — Molasses is incorporated with wheat flour (plus soya flour, wheat starch or ungelatinized starch) and mixed into a slurry, before dehydration as a thin film on a heated surface.

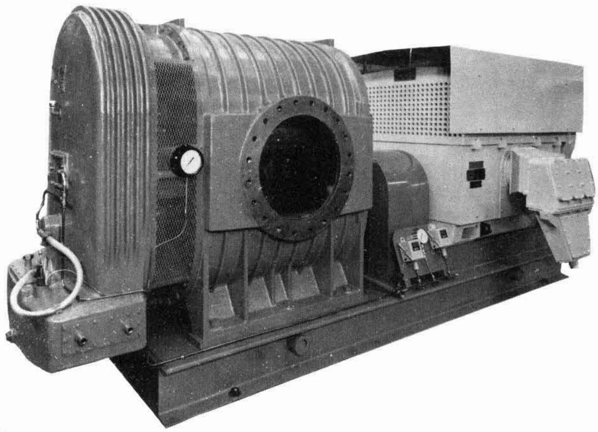
Continuous centrifugal. A. Mercier, of La Madeleine, France, *assr.* Fives-Cail Babcock. **3,989,185.** June 23, 1975; November 2, 1976.

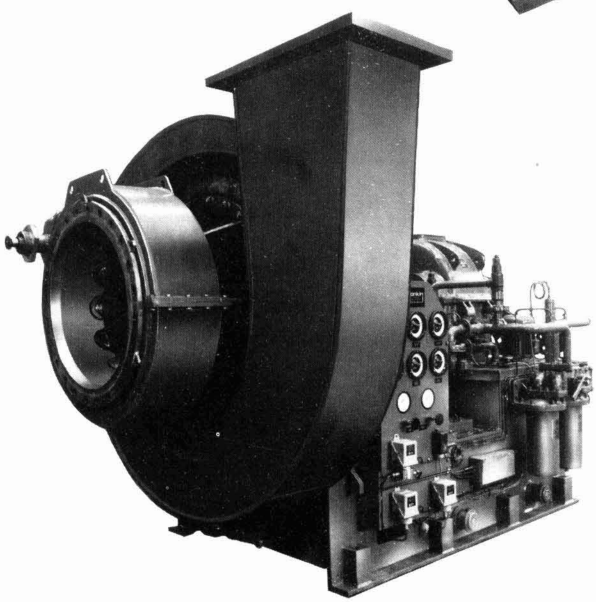
The continuous centrifugal has a conventional housing 1 and conical drum 2 comprising a solid cone 4 with a spaced screen 5. It is suitably driven through hub 3 and sugar is discharged through space 7 into the exit 9 while molasses passes through gap 6 from the space between the cone 4 and screen 5 and is discharged through pipe 8.



Mounted above the hub 3 is a dish-shaped receptacle 10 provided with a flange 11; the bottom of flange 11 is a cone 13 while above it is a continuation 12 of the cone, with a closure 14 and suspended vertical annular wall 16. The closure 14 is pierced to admit the central feed pipe 15. The serrated annular top of dish 10 is higher than the bottom of the annular wall 16 so that massecuite delivered to the machine passes between the two walls and is uniformly distributed on the inside of cone 12. The flange 11 is provided with circumferential slots, wider near the radial arms between the slots, which allow the massecuite to pass through onto cone 13 to provide a uniform feed to the bottom of screen 5.

Centrifugal. W. Werner, of Braunschweig, Germany, *assr.* Salzgitter Maschinen AG. **3,989,536.** December 22, 1975; November 2, 1976. — The conduits and operation-





al details of the compressed air system for operation of the centrifugal design claimed in US Patent 3,961,746[1] are specified in greater detail.

Food process antifoam. R. J. Wachala and R. E. Svetic, of Chicago, IL, USA, *assrs.* Nalco Chemical Co. **3,990,905.** February 9, 1976; November 9, 1976. — A material which may be used (at 100 – 300 ppm) (in the diffuser) (added to raw juice) to combat foam formation during beet sugar processing comprises 0.1 – 10% w/w in a liquid hydrocarbon oil (a non-toxic mineral oil) of a bis-amide of the structure $R.CO.NH.(CH_2)_n.NH.CO.R$ where n = 1-6 and R is a saturated or unsaturated straight or branched-chain aliphatic group having 5 – 22 C atoms (ethylene bis stearamide). The material may also contain 0.1 – 30% of a surfactant capable of breaking a water-in-oil emulsion of the diamide (a water-insoluble fatty acid, ester or salt derived from edible fat or oil).

Enzymatic isomerization of dextrose to levulose. A. Bouniot and M. Guérineau, of Deux-Sèvres, France, *assrs.* Rhone-Poulenc S.A. **3,990,943.** September 25, 1974; November 9, 1976. — Isomerization is obtained by treating an aqueous dextrose solution (of $\not>$ 60% concentration) (at 50-75°C) with a dextrose isomerase in the presence of the activating cations Mg^{++} or Mg^{++} plus Co^{++}, the enzyme being brought into contact with a (sulphonyl or carboxyl type) cation exchanger in the Mg^{++} (and Co^{++}) form so that it becomes immobilized.

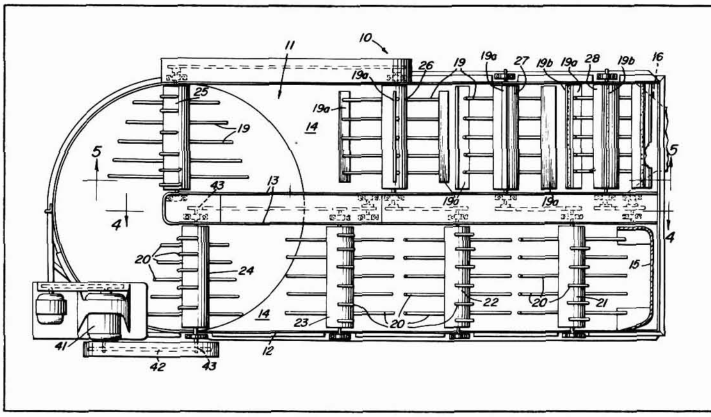
Ripening of sugar cane. L. G. Nickell, of Honolulu, HI, USA, *assr.* Hawaiian Sugar Planters' Association. (A) **3,992,186.** April 5, 1974; November 16, 1976. (B) **3,992, 187.** February 25, 1975; November 16, 1976. (C) **3,992,190.** April 17, 1975, November 16, 1976. The sugar content of cane is increased by treating (A) a few (2 - 10) weeks before harvest, with tetrahydrofuroic hydrazide (5-20 gal. $acre^{-1}$ of an aqueous solution containing 0.1 - 2% of a surfactant), (B) 1-4 lb. $acre^{-1}$ of 6-aminopenicillanic acid or its K, Na or NH_4 salt or penicillamine or its hydrochloride, sulphate or phosphate, 2 - 10 weeks before harvest, or (C) 1-4. $acre^{-1}$ of cacodylic acid or its Na salt, applied as an aqueous solution (5-8 weeks before harvest).

Method for increasing the yield of sucrose. H. Suzuki, H. Yoshida, Y. Ozawa, A. Kamibayashi, M. Sato, A. Mori and M. Endo, *assrs.* Agency of Industrial Science & Technology, of Tokyo, Japan. **3,992,260.** May 22, 1974; November 16, 1976. — Raw beet juice (at 13 – 15°Bx, pH 5 and < 65°C) is treated with α-galactosidase and its raffinose content hydrolysed to sucrose and galactose, the enzyme then being removed before further processing. Alternatively, beet molasses at 45 - 55°C, 15 - 60°Bx (30°Bx) and pH 4.8 - 5.2 (5) is treated with the enzyme during 2-3 hr (2½ hr) to give 50 – 90% hydrolysis of the raffinose present.

Media containing molasses and corn steep liquor for producing dextrose isomerase from *Actinoplanes* and method. K. K. Shieh, of St. Louis, MO, USA, *assr.* Anheuser-Busch Inc. **3,992,262.** February 10, 1975; November 16, 1976. — An improved medium for cultivating *A.* spp. (particularly *A. missouriensis*) contains 1 – 10% molasses (beet and/or cane molasses), 0.6 – 4% of corn steep liquor from which the sludge has been removed and an additional nitrogen source [$(NH_4)_2SO_4$ or 0.1 – 0.6% of $NaNO_3$]. The inoculum is grown in the medium and yields increased amounts of enzyme in shorter times.

Cleaning bagasse fibre. J. T. McCloskey and E. J. Villavicencio, *assrs.* Process Evaluation and Development Corp., of Dallas, TX, USA. **3,992,754.** February 5, 1975; November 26, 1976.

Bagasse is delivered through chute 15 into a U-shaped wash tank having an outer wall 12, inner walls 13 and connecting bottom 14. At the middle of the tank the bottom 14 is provided with a conical sump having a valve at the apex of the cone. A series of horizontal rollers 21 – 28 are provided in the tank, driven by suitable means and having curved fingers 20 of equal length except for those on the rollers 24 and 25 above the sump. These fingers are of different lengths to feed material from the inlet to the outlet side of the tank. Paddles 19a are fitted to the fingers on the rollers 26 – 28 and the paddles on the fingers of roller 28 have also rubber flaps to give a squeegee-like action against the upward sloping bottom of the tank towards the discharge chute 16.



Bagasse is delivered into the tank which contains water, maintained by a level controller at about six inches below the axis of the rollers. The fingers on the roller 21 cause the bagasse to be immersed in the water and carry it towards the next roller. Between the two rollers the natural flotation of the bagasse causes it to rise to the surface of the water before the arms on roller 22 cause it to be immersed again. This alternate immersion and flotation cause the separation of sand, dirt, etc., which falls to the bottom of the tank, to be carried to the sump, from which it is withdrawn at intervals. The bagasse is directed to the outlet side of the tank and carried by the fingers and paddles 19a to the discharge chute, surplus water draining back into the tank from the inclined part of the bottom.

[1] *I.S.J.*, 1979, **81**, 283.

TRADE NOTICES

The Lotus roll. Wen Hsing Machinery & Electronic Industry Corp., 27 Industry 2nd Rd., Jen-Wu Village, Kaohsiung, Taiwan; Unice Machine Co., 1275 Columbus Avenue, San Francisco, CA 94133, USA.

The Lotus roll is the subject of US Patent 3,969,802[1] and is intended to replace the conventional top roll in a cane mill. Although grooved in accordance with the client's specifications, it has a perforated surface which provides an easy exit for juice which is normally reabsorbed; the juice is discharged at both ends of the Lotus shell and falls harmlessly between the two bottom rolls into the juice tray. The result is increased extraction and reduced bagasse moisture. The cast steel alloy roll can be installed at any time during the crushing season without need for any modification to the mill.

Moisture tester. Henry Simon Ltd., Special Products Division, P.O. Box 31, Stockport, Cheshire SK3 0RT, England.

A new version of the Carter-Simon rapid moisture tester has been introduced. Designated the Series 7, it is fitted with a highly accurate automatic proportional temperature control which also reduces the warming-up and recovery periods. In addition, it may also be fitted with an optional integral alarm timing device to remind the operator when to insert and remove samples. The instrument uses a drying technique in which preheated air passes along specially designed oven ducts and over the test samples, thus permitting higher temperatures and shorter drying periods without decomposition of the product. Sugar is one of the materials for which the instrument is intended.

Maintenance welding. Eutectic + Castolin Institute, 40-40 172nd St., Flushing, NY 11358, USA.

Eutectic + Castolin welding processes have many applications in the cane sugar factory; they employ special alloys to provide wear-resistant coatings to extend the service life of all types of equipment by protecting them against abrasion, corrosion and other damaging conditions. The RotoLoy spray flame welding system can be utilized in any position, which is particularly advantageous for such tasks as spraying inside diameters of many critical wear parts, including pillow blocks, bearing housings and packing sleeves; the RotoTec 80 spray system is particularly of value for the occasional user who wants a simple, flexible system, and both processes use a wide range of metal powder alloys suitable for a variety of base metals. The TeroMatec-Peripheric welding process is a semi-automatic system using flux-cored continuous electrodes which is far more economical than systems using stick electrodes as well as being the fastest and most efficient semi-automatic system. Components which have been successfully treated with Eutectic + Castolin systems include drive sprockets, stub axles, king pins, mill roller pinions, crystallizer worm wheels and mill drive gears, main feeder pump, juice pump and molasses pump shafts, and butterfly, gate and sluice valves.

Sugar cane separation. Intercane Systems Inc., 1679 Howard Ave., Windsor, Ontario, Canada N8X 3X2.

The Tilby system is a revolutionary way of handling cane in place of traditional milling. The whole cane, topped and detrashed, is chopped into billets and fed by conveyor to a separator which splits the billets, removes the pith and wax-bearing epidermis and delivers the rind sections in original billet length or in the form of chips to further processing. The C-6 is operated by one man and is powered by two motors having a total rating of 35 hp; it has a rated throughput of 5-6 $tons.hr^{-1}$. The C-20 is operated by two men and has an hourly throughput of 20 tons of cane.

PUBLICATIONS RECEIVED

Pro-Cane. Stake Technology Ltd., 20 Enterprise Ave., Ottawa, Canada K2G OA6.

Pro-Cane is an animal fodder produced by continuous digestion of bagasse with steam under pressure to give a much higher digestibiility (as determined by the Tilley-Terry in vitro technique), which has been found to increase the intake of other feed ration ingredients when added at up to 30% on dry matter. Details of typical composition and feedlot trials are contained in reports available from Stake Technology.

Filter cake and bagasse composting. French Natural-Humus Co., Thorigny, Lagny-sur-Marne, France 77400.

Information is available from the company on the use of Cofuna S.B. yeast to produce a compost from filter and/or bagasse. Requisite for the process (which normally gives results within two months) is a moisture content of the mixture of at least 55% and a pile height adequate to provide the temperature necessary for the anaerobic fermentation process. The yeast is added at the rate of 10% by weight, and a minimum recommended size for the trial is a pile containing 250 tonnes. A field trial is reported in which addition of the compost at 1 $tonne.ha^{-1}$ considerably increased cane yield.

Toft cane harvesters. Toft Bros. Industries Ltd., P.O. Box 932, Bundaberg, Queensland 4670, Australia.

The Toft Robot 6000 rubber-tyred and 6500 tracked cane harvesters are featured in a 4-page brochure which illustrates the salient features. Full details are also given, on a separate specification sheet, of the Series 2 6000 and 6500 harvesters which are improved versions.

Cameco 1000 B heavy-duty cane harvester. Cane Machinery & Engineering Co. Inc., P.O.Box 968, Thibodaux, LA 70301, USA.

Leaflet 3M79 describes the outstanding features of the Cameco 1000 B harvester which is designed for heavy-duty work in both green and burnt cane. When not in use, the elevator can be carried in a horizontal position along the harvester, thereby avoiding contact with trees and power lines and preventing damage caused by bouncing over rough ground.

Herbicides. Ciba-Geigy AG, Basel, Switzerland.

The latest brochure gives details of Ciba-Geigy selective herbicides for use in cane, and describes their preparation and use. The products mentioned are Gesapax, Gesapax combi, Gasaprim, Gesatop Z, Gesapax H, Gesapax plus and Igran.

Pumps, valves and compressors. Klein, Schanzlin & Becker AG, Werk AMAG, Postf. 2644, D-8500 Nürnberg 1, Germany.

A 31-page booklet illustrates the activities of KSB in the manufacture and marketing of pumps, valves and compressors for use in a wide range of applications.

Instrumentation company acquired. — Negretti & Zambra, manufacturers of laboratory apparatus, pressure gauges, flowmeters, level indicators and controllers, have been acquired by The British Rototherm Co. Ltd.

[1] *I.S.J.*, 1980, **82**, 31.

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

Argentina sugar exports[1]

	1979	1978	1977
	tonnes, raw value		
Afghanistan	0	0	10,869
Algeria	0	14,242	0
Chile	70,876	22,035	185,218
China	0	0	21,114
Colombia	0	0	17,237
Denmark	0	0	12,600
Egypt	25,541	43,355	8,804
Finland	0	0	11,278
France	0	0	11,500
Ghana	0	0	6,521
Haiti	10,695	5,419	0
Indonesia	25,995	12,094	0
Iran	0	28,042	13,695
Italy	0	0	1,087
Jamaica	0	5,435	0
Jordan	0	0	5,435
Libya	0	0	6,195
Malaysia	0	0	12,199
Morocco	13,971	0	76,983
Pakistan	0	0	10,869
Portugal	14,701	19,000	44,644
Rumania	0	0	32,206
Senegal	0	6,000	26,600
Sri Lanka	0	0	11,956
Sudan	0	12,287	0
Sweden	9,602	0	0
Syria	0	0	29,422
Uruguay	20,615	0	4,376
USA	139,698	186,915	325,212
USSR	8,551	0	0
Venezuela	11,956	25,691	35,132
Yemen	0	0	4,565
Zaire	0	542	0
	352,201	366,815	939,959

New fuel alcohol information service. — G.V. Olsen Associates, an agribusiness intelligence research and advisory company in New York, has established a new gasohol and biomass energy information service, providing special reports and monthly up-dating services. In response to the growing interest in alcohol fuels, the company has released "Gasohol: A Selected Bibliography"; this report contains over 100 summaries of articles and government reports on economic and technical aspects of gasohol. Subjects include economic factors; production plants; fuel and engine performance; raw material sources; environmental factors; legal considerations, and future outlook. Interested persons should write to G. V. Olsen Associates, 170 Broadway, New York, NY 10038, USA.

Sugar chemicals licence for Thailand. — Talres Development BV, part of Tate & Lyle Investments Limited with responsibility for sucrochemicals licensing, has signed an agreement with Tallest Limited, a Thai consortium, for the licensing of their TAL sucrose surfactant process. Tallest will manufacture TAL sucrose surfactants from local sugar and tallow or coconut oil. It is anticipated that the production plant, sited near Bangkok, will be on stream by early 1982 to manufacture a range of products for use mainly as industrial surfactants and lubricants. In the interim, Tallest will import TAL from Talres to enable them to formulate detergents in Thailand. The TAL process uses a sugar substrate to produce a competitive alternative to existing petrochemical-based surfactants. Because the feedstock is indigenously grown, the Thai project will save approximately $2.5m a year in foreign exchange currently used to import petrochemicals.

Research study on bagasse fuel[2]. — A grant has been made by the Australian National Energy Research, Development and Demonstration Council to the Sugar Research Institute and to Queensland University for the development of methods of treating and storing bagasse with the object of making sugar factories self-sufficient in fuel. Cane in Australia is generally of low fibre content and oil is used as a supplementary fuel, some 36,000 tonnes or about 1% of Australia's total requirement having been used in 1978.

Japan sugar imports[3]

	1979	1978
	tonnes, raw value	
Australia	717,930	795,153
Brazil	0	21,189
Cuba	390,438	364,698
Fiji	10,497	0
Guyana	0	5
Philippines	287,592	54,836
South Africa	446,642	497,057
Taiwan	122,682	159,086
Thailand	625,249	386,417
	2,601,030	2,278,441

Canada sugar factory modernization[4]. — The Quebec Government plans to invest Can. $32.7 million to develop and modernize the equipment of Quebec Sugar Refinery at Mont St.-Hilaire, near Montreal. The plans are to raise capacity to 3600 tonnes/day and reduce the cost of processing beets by 50%.

Booker McConnell Ltd. 1979 report. — Of the companies in the Booker Group concerned with sugar, Fletcher and Stewart Ltd. produced a creditable result from a turnover some 3% above that of 1978. There were fewer major projects and competition was more intense. The largest profit contributions came from contracts for expansion of the Mumias factory in Kenya, the Juba sugar project in Somalia and the Batangas refinery project in the Philippines. The Asalaya factory in the Sudan was finally completed and commenced operations in January 1980. Also in the Sudan, a maintenance contract was undertaken at the Sennar factory. The largest individual orders for unit equipment were for milling equipment supplied under sub-contract to A/S De Danske Sukkerfabrikker for Vietnam and a diffuser for the Brigg factory of British Sugar Corporation Ltd. The present position on major factory projects is less healthy although the rise in the price of sugar gives some encouragement for the future. Several proposals were made in 1979, notably in the Philippines, Thailand, Indonesia and China, and contracts have been signed for two of these. The FS product range has been extended to cover distilleries for both potable and power alcohol. A contract for a potable alcohol distillery in Fiji should be completed in 1980 and FS has a number of good prospects for power alcohol distilleries in cane growing countries. In August 1979, FS acquired 47½% of the equity of Elfa-Apparate-Vertriebs, a West German company specializing in the design and supply of equipment for beet sugar factories. Early in 1980 it also acquired 49% of the equity of a new joint venture company in Mexico, in order to participate in this large market. The sugar division of Booker Agriculture International had another successful year, despite a depressed sugar market for much of the period. The Juba sugar project in Somalia remains on schedule and production will start in 1980; at Mumias the major expansion was completed, and work has started on implementation of the Ramu project in Papua-New Guinea which combines a major new sugar development with an existing livestock operation. Continuing technical and management services were provided for other estates and factories in Guyana, Costa Rica, St. Kitts, Madagascar, Senegal, Kenya, Nigeria and Indonesia.

Niger sugar cane production[5]. — Sugar cane production in 1979 reached 155,000 tonnes and is to be raised to 315,000 tonnes once the new sugar factory project in Tillabery comes on stream in 1983, when sugar production capacity will be 30,000 tonnes per year.

Austria beet sugar campaign, 1979/80[6]. — In the 1979/80 campaign the six Austrian sugar factories sliced a total of 2,146,267 tonnes of beets to produce 376,201 tonnes of white sugar, 623 tonnes of afterproduct-raw sugar, 45,724 tonnes of molasses and 150,263 tonnes of dried pulp and pellets. Because of stagnating consumption, the 100,000 tonnes of sugar in stock is likely to be increased by a further 75,000 tonnes/year in the coming years so that efforts are to be made to seek export outlets.

1 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 86.
2 *Australian Sugar J.*, 1980, **71**, 501.
3 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, S80.
4 *Westway Newsletter*, 1980, (77), 8.
5 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 172.
6 *Zuckerind.*, 1980, **105**, 288.

Belgium sugar imports and exports[1]

	1979	1978
	—— tonnes, tel quel ——	
Imports		
France	108,361	25,742
Germany, West	2,752	6,972
Holland	2,888	395
Other countries	481	344
	114,482	33,453
Exports		
Algeria	42,447	0
Bahrein	6,205	7,880
Bangladesh	2,638	0
Burundi	65	1,000
Cameroun	1,094	1,873
Chad	1,184	375
Chile	11,200	11,700
Congo	4,371	197
Egypt	0	3,460
France	1,854	1,941
Gabon	7,198	864
Gambia	1,570	300
Germany, West	21,960	33,348
Ghana	21,815	1,500
Holland	2,351	891
Hong Kong	600	0
Iceland	252	812
Indonesia	620	90
Iran	11,300	24,715
Israel	19,245	7,447
Ivory Coast	698	1,357
Kenya	14,091	200
Kuwait	24,000	12,000
Lebanon	40,753	25,545
Mauritania	3,028	11,632
Morocco	0	8,200
Niger	2,351	891
Nigeria	85,135	50,496
Norway	2,573	2,350
Oman	6,200	3,025
Qatar	0	3,050
Rwanda	3,162	1,300
Saudi Arabia	364	5,390
Sierra Leone	820	200
Somalia	60	5,289
Sri Lanka	130	11,780
Sudan	11,098	0
Surinam	0	1,600
Syria	0	8,764
Togo	931	0
Tunisia	0	35,726
UK	650	1,611
United Arab Emirates	17,510	8,114
USA	60	21,665
USSR	37,002	0
Vietnam	1,531	0
Yemen, North	16,855	5,577
Zaire	10,712	3,515
Other countries	6,082	5,344
	465,682	373,148

Benin sugar project[2]. — Repayment and funding of a US $55 million line of credit has been guaranteed by the UK Export Credits Guarantee Department to enable contracts to be placed in the UK for goods and services to complete construction of a sugar factory of 3750 tcd capacity for the Sucrerie de Savasa, a sugar company in the People's Republic of Benin. The project is a joint venture between Benin and Nigeria which hold 49% and 46% of the equity, respectively, the balance being held by Lonrho Ltd.

Thailand sugar exports[3]

	1979	1978
	—— tonnes, tel quel ——	
Canada	11,500	0
China	71,662	236,177
Indonesia	0	5,250
Iran	0	85,800
Iraq	9,700	0
Japan	655,688	393,763
Korea, South	87,258	72,547
Malaysia	111,530	114,971
Morocco	85,849	0
New Zealand	18,000	0
Singapore	44,600	23,987
Sweden	20,778	12,600
USA	11,177	64,343
USSR	42,703	0
	1,170,445	1,009,438

Austrian sugar technologists' association meeting. — The 1980 meeting of the FZÖ is to take place during June 20 — 21, at the Hilton Hotel, Vienna, with presentation of technical papers on the first day. These will include papers by Dr. L. Wieninger on the influence of extraction water hardness on juice quality, by Prof. Dr. E. Göttinger on aspects of sugar research in medicine, by Prof. Dr. H. Clodi on sucrose in human nutrition, Prof. Dr. K. Hagmüller on the influence of sucrose on amino-acid transport in the small intestine, by Dipl.-Ing. A. Graf on experiments on the preservation of sugar beet pressed pulp, and by Dr. W. Obritzhauser on feeding experiments with ensilaged sugar beet pressed pulp. Further information is available from Fachverein der Zuckerfabriken Österreichs, Postfach 155, A-1031 Vienna.

Australia 1979 sugar crop[4]. — For the second successive season, owing to the operation of the International Sugar Agreement quota provisions, Australia's sugar production was restricted to near the level of mill peaks. Although some cane was left to stand over to the 1980 season, the overall tonnage was not nearly as great as was the case at the end of the 1978 season. In Queensland the area harvested was 255,257 hectares, which compares with 237,657 hectares in the 1978 season. Cane tonnage harvested was 19,861,754 tonnes, about 273,000 tonnes less than in 1978. However, improved sugar content in nearly all areas resulted in sugar output from the smaller cane crop, at 2,807,890 tonnes, 94 N.T., being about 59,000 tonnes above the previous season's output. Levels of c.c.s. were generally disappointing in North Queensland but satisfactory in the rest of the state. Although New South Wales mill areas had disappointing sugar content levels, they also crushed slightly less cane, at 1,290,877 tonnes, to produce slightly more sugar at 155,705 tonnes 94 N.T. The area harvested was 11,839 hectares. In 1978 the N.S.W. crop of 1,321,505 tonnes of cane yielded 152,623 tonnes of sugar. Combined Australian production in 1979 totalled 2,963,595 tonnes 94 N.T. sugar from 21,152,631 tonnes of cane, against 2,901,481 tonnes of sugar from 21,456,976 tonnes of cane in 1978.

Alcohol — sugar production economics in Brazil[5]. — The *Financial Times* has quoted a leading Brazilian economist, João Francisco de Aguiar, as having calculated that Brazil could earn more by exporting her 1980 cane production as sugar than would be saved in fuel substitution by alcohol. The 20% alcohol currently mixed with petrol represents a saving of $300 million but, if the 3,400,000 tonnes of cane used to make this alcohol were used for sugar production, it would bring export earnings of $1500 million at current prices. The Minister for Trade and Industry has recently stated that the country's alcohol production targets are not to be altered, however, and that the government does not intend to attempt a production balance between sugar and alcohol. Ironically, owing to lack of storage facilities, 1980 alcohol production of 2,000,000 hl per month will overtake demand so that some of the product will have to be exported. Already there have been reports in Brasilia that the next meeting of the National Alcohol Council will authorize the export of an extra 1,500,000 tonnes of sugar which will earn $600 million.

[1] C. Czarnikow Ltd., *Sugar Review*, 1980, (1483), 51.
[2] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 211.
[3] C. Czarnikow Ltd., *Sugar Review*, 1980, (1479, 30.
[4] *Australian Sugar J.*, 1980, **71**, 446-447.
[5] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 190-191.

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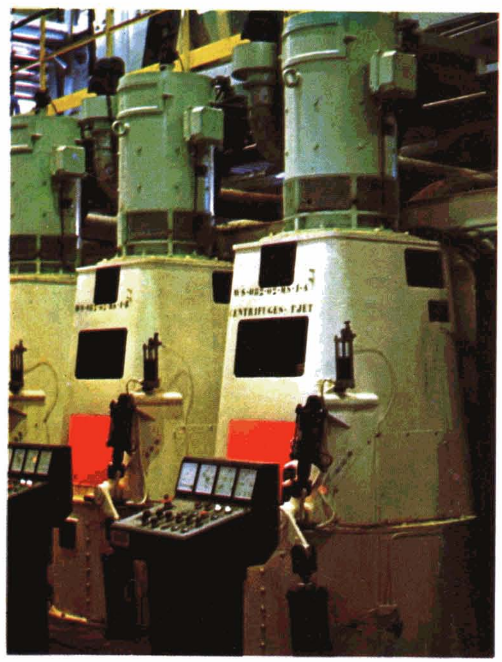

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