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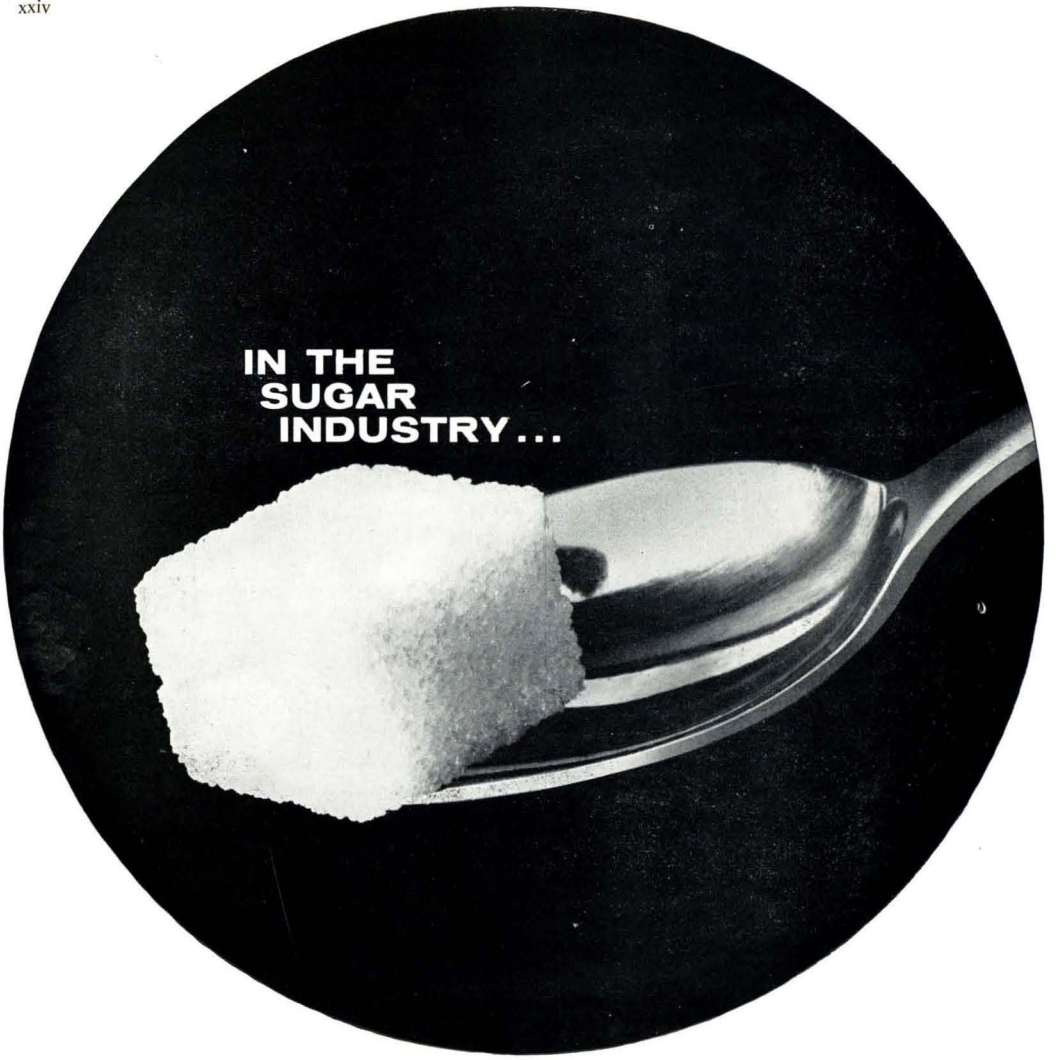

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THE
INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

European beet sugar production, 1964/65.

The first estimates of European beet sugar production in the current campaign were published by F. O. Licht K.G. at the beginning of October[1]. They are tabulated elsewhere in this issue. With known increases in area planted to beets, a large crop has been forecast for some time and it therefore came as no surprise that Licht puts total production as high as 23,429,000 metric tons, raw value, compared with 19,663,463 tons in the 1963/64 campaign.

The largest figure is, of course, that of the U.S.S.R. and the lack of information on the Soviet sugar industry therefore makes for great difficulty in forecasting accurately because of the margin of error involved. As C. Czarnikow Ltd. point out[2], "Sugar yields vary widely from year to year . . . Twice in the past seven seasons they have averaged just over 2·5 tons to the hectare in the U.S.S.R. and if this were attained this season it would result in a crop in the region of ten million tons. On the other hand last season's yield was only 1·86 tons to the hectare and this, if repeated, would give only some 7·5 million tons of sugar. Licht mentions that weather conditions in the two most important sugar producing Republics of the Soviet Union have been favourable this season which should result in a satisfactory tonnage of roots. At the same time, however, the substantial expansion in the area will bring difficulties, especially in regions which are not traditional beet producers." Licht has, in fact, come to the conclusion that production will amount to 8·6 million tons.

Appreciable increases are expected for several other countries; the U.K. for instance, is expected to produce 950,000 tons—more than 100,000 tons up on 1963/64, while similar increases are expected in Belgium and Spain and even bigger increases are anticipated from Holland, Poland, Rumania and Turkey. The only country where an appreciable reduction is expected is Czechoslovakia, where the beet area has been reduced and yield of beet is expected to be lower than last year because of low rainfall.

Sugar Board 7th Annual Report

The Seventh Annual Report of the Sugar Board was published on the 25th September. It deals with the activities of the Board from 1st July, 1963 to 30th June, 1964 and includes an audited statement of the Board's Accounts for that period.

World prices for sugar continued to fluctuate violently during the year. From the high point reached just before the start of the year of over £100 a ton, world prices fell to under £50 a ton in August, 1963, but rose again to £105 in October. After that world prices fell continuously, though at varying rates and with rises interrupting the fall in January and April, 1964. The world price at the end of the year on 30th June was £46 and it has since fallen, at an irregular rate, to £32 10s.

The average world price of raw sugar in 1963/4 was 68% higher than in 1962/3. However after the operation of the Sugar Board's distribution payments, and thanks to the steady supply of sugar from the home farmer and the Commonwealth Sugar Agreement producers at less than world prices, the refiners' average selling price in the United Kingdom rose by only 2·2% over the same period.

For most of the year to the end of June the Board were making a substantial surplus on their trading, which amounted to some £21 million, but to protect the consumer from increased domestic prices resulting from the increased world prices, the Board paid out some £54 million in Distribution Payments. Moreover, in this period of widely fluctuating prices, traders' purchases were naturally irregular with the result that the pattern of the Board's sales did not correspond with the pattern of the Distribution Payments. These are the main reasons why the Board's overall deficit increased substantially despite a receipt of £13 million from the British Sugar Corporation and over £4 million from Surcharge which was re-imposed at the end of May. The Report also notes that over the last two years retail prices of sugar and sugar-containing goods in the

[1] *International Sugar Rpt.*,1964, **96**, (27), 1–2.
[2] *Sugar Review*, 1964, (682), 177.

United Kingdom, appears on average to have risen by less than tne increases in the real cost of sugar in the United Kingdom caused by increasing costs and the high world prices.

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International Sugar Council.

The Annual Report and Accounts of the International Sugar Council for 1963 has been published and provides a record of the activities of the Council last year. Argentina, Jamaica and Trinidad & Tobago acceded to the International Sugar Agreement during 1963 and it was also extended to Swaziland. The Council held three Sessions during the year while its Executive, Statistical and Financial Committees each met twice. There was one meeting of the Committee on Sugar Consumption. Extension of the Agreement for two years beyond its scheduled expiry date of 31st December 1963 was arranged by a Protocol, and a Preparatory Committee established to study the possible bases and framework of a new Agreement. This Committee reported to the Council in June 1964 and its report was circulated to member Governments. Their views will presumably be expressed at the meeting of the Council scheduled for 2nd November.

* * *

More U.K. sugar beet in 1965.

British farmers will be able to plant an additional 7500 acres to sugar beet in 1965 as a result of a Government decision following the ending of a commitment to buy South African sugar[1]. The Minister of Agriculture, Fisheries and Food and the Secretary of State for Scotland have authorized the British Sugar Corporation to increase their contracts for the coming season by 7250 acres in England and Wales and 250 acres in Scotland.

The increased tonnage produced will be handled by the existing factories of the British Sugar Corporation.

From 1958 to 1963 the total permitted home beet acreage remained at 414,600 acres. Improved production techniques have increased yields of sugar in beet per acre from 1·88 tons in the five years ended 1958/59 to 2·26 tons in the five years ended 1963/64, an increase of 20%. The permitted acreage was increased by 20,750 acres for the 1964 crop, and is now increased by a further 7500 acres for 1965.

In 1963 the breakdown of area between England and Wales and Scotland was 400,000 acres in England and Wales and 14,600 acres in Scotland. In 1964 the respective figures were 420,000 acres and 15,350 acres, while in 1965 they will be 427,250 acres and 15,600 acres.

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U.S. sugar legislation.

The U.S. Senate adopted an amendment to the Sugar Act on the 30th September which provided for a 10% increase in the market allotment for beet sugar producers and more than 20% increase for cane sugar producers, for 1964 only. The amendment provided a six months extension to present foreign quotas and gave additional marketing of 500,000 short tons in 1964 for domestic producers.

Congress adjourned, however, before the amendment could go through the House of Representatives so that there is no legislation continuing the Sugar Act beyond the end of the year. This has had a disturbing effect on the U.S. domestic market but the House of Representatives Agriculture Committee Chairman is reported[2] to believe that the U.S.D.A. has sufficient authority under existing laws to continue the Sugar Act operations and establish foreign quotas for 1965 in much the same fashion as in 1964.

The Chairman has expressed the opinion that the provisions of the Act levying an import fee on sugar imported under open-end global quota expire as does the fee on sugar imported under country-by-country allocations.

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Indian sugar prospects[3].

The Indian Minister of Food and Agriculture is reported to have announced that prospects are bright for a substantial increase in sugar production in India in the 1964/65 season which commences in November.

According to the first estimate the area under cane is 5,600,000 acres, an increase of 7·6% on the 1963/64 area. The crop is reported to be in good condition, following beneficial rains. The Minister stated that the 1963/64 season's output was estimated at 2,550,000 tons.

The Sugar Enquiry Commission, which was established at the beginning of August, submitted in September an interim report to the Government containing recommendations on further incentives to encourage the production of sugar. A decision by the Indian Government on action to be taken on the recommendations is expected shortly.

* * *

Sugar factories of the Soviet Union[4].

According to the Soviet manual of industry 276 sugar factories were working in the U.S.S.R. in 1963. Most of these factories had a capacity of 700 to 1500 tons of beets per day. Only 15·6% of the factories have a slicing capacity exceeding 2000 tons. The following table gives a survey of the Soviet sugar factories.

	1960	1961	1962
Total sugar factories	261	268	276
Slicing capacity (tons/day)			
Up to 300	4	1	1
300–500	4	4	3
500–700	9	16	9
700–900	48	40	41
900–1100	55	48	53
1100–1300	42	52	42
1300–1500	31	36	38
1300–1700	18	22	22
1700–1900	19	14	14
1900–2000	8	14	10
2000 and more	23	21	43

[1] *I.S.J.*, 1964, **66**, 310.
[2] *Public Ledger*, 17th October 1964.
[3] C. Czarnikow Ltd., *Sugar Review*, 1964, (680), 167–168.
[4] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (24), 12–13.

CANE CULTIVATION IN QUEENSLAND

THREE separate recent, or fairly recent, publications[1] all deal with cane growing in Queensland and give a good idea of the progress and the expansion in production that is being made or is about to be made in that country.

A good deal of the Report of the Bureau of Sugar Experiment Stations for 1963 is concerned with investigations on pests, diseases and weeds. It is believed that interest in weed control has increased because of the lower price for harvested cane because of high extraneous matter content and also because of high cutting costs. Trials in the Lower Burdekin area with Johnson grass (*Sorghum halepense*) showed that an almost complete kill of rhizomes and tops was achieved by spraying twice with a mixture of 8 lb 2,2-DPA and 32 lb TCA per acre. The cost of treatment was approximately £10 per acre—substantially less than other successful treatments. A uracil compound "Hyvar" showed promise with Johnson grass control at Ingham when sprayed on the grass at 8 lb per acre. Early indications were that two treatments at this rate could cause complete eradication in non-cropped land.

Aerial spraying of giant sensitive plant (*Mimosa invisa*) with 2,4,5-T, plus wetting agent, proved efficient and economical in both cane and pasture. With regard to billygoat weed (*Ageratum houstonianum*), which is considered to have probably the greatest overall nuisance value of any cane field weed in Queensland, DCMU at 2 lb active ingredient per acre, costing approximately £5 per acre, was recommended for commercial use. For pre-emergence weed control 2,4-D DCMU at 4-5 lb per acre gave the best results.

In tests with nematodes, molasses and filter mud had little effect in control as compared with the fumigant used (DBCP).

Unusually dry conditions during early growth of cane in some areas during 1962 resulted in attack from some minor insect pests being more severe than usual. This applied to the moth borer *Ephysteris chersaea*, and "Childer's grub" (*Pseudholophylla furfuracea*). Control measures against soldier fly (*Altermetoponia rubriceps*), which caused a loss of 7375 tons of cane on 740 acres, are described, viz. broadcasting of crude BHC dust or "Dieldrin" and its incorporation in the soil before planting. BHC dust was successfully used against the yellow winged locust (*Gastrimargus musicus*), adults and hoppers. Funnel ants (*Aphaenogaster pythia*) were successfully combated by broadcasting "Aldrin" at 12 lb per acre or "Heptachlor" at 9 lb per acre. This greatly reduced the number of mounds formed. Other minor cane pests referred to are army worms, wire worms, cicadas, rats, pigs, bandicoots, striped phalangers, foxes, bald coots and white cockatoos.

Disease investigations reported on relate to chlorotic streak, ratoon stunting disease, mosaic, striate mosaic, Fiji disease, leaf scald, downy mildew and red rot. "Pseudodwarf" (origin at present unknown) and Basal stem, root, and sheath rot (due to an unidentified *Basidiomycete*) are other diseases discussed. Reference is made to a peculiar or abnormal condition of the germinating bud in planting setts, referred to as "wart-eye", which prevents subsequent growth. The causal agent and means of circumventing the trouble are being investigated.

The variety Pindar was the leading variety in the State for the fifth time in succession, being responsible for over 2 million tons of cane. Q 50 was next in terms of tonnage, having displaced Trojan. The South African variety N:Co 310 has become a major variety in the Central District. Among new varieties the Mackay bred Q68 proved successful over such a wide range of country that it was approved in 1963 for planting in ten mill areas. Two varieties showed considerable drought resistance, viz. Q76 and H 48-3166, the latter a Hawaiian variety. The variety Q 78, a very erect variety with good early sugar content, should be well suited for mechanical harvesting.

In the report of the Queensland Cane Growers' Association information is given on recent developments in mechanical harvesting, including figures showing the rate of growth from 1956 to 1963. The overall increase in mechanical harvesting as compared with the previous season was 47%. Two new harvesters made an appearance, viz. the Don-Mizzi chopper harvester and the Toft whole stalk bundler. Both machines performed well within the limits of their application to prevailing local conditions. A photograph shows the Don-Mizzi harvester "operating in twisted lodged Q71 plant cane at Bundaberg, in open furrows not normally cut by harvesters". Cane cut by Massey-Ferguson harvesters represented an increase of 52% on last season.

F.N.H.

Control of sugar beet downy mildew (*Peronospora farinosa*) **by sprays.** W. J. BYFORD and R. HULL. *Ann. Appl. Biol.*, 1963, **52**, 415–422.—No fungicide tested gave more than partial control. Even frequent spraying commencing shortly after seedling emergence rarely did more than halve the incidence. The degree of control was not adequate for commercial use.

* * *

Sugar beet eelworm larvae. F. MORIARTY. *Ann. Appl. Biol.*, 1963, **53**, 423–430.—This deals with "the hatch of beet eelworm (*Heterodera schachtii* Schmidt) larvae in 'Rivanol', and its use for the estimation of field populations". Hatching of larvae from cysts was greatest in 1% "Rivanol", which inhibited the growth of micro-organisms. The hatching effect of "Rivanol" was specific to beet eelworm out of five *Heterodera* species tested.

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[1] 63rd Annual Report of the Bureau of Sugar Experiment Stations, Brisbane, Queensland, 1963, 89 pp.
37th Annual Report, Queensland Cane Growers' Association, Brisbane, 1964.
Producers' Review, 1964, **54**, (3).

INDIAN SUGAR TECHNOLOGISTS' CONVENTION

Proceedings of the 31st Annual Convention of the Sugar Technologists' Association of India, 1963

THESE proceedings, in two parts, consist of 32 papers, about a third of which are concerned with aspects of the cultivation or production of sugar cane in India.

In a paper on the germination of sugar cane setts under excessively wet soil conditions K. K. PRASAD RAO *et al.* record observations in the West Godavari District of Andhra Pradesh in a season when unprecedented rain fell during a period that is normally fairly dry. Cane recently planted in low lying fields was seriously affected in regard to germination and replanting was necessary. Tests subsequently made under similar conditions led to the conclusion that three-budded setts planted at an angle of 45° with the lowest bud only in the soil and well pressed in, gave the best germination.

The effects of N-P-K fertilizing, at different levels, on ratoon crops are discussed by V. P. VAIDYA and J. N. PATEL as a result of large scale field trials as well as small randomized plots. No residual effect on ratoon crops was noticeable from nitrogen applied to the plant crop, while that from phosphate was negligible. There was no difference in yield between 300 lb N and 350 lb N per acre. Judicious manuring and more adequate irrigation are considered necessary to improve yields from ratoon crops. In considering cane cultivation in Uttar Pradesh one writer (KIRTI KAR) stresses the fact that, with increasing use of high yielding varieties which take more out of the soil than the older varieties, it is essential that more attention should be given to manuring.

Four other papers are concerned with soils: S. C. SEN discusses the carbon and nitrogen status of sugar cane-growing soils in Bihar. This is a continuation of some earlier work. Organic carbon varied from 0·43% in sands to 0·60% in silt loams, while organic nitrogen varied from 0·047% in sands to 0·60% in loams. Figures for ammoniacal nitrogen and nitrate followed similar patterns in regard to soil type. Other papers describe a soil survey of the sugar cane soils of the Maholi Cane Development Zone in the Sitapur District, the effects of soil moisture and free calcium carbonate on the fixation of applied phosphatic fertilizer in calcareous soil, and the soils of the Mawana factory zone (Meerut District, U.P.).

A paper on pollination studies provides a brief historical review of the subject and reports the results of experiments carried out to test these different methods of carrying out artificial pollination under the prevailing conditions (at the Sugar Cane Research Institute, Pusa, Bihar). The dusting method, yielding 30·85% germination, was superior to the control (16·30%) and to spraying the pollen in water (2·20%).

Red rot disease of sugar cane (*Physalospora tucumanensis*), so troublesome on the Indian Subcontinent, is the subject of one paper. In it the writers give an account of an eradication campaign in the district of Champaran in Bihar when over 6 million infected clumps were eradicated from an area of 13,000 acres in one season. Only one variety (B.O. 10) was found to show any degree of resistance.

F.N.H.

SUGAR CANE PROSPECTS IN KENYA

IN "A National Cash Crops Policy for Kenya (Pts. I & II)" by L. H. BROWN (Acting Director of Agriculture, Govt. of Kenya) several references to sugar cane cultivation and production occur. It is stated—"The Ministry Working Party on sugar development recommended that additional production of white sugar up to about 70,000 tons should be organized in the Muhoroni, Songhor, Chemelil and Miwani areas of Nyanza Province. It has already been stated that production might in certain circumstances exceed that amount.

The majority of this increased production would be produced by commercial cane growers in that area. These people require no more than sound advice as to varieties and methods of cultivation, which is already available, and which could greatly increase the yield of existing estates. A proportion of the sugar production, would, however, come from (*a*) smallholder settlements under the aegis of the land Development and Settlement Board; (*b*) pilot irrigation schemes on the Kano plains; (*c*) smallholder production of rain-grown cane in adjacent areas of Central Nyanza, Nandi and Kipsigis Districts. The main expenditure would be in (*a*) and (*b*) and funds for both would presumably be provided by the Ministry of Land Settlement and Water Development; (*c*) again requires nothing but advice from existing field staff.

Increased production cannot be encouraged without additional factory capacity, at present lacking; no concrete plans for development can therefore be formulated in detail." Sugar is one of the largest of Kenya's imports. A proportion of the country's sugar requirements is at present imported from Uganda. Nevertheless roughly one third of the country's needs in sugar is met from importations from outside East Africa. With consumption rising steadily there is considered to be ample scope for expansion of local production in Kenya.

F. N. H.

SUGAR CANE BREEDING

THE special number[1] of the *Indian Journal of Sugar Cane Research and Development* issued in connexion with the Golden Jubilee celebration of Coimbatore contains, appropriately enough, a number of interesting articles on different aspects of sugar cane breeding, some of them written by well known authorities or research workers.

T. S. VENKATRAMAN gives his reminiscences of the early days of Coimbatore, which started on 6 acres of land too heavily impregnated with salt to grow cane, but which was soon put right and made capable of growing 30-ton crops of cane. A. J. MANGELSDORF of Hawaii gives his impressions of a sojourn made at Coimbatore in 1929, along with Dr. U. P. DAS, a celebrated cane breeder of that time who unfortunately lost his life in a laboratory explosion.

International cooperation in sugar cane breeding is discussed by J. N. WARNER, also of Hawaii. He pays tribute to the international rôle played by Coimbatore in the past by willingly distributing her cane to other cane-growing countries and points out that Hawaii's "wonder cane", H32-8560, which set a new level of production in Hawaii when it appeared, had a Coimbatore cane (Co 213) for one of its parents. Praise is given for India's Spontaneum Exploration Scheme for augmenting the number of clones of *Saccharum spontaneum* available to other sugar cane breeders. This has as its counterpart the rôle played by Queensland, Hawaii and the United States in collecting clones of *officinarum* and *robustum* in the New Guinea area. Tribute is also paid to the wisdom of the establishment of the world collection, or bank, of sugar cane germ plasm at Canal Point in Florida and later at Taliparamba in India.

The value of Coimbatore varieties to Queensland is the subject of a paper by J. H. BUZACOTT, Senior Plant Breeder of the Queensland Bureau of Sugar Experiment Stations. He points out that the main value of Indian varieties in Queensland has been as parents in the breeding of other varieties, giving as examples *Pindar* and *Trojan* (1st and 2nd in the 1961 Queensland crop) bred from the Coimbatore cane Co 270 as female parent, also the less important varieties *Ragnar* and *Orion*. Several other important or promising varieties in Queensland have Co 270 as a grandparent. Out of 44 varieties at present approved for growing in Queensland no less than 29 include Coimbatore varieties in their lineage.

C. O. GRASSL of the U.S. Crops Research Division discusses problems relating to the origin and evolution of wild and cultivated *Saccharum*. The complex chromosome make-up of the many known clones of *Saccharum spontaneum* is discussed at some length and this is followed by a discussion of *S. robustum*, *S. officinarum*, *S. sinense* and *S. barberi*. The need for further collecting in less known areas is stressed.

In connexion with wild cane or sugar cane allies the potentialities of *Sclerostachya fusca* and *Narenga porphyrocoma* in sugar cane breeding are dealt with by N. R. BHAT. He stresses their attractive features, viz. resistance to red rot, smut and mosaic diseases, resistance to water logging, early flowering, high tillering and erect growth habit.

Several papers are concerned with the cytological aspects of sugar cane breeding. Some historical facts about cytological investigation of sugar cane are given in a paper by G. BREMER, formerly cytologist at the Sugar Experiment Station at Pasuruan in Java. Cytoplasmic inheritance in *Saccharum* is dealt with by T. S. RAGHAVAN and cytological studies in *Saccharum* and allied genera by S. PRICE.

Trends in breeding sugar cane for mainland areas of the United States during the last decade are discussed by I. E. STOKES. Reference is made to the latest collection of material from remote areas of New Guinea which made available more than 300 new clones. Factors affecting the flowering of sugar cane are discussed at great length by H. F. CLEMENTS and M. AWADA of Hawaii, their paper having also been published in Hawaii (Technical Paper No. 591).

The root system of sugar cane—an evaluation of its salient features, is discussed by H. EVANS, who has made many contributions in this particular field of study. He gives a historical summary of investigations carried out on sugar cane root development, also a critical assessment of root characteristics that are significant to the development physiology of the cane plant and its adaptation to its environment. Recent techniques, such as the uptake of tagged elements, are discussed.

F.N.H.

[1] *Indian J. Sugar Cane Res. Dev.*, 1964, **8**, (2), 89–238.

Agricultural Abstracts

Field bindweed control. A. F. WIESE, R. G. DAVIS and J. P. SMITH. *Texas Agric. Expt. Sta. Progr. Rpt.*, 1963, (2269), 1–3; through *Biol. Abs.*, 1964, **45**, 2078. Both liquid and dry formulations of "Tritac" and "Fenac" applied for the eradication of small patches of field bindweed (*Convolvulus arvensis*) and Texas blueweed (*Helianthus ciliaris*) gave control equal to or better than that obtained with comparable rates of TBA and PBA. The recommended rate of application for the two new herbicides is 20 lb per acre.

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The control of saline groundwater. T. TALSMA. *Med. Landbouwhogeschool, Wageningen* (Holland), 1963, **63**, (10), 1–68.—This paper, in English, concerns, in part, field investigations carried out in the Murrumbidgee Irrigation areas of south eastern Australia where the salinity problem is caused by the occurrence of saline groundwater in certain districts. The first chapter is a discussion on the general drainage requirements to control the salinity factor.

Climatology in Hawaiian sugar cane industry. J. H. CHANG. *Pacific Science*, 1963, **17**, 379–397.—The long and noteworthy history, dating from 1883, of climatological study in the Hawaiian sugar cane industry is outlined. The benefits that have resulted, since the second world war, of the pooling of resources by the sugar cane and pineapple industries for climatological study are also stressed. The paper summarizes the experiences and results obtained during the past three decades, which it is thought "may very well benefit research workers in other parts of the world, especially those in the tropics."

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Sugar beet yellows in eastern England. G. E. RUSSELL. *Ann. Appl. Biol.*, 1963, **52**, 405–413.—This deals with "some factors affecting the relative incidence, distribution and importance of beet yellows virus and sugar beet mild yellowing virus in eastern England, 1955–1962". Sugar beet mild yellowing virus (SBMYV) was much more common than beet yellows virus (SBYV) in S.E. England during 1961 and 1962. SBMYV probably caused about 3 times as much sugar loss as SBYV in England in 1961 and 10 times as much in 1962. *Aphis fabae* appears not to spread SBMYV in the field.

* * *

Importance of insecticides and "Agallol" in late planting of sugar cane. R. L. BHOJ and A. NATH. *Indian Sugar*, 1963, **13**, 497–498.—In eastern Uttar Pradesh cane is often planted late because of food crops or cash crops occupying the land. Such cane is liable to heavy insect attack (termites and borers). Advantages of using gamma-BHC or, failing this, "Chlordane" dust and treating planting setts with "Agallol" are outlined.

* * *

Control of grasshoppers on sugar cane in Uttar Pradesh. K. M. GUPTA and A. P. SAXENA. *Indian Sugar*, 1963, **13**, 509–511.—Severe damage may be caused by grasshoppers (*Hieroglyphus banian* and *H. concolor*). Effective control was obtained by aerial spraying with 0·75 litres of 30% "Aldrin E.C." in 23 litres of water. Dusting with BHC in two formulations and two doses with ground equipment was quite effective and economical.

* * *

Weed control with "Alipur" and "Pyramin" in sugar beet. H. BEINHAUER. *Zucker*, 1964, **17**, 59–64. Experiments showed that "Pyramin" was, in general, more satisfactory in controlling weeds in beet than "Alipur". Its use (at 4 kg/ha) is recommended from sowing up to emergence and after emergence when the first true leaf is about the size of a pea.

Mechanization of cane agriculture in Mexico. D. ONTIVEROS HERNÁNDEZ. *Bol. Azuc. Mex.*, 1963, (173), 3–12.—The various makes of tractor in use in cane fields in Mexico are dealt with. A table shows the number of tractors in use in different districts of Mexico, while another shows the proportion of different makes of tractor in use.

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Cultivation of ratoon crops. ANON. *Bol. Azuc. Mex.*, 1963, (173), 15–19.—This is a general discussion of the correct treatment of ratoon crops in Mexico.

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Nutgrass investigations. ANON. *Australian Sugar J.*, 1964, **55**, 777.—Because of the troublesome nature of this weed (*Cyperus rotundus*) further investigations are being carried out at the Mackay Experiment Station. In a severely infested site there were 12·77 tons of nutgrass tubers per acre in the top 12 inches of soil. Small trial plots showed it decreased soil moisture in cane fields considerably. Cane in infested plots was yellower, less vigorous and showed greater drought distress than cane in non-infested plots.

* * *

Uptake of nitrogen, phosphorus, potassium, calcium, magnesium and sulphur by sugar cane in Louisiana in 1963. L. E. GOLDEN and R. RICAUD. *Sugar Bull.*, 1964, **42**, 170–173.—Details of this work, begun in 1959, have been published elsewhere. A table is given summarizing results of analyses from 4 different areas. Ca and Mg are present in most Louisiana soils in excess of amounts required for good cane growth.

* * *

Aqua ammonia injury risk. ANON. *Producers' Rev.*, 1964, **54**, (3), 75.—The injury risk to aqueous ammonia-distributing plant operators is discussed. It is argued that the pressure at which the material is fed in, in the event of breakage of the hose, is the major hazard and that gravity feed would be relatively safe.

* * *

Aqua ammonia effect on soil bacteria. ANON. *Producers' Rev.*, 1964, **54**, (3), 75.—The bacterial count in the soil falls very rapidly after the application of aqueous ammonia but multiplies from 6 to 25 times ten days after the application. Fungi in the soil are also reduced drastically in the same way but do not regenerate themselves so rapidly. The nematode population is also reduced and regeneration is slow. There was nothing to fear regarding the action of aqueous ammonia on soil bacteria.

Weedicides improved by wetting agents. C. A. REHBEIN. *Cane Growers' Quarterly Bull.*, 1964, **27,** 112–114.—Various wetting agents, or surfactants, were tested in controlling weeds, notably billygoat weed (*Ageratum houstonianum*), with 2,4-D in northern Queensland. The use of surfactants proved beneficial. Details are given.

* * *

Meringa cowpea—a new legume. J. H. BUZACOTT. *Cane Growers' Quarterly Bull.*, 1964, **27,** 119.—This is the first commercial variety of cowpea (*Vigna unguiculata*) to be released from the Bureau of Sugar Experiment Stations. Its yield of green matter is superior to existing varieties and it shows good field resistance to wilt. Other good points are outlined.

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Wallaby control. I. F. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1964, **27,** 120.—Cane growers in Queensland sometimes suffer from wallaby damage. Blood meal at a rate between 1 and 1½ cwt per acre is recommended. It proved superior to other repellants tried.

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Mercurial treatment hastens germination. S. O. SKINNER. *Cane Growers' Quarterly Bull.*, 1964, **27,** 124.—The advantages of mercurial treatment of cane setts in Queensland for counteracting "pineapple disease" of cane (*Ceratoaptis paradoxa*) has been long known. The manner in which it hastens sprouting of the sett is here described, a convincing photograph being included.

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Control of the Childers cane grub. J. ANDERSON. *Cane Growers' Quarterly Bull.*, 1946, **27,** 129–132. Successful control is claimed to be possible by broadcast dressings of gamma isomer BHC incorporated into fallow soil; 8 lb (in dust form) per acre is required, to be spread evenly and covered as soon as possible.

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The sour cane problem. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1964, **27,** 133–134.—The harvesting of cane with chopper-type machines is now common in Queensland and the purpose of this article is to point out some of the problems inherent in this method of harvesting and to suggest how souring or deterioration may be reduced.

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Influence of soil moisture and temperature on yield of sugar cane and recoverable sugar in Louisiana. G. LAL and W. H. PATRICK. *Sugar Bull.*, 1964, **42,** 181, 185–186.—The soils of the area have high water holding capacity and well distributed rainfall of about 60 in. Drought hazard is low. It is concluded that surface runoff and internal drainage are important factors in the production of sugar cane and that the inverse relationship between moisture surplus and yield of sugar cane illustrates the limitation imposed by these factors. Poor drainage was regarded as a more severe limitation to cane yields than lack of irrigation.

Where are the New Guinea canes? J. H. BUZACOTT. *Cane Growers' Quarterly Bull.*, 1964, **27,** 135–136. There have been in all 8 expeditions to New Guinea to collect sugar cane varieties. Information is given on the use that has been made of some of these New Guinea forms or varieties and of their present rôle in sugar cane breeding programmes.

* * *

Recommendations for the control of mosaic disease in sugar cane in Louisiana for 1964. ANON. *Sugar Bull.*, 1964, **42,** 182, 185.—The extent of losses (17·5–34%) in different varieties, due to the disease, is outlined. The importance of using clean seed cane is stressed and recommendations made for carrying out efficient roguing.

* * *

Recommendations for sugar cane insect control in 1964. W. H. LONG and E. A. CANCIENNE. *Sugar Bull.*, 1964, **42,** 183–184.—For sugar cane borer, the worst pest in Louisiana, "Endrin" 2%, "Guthion" 10%, and "Sevin" 20% at 15 lb per acre are recommended. The "Guthion" or "Sevin" will control borers resistant to "Endrin". Recommendations are also made for springtails, wireworms and army worms.

* * *

Effects of hot water treatment and cold water (freezing) on germination of sugar cane setts. V. S. TRIPPI. *Rev. Agron. Noroeste Argentino*, 1963, **4,** (1), 25–33. The history of hot water treatment, for disease control, is briefly referred to. In these experiments the action of hot water at 50°C for two hours and cold (0°C) for 6 hours on germination of cuttings of the variety Tuc. 2645 was studied. Germination was stimulated by both treatments and more shoots developed.

* * *

The economic aspect of nitrogen fertilization in sugar cane. P. J. ASO and F. A. FOGLIATA. *Rev. Agron. Noroeste Argentino*, 1963, **4,** (1), 43–56.—Ammonium sulphate dressings (20% N) of 25, 50, 75, 100, 125 and 150 kg/ha of N were correlated with yields to determine the most economical rate. The greatest net profit was obtained with the 100 kg/ha of N rate, but the highest return per peso invested in fertilizer was obtained with the lowest rate used, i.e. 25 kg/ha of N.

* * *

The propagation capacity of different parts of the sugar cane stem. V. S. TRIPPI and A. J. B. LIZARRAGA. *Rev. Agron. Noroeste Argentino*, 1963, **4,** (1), 119–127. A comprehensive study was made of germinating ability of butt ends, central portions and top ends of cane stalks used as planting setts, without irrigation and employing the variety Tuc. 6001. Butt ends and centres showed no differences but top ends were markedly inferior, needing three times the number of setts to give the same germination rate. This was attributed to their being much more vulnerable to the drying conditions that prevailed.

The resistance of sugar cane to 2,4-D, TCA and CMU. V. S. TRIPPI. *Rev. Agron. Noroeste Argentino*, 1963, **4**, (1), 85–87.—It was found that 2,4-D in dosages up to 12 l/ha was not harmful. TCA was innocuous up to 20 kg/ha, but dosages of 40 and 60 were harmful without killing the plants. CMU in dosages of 1–2 kg/ha was not harmful but higher dosages (4 and 6 kg/ha) noticeably injured the canes, although they had recovered after 50 days.

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The action of 2,4-D on nutgrass (*Cyperus rotundus*). V. S. TRIPPI and J. R. MESIAS. *Rev. Agron. Noroeste Argentino*, 1963, **4**, (1), 111–118.—Field experiments were carried out to test the effects of 2,4-D on nutgrass in ploughed plots. At a concentration of 4 l/ha the number of shoots was reduced by 50%, tubers in the soil being reduced by 30%. Preliminary ploughing or cultivation to dislodge the tubers is advised. The herbicide affects metabolism or carbohydrate formation in the tubers not destroyed.

* * *

Studies on the germination and moisture relationships of sugar cane setts. R. R. PANJE and T. RAJA RAO. *New Phytologist*, 1964, **63**, 140–152.—Among the factors which influence germination of sugar cane setts in the field the water content of soil and sett are all-important. These studies were undertaken to elucidate the moisture relationships in germinating setts and the precise rôle of moisture in the early stages of germination or sprouting. It was found that the meristematic cells of the bud (and root primordia) must attain a certain critical water content before they can start to sprout.

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Control of some difficult grasses with "Diuron". K. HARADA *et al. Sugar J.* (La.), 1964, **26**, (8), 23–26. Experiments have been successful in Hawaii in combating *Chloris radiata* (plush grass), *Panicum conjugatum*, *Digitaria procumbens* (Pangola grass) and *Cynodon dactylon* (Bermuda grass).

* * *

Production of sugar cane in Tucumán. W. E. CROSS. *Sugar J.* (La.), 1964, **26**, (8), 32–36.—The writer was Director of the Tucumán Agricultural Experiment Station from 1916 to 1946 and here gives general recommendations about sugar cane growing under the prevailing sub-tropical conditions. A historical account of the varieties cultivated is included.

* * *

Another visit to the experiment station. ANON. *S. African Sugar J.*, 1964, **48**, 20–23.—This is a brief description, with photographs, of the work of the Entomology Section of the South African Sugar Association's Experiment Station at Mount Edgecombe near Durban. The function of the Section is to study insect and other pests of sugar cane, their effect on the crop, their distribution and control. At present the research work of the Station is largely concerned with two projects—eelworms and the green leaf sucking insect, *Numicia viridis*, a relatively new pest.

Australian cane loader in Swaziland. ANON. *S. African Sugar J.*. 1964, **48**, 37.—The Toft tractor-mounted cane loader, manufactured in Queensland, is described in action in Swaziland. A photograph shows the machine in the course of stacking a bundle of cane of approximately 5 tons, the operation taking 12 minutes.

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Trends in sugar beet field mechanization. A. ARMER. *Sugar y Azúcar*, 1964, **59**, (2), 59–61.—An account is given of developments in field mechanization that have taken place with the sugar beet crop in the United States, dating from World War II, which forced the pace with mechanization.

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Investigations on the yellows virus of sugar beets. F. SCHNEIDER, U. BEIB and R. MARX. *Zucker*, 1964, **17**, 117–125.—This is an interesting account of a study of the virus by means of electron microscopy. Photomicrographs of 30,000 magnification are reproduced. It is claimed that qualitative differences between two strains of yellows virus have been differentiated seriologically for the first time. In correlating particle length and infectivity it was concluded that only particles with a normal length of about 1250 mμ are infectious.

* * *

Can circular hoeing of sugar beet be replaced by applying "Pyramin"? H. HORNIG. *Zucker*, 1964, **17**, 162–165.—An account is given, with photographs, of experiments to test the feasibility of doing without circular hoeing by applying "Pyramin" after singling.

* * *

Minimal size for profitable sugar cane holdings. ANON. *La Ind. Azuc.*, 1964, **69**, 75.—The belief is expressed that 30 hectares constitutes the minimum size for an economical holding.

* * *

Promising cane varieties in Tucumán. ANON. *La Ind. Azuc.* 1964, **69**, 85–88.—An account is given of cane varieties that have proved promising in the Argentine province of Tucumán, notably C.P.34–120, C.P.48-103, N:Co 310, C.P.44-101 and C.P.43-74. A brief description of each variety is given and some other varieties are discussed.

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Sugar cane research in Jamaica. T. CHINLOY. *Sugar y Azúcar*, 1964, **59**, (3), 31–32.—The major projects being undertaken by the Research Department of the Sugar Manufacturers' Association in Jamaica are dealt with, e.g. nutrition control, variety selection, cultivation studies, testing of herbicides, irrigation, pests and diseases, and collection and analysis of data.

* * *

Sugar cane variety trials in Tucumán. ANON. *La Ind. Azuc.*, 1964, **69**, 113–114.—Yield figures are given for a dozen different varieties, grown over a four-year period at 3 centres. C.P.48-103 gave the best overall performance.

THE COURSE OF THE NON-SUGARS FROM THICK JUICE TO WHITE SUGAR

with special attention to saponins

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Paper presented to the 17th Technical Conference, British Sugar Corporation Ltd., 1964.

PART II

To take advantage of the use of the elimination factors one must know the concentration of the relative non-sugars in the white sugar. For colour, ash and SO_2 this concentration is known, but not much is known about floc and foam at the moment. These phenomena can only be determined in the finished product by imitating its practical use. The question then arises as to determination of the floc and saponins in the massecuite. As is shown in Table I, the saponins have been analysed in all products, for an attempt has been made to correlate the foaming of the white sugar with the saponins content as measured with antimony pentachloride.

The Foaming of White Sugar

In the literature there is much confusion about the conceptions floc and saponins. Both are said to be the reason for the foaming of the white sugar. As already shown by CARRUTHERS[5] only a part of the floc is due to saponins, a fact confirmed by floc determination with hyamine. In Table IV the floc (hyamine) and the saponins contents are given for massecuites and the corresponding white sugars obtained in the laboratory by washing with increasing amounts of water in the centrifugal. All the sugars foamed.

Table IV

	Boiling 1		*Boiling* 2	
	p.p.m. floc	*p.p.m. saponins*	*p.p.m. floc*	*p.p.m. saponins*
massecuite	227	42	704	58
sugar 1	32	5·8		
,, 2	4·7	2·0	4·2	1·8
,, 3	3·1	1·8	1·3	1·4
,, 4	2·6	1·6	1·3	1·2
,, 5	2·1	1·6	1·6	1·2

From this table it appears that the removal of the saponins from the sugar is poorer than the removal of the floc. The floc/saponins relationship varies greatly, although we cannot be very exact, since the floc determination is not very precise. It is certain, however, that the quality cannot be further increased beyond a certain point by further washing.

The literature tells us that the saponins in the sugar industry belong to the triterpenoid type and it has been proved[9] that the triterpenoid oleanolic acid is present in the raw juice. The triterpenoids can be determined colorimetrically with antimony pentachloride, and we have adopted this method; it may be rather laborious but it is sensitive and reproducible. Even in a white sugar which does not foam according to our standard test, saponins can be determined quantitatively. In an absolutely non-foaming white sugar, no saponins were found. The question arises as to how foaming is to be defined; hitherto the standard method of PAINE *et al.* has been used[10]. This is not a real foaming determination, but more of a boiling test; however it corresponds well with practice. By rigorous standardization the foaming capacity of a sugar can be fixed reproducibly as a number.

As determined by this method all the sugars with a foaming number from 35–40 and more will give difficulties in practice for certain consumers. A white sugar from a refinery with charcoal has a foaming number of 30.

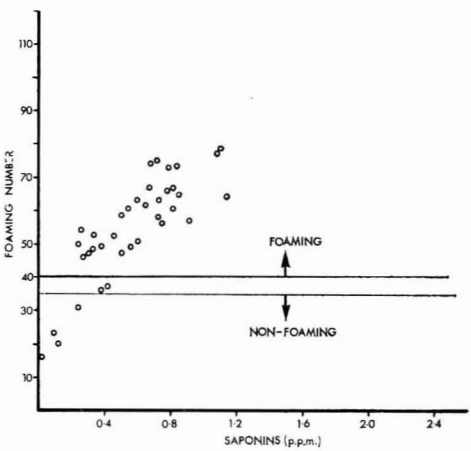

Fig. 4

Fig. 4 gives the correlation between saponins (in p.p.m.) and the foaming number of a number of white sugars from different beet sugar factories. From this we may conclude that there is a qualitative connexion between the foaming number and the saponins content. In practice it is also found that sugar with less than 0·2 p.p.m. saponins never foams and sugar with more than 0·4 p.p.m. always foams. The sugar from the factory we took as an example in Table I was a very heavily foaming one.

The fact that about 1% of the saponins from the massecuite passes into the white sugar (Table 2) implies that the saponins content of the massecuite should not exceed 10 p.p.m. In order to know how this value is reached in a beet sugar factory, the course

[9] VAN DER HAAR: *Rev. Trav. Chim.*, 1927, **46**, 775.
[10] *Ind. Eng. Chem.*, 1924, **16**, 1252.

of the saponins in the process must be followed. The behaviour of the saponins during juice purification is as follows:—

Table V

	p.p.m. saponins
Raw juice	118
Prelimed juice	28
Limed juice	8
First carb. juice	13
Thin juice	12

As is already known, about 90% of the saponins disappear during the juice purification. The conditions during juice purification may influence the quantity of saponins.

Table VI
Influence of liming on the saponins content of 1st carbonatation juice

	p.p.m. saponins
raw juice	254
0·5% CaO	12·8
1·0% CaO	6·8
1·5% CaO	6·5

Table VII
Influence of the end point of 1st carbonatation on the saponins content

Sample		*p.p.m. saponins*
1	pH 11·4	3·9
	pH 10·4	6·9
2	pH 11·4	4·4
	pH 10·6	7·8
3	pH 11·4	4·7
	pH 10·1	10·9

Parallel to the removal of colour and lime salts we get less saponins in the thin juice if more lime is used, and if the end point of first carbonatation is higher. Another question is the variation from year to year and from region to region; these variations are shown (Table VIII) by the saponins content in the thick juice from several factories. The purification in the six factories of the Centrale Suiker Maatschappij is about the same. Another important thing is that the quality of the thick juice determines the quality of the white sugar. From an analytical point of view it is important that we always have very good bulk samples of all thick juices of our factories at our disposal.

Table VIII
Average saponins content in thick juice over a period of three campaigns

	p.p.m. saponins in thick juice		
	campaign 61/62	*campaign* 62/63	*campaign* 63/64
Factory 1	32	45	30
,, 2	15	21	30
,, 3	21	25	28
,, 4	32	50	48
,, 5	22	43	40
,, 6	17	20	31

There is rather a big difference from factory to factory and from year to year. Thus the saponins content is yet another thing which depends strongly on the quality of the beet.

It is interesting to see how the saponin changes during a campaign. Table IX gives figures from the 1962/63 campaign.

Table IX

Period no.	*p.p.m. saponins in thick juice* 1	2	3	4	5	6
Factory 1	64	38	44	45	38	42
,, 2	17	25	24	20	24	19
,, 3	19	30	24	24	29	
,, 4	56	53	60	62	47	41
,, 5	53	38	32	46	46	43
,, 6	30	23	19	20	16	15

It appears that there is no fixed rule that the saponins content will decrease or increase during the campaign.

The conclusion from Tables VIII and IX and Fig. 4 is the well known fact that guaranteed foaming-free sugar cannot be made directly with all the thick juice entering the 'A' pan, a fact also met the cane sugar industry. Saponins were also present in cane sugar which we analysed.

From Tables I, II and III can be derived the fact that non-foaming sugar can be boiled from remelts without difficulty, for with good working at the intermediate product station, the remelts have a saponins content of 2–6 p.p.m. Non-foaming white sugar does not always need to be boiled from remelts however; a good example being that from factory 6 in Table IX. In that campaign the saponins content of the thick juice was so low that a non-foaming white sugar could be produced from boilings with a relatively large amount of thick juice. The factory was very successful especially at the end of the campaign.

The carbons 1, 2, 3 and the resin were examined to find the influence of several adsorbents on the removal of saponins: the best was carbon 2.

Table X
Adsorption of saponins by carbon 2

	input p.p.m.	*output p.p.m.* 0–30 vol.	60–90 vol.	120–150 vol.
Thick juice	43	6	33	28
Remelts	3·5		0·6	

From all the data in this section we can conclude that the possibility of making a non-foaming white sugar using thick juice in the first product depends on the composition of the beet. Even if we are using adsorbents for removal of the saponins in the thick juice, we are governed by the quality of the beet. This dependence has not been forecast up to now.

The Determination of Saponins

As postulated before, Fig. 4 gives a qualitative correlation between foaming number and saponins content. The concentration of the saponins in the range of the non-foaming sugars is very low. The foaming number is determined by a boiling test, and we are led to find which other components also give foam, defined in such a manner. Table XI gives the effect of adding a number of substances (at about 100 p.p.m.) to non-foaming white sugar.

Of the agents used only the protein products have a foaming action (gelatin and albumen); the polysaccharides (dextran and agar agar) do not foam.

Table XI

Additives	*Foaming number*
none	36
NaCl	32
KCl	34
glutamic acid	31
asparagic acid	35
olive oil	69
dextran	27
albumen	120
agar agar	28
invert sugar destruction products	40
caramel	50
melanoidins	31
gelatine	98
anti-foam agent (Bayer "Neu 7700")	78
cholesterol	51

It is clearly demonstrated that the foaming test in fact is a boiling test: the anti-foam agent promotes "foaming". Cholesterol, which has a structure related to the steroid beet sugar saponins, also promotes foaming.

It is interesting to compare the data of Table XI with the foaming properties of saponins. This is done in two ways. The saponins contents are determined in raw juice and molasses, the two extremes of the factory. From these, successive quantities are added to the non-foaming white sugar. The result is given in Fig. 5. The raw juice and molasses give two different lines. It may be concluded from Fig. 5 and Table XI that:

(a) foaming of the sugar is caused by real foaming agents. In Table XI the effects of 100 p.p.m. quantities are given, while in Fig. 5 only a few p.p.m. are seen to be needed to produce foam;

(b) the nature of the foaming agent differs from raw juice to molasses.

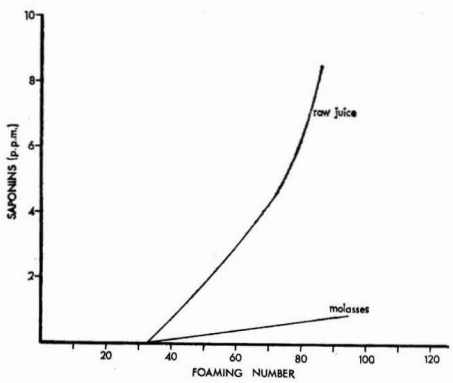

Fig. 5

What is determined by the antimony pentachloride method? The analysis starts by precipitating the saponins by acidifying the solution. This precipitation is not quantitative. By adding to different sugar solutions standards of saponins obtained from raw juice or a standard from the British Sugar Corporation, kindly given to us by Mr. D. HIBBERT, or a trade product, a yield of about 70% was recovered. VAN DUUREN[11] recovered about 70–75% by extracting the acidified solutions with ethyl acetate and no better separation has been realised up to now. By adding 10% of "Norit" to a solution all foaming agents may be removed quantitatively, but we are not yet able to separate them from the carbon.

The colour reaction with antimony pentachloride is not specific for the triterpenes. A survey of the different agents for the colour reactions has been given by NEHER[12]. Yet antimony pentachloride is one of the most sensitive. The composition of the precipitate can be determined by thin layer chromatography, as has already been done by VAN DUUREN[13] and TSCHESCHE *et al.*[14] It is difficult however, to determine the compounds corresponding to the spots obtained by chromatography of precipitates from juices and white sugar. A certain amount of precipitate was obtained by acidification of molasses and this extracted with petroleum ether, ether and methanol in a Soxhlet apparatus. The ether and methanol extracts were hydrolysed. The chromatograms of these extracts and the hydrolysed products were compared with those obtained by EIS *et al.*[15], which showed there to be glucides of oleanolic acid (R_f 0·73), glucosidic salts (R_f 0·20–0·40) and sapogenin (R_f 0·90) which is formed by hydrolysis of the saponins. In the white sugar sapogenin alone is present or at least in a greater concentration that the other saponins.

What we do not know, however, is what the foaming properties are of the different kinds of saponins. Consequently, in conclusion, we can say that in normal factory practice we can depend on the correlation found between the saponins and foaming number. But the nature of the saponins differs during the process, and, as we are still far from knowing the properties of the different saponins, we are not able to separate the harmful ones from the thick juice.

SUMMARY

Nowadays the customer asks more and more for a quality of white sugar suited to his own special purposes. Therefore, it is important to know how such a white sugar can be made.

In the various factories of the Centrale Suiker Maatschappij the relationship has been examined between the absolute amounts of the non-sugars in the white sugar, and the absolute amounts of these non-sugars which are introduced into the vacuum pan. In this paper the data for the boiling of a normal consumption sugar have been considered.

Of the intake of the various non-sugars 1% at most goes to the crystallized sugar. Thus the elimination efficiency for the non-sugars is very high during crystallization. From the analysis of the white sugar required the composition of the corresponding masse-cuite can be calculated.

[11] *Med. Inst. voor Rationele Suikerproductie*, 1963, (1).
[12] "Chromatographie von Sterinen, Steroiden und verwandte Verbindungen." (Elsevier, Amsterdam). 1958.
[13] *J. Amer. Soc. Sugar Beet Tech.*, 1962, **12**, 57.
[14] *J. Chromatography*, 1961, **5**, 217.
[15] *Ind. Eng. Chem.*, 1952, **44**, 2844.

The capacity of several carbons for eliminating non-sugars has also been examined, and the elimination factors for floc and colour estimated. These factors are not nearly so great as those obtained by crystallization.

Until now little has been known about the non-sugars which cause foaming of white sugar. By a closer examination there seems to be correlation between the saponins content of the white sugar and the foaming number, as estimated by the foaming test. Below a certain saponins content, the sugar will not foam.

The maximum concentration of saponins in non-foaming sugar being determined, the question is considered whether or not it is possible to obtain a non-foaming sugar if thick juice is one of the components of the 'A'-massecuite. The amount of thick juice which can be allowed to be introduced into the white sugar pans appears to depend on the quality of the beet, in which the saponins concentration varies.

The saponins content has been analysed by acidifying the sugar solutions and estimating the saponins by antimony pentachloride. The saponins which are defined in this way have been separated by thin layer chromatography in the various solutions. The composition of the saponins in white sugar is somewhat different from those in the juices.

APPENDIX

Analytical Methods

Potassium is estimated by flame photometry. For white sugar a solution of 20° Brix is used. In this case a special standard solution has been taken.

Sulphur dioxide is determined by the distillation method[16] of the Syndicat National des Fabricants de Sucre de France.

Lactic acid. The method of STARK, GOODBAN and OWENS[17] is used for routine analysis. Other methods have not, so far, given satisfactory results.

Saponins. The saponins are determined as given by WALKER[18]. Antimony pentachloride is used as a colour reagent. Antimony trichloride is used for the spraying of the chromatograms. The spraying can also be with phosphomolybdic acid.

Colour. The colour is estimated at 420 mμ after filtering the solution over "Fibra-flo 7c" (Johns-Manville Co.).

IMPROVEMENTS IN EFFICIENCY OF DECOLORIZATION USING SOLID ADSORBENTS

A Comparison of Methods

By F. M. CHAPMAN (Tate and Lyle Ltd.)

Paper presented to the 17th Tech. Conf., British Sugar Corp. Ltd., 1964.

Introduction

IN the past few years decolorization by solid adsorbents has been much in the news. Powdered carbon, used on a throwaway basis, was expensive to buy and because of the associated press station, it was also expensive to operate. Consequently, powder has steadily lost ground to granular carbon used in static beds. Early installations had these beds running in parallel, but it was soon realised that the carbon could be used more effectively if the columns were coupled in series, permitting the adsorbent to be heavily loaded before incurring the losses inevitable in regeneration.

More efficient use of granular carbon soon prompted the more efficient use of bone char, and this has resulted in a number of semi-continuous counter-current "slugging" systems using either adsorbent. It this trend continues it is only a question of time before someone proposes a continuous counter-current system for decolorizing resins, so at this juncture it seems sensible to halt and examine some fundamental relationships.

What are the objectives?

In a normal year Messrs. Tate and Lyle have been spending directly on decolorization about £1,000,000 per annum; of this total only about 20% was for adsorbent, while 80% was for labour, steam, power and overheads. As general improvements we aim (a) to reduce the total costs and (b) to eliminate a number of dirty, exhausting and unpleasant jobs. Item (b) also falls into two phases, namely reducing the number of operations, and multiplying muscle.

[16] *Proc. 12th Session ICUMSA*, 1958, 106.
[17] *J. Agric. Food Chem.*, 1953, **1**, (8).
[18] *J. Amer. Soc. Sugar Beet Tech.*, 1956, **9**, 233.

Reducing operations

More efficient use of an adsorbent immediately starts a beneficial cycle. The lower the "burn" the longer the interval between "starts" of new cycles, and, in consequence, the smaller the number of non-effective cisterns. Logically this leads to a conclusion that if the daily "burn" of adsorbent is to be handled by one man on the first shift, then the optimum average "start" is one cistern unit in 48 hr. Then, if the quality of the incoming raw sugar worsens, it is simple to move from 3 to 4, 5 or 6 units in 6 days, or conversely, with better raws to go the other way, but always using only one man on daywork.

Parallel running

It is evident also that the longer the "start", the larger must be the cistern, and this truth was early appreciated at Aiea Refinery on Oahu, where cisterns large in relation to the daily melt led to very economical operation.

As a further example, let us instance a refinery melting 100,000 lb/hr and burning 10% bone char on melt. It must

on 6-hr "starts" use cisterns holding 60,000 lb (950 cu.ft.),

on 24-hr "starts" use cisterns holding 240,000 lb (3800 cu.ft.), and

on 48-hr "starts" use cisterns holding 480,000 lb (7600 cu.ft.).

If the liquor "transit time" is 5 hr the volume of char in contact with liquor must be 1800 (+10% for various recirculations) say 2000 cu.ft. × 5 = 10,000 cu.ft. Because it is not practical to have 1½ cisterns, one must then compromise and settle for an average start of 24 hr, giving 3 × 3800 cu.ft. cisterns in parallel running liquor (a transit time of 5·9 hr). Then, providing it is *possible* for a man to empty and fill *two* cisterns in 8 hr, a temporary need to burn say, 12% char, can be met by putting on 6 cisterns in 5 days, and 8% char can be met by 4 cisterns in 5 days.

Series Running

If it is possible to couple cisterns in a series of four, the same decolorization can be done by burning only 5% of char. In this case the volume of a cistern must be 5 × 2000/4 = 2500 cu.ft. ≡ 155,000 lb char. A 24-hr "start" then gives a "burn" of 6·5% char on melt, so that 5% char on melt can be obtained by putting on 4 cisterns in 5 days.

"Series running" is worth while probably only for liquor, so the secondary operations of decolorizing granulated syrup, sweetening-off and washing can be done in single cisterns, it being necessary only to schedule these operations to fit in with a 24-hr "start".

Pressure drop

A basic problem in decolorization is resistance to flow through a bed of adsorbent. The relationship between speed of decolorization, degree of decolorization and pressure drop is ill-defined, because of the disproportionate effect of small quantities of "fines" (removing 0·1% of fines can reduce flow resistance by 20–40%).

But for efficient decolorization liquor flow whether "up" or "down" must be through a "compacted" bed. If the bed is uncompacted the liquor will flow preferentially where the resistance is lowest, and the adsorbent will be used inefficiently. This is readily understood if one recognises that the liquor does not seek to be decolorized, it is urged only by pressure to pass from one end of the bed to the other. But, conversely, if the adsorbent bed be "compacted" and the resistance equalised it does not matter whether liquor flow be "up" or "down", although "down flow" gives better clarity.

One problem then is to keep pressure drop within reason. The specific resistance (R) of the adsorbent can be reduced by backwashing, but there are evident limitations to this procedure. The best bet is to hold the depth of adsorbent in the traditional bracket of between 16 and 25 ft. Calculations will show (other things being equal) that pressure drop varies inversely as the 4th power of the diameter of the column of adsorbent, i.e. increasing diameter by 50% reduces pressure drop by a factor of 5, while doubling the diameter reduces it by a factor of 16. This then leads us to the inexorable conclusion that, regardless of the direction of liquor flow, "up" or "down", and regardless of whether the plant is a slugging column on very short "starts" or a battery of static beds on very long "starts", *for the same transit time and the same pressure drop to give the same degree of decolorization, the GEOMETRY of the decolorizing system must be similar.*

Recapitulating, *specific resistance* is a function of mean particle size modified by size distribution and fines, *pressure drop* is controlled by depth of bed, velocity of flow, specific resistance and viscosity of liquor, *decolorization* is a function of adsorbent quality, adsorbent size, pressure drop and transit time, and the *diameter of the decolorizing column* (other things being equal) is related directly to the hourly flow of liquor, and is independent of all other factors.

It then follows that for reasonable pressure drops all systems should be "squat", but the degree of "squatness" will increase with throughput, e.g. for the following conditions:

Sp. resistance = 0·45 p.s.i./sq. ft./hr at 25 c.p.
Transit time 5 hr.

Liquor flow (*cu.ft./hr*)	1000		4000	
Max. work pressure on cistern heads (p.s.i.)	50	100	50	100
Depth of bed of adsorbent (feet)	4 × 5·9	4 × 8·4	4 × 5·9	4 × 8·4
Diameter of cisterns (feet)	16·5	13·8	33·0	27·5

Comparison of batch and slugging systems

Fig. 1 shows a diagrammatic arrangement for a liquor flow of 1000 cu.ft./hr (28 cu.m./hr), i.e. 59,000 lb solids at 70°Bx ≡ 53,000 lb solids at 65°Bx.

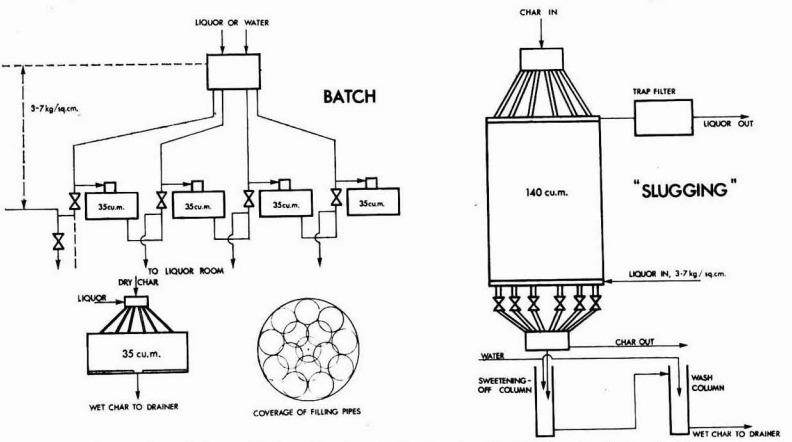

Fig 1: Comparison of Plant for Decolorization by "Batch" or by "Slugging" Liquor Flow 28 cu. m./hour

Total volume of adsorbent, linear velocity of liquor, pressure drop, and the scantlings of the cisterns are in both cases the same. Advantages of the competing systems are:—

BATCH

(1) Liquor flow is downwards, and the capital and operating cost of a trap filter station can be avoided.

(2) Sweetening-off, and washing to waste, are downwards and predictable. The cost and control of separate sweetening-off and washing columns is avoided.

(3) Each time a cistern is emptied, the bottom can be inspected and sterilized. There is no possibility of stagnant char.

(4) The operations of emptying, inspecting and filling can be compressed into one shift.

(5) The plant, being relatively "shallow", can be located in the lower floors of a tall process building.

SLUGGING

(1) The expensive parts of a cistern are the pressure ends. Slugging needs only *two* ends while batch needs *eight*.

(2) Floor area required is only ¼ of batch (but to this must be added the area occupied by the trap filter station and the sweetening-off and washing columns).

(3) Theoretically, slugging in "n" stages will give a lower char "burn" than batch in 4 stages. But it is perhaps a measure of the volumetric inefficiency of slugging that practical operation does not seem to show an advantage.

Conclusions

In the author's view, and taking the operation *seriatim*,

Decolorizing: "Batch" is much more advantageous, because the adsorbent cannot "uncompact", and pass dark and cloudy liquor to the trap filters. The cost (capital and operating) of the trap filters themselves can be avoided.

Sweetening-off: Because of downward flow through a compacted bed, batch working is much better, and results are predictable.

Char washing: There is no difference.

Replacing char at the top: Large cisterns are batch-filled. With "slugging", however, incoming adsorbent meets outgoing liquor, and trouble with carry-over of dark liquor and carbon fines is inevitable.

Removing char at the bottom: In batch work, char when removed has been washed, and hydraulic discharge is rapid.

With slugging, equal quantities of liquor-saturated char have to be removed slowly and evenly from a large area, and this operation must obviously be of limited success. "Slugging" will be cheaper in vessels and also in piping, but this advantage will be offset by the cost of separate columns for sweetening-off and washing and the relatively high cost of trap filters and their operation.

The "burn" of adsorbent (i.e. the cost of the kiln) should be about the same in both cases.

Controls: Batch working will show to advantage since in each case there are only 3 effluents—liquor, sweet, water and wash water—to be controlled; slugging requires continual monitoring of the colour and clarity of the liquor, of the final Brix of the sweet water, and the final TDS of the wash water, while with batch working this testing is infrequent.

Labour: A "slugging" system is, in essence, a batch system on very short "starts", and the increased frequency of operations and the possibility of malfunctioning are likely to make more demands on labour and on supervision.

Summary

Comparison is made of "slugging" systems with large cisterns operated in series. It is shown that "slugging" is a batch system on very short "starts", while large cisterns can be "batched" on very long "starts" (24 hr).

Static cisterns have great flexibility; piping and controls are elementary. "Sluggers" are equally flexible, but there are ever present hazards in

(*a*) dark or cloudy effluent whenever the bed is slugged.

(*b*) Continual monitoring of sugar in char leaving the sweetening-off column.

(*c*) Continual monitoring of the TDS in char leaving the washing column.

For equal (average) decolorization, the geometrical problems in "sluggers" and in static cisterns are identical. One needs the same scantlings, the same pressure drops, and the same volume of adsorbent in contact with liquor.

A slugging system is cheaper in pressure ends and in piping, but it requires two supplementary columns, a trap filter station, and probably more labour.

It is concluded that static cisterns in series are a much better bet than "sluggers".

THE FATE OF FORMALDEHYDE IN SUGAR BEET JUICES

By A. CARRUTHERS and J. F. T. OLDFIELD

Paper presented to the American Society of Sugar Beet Technologists, February, 1964, and the *17th Technical Conference, British Sugar Corporation Ltd.*, June, 1964.

FORMALDEHYDE solution is one of the most effective and convenient reagents for controlling microbiological activity in the beet factory process. The total fermentation in continuous diffusion is frequently less than in battery operation but the corrosive effects of acid production are more apparent in continuous diffusers as the fermentation tends to be localized towards the juice end of the diffuser. Whereas heavy formaldehyde dosing was common in the return water systems of battery diffusers, with the adoption of continuous diffusers the use of formaldehyde at the juice end has greatly increased and may exceed 1 lb of formalin (40% formaldehyde solution) per ton of beet. In terms of anhydrous formaldehyde, this is equivalent to about 0·1 per 100 sugar or about 1% of the non-sugars in juice and, since much of the formaldehyde is carried forward in the raw juice to process, the fate of formaldehyde in the purification stages is of considerable importance.

Determination of formaldehyde

Formaldehyde was determined colorimetrically by the method of NASH[1] which depends on the synthesis of diacetyldihydrolutidine by the Hantzsch reaction between formaldehyde and acetylacetone in the presence of excess ammonium salt. Each test solution was diluted to a formaldehyde concentration in the range 1–8 p.p.m. and the absorption was measured at 410 mμ in a 1-cm cell.

Free formaldehyde in raw juice

Although formaldehyde is a very reactive substance, the bactericidal effect is not sensibly diminished even after several hours contact with raw juice. Consequently the inhibitive effect of formaldehyde can be transmitted by the juice flow to relatively inaccessible parts of the counter-current diffusion system to an extent not possible with, for example, chlorine which is an extremely efficient bactericide when added to raw juice but reacts so rapidly with juice constituents that after a few minutes' contact no inhibitive effect remains.

It is therefore apparent that the majority of the formaldehyde in the juice stream is not decomposed by, or irreversibly combined with, juice constituents.

The validity of this deduction was investigated by addition of known amounts of formaldehyde to raw juice; the samples were heated at 80°C for 30 minutes and the formaldehyde content was then determined by the NASH procedure. A formalin usage of 1 lb per ton of beet is equivalent to an average formaldehyde addition of about 0·02% on juice but, since formalin is generally applied by intermittent shock dosing, the experiment was conducted with formaldehyde additions ranging from 0·001% to 0·15% on juice. The recovery of formaldehyde as a percentage of the applied dosage is recorded in Fig. 1.

Even at the lowest dosage, 50% of the applied formaldehyde was recovered and the recovery rose rapidly to almost 90% with a formaldehyde addition of 0·02% on juice, and to about 98% at higher dose rates. Formaldehyde applied during diffusion is in contact with a mixture of juice and partially exhausted cossettes so that the possibility arises of combination with protein or other pulp constituents. On treating mixtures of juice and pulp with formaldehyde at a level of 0·01% on total liquids however, the recoveries ranged from 78–83% which are very similar to those obtained with juice alone.

It is thereby confirmed that the majority of the formaldehyde introduced into the diffuser remains in a free or very lightly bound form.

[1] *Biochem. J.*, 1953, **55**, 416.

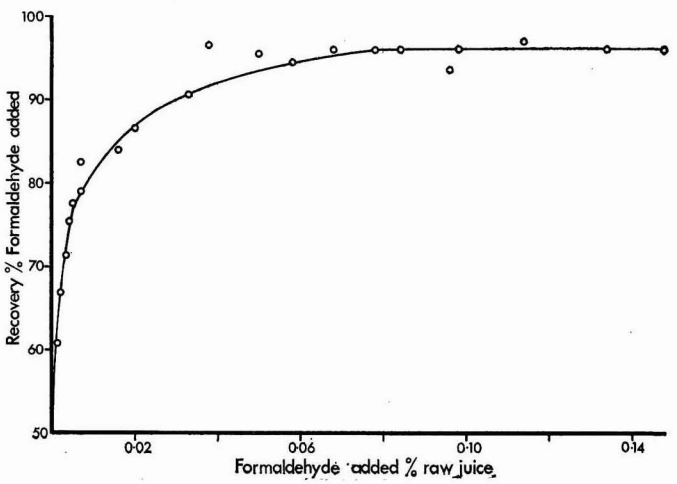

Fig. 1

This conclusion is perhaps rather unexpected in view of the common supposition that the bactericidal effect of formaldehyde may be due to combination with bacterial protein. Despite the large excess of protein nitrogen over added formaldehyde, very little if any of the formaldehyde reacted with pulp constituents.

The slight measured loss of formaldehyde in juice appears to be real and was not due to interference by the juice amino acids in the Hantzsch reaction since 0·02% formaldehyde could be recovered quantitatively from synthetic solutions containing 20 moles of either glutamine or glycine per mole of formaldehyde. Probably a small amount of the formaldehyde combines with some juice constituents since the form of the curve approximates to that of a second order reaction and the unaccounted formaldehyde at the high dose levels increased with increasing raw juice Brix. This loss would have only a slight effect in reducing the amount of formaldehyde carried through with the juice to process.

Since amino acids can be determined by the Sörensen formol titration, based on the reaction between excess formaldehyde and amino acid to form an N-methylene derivative, the extent of this reaction in juice was investigated. As the reaction with amino acids is reversible, the Hantzsch reaction cannot be used to estimate free formaldehyde, since the progressive removal of formaldehyde leads to complete recovery. The reaction was therefore investigated by potentiometric titration to pH 8·05 of solutions containing 33 millimoles of glycine per litre with formaldehyde addition in the range 0·06 to 2·5%. The concentration of methylene derivative was estimated from the titration and the concentrations of free amino acid and formaldehyde were calculated by difference. These values together with the calculated concentration equilibrium constants are recorded in Table I.

To obtain measurable yields of the methylene derivative, the experimental concentrations of amino acid and formaldehyde were higher than occur in factory practice and even so, the amount of methylene derivative formed was very low at the lowest formaldehyde addition whereas very little free amino acid remained at the highest formaldehyde level. Consequently the equilibrium constants cannot be calculated very precisely at these two formaldehyde concentrations but nevertheless it appears that the equilibrium constant becomes smaller as the formaldehyde content is reduced. For an average amino acid concentration in juice of 15 millimoles per litre formaldehyde concentrations of either 0·03% or 0·003%, a K value of 0·0029 would correspond to combination of only about 3% of the formaldehyde and even if the equilibrium constant was as high as 0·008, only 10% of the formaldehyde would be combined with amino acids.

Table I

Interaction of Formaldehyde and Glycine
(Concentrations in millimoles per litre)

Formaldehyde added	*N-methylene derivative*	*Residual formaldehyde*	*Residual glycine*	$K \times 10^3$ (*millimoles^{-1} litres*)
20.7	1·8	18·9	32·6	2·9
41·2	5·1	36·1	29·1	4·8
78·8	11·2	67·6	21·4	7·7
158·6	17·9	140·7	18·1	7·1
241	21·4	220	11·8	8·2
320	23·7	296	9·3	8·6
485	26·5	459	6·9	8·4
630	28·1	602	4·5	10·4
777	29·0	748	3·1	12·5

It is therefore concluded that the greater part of the formaldehyde introduced into the juice end of the diffuser will be carried through as free formaldehyde into the carbonatation system.

Degradation of formaldehyde in carbonatation

The effect of liming and carbonatation on formaldehyde in raw juice was examined by clarification of juice containing formaldehyde-C-14. Paraformaldehyde-C14 (1·16 mg = 100 μc) plus inactive paraformaldehyde (4·8 mg) was suspended in 1·1 ml water and converted to formaldehyde-C14 by heating at 100°C in a sealed tube for 5 hours. A test experiment with inactive paraformaldehyde showed that more than 90% conversion was obtained in 30 minutes under the experimental conditions.

One ml (91 μc) of the radioactive formaldehyde solution was added to 30 ml of raw juice from the laboratory micro-battery to give a total formaldehyde concentration of about 0·02% and samples of the untreated mixture were removed for counting. Since formaldehyde is volatile, appreciable losses occurred

if the radioactive juice was dried directly for counting but this loss was prevented by converting the formaldehyde into the non-volatile dimedone derivative on the sample counting pan. 25 μl aliquots of the radioactive juice were transferred to a tared sample pan, 40 μg of inactive formaldehyde was added together with 100 μl of a 1% solution of dimedone in methanol. Water was added to give a total volume of 600 μl to fill the source area of the sample pan and the solution was evaporated to dryness under an infra red lamp. The sample was reweighed and counted using a Philips end window G.M. tube type 18505 under conditions of standard geometry as reported previously[2]. The count rate was corrected for self-absorption to give a calculated zero absorption rate of 7580 c.p.m. per 25 μl of juice.

A sample of the radioactive juice (15 ml) was heated to 80°C in a centrifuge tube in a water bath and stirred with a fine jet of air. The juice was defecated using dry lime (1·6%) for 5 minutes and gassed with carbon dioxide from a low pressure reservoir to the first and then to the second carbonatation end points. The carbonatation precipitates were removed by centrifugation. A sample of the second carbonatation juice was dried and counted as before and it was found that 75% of the initial radioactivity had passed through into the second carbonatation juice.

Aliquots of the second carbonatation juice were applied to a strip of Whatman No. 1 filter paper, 50 cm in length, and subjected to high voltage electrophoresis at 100 V/cm for 15 minutes in 1% ammonium carbonate. The filter paper was then exposed for 24 hours for autoradiography with Ilford X-ray Industrial G film. The positions of the bands of radioactive products revealed on the film were remarkably similar to those reported previously[2] for the acidic products produced by alkaline degradation of fructose or glucose; the experiment was therefore repeated without formaldehyde but substituting uniformly labelled fructose-C14 (4·9 mg = 100 mc) plus inactive fructose (30 mg). The two second carbonatation juices were applied side by side to the same paper strip for electrophoresis and autoradiographs of the products prepared. The relative intensities and locations of the bands are reproduced in Fig. 2.

During liming and carbonatation both the formaldehyde and the fructose were converted almost exclusively into anionic products. No cationic components could be detected in either system and there was no detectable loss of activity from either second carbonatation juice on treatment with a strong cation exchange resin ("ZeoKarb 225") whereas 92% of the activity arising from formaldehyde degradation and 95% of the activity arising from fructose degradation could be absorbed on a strong anion exchanger ("De-Acidite FF").

The principal product bands have been labelled 1 to 8, the higher numbers representing the most mobile of the electrophoretic bands. The electropherogram shown in Fig. 2 was cut into strips to isolate the product bands, including some faint intermediate bands which were visible on the original autoradiograph. The strips were eluted and counted to determine the relative yields and these values are also recorded on Fig. 2.

Band No.	Relative Activity % Total	
	Formaldehyde	Fructose
1	4	6
1a	6	1
1b	8	2
2	12	28
3	16	11
4	26	14
5 } 6 }	24	33
7	2	2
7a	1	2
8	>1	>1

Fig. 2

At the present stage of the investigation, the fructose degradation products have been examined in more detail than the products from formaldehyde and only a few of the latter have been positively identified, but from electrophoretic and chromatographic separations it appears that the majority of the bands consist of the same acids, or closely related isomeric acids, regardless of whether the source was formaldehyde or fructose. The relative proportions of the products are clearly different with the different sources and it is probable that, as with fructose, the proportions of the formaldehyde products will vary according to the initial concentration and the defecation conditions.

Band 8 consists of formic acid and was obtained in higher yield from formaldehyde than from fructose. Most of the remaining bands do not consist of a single substance and after elution from the electropherogram the bands can be further resolved by chromatography. The carbon chain length increases with decreasing electrophoretic mobility and, although simple carboxylic acids contribute to the more mobile bands, the principal constituents are the hydroxy-acids forming the lower homologues of the saccharinic acid series.

[2] CARRUTHERS & OLDFIELD: *Zucker*, 1960, **13**, 330.

The acids forming band 7 contain two carbon atoms and can be resolved into separate bands of glycollic and acetic acid by chromatography in 70:30 *n*-propanol:0·880 ammonia.

Band 6 consists predominantly of lactic acid which represents the major single product of alkaline degradation of fructose and is also one of the principal products of the degradation of formaldehyde.

The faint band 5 in the fructose separation is probably glyceric acid. This band was less clearly resolved from lactic acid in the formaldehyde separation.

Band 4 contains 2,4-dihydroxybutyric acid and this band represents a higher proportion of the products from formaldehyde degradation than from fructose degradation. The band is more diffuse from the formaldehyde treatment and may contain other 4 carbon atom acids.

Band 3 is again the more prominent in the formaldehyde degradation. This band probably contains pentosaccharinic acids.

Band 2 is a prominent product of the fructose degradation and in the band from this system several of the isomeric glucosaccharinic acids have been identified. This band is not a major product of the formaldehyde degradation but a series of bands of low intensity occur in this region.

Band 1 is almost immobile and may be due either to lactones or unreacted carbohydrates. This band does not contain any unreacted formaldehyde and none of the other bands could be detected by electrophoresis of the radioactive raw juice before liming.

Carbohydrates can be produced by aldol condensations from formaldehyde, and even in the nineteenth century syrups containing hexoses had been prepared from paraformaldehyde by BUTLEROFF, and from formaldehyde by LOEW; although the overall yields were low, these syrups contained α-acrose which was shown by FISCHER to be DL-fructose.

It was therefore to be expected that some hydroxy acids would be formed by alkaline degradation of formaldehyde, particularly as it is not essential for the condensation to proceed as far as hexoses before degradation is initiated. It is, however, rather surprising that the various acids should be obtained so quickly and in such good yield, and that the products should be so similar to those formed by alkaline degradation of fructose.

Rate of decomposition of formaldehyde during liming

The rate of decomposition of formaldehyde was examined initially by liming an aqueous solution of formaldehyde at 80°C and residual formaldehyde was measured by the NASH procedure. To facilitate analysis the concentration of formaldehyde was higher than in factory practice and, as the time required for carbonatation was expected to be long relative to the rate of decomposition, the reaction was stopped at the required time intervals by neutralization with hydrochloric acid. Because of the analogy with fructose degradation, reducing materials were also measured with triphenyl tetrazolium chloride[3] during the degradation.

1 ml of formalin (approximately 33% formaldehyde) was diluted to 25 ml with water and the solution was heated in a water bath to 80°C. Dry lime (0·4g) was added to the solution at 80°C and at 1 minute intervals a 1 ml aliquot was withdrawn, neutralized immediately with 0·7 ml of N hydrochloric acid, and diluted to 25 ml for determination of the concentrations of formaldehyde and reducing material. The concentrations of the latter were expressed relative to fructose standards.

The experimental results are recorded in Fig. 3. It was observed that the solution suddenly developed a yellow coloration 5 minutes 10 seconds after liming.

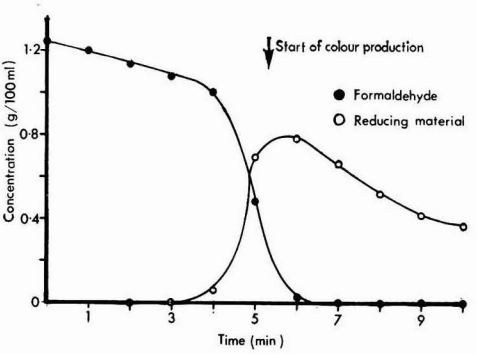

Fig. 3

A slow decomposition of formaldehyde occurred during the first 4 minutes after liming but thereafter the formaldehyde was rapidly decomposed, the concentration falling to zero with an almost equivalent production of reducing material. The reducing material was not stable and colour was produced soon after the concentration of reducing material became significant. The subsequent decomposition of the reducing material followed a curve which was a prolongation of the initial formaldehyde decomposition.

The slope of the formaldehyde decomposition curve does not follow any simple 1st or 2nd order reaction and some other species must be involved to initiate the rapid stage of decomposition. Possibilities for such a "starter" could include many of the acidic products detected in the radiochemical experiments but some of the more reactive non-acidic products of reducing sugar degradation seemed more probable. The experiment was therefore repeated in the presence of added glyceraldehyde at an initial concentration of 0·008%. Glyceraldehyde is not stable under alkaline conditions and is in equilibrium with dihydroxyacetone with has been tentatively identified in low yield as a product of hexose degradation. The decomposition of the

[3] CARRUTHERS & WOOTTON: *I.S.J.*, 1955, **57**, 193.

formaldehyde, the production and subsequent degradation of reducing material and the colour production followed a similar pattern with glyceraldehyde addition, as shown in Fig. 4, but the reaction rates were greatly increased; the formaldehyde concentration fell to zero in about 1½ minutes and the reducing material was decomposed more rapidly.

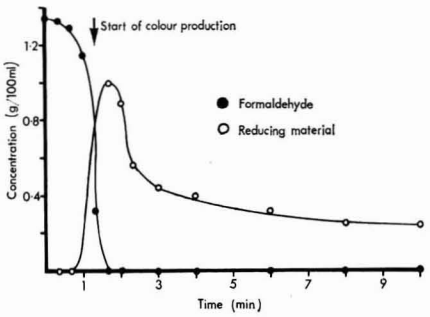

Fig. 4

The concentration of reducing material does not fall exponentially to zero showing that either the initial reducing material is a mixture of different substances, or that some of the products of the initial degradation of reducing material are also reducing. A similar type of curve is obtained on measuring the rate of change of reducing material during alkaline degradation of fructose or glucose.

Probably many other unstable aldehydes and ketones will accelerate the alkaline degradation of formaldehyde and it was found that addition of even a minute amount of fructose (0·004%) was sufficient to reduce the time of complete formaldehyde decomposition to about 2½ minutes.

The degradation of formaldehyde at the lower concentrations realised in factory practice was also examined in synthetic solutions. All the solutions were treated with 1·6% lime at 80°C and the degradation rates for 0·021% formaldehyde without additives, with 10% sucrose, with 0·007% fructose or with 0·12% fructose are recorded in Fig. 5. At this low concentration it was not possible to detect colour production which could be attributed to the formaldehyde degradation.

At concentrations similar to those in raw juice, the rate of alkaline degradation of formaldehyde in aqueous solution without additives was very slow; less than 5% being decomposed in 10 minutes. In 10% sucrose solution however the reaction rate was greatly increased; this increase may be due to the greater solubility of lime in sucrose solution, or to the presence of trace impurities in the sucrose which initiate the chain reaction or perhaps to alkaline degradation of the sucrose itself to yield such starters. The increased reaction rate was not due to traces of fructose in the sugar since the concentration of reducing sugars in solution was less than 0·0003% and without the sucrose this amount of fructose did not measurably increase the reaction rate. Even without sucrose, however, 0·007% fructose brought about a very rapid degradation of the formaldehyde and when the fructose concentration was increased to about that of total reducing sugars in raw juice almost complete destruction of the formaldehyde occurred within 1 minute of liming.

Although there may well be many compounds in raw juice capable of initiating the chain reaction, it is not necessary to invoke substances other than sucrose and reducing sugars in juice in order to explain the complete degradation of formaldehyde during liming and carbonatation.

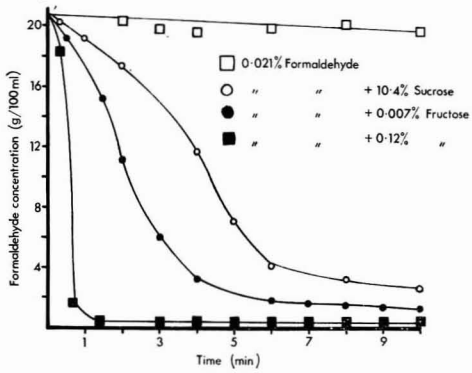

Fig. 5

Conclusions

1. When formaldehyde is introduced towards the head end of the diffuser, very little if any of the formaldehyde reacts with pulp constituents. Only small amounts combine irreversibly with juice constituents or combine in the reversible condensation with amino acids and the greater part is carried forward as free formaldehyde into the raw juice to process.

2. The formaldehyde is rapidly and completely decomposed during liming. About 70% of the formaldehyde added to raw juice could be accounted for as acidic products in second carbonatation juice.

3. The acidic products can be separated by electrophoresis into a series of products increasing in carbon chain length with decreasing mobility. The products are very similar to the products of alkaline degradation of fructose, consisting of simple carboxylic acids and the lower homologues of the saccharinic acid series.

4. Formaldehyde alone is comparatively stable in alkaline solution. In the presence of degradation products of formaldehyde itself, or of fructose or of simple unstable aldehydes, the formaldehyde is rapidly decomposed to give an almost equivalent yield of reducing material. This reducing material is unstable in alkaline solution and decomposes to yield the acidic material together with small amount of yellow products.

Acknowledgment

The authors wish to acknowledge the invaluable assistance of their colleague C. W. Elliott in the investigations reported in this paper.

Automatic cane cleaner controls at H.C. & S. Co., Paia Mill. G. R. WEBSTER. *Rpts.* 1963 *Meeting Hawaiian Sugar Tech.*, 178–181.—Details are given of the cane cleaner automatic control system, similar to that installed at Puunene[1]. Some problems are discussed and certain measures to be adopted are described.

* * *

Experimental feeder table control system at McBryde factory—a progress report. G. E. SLOANE. *Rpts.* 1963 *Meeting Hawaiian Sugar Tech.*, 182–186.—An experimental cane feeder table control system installed in 1963 to study sugar factory automation has proved promising with a cascade control system, although cane periodically becomes jammed against the sides of the feed table while the other ends of the stalks ride on the carding drum. If the carding drum becomes overloaded the control system stops the feeder table. Single loop control, using the drum motor load as the control variable, is not efficient when used with an eddy current clutch drive since changes in the torque load on the clutch produce speed fluctuations unrelated to the motor load and cause over- and under-feeding.

* * *

Operating data of Silver continuous centrifugals at Hutchinson. E. L. LUI. *Rpts.* 1963 *Meeting Hawaiian Sugar Tech.*, 203–204.—Charging of the Silver-Hein, Lehmann continuous centrifugals has been improved and molasses purity reduced by installing an aerating "feeder", which consists of a trough-type mixer with paddles. The amount of air introduced into the massecuite varies with the exposure time. Without the feeder considerable whipping in the basket occurred. Some mention is made of the stainless steel screens and advice is given on the initial start-up of this type of centrifugal.

* * *

Western States continuous centrifugal. A. F. WULFE-KUHLER. *Rpts.* 1963 *Meeting Hawaiian Sugar Tech.*, 205.—A Roberts continuous centrifugal with a 34-in dia. basket and powered by a 40 h.p. motor at 2200 r.p.m. has been installed at Waialua for low-grade work. With a capacity of 1½–2 tons of massecuite per hr, molasses purity was 1·2–5 units higher than with batch machines. A basket with a 30° slope replacing the original 34° slope basket had a massecuite capacity of 1–1½ tons/hr but did not reduce molasses purity. With re-installation of the original basket and using steam plus atomized water instead of steam alone, the capacity was 1–2 tons/hr but the molasses purity was still 1–2 units higher than with the batch machines. A Silver-Hein, Lehmann continuous centrifugal is to be installed for comparison with the Western States machine.

Packaging of granulated sugar in 1-kg packets. I. PÁVEL. *Cukoripar*, 1963, **16**, 329–331.—Details are given of the packaging line at Acs sugar factory (Hungary) for filling 1-kg packets at the rate of 625 kg/hr.

* * *

Pilot plant trials of vacuum filtration running "middle juice carbonatation" process. J. D. TANEJA and S. C. JOLLY. *Indian Sugar*, 1964, **13**, 666–670, 678.—Details are given of tests with a pilot-scale rotary vacuum filter used to treat 1st carbonatation juice. The advantages of continuous filtration over batch filtration are considered so great as to warrant its introduction into Indian factories, but modifications to improve cake washing and discharging, etc. are thought necessary. The economics are also considered.

* * *

Perfection of the classical crystallization process. R. GRANDADAM. *Ind. Sacc. Ital.*, 1964, **67**, 1–10. The influence of massecuite crystal content on crystallization rate is discussed, and it is proposed that part of the massecuite produced be centrifuged and the mother liquor returned and mixed with massecuite of the same strike. In this way the crystal content may be reduced to the optimum for crystallization rate and the Brix may be increased without raising the viscosity of the massecuite to a practically excessive level. The crystallization is thus more rapid and molasses better exhausted. A three-strike system may be reduced to two strikes, and better quality sugar is produced.

* * *

Advantages of a new system for recovery of steam liberated in the boiler feed water tank. O. CHIOETTO. *Ind. Sacc. Ital.*, 1964, **67**, 11–12.—Instead of connecting the boiler feed water tank equilibrium tube to the evaporator second effect it is proposed that connexion be to the first effect, whereby the feed water temperature may be lower and boiler efficiency raised.

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The settling rate of sugar crystals in mother liquor. G. VAVRINECZ. *Cukoripar*, 1964, **17**, 40–42.—The Oseen formula for calculating the settling rate of solid particles in a solution has been simplified for calculation of the settling rate of sugar crystals in a mother liquor of 1·45 s.g. and a viscosity of 50 poises. The formula is an empirical one and was derived from sieve analysis of a number of low-grade sugars.

[1] *I.S.J.*, 1963, **65**, 369.

New clarifier for the Williamson process. L. C. ROJAS. *Bol. Azuc. Mex.*, 1964, (175), 28–29.—An account is given of factors affecting the Williamson phosphate defecation-aeration technique of refinery clarification. It has been found that a zone of clear liquor exists 5 cm from the bottom of the clarifier tank, across the whole width and between points 1 metre from the liquor feed end and 1·35 metres from the exit end. In a new design of tank, therefore, clear liquor is discharged through a series of 2-inch pipes collecting from this zone, while a single feed distributor delivers near the surface of liquor in the tank. Practical experience over three seasons has confirmed its advantages.

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The dust explosion at Köpingebro 1960. I. The explosion accident at Köpingebro. Course of events and causes. O. AF GEIJERSTAM. *Socker Handl.* II, 1963, **18**, 33–40. **II. Electrostatically initiated explosion of sugar dust in air. Investigations at Köpingebro in 1961.** D. MÜLLER-HILLEBRAND. *ibid.*, 40–56. **III. Studies of sugar dust and its origin. Measures recommended.** G. ANDERSSON, B. HÖGLUND and O. WIKLUND. *ibid.*, 56–70. **IV. Other protective measures against dust explosions and their effects.** B. HÖGLUND, R. MÜNCHMEYER and N. MANSSON. *ibid.*, 70–83.

I. Details are given of the considerable damage caused by a dust explosion in one of two 20,000-ton white sugar silos at Köpingebro sugar factory, Sweden, on 6th May 1960. From the evidence it is concluded that the explosion resulted from spontaneous discharge of static electricity in a huge cloud of sugar dust arising from a "sugar slide" down the steep, hard sides of a crater in the silo under conditions of high temperature and fairly low relative humidity.

II. Investigations revealed an electrical charge of $16–25 \times 10^{-9}$ C/g of dust. While the amount of dust formed increases considerably with a temperature rise above 24°C, it is suggested that the severity of the explosion and the extent of combustion would have been less pronounced had the initial flame not reached the unloading room below the central tower where the pressure from the burning dust increased in the limited space to the explosive level. Full details are given of experiments.

III. Methods of determining the amount of sugar dust in the air are described and the characteristics of sugar dust are discussed, as is formation of dust in the factory and silo. Recommendations are given on the basis of the findings for elimination of dust formation during processing, and filling and emptying of the silo, as well as binding of dust to the larger crystals.

IV. Safety precautions mentioned include banning of certain practices and adoption of other procedures in order to prevent dust formation, and structural modifications including the installing of explosion doors.

Granulated sugar storage in silos. G. FEJES. *Cukoripar*, 1964, **17**, 65–74.—The advantages of bulk storage are considered and two types of silo are described, viz. the Weibull and Lucks. While the latter is more expensive, it has no mechanical equipment within the storage space and the danger of explosions is reduced.

* * *

White sugar evaluation on the basis of a points system. K. JÁNOSFY. *Cukoripar*, 1964, **17**, 81–84.—The method, already described by STRUBE, consists in comparing the colour type of dry sugar with standard samples, determining the colour and turbidity of a solution of the sugar as extinction coefficient, and measuring the conductimetric ash content. Each of these factors is allotted a number of points and the total number indicates the sugar quality and may be used as a basis for the selling price. The system is recommended for Hungarian conditions.

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Technological properties of decolorized refinery liquors. R. BRETSCHNEIDER, K. ČÍŽ, O. KOPÁČOVÁ, J. PŘÍHODA and A. SVOBODA. *Listy Cukr.*, 1964, **80**, 58–68.—Load tests with 60°Bx refinery liquors at 75–95°C showed that colour increased with temperature and time and that there were no obvious differences between the effect on decolorized and non-decolorized liquors. At constant temperature and time, the colour increased with pH (6–8·5), the effect being slightly lower in the case of decolorized liquor. Adding 0·01, 0·1 and 1·0% (on liquor solids) of NaCl, NH_4Cl and iron sulphate caused the colour of non-decolorized liquors to increase more than with the decolorized liquor. Iron sulphate doubled the colour content. Storage of the liquors in iron containers resulted in a colour increase in both decolorized and non-decolorized liquors. Liquor treated by bone char, active carbon and various resins was held at 80°C for 10 hr at pH 8·2. The colour increase was given per 100 g and as % of the original colour content. The increase ranged from 30·3% for bone char-treated liquor to 80·9% for liquor treated with "Dowex 1-X", while liquors treated with "Asmit 259" and "Amberlite IRA-401" showed no colour increase.

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Technological developments (in the Japanese sugar industry). T. ANDO and M. KAMODA. *Sugar y Azúcar*, 1964, **59**, (4), 43–45, 72.—Of the twenty-four Japanese refineries with a daily melting capacity exceeding 100 tons, seventeen use anion exchange filtration after active carbon decolorization and three use bone char treatment as well as active carbon and anion exchange. Generally, sugar liquor equivalent to about 150 tons of raw sugar is treated by the resins in a 7–8 hr cycle. Service life is extended to more than 1300 cycles by using ceramic filters to prevent bone char and active carbon particles entering the resin tanks. The treated liquor at 62·4°Bx has an apparent purity of 98·8 and a colour content of

<0·10°St. Other schemes include: a patented electrolysis method of purifying syrup for candy crystal production (not yet used because of the low filtrability of the treated syrup); automatic control of the magma mingling process whereby the ratio of affination syrup to incoming raw sugar is kept constant by feeding data from the band weigher to a diaphragm control valve which adjusts syrup flow; and raw sugar affination with organic solvents. The installation of automatic Western States centrifugals has resulted in more efficient affination, but many refineries use other types including Escher Wyss, BMA and "Hydromat" continuous machines. Fluidization cooling has proved more efficient than cooling in rotary machines. Automatic packaging machines have also been introduced. Information is also given on the types of refined sugar produced.

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The efficient use of steam. M. D. ENDERSBY. *Sugar y Azúcar*, 1964, **59**, (4), 51–53, 72.—Comparison of the economics shows that while steam generated by three coal-fired high-pressure boilers would cost over £154,000 more per annum than steam generated by 12 low-pressure oil-fired packaged boilers, this sum is reduced to £3000 for oil-fired high-pressure boilers. It is calculated that £141,000 per annum could be saved by reducing vapour consumption for process hot water, syrup heating, space heating, etc.

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The problem of entrainment in evaporators. A. L. WEBRE. *Sugar y Azúcar*, 1964, **59**, (4), 54–57, 72. The performance of a quadruple-effect evaporator is analysed to show the effect of tube size on juice-vapour velocity, and possibility of entrainment. The various types of entrainment separators available are described and some information is given on the results obtained.

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A continuous rapid crystallizer. H. M. BAUSERMAN. *Sugar y Azúcar*, 1964, **59**, (4), 58–60, 72.—Details are given of the Stearns-Roger Corporation continuous crystallizer which is provided with large semi-circular fan-shaped blades mounted on a double hollow central shaft giving about 1·4 sq.ft. of heat transfer surface per cu.ft. of massecuite. Cooling water flows through the central shaft at 10–40 g.p.m. against massecuite flow, its temperature and flow rate being so controlled that the massecuite is cooled at a required rate.

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Tongaat to increase crushing rate to 300 tons of cane per hour. ANON. *S. African Sugar J.*, 1964, **48**, 185. Details are given of the additional equipment to be installed and of the modifications to the two milling tandems at the Maidstone sugar factory to increase the crushing rate from 225 to 250 t.c.h. and finally to 300 t.c.h.

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Expansion programme for Renishaw factory to cost R600 000. ANON. *S. African Sugar J.*, 1964, **48**, 187.—Information is given on the modifications and additions to the equipment to raise the crushing rate at the factory from 55 to 77 t.c.h. Mirrlees Watson will supply a 36 × 66 in crusher and two 34 × 66 in mills, while A. & W. Smith gearing and turbines are to be provided for the mill drives.

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Crystallization and its control. F. SCHLANITZ. *Zeitsch. Zuckerind.*, 1964, **89**, 197–201.—A conductivity measuring instrument was compared with a Honeywell B.P.E. instrument for supersaturation determination during the boiling of a 96·5 purity *A*-massecuite. Certain pan design defects were found: the circulation of the massecuite was too low to permit the dissolved sugar to grow on the surface of the crystals at a rate equivalent to syrup feed; once the maximum level was attained the massecuite had to be further heavied up to obtain the right consistency for the crystallizer and centrifugal; a considerable amount of fine grain was formed after heavying up was reached owing to the higher supersaturation, indicating that the width of the metastable zone varies with temperature at constant purity: the lower the temperature the wider is the zone. While a constant and very low temperature can be maintained only if the pan is provided with its own condenser and air pump, fine grain formation was successfully prevented by maintaining a constant supersaturation and introducing water to improve circulation, increasing crystal yield by 2%. It was found that the curves traced on the conductivity and B.P.E. charts differed widely, the latter indicating supersaturation correctly while the former indicated undersaturation of the massecuite. The measuring accuracy of the B.P.E. instrument was ±0·25%, the pen reacting to a change in supersaturation of about 0·001.

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Filtrability studies at Isis. K. BOYDEN. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 219–222.—Various factors likely to affect sugar filtrability were studied, viz. turbidity (negligible effect under normal conditions), juice pH (serious effect below 7·5), type of saccharate and position of saccharate addition. Liming juice with a mixture made up of clarified juice, lime and syrup gave better results than did a 5:1 mixture of clarified juice and lime. Adding the saccharate in the juice line prior to the flash tank rather than at the top of the flash tank also gave better results. Badly frosted case had no detrimental effect on filtrability. Material stored over a week-end apparently has an adverse effect on sugar filtrability.

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Modern low voltage switchgear. H. F. SCHERNICKAU. *Proc. 31st Conf. Queensland Soc. Sugar Cane Tech.*, 1964, 213–218.—The advantages and applications of low voltage switchgear are discussed and a description is given of a modern contactor answering all the requirements of automatic control. Motor starters and motor protection are also dealt with.

BEET FACTORY NOTES

Counter-current ion exchange column. A. ZSIGMOND and V. GRYLLUS. *Cukoripar*, 1963, **16**, 282–286, 305–310.—A general survey is presented of ion exchange processes and of the equipment used in the sugar industry. A new type of batch column is described which comprises a rather wide cylinder, the interior of which is divided into two concentric sections by an inner wall so that the outer section resembles a narrow corridor running around an inner vessel. The inner wall stops short of the top of the column. The top cover is depressed in the centre to permit uniform flow of liquid. The liquor enters through ports in the base of the annular section and leaves through a number of ports in the bottom of the centre section. The bottom of both sections is covered with a layer of grit and the resin fills the remainder of the space when swollen to maximum volume. An automatic de-aeration unit is connected to the top cover. Advantages of the column include no back-washing with consequent need for dead space, regular distributing of liquor and uniform flow rates, reduced consumption of chemicals for regeneration and lower resin losses, minimum dilution of solutions, rapid response to variations in density (as in sweetening-off) and low installation costs.

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Control of lime burning by gas analysis. J. BARCSAY. *Cukoripar*, 1963, **16**, 324–328.—The output and efficiency of a lime kiln is determined from the composition of the waste gas whereby *inter alia* the ratio of decomposed $CaCO_3$ to burnt coke is calculated. Formulae are presented based on an average coke composition.

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Cooling of after-product massecuite with air. A. GYORY. *Cukoripar*, 1964, **17**, 16–18.—At Szolnok sugar factory the Bock crystallizers were partly filled with massecuite leaving the upper part free to a depth of 50 cm. A corresponding volume of air was blown slowly over the massecuite during thorough stirring. In this way, the massecuite was cooled from 73–74°C to 45°C in 30 hr and molasses sugar was reduced.

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Effect of storage on change in the technological quality of sugar beet. K. VUKOV and L. BÁRÁNY. *Cukoripar*, 1964, **17**, 19–22.—Beet stored in small clamps for 8 days suffered a weight loss of 14·5% and a daily sugar loss of 0·15% on beet. The invert sugar, amino N, ammoniacal N, total anion, lactic and volatile acids contents became considerably higher while the elasticity modulus and diffusion constant were much reduced. Further storage was impaired. While wilted beet could contain a greater weight of sugar than fresh beet, it was found that the total losses and white sugar yield % on weight of beet could also be higher than with fresh beet. Beet stored for a long time in artificially ventilated piles measuring 15 × 24 m at the base and 4 m high suffered daily sugar losses of 0·037% and a weight loss of only 0·77%. The elasticity modulus was lower but the diffusion constant was increased. The loss in white sugar was 0·8% on beet lower than with beet stored in normal factory piles.

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Sugar beet storage and loading mechanization in Hungary. S. JERMY. *Cukoripar*, 1964, **17**, 33–37. Problems associated with beet storage at scattered points away from the factory are discussed. Artificial ventilation is recommended. Plastic sheeting is advocated for protection of the stored beet and various types are compared. Temperature control by means of thermistors is discussed. Hungarian, Czechoslovak and Soviet unloading pilers are compared.

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Performance of a modernized RDA-57 diffuser with internal cossette heating. S. T. KOZHEMYAKIN and B. A. KUTSENKO. *Sakhar. Prom.*, 1964, **38**, 341–343.—The 3rd and 4th compartments of a modified twin-scroll RDA-57 rotary diffuser are separated by a baffle; juice in the 4th compartment is withdrawn, passed through a heater, and returned to the diffuser, entering on the other side of the baffle and then passing against the flow of cossettes back through to the 1st compartment. Cossette press-water is de-pulped, heated and re-fed to the diffuser, the amount being regulated by a valve before the pulp trap. At a draught of 139·3% losses in pulp were 0·38% on beet (the average for approximately 93,000 tons of beet sliced).

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Action of sodium triphosphate on the heating surface of an evaporator. M. N. ZABOLEV. *Sakhar. Prom.*, 1964, **38**, 344–346.—The addition of sodium triphosphate to 2nd carbonatation to overcome difficulties with sub-standard beet was found to cause pitting in evaporator carbon steel tubes and corrosion in juice heaters, etc. The effect, ascribed to the formation of mono-and diphosphates and orthophosphoric acid, was particularly marked with new tubes. This is attributed to frequent treatment of old tubes with sodium carbonate and acid.

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Automatic milk-of-lime feeder used in A. S. Fedchenko's system. YU. M. POLYAKOV. *Sakhar. Prom.*, 1964, **38**, 346–349.—Milk-of-lime enters a measuring chamber in the apparatus described where its density governs the position of a float. This is connected to a needle valve and alters its aperture to compensate for varying density. The milk-of-lime overflows into a supply chamber and thence through the needle valve to process, its flow relative to juice flow being controlled by a hollow elbow which returns excess lime to the lime station. This elbow rotates through 90° from vertical to horizontal, varying the hydrostatic head of lime and thus the flow through the

needle valve. Its position is governed by the automatic control system regulating the juice:milk-of-lime ratio. Details are given on the remote controls and recorders. A visual and audible emergency signal is actuated when flow stops.

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Improving the performance of automatic controls for the carbonatation station. V. I. AKSENFEL'D. *Sakhar. Prom.*, 1964, **38**, 352–354.—The type of equipment to use for measuring CO_2 concentration in saturation gas, raw juice flow, and the level in 1st and 2nd carbonatation vessels is discussed as is the use of antimony electrodes capable of being cleaned mechanically and of ultrasonics to prevent scaling of the electrode unit.

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Experience in automatic regulation of beet feeding to the factory. M. A. TURKIN. *Sakhar. Prom.*, 1964, **38**, 354–357.—Details are given of the controls at Merkenskii sugar factory which regulate the flow of beet from the pile to the washer. The main control is an actuator connected to a tube fixed to the axles of the conveyor before the beet elevator. As the quantity of beet on the conveyor increases so too does the angle of the tube and at the maximum limit the impulse transmitted to a time relay causes the entrance to the flume to be closed and only water allowed to flow through the beet pump. Other controls mentioned operate to prevent overloading of such equipment as the beet pumps and washer, stopping intermediate processes where necessary. A wiring diagram of the main scheme is presented.

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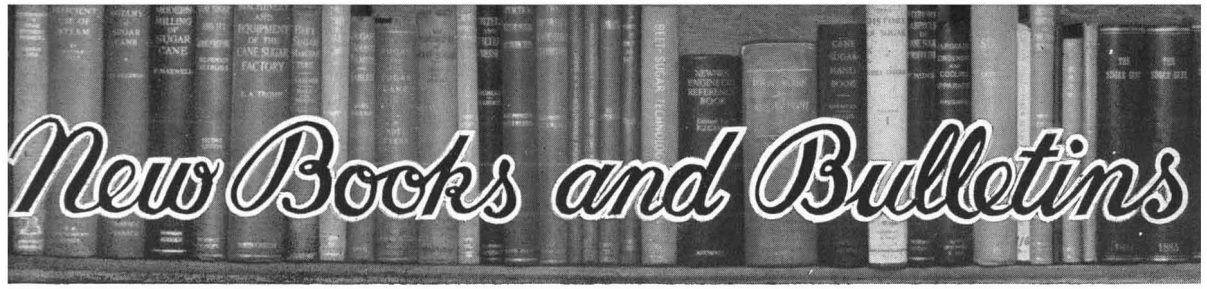
Analytical study of sugar extraction from beet in diffusers. E. T. KOVAL' and A. YA. ZAGORUL'KO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **12**, 78–104.—The numerous factors which cause the actual diffusion process to deviate from the theoretically ideal process are enumerated and discussed. Equations are developed describing actual diffusion which take into consideration these factors. For this, the cossette thickness (so-called "equivalent" thickness) has been expressed in terms of (1) the thickness of an unlimited lamina and (2) the diameter of an unlimited cylinder. The equations cover the conditions of press-water return and non-return and permit the construction of theoretical curves describing the change in sugar concentration in cossettes and in the extraction liquor throughout the diffuser. It is also possible with these to find the diffusion constants at any point along the diffuser. An expression has been developed for calculating the diffusion constant introduced by the Hungarian Sugar Industry Institute; for actual diffusion this is a function of BIOT's diffusion criterion and takes into account diffusion and hydrodynamic conditions in a diffuser when the cossettes are in contact with the liquor.

Accelerating sedimentation of the solid phase in carbonatation juices using high molecular flocculants. YU. D. GOLOVNYAK and A. K. KARTASHOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1964, **12**, 104–138.—The use of synthetic flocculating agents in a number of industries including the sugar industry is discussed and the mechanism of the action of high molecular flocculants described. The requirements of such flocculants in the beet sugar industry are listed. Eighteen were tested, four in detail. In amounts of 5–20 p.p.m., using 0·1% and 0·2% solutions in laboratory and factory tests, respectively, the flocculants were placed in the following decreasing order as regards quality of the supernatant from 1st carbonatation juice: hydrolysed polyacrylonitrile > sodium polymethacrylate > polyacrylamide > sodium alginate. Mixtures of flocculants had less effect than their individual components. It was found that no flocculant remains in the treated juice, and that the flocculant should be added to the juice line between the heater and clarifier at optimum 1st carbonatation alkalinity (the effect of alkalinity on the efficiency of flocculants is discussed). The flocculating effects of pectins and albumins are considered. While raw juice improved 1st carbonatation juice settling and was only slightly inferior to sodium polymethacrylate, the optimum effect was acheved by adding press-juice to carbonatation juice. However, as the authors admit, producing juice from unheated cossettes is very difficult. In most cases the heating of flocculants (to 85°C) before adding to 1st carbonatation juice gave better results than heating after addition. Adding raw sugar to 1st carbonatation juice (5% by volume) increased the settling rate and gave a better supernatant, but to a far lesser extent than a synthetic flocculant. Its effect is attributed to the presence of high molecular substances in the molasses film surrounding the crystals. Juice filtration was impaired, however, while increasing the amount of raw sugar had an adverse effect (because of viscosity rise) on settling. Adding milk-of-lime (0·3–0·5% CaO) to 2nd carbonatation juice and subsequently treating with 5 p.p.m. of sodium polymethacrylate improved mud separation. On their own, the operations were without effect. The use of filters for this purpose is not recommended and reference is made to the use of settlers outside the USSR (e.g. as in the BMA scheme). However, when stale beet are processed it is impossible to obtain a clear 2nd carbonatation juice by this means even when using polyacrylamide. The best effect is obtained by treating with an electrolyte (coagulant) followed by a flocculant. Sodium triphosphate used as coagulant followed by polyacrylamide gave clearer juice than they did singly or than did milk-of-lime treatment (0·3% CaO). Photomicrographs are given of the mud particles with each treatment. The thickened muds should be sent to pre-liming and not filtered. Other advantages of treatment with sodium triphosphate and of mud separation by settling are summarized.



ICUMSA Methods of Sugar Analysis. Ed. H. C. S. DE WHALLEY. 153 pp; $5\frac{3}{4} \times 8$ in. (Elsevier Publishing Co. Ltd., Amsterdam.) 1964. Price: 45s 0d.

It is noted in this book that the Editor, H. C. S. DE WHALLEY, died on 20th March, just before it went to press—"May this volume remain a fitting tribute to his life-long endeavours to improve and standardize analytical methods for the benefit of the sugar industry everywhere." We have no doubt that it is a fitting tribute and would have been the apple of Mr. DE WHALLEY's eye had he survived to see its publication.

It is small, not too expensive, and possesses the advantage of containing detailed but straightforward instructions for the methods given, so that it is not necessary to make frequent references to original papers. The methods are classified as general methods and special methods, the former dealing with the determination of sucrose, reducing sugars, raffinose, ash, etc., while the latter are concerned with raw sugar polarization, sugar determination in beet, weighing, taring and sampling of raw sugar, factors causing deterioration of sugar in storage, etc. Each method is classified as official, tentative, or for guidance.

The scope of the work and its authoritative character, among its other virtues, are sure to make it a best-seller, essential to all sugar industry analysts.

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F. O. Licht's Internationales Zuckerwirtschaftliches Jahr- und Adressbuch 1963/64 (International Sugar Economic Yearbook and Directory). H. AHLFELD. 428 + 60 pp.; $8\frac{1}{2} \times 11\frac{1}{2}$ in. (F. O. Licht K.G., P.O.B. 90, 2418 Ratzeburg, Germany.) 1964. Price: DM 40.-; £3 12s 6d.

It is very difficult to find new ways in which to express one's thoughts on a publication that appears regularly year after year and particularly when there is so little to criticize. Suffice it to say that the latest edition of this well known yearbook maintains the very high standard set at its inception and can be commended to all readers as one of the most useful guides to the world's sugar factories. The form in which the book is laid out is the same as with previous editions. Thus we have the sections on laws, agreements and contracts, German and other sugar organizations, sugar importers and exporters in Europe and other continents, details of German beet sugar factories and refineries, of other European and non-European beet factories and refineries (except China and Russia), of cane sugar factories and refineries, except those in Mainland China, and reports covering the sugar machinery and factory construction industries, as well as reports from sugar equipment and factory manufacturers. There is a Buyer's Guide, an English-German vocabulary and a selection of sugar publications with publishers' addresses. The atlas contains maps of Puerto Rico, Guatemala, British Honduras, El Salvador, Colombia and Peru. The information has been brought up to date and changes in the status of former British colonies are reflected in the lists, Jamaica and Trinidad & Tobago now being separate from the West Indies, and Kenya, Uganda and Tanganyika now appearing separately. Some omissions have been rectified (Ceylon, Thailand and the new Florida factories) and four new countries are included: Tunisia (beet) and Iran, Nepal and Nigeria (cane). The lists of Japanese firms are somewhat incomplete and the reviewer notes the somewhat haphazard arrangement of the U.S. beet sugar firms. However, whatever criticism there is to make is negligible in relation to the very good results achieved by the compilers of the book.

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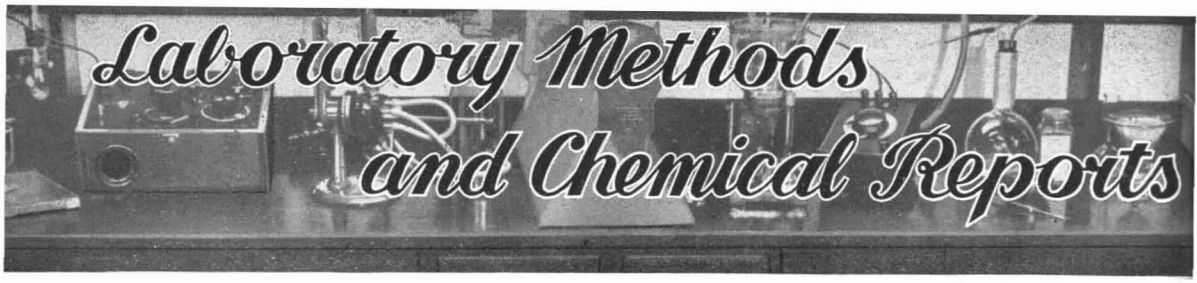
An Introduction to the Chemistry of Carbohydrates. 2nd Edn. R. D. GUTHRIE and J. HONEYMAN. 144 pp; $5\frac{1}{2} \times 8\frac{1}{2}$ in. (Clarendon Press: Oxford University Press, Amen House, Warwick Square, London E.C.4.) 1964. Price 21s 0d.

The book was originally introduced to provide a compact, up-to-date account of the chemistry of a selected number of carbohydrates. It is suitable for students reading for an Honours degree in Chemistry and succeeds admirably in providing information on the major carbohydrates clearly and succinctly, with clear illustrations and a well-organized layout. It deals with the constitution, synthesis, ring structure and conformation of monosaccharides, and discusses their reactions to acids and alkalis. There follow chapters on ethers and acetals, esters and anhydro sugars, glycol-splitting reagents, nitrogen-containing monosaccharide derivatives, branched-chain sugars, deoxy sugars and polyols. A separate chapter is devoted to ascorbic acid, another to di-, tri- and tetra-saccharides, and another to polysaccharides. A new chapter deals with physical methods used in the study of these materials, including paper, thin-layer, column and vapour-phase chromatography, electrophoresis, etc. It will make possible a deeper understanding of the more theoretical studies reported in our pages and elsewhere, as well as providing a suitable basis for further study on carbohydrate chemistry.



Application of the 20-gram dilution method for molasses analysis. G. VAVRINECZ. *Cukoripar*, 1963, **16**, 311.—The method described involves the use of a Pulfrich refractometer with a L-1 head which is used to determine the Brix of a 20 g ± 5 mg sample diluted to 100 ml. Fifty ml of the solution is then clarified with 8 + 8 ml of Herles' reagent, made up to 100 ml, and the polarization determined in a 200-ml tube.

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Studies on sucrose crystallization in the presence of raffinose. G. MANTOVANI and F. FAGIOLI. *Zeitsch. Zuckerind.*, 1964, **89**, 202–205.—Under static conditions at 20°C raffinose in quantities of 0–10 g/100 g water was found to have very little effect on sucrose solubility, the salting-out effect being almost negligible. However, the effect on crystallization was marked: in the presence of 2 g raffinose/100 g water (about 65% of the solution) the crystallization rate was more than halved, a drop which cannot be explained by the increase in viscosity that results. Colorimetric analysis with anthrone of sucrose crystals grown in a solution containing 1·5% raffinose (on 100 g water) and subjected to paper chromatography revealed the presence of 2500 p.p.m. on average of raffinose (1800–3900 p.p.m.). That the crystallization rate reduction is attributable to the inclusion of raffinose in the sucrose crystals is borne out by the already known fact that raffinose causes a change in the shape of sucrose crystals.

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Lactic acid determination in sugar factory juices. V. PREY, W. BRAUNSTEINER, R. GOLLER and F. STRESSLER-BUCHWEIN. *Zeitsch. Zuckerind.*, 1964, **89**, 205–206.—Lactic acid in sugar juices and molasses solution is determined by thin layer chromatography on paper using 15:20:7 ether:benzene:formic acid as solvent and developing with an alcoholic solution of bromphenol blue. Total time is 30 min and using standard concentration spots for comparison it is possible to determine lactic acid down to 0·4% concentration at an accuracy of ± 10%. This is equivalent to 3–3·8% lactic acid or 1 part per 100 parts sucrose.' Greater precision can be achieved by using smaller intervals of concentration between the standard spots.

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Application of the Zeiss leucometer in the sugar industry. K. JÁNOSFY. *Cukoripar*, 1964, **17**, 8–14. An illustrated description is given of this instrument[1] for determining sugar whiteness value. The remittancy values obtained with it are almost identical with the "albedo" values obtained with the Zeiss reflectometer. The absolute values given by the leucometer cannot be related to the international CIE system. The use of the leucometer in preparing white sugar standards of graduated colour in Hungary and East Germany is described.

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The use of ultrasonics in sugar production. G. S. BENIN. *Sakhar. Prom.*, 1964, **38**, 335–341.—A short survey is given of the work carried out to determine the effect of ultrasonics on the composition of various substances including sugar solutions. Diffusion tests were carried out in a special apparatus in which a magnetostrictor mounted below the diffusion cell generated ultrasonic waves for 6, 12 and 18 min during 30 min diffusion (the magnetostrictor being switched on 6 or 12 min after the start of diffusion). The extraction water temperature was 75°C and the juice and cossettes were mixed by an agitator rotating at 8–9 r.p.m. In all cases the sugar loss in pulp rose and the coefficient of sugar extraction fell with the use of ultrasonics. However, the increase in pulp sugar is considered apparent and not true, since it results from differential rates of formation of dextro- and levo-rotatory sucrose decomposition products.

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Automatic determination of the density of sugar syrups. L. N. KUZ'MENKOV, T. M. PAVLYUKEVICH and M. I. KONDRATENKO. *Sakhar. Prom.*, 1964, **38**, 350–352.—The PPI-265 A density meter described is a float-type device in which the float (filled with inactive solution) is connected to the ferro-magnetic plunger of a differential transformer in turn connected to a secondary device calibrated in units of density.

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The application of a photocolorimeter to the control of sugar quality. N. L. TROYANOVA and G. A. KLIMENT'EVA. *Sakhar. Prom.*, 1964, **38**, 360–362. Results of tests in which the colour of prepared white sugar samples was determined with a FEK-M photocolorimeter using a blue filter and a 5 cm cell showed that the relationship between the colour expressed in °St (using 0·5 and 0·25 normal glasses) and as extinction is linear, somewhat greater scattering occurring in the range 1–2°St than in the range 0·4–1·0°St. An equation presented for calculating °St/100°Bx from the extinction $\left(\frac{\text{extinction} - 0{\cdot}08}{0{\cdot}15}\right)$ has given values which differ from measured values by + 0·87 to — 0·90°St.

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[1] *See I.S.J.*, 1963, **65**, 307.

PATENTS

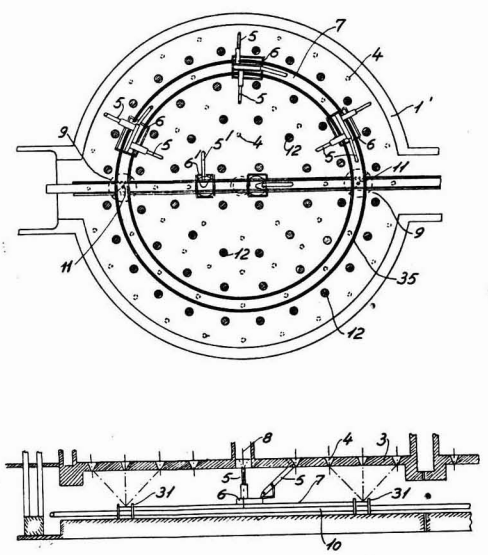
Preventing or reducing foam formation. FARBENFABRIKEN BAYER AG., of (22c) Leverkusen-Bayerwerk, Germany. **928,906.** 24th November 1961; 19th June 1963.

Foam formation in a lye, used e.g. for cleaning milk or other bottles, is prevented by incorporation of 1:10,000 of a polyglycol ether of sucrose prepared by treating propylene oxide with sucrose in a molar ratio of 80:1 in an autoclave at 130°C in the presence of 1% of KOH on weight of sucrose.

* *

Conveying of silo material. A/S DE DANSKE SUKKERFABRIKKER, of Copenhagen, Denmark. **943,752.** 16th February, 1961; 4th December, 1963.

The floor 3 of a circular silo is supported by pillars 12 passing through a pit below. The pit is enclosed by wall 1 and contains an annular conveyor 7 mounted above a horizontal endless conveyor 10. Sugar is discharged from the holes 4 in the silo floor and is directed by tubular rotatable chutes 5 into a loading



device 6 such as a hopper mounted above and feeding the annular conveyor. The latter is rotated about the central axis 8 by a driving mechanism (not shown) and conveys sugar to the zones 9 where scrapers 11 discharge it to conveyor 10. Sugar from the centremost holes 4 is collected by chutes 5′ and fed through hoppers 6′ directly to conveyor 10, which removes the combined sugar from the silo.

Production of dried vegetable (cane) juice. CHARLES PAGE & CO. LTD., of London S.W.1. **946,841.** 8th September 1961; 15th January 1964.

Cane juice is (neutralized with lime,) concentrated (to at least 85°Bx, at least partly under reduced pressure) to a treacly consistency (and crystals forming are separated) and a dry non-hygroscopic inert and insoluble powder added [maize, tapioca or potato starch, tricalcium phosphate, kaolin, talc, calcium or magnesium carbonate, in a proportion of 1–15% (2–8%) on solids in the concentrated juice], so as to form a fine dispersion. The product is then dehydrated (under reduced pressure) to form a dry non-hygroscopic powder (up to 10% of which is recycled to the concentrated juice).

* * *

Refining of sugar solutions. SUGAR CHEMICAL CO. ETBT., of Vaduz, Liechtenstein. **947,940.** 10th November 1961; 29th January 1964.

Sugar solution previously treated by carbonatation or other conventional process is contacted (at 80–100°C) with a cation exchanger in the Na form and an anion exchanger in the Cl form (in substantially equal amounts, in a mixed bed), interrupting the contact when 60–75% of the Cl^- of the anion exchanger has been exchanged for ions from the sugar solutions. The resins are regenerated by treating with a (25%) NaCl solution (at 90–100°C).

* * *

Preparation of D-fructose. C. F. BOEHRINGER & SOEHNE G.M.B.H., of (17a) Mannheim-Waldhof, Germany. **949,293.** 9th November 1962; 12th February 1964.

A 5–30% (10–20%) aqueous solution of glucose (obtained by hydrolysis of sucrose) is isomerized [at 20–80°C (25–35°C)] in the presence of Na or K aluminate as a base catalyst [in the ratio of 0·5:1–1:1 (0·75:1) Al:glucose by weight], the aluminate containing 1 gram-atom of Al to 1·5–2 (1·9) mol of KOH or NaOH and obtained by dissolving Al or technical $Al(OH)_3$ in NaOH or KOH solution. The Al is precipitated from the reaction mixture as $Al(OH)_3$ and is removed, while the D-fructose is isolated as Ca fructosate which is decomposed with CO_2 and the D-fructose recrystallized from methanol.

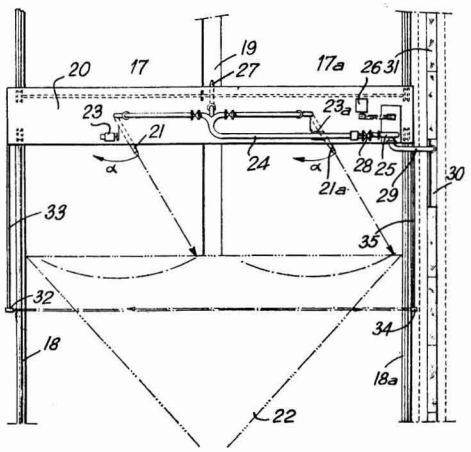
* * *

Conveying sugar beet to a washing station. SUCRERIES ET DISTILLERIES DU SOISSONAIS, of Soissons (Aisne), France. **950,036.** 5th June 1962; 19th February 1964.

A beet silo has a central trough 19 with floors 17, 17a sloping down towards it, and low walls 18, 18a at the sides. A travelling bridge 20 carries two pipes

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 4s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

21, 21a which oscillate under the action of driving means 23, 23a, delivering water under pressure; this is drawn from channel 30 through pipe 29 and sent



by pump 25 and valve 28 to the pipes, and also to pipe 27 which supplies the transport water for the trough 19. The bridge moves towards the pile of beet 22, eroding the bottom of the pile and sending the beet into the trough for conveying to the washer. Movement of the bridge is automatically controlled by a diminishing size detector such as light source 32 on the bridge and a photocell 34 on the other side; when the beet is carried away to the extent that light can strike the photocell, this causes the bridge to move along towards the pile until this interrupts the light beam.

* * *

Continuous cutting of sugar cane (for diffusion). A. E. RADINGER, H. C. RADINGER and R. PILGRAM, trading as H. PUTSCH & COMP. **950,398.** 25th October 1962; 26th February 1964.

The machine for use in preparing cane for diffusion comprises a rotary cutter which revolves about a vertical axis and includes a drum frame carrying a series of cutter boxes located around the periphery. Cane is presented to the cutters by two endless belt conveyors in the form of bunches forming a continuous line, the growth axis being substantially perpendicular to the drum periphery. The cane conveyor belts are spaced one above the other and one pivots towards the other and is pressed hydraulically or pneumatically in this direction so compressing the cane. The feed line is staggered in the direction of drum rotation with respect to the drum radius. The cut cane drops into a hopper inside the drum casing and below the drum. Any portions of fibre remaining on the cutter are removed as it passes an external source of air or liquid under pressure which blows the fibre off and down into a gutter from which it is washed away.

Resin for sugar solution decolorization. VEB FARBENFABRIK WOLFEN, of Wolfen, Kr. Bitterfeld, Germany. **950,501.** 8th November 1961; 26th February 1964.

Suitable anion exchange resins are cross-linked copolymers comprising a monovinyl aromatic hydrocarbon and (0·5–5 mol % of) a divinyl hydrocarbon which contains, in addition to quaternary ammonium groups, one or more additional polar groups selected from ^{-}CN, $^{-}COOR$, $^{-}COOH$ and $^{-}SO_3R$ where R is an alkyl radical (in a proportion of 0·02–0·3 mol of polar groups per mol of quaternary ammonium groups). They are prepared by copolymerizing an aromatic monovinyl hydrocarbon, a divinyl hydrocarbon and a vinyl monomer containing the polar group and subsequently chloroalkylating and finally aminating with a tertiary amine.

* * *

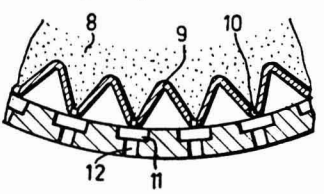
Production of itaconic acid. CHAS. PFIZER & CO. INC., of Brooklyn, N.Y., U.S.A. **950,570.** 13th April 1962; 26th February 1964.

A carbohydrate solution containing beet molasses as the source of 10–30% by weight of carbohydrate is inoculated with an itaconic acid-producing strain of *Aspergillus* (*A. terreus*, *A. itaconicus*) and fermented under submerged aeration conditions at 35–42°C until the itaconic acid concentration reaches 2–5 g/100 ml, 20–50% of the acid is neutralized and fermentation allowed to proceed until itaconic acid production is negligible. The beet molasses medium may be employed as a primary carbohydrate source in growing an inoculum which is then transferred to a cane molasses medium (10–18% w/v sugar) for production fermentation.

* * *

Strainers for the drums of centrifugal separators. ESCHER WYSS AG., of Zurich, Switzerland. **950,832.** 4th March 1960; 26th February 1964.

A capillary layer of moist sugar forms near the periphery of a cylindrical drum of a push-type centrifugal and this is minimized by providing the drum with a corrugated inner surface either in the form of a corrugated plate 9 or bars of triangular cross-section, or other means. By making the corrugations sufficiently steep the volume of capillary



layer in reduced to a fraction of that with a cylindrical drum, and by making suitably-dimensioned holes 10, grooves 11 and discharge orifices 12, all or almost all of the capillary layer may be separated into a collection chamber instead of being discharged with the bulk of the centrifugally dried sugar.

TRADE NOTICES

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

Sugar cane herbicide. Amchem Products Inc., Ambler, Pa., U.S.A.

Called "Fenatrol" internationally and "Fenac" in the United States, a new pre-emergence weed killer for use on sugar cane is based on the sodium salt of 2,3,6-trichlorophenyl acetic acid. It is available as a water-soluble powder containing 40% active ingredient or as a liquid containing 1½ pounds acid equivalent per U.S. gallon. "Fenatrol" is designed to give long-term control of both broadleaf weeds and grasses, particularly seedling Johnson grass (*Sorghum halepense*), a weed considered very difficult to control in sugar cane in Louisiana.

Consistently higher yields of sugar have been recorded when weed control has been achieved with 2–3 pounds of active "Fenatrol" per acre. In addition, interesting results have been obtained using "Fenatrol" in combination with an emulsifiable acid formulation of 2,4-D, "Silvex" or "Atrazine". Results of these combinations show that post-emergence applications may prove useful. Other experiments with "Fenatrol" include the possibility of low-volume application by air.

"Fenatrol" is registered for use in plant cane and is applied at the time of planting or shortly afterwards, before the weeds have emerged. Indications are that it will be equally useful when applied to ratoon or stubble cane.

* * *

Mechanized cane harvesting. Massey-Ferguson (Export) Ltd., Banner Lane, Coventry, Warwickshire.

The Massey-Ferguson system of mechanized cane harvesting is based on the MF 515 Cane Harvester which provides cane growers with a one-man operated mechanical means of topping, cutting and loading in one complete operation.

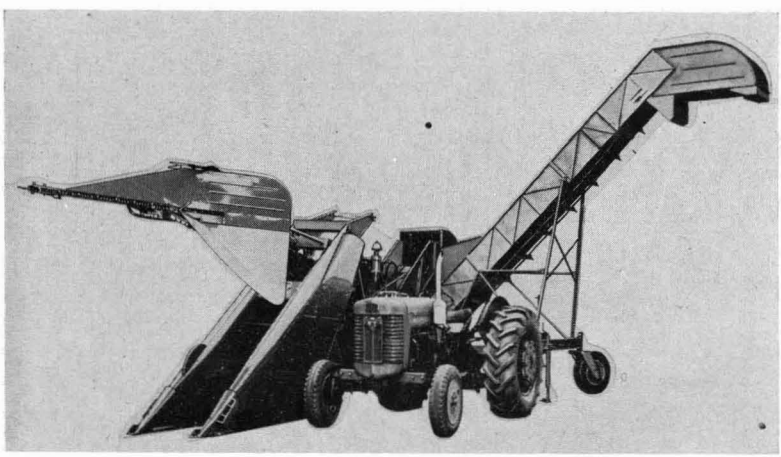
The MF 515 has been well proved in the cane fields of Australia and other sugar producing countries, as a dependable, practical machine which returns considerable savings in time, labour and cost. It has proved successful because of its ability to harvest badly lodged and tangled cane as well as upright stands.

The Massey-Ferguson system of mechanized cane harvesting is ideal for areas where: cane is burnt prior to harvesting, row spaces are 5 ft (1·5 m) or more apart, cane is grown on flat or ridged land, with the ridges not exceeding 12 in (30 cm) in height, and mill facilities are suitable for unloading chopped cane.

Capacity is from 10 to 15 tons per hour; in Australia crops yielding 70 tons per acre have been harvested successfully and maximum harvesting efficiency is achieved in crops yielding 30 to 40 tons per acre.

The high harvesting efficiency returns greater savings in time, reduced labour problems and greater profit from the crop.

The harvester consists of a topper, base cutter, gathering walls, conveyor, choppers, elevator, hydraulic controls and engine for operating the mechanism. Side-mounted on an MF 65 tractor, the harvester is driven along the row of cane, where the tops are gathered by two arms at the forward end of the boom and conveyed by chains to a rotating bladed disc which severs them. A spinning thrower deflects the severed tops on to a delivering chute which drops them clear of the machine. Topping height is hydraulically adjustable from 4 to 10 ft (1·2 m to 3 m) whilst in motion to cater for variations in the height of the crop. The cane sticks are contained between the gathering walls and guided to a rotating toothed disc which cuts the butts. As the sticks fall forward, the butts are carried over a short conveyor into choppers where they are cut into billets approximately 14 in (35·4 cm) long. Billets are cut cleanly and without bruising. A space provided between the conveyor and choppers allows stones and dirt to fall through so that a clean sample is conveyed by the elevators into the container used to transport the cane from the field.



A unique feature of the cane harvester is the design of the gathering walls which prevent cane sticks escaping after they have been cut. A circular saw is incorporated in the right hand gathering wall and assists the harvesting of badly lodged and tangled cane.

* * *

PUBLICATIONS RECEIVED

SPRINKLER IRRIGATION PLANT. Wright Rain Ltd., Crowe, Ringwood, Hampshire.

A series of Technical Bulletins have been issued to provide detailed information on the irrigation equipment supplied by Wright Rain Ltd. It includes the various sprinklers, irrigation pumps and aluminium alloy irrigation pipes, while another publication, entitled "Make money from water with irrigation by Wright Rain", also provides information and illustrates the Company's range of pipes and fittings—couplers, plugs, bends, etc.

* * *

DORR-OLIVER PROCESSES AND EQUIPMENT FOR THE SUGAR INDUSTRY. Dorr-Oliver Inc., 77 Havemeyer Lane, Stamford, Conn., U.S.A.

This new bulletin, EA10E, provides illustrations and information on Dorr-Oliver equipment in use in the beet sugar industry. It includes the "Dorrclone" and bowl desilter for removal of sand and pulp from juice, the Dorr drum slaker for milk-of-lime preparation, a juice-lime proportioning device, continuous carbonatation equipment, the ATV tray thickener, the Oliver rotary filter, etc.

* * *

EWART CHAINBELT CATALOGUE. CONVEYING AND DRIVING CHAINS. Ewart Chainbelt Co. Ltd., Derby.

The loose-leaf folder of almost 300 pages contains the latest literature on many types of Ewart conveying and driving chains and sprockets, including cane sugar mill chains and sprockets (Catalogue 300). It provides engineering, metallurgical and lubrication data, with specifications, dimensions, strengths, etc., as well as illustrations of the chains separately and in various installations. Each catalogue and brochure is printed in four languages and gives complete statistical information in English and metric systems.

* * *

"MARIC" WATER FLOW CONTROL. Thomas Budden Ltd., Shirley Works, Woodside Rd., Sidcup, Kent.

A leaflet describes this automatic flow control valve which is described as simple, inexpensive, reliable and self-cleaning. It delivers a constant flow of water while subject to a mains pressure variation of 15 to 200 p.s.i. and is available in a range of ¼–20 g.p.m. It works by means of a flexible synthetic rubber ring which is pushed along an accurately tapered orifice by increasing pressure so constricting the aperture to compensate for the higher pressure.

* * *

BREWING SUGARS. The Manbré & Garton Group, Winslow Rd., Hammersmith, London W.6.

The Manbré Group have produced this new brochure, giving a summary of the brewing sugars supplied by Manbré Sugars of Hammersmith and Newton-le-Willows, Martineaus of Hammersmith and Dutson & Knight of Bristol, together with information on delivery facilities, packing and technical service. The range includes four grades of invert sugar, cane sugar with and without added invert, "Manbrose"—a sugar having a balanced ratio of ready- and slow-fermentables as well as non-fermentables, priming sugars, sugar candy and candy sugar and priming, a dark priming sugar "Trivert", etc.

"VIBRALINE" VIBRATING CONVEYORS. Stephens-Adamson Mfg. Co., Aurora, Ill., U.S.A.

Bulletin 364 describes a new standard-medium duty natural frequency vibrating conveyor which features "Scotch Ply" stabilizers to support the conveyor trough and control the spring action. It is available in standard sizes—12, 18 and 24 inches wide, with straight or flared sides to the trough which may also be in carbon or stainless steel, and will handle bulk solids at up to 100 tons/hr.

* * *

CALIBRATION DATA FOR "METRIC" SERIES ROTAMETERS. Rotameter Manufacturing Co. Ltd., 330 Purley Way, Croydon, Surrey.

A new 20-page booklet has been published on a new method of calibrating the "Metric" series of instruments without the customer needing to return them to the factory. The tubes of these "Rotameters" have a fired-on reference scale in millimetres which can be interpreted by the user for flow measurement of the gas or liquid passing. These flow scales have been produced at the Rotameter Mfg. Co. Ltd. factory, but this new booklet enables the user to calculate the scale for himself.

* * *

A.C. MOTORS. Mather & Platt Ltd., Park Works, Manchester 10.

Publication E.2820 is a new brochure describing, illustrating and giving dimensions and other data on ventilated and totally enclosed fan-cooled Mather & Platt A.C. motors up to 350 h.p. It also provides a list of U.K. and overseas agents and is accompanied by a price list for the range of motors described

* * *

Bagasse Products Co. Ltd.—This new Company has been formed to operate the pilot plant for making bagasse board referred to earlier[1] and will also process it in flat and moulded forms, to be sold under the name "Bagelle". The Company has been formed by Tate & Lyle Ltd. and S. Hille & Co. Ltd., furniture manufacturers with long experience in moulding board and reinforced plastics.

* * *

Iran sugar factory extension.—A. F. Craig & Co. Ltd. have been awarded the contract by the Iran Government for extension of Abkouh sugar factory, near Meshed. The existing factory has a capacity of 650 tons of beet per day and is to be increased to 1600 tons, with installation of modern beet handling and clarification equipment, a continuous diffuser, beet pump, etc. The existing factory will continue to make loaf sugar while new plant will make white granulated sugar. It will include a quintuple-effect evaporator, low-head vacuum pans, water-cooled crystallizers, continuous centrifugals for after-product and semi-automatic centrifugals for white sugar. Two oil-fired water-tube boilers will provide 265 p.s.i.g. steam and steam-driven and diesel-driven alternators are to be installed. A plant will be included for desugarization of 100 tons of molasses per day. All the pulp is to be dried and sold as cattle feed.

* * *

Cane harvester manufacture in Louisiana.—The International Cane Machinery Corporation of Hawaii has contracted with J. & L. Engineering Company of Jeanerette, Louisiana, to manufacture two Duncan cut-load cane harvesters and a transload station with dry cleaning for Central Aguirre Sugar Co. in Puerto Rico, and a single-row cane cutter for C. Brewer (Puerto Rico) Inc.

* * *

Czech sugar factory for Syria[2].—A contract has been signed by Technoexport of Prague and Sugar and Agricultural Products Industries Corporation of Damascus for the delivery of a beet sugar factory and refinery of 2000 tons of beet and 300 tons of raw sugar daily capacity. It is to be erected in the north of Syria, about 45 km south-west of the port of Lattaquieh on the Oronto river.

[1] *I.S.J.*, 1964, **66**, 399.

[2] *Czechoslovak Heavy Industry*, 1964, (10), 22.

European Beet Sugar Production Estimates, 1964/65[1]

	(*metric tons, raw value*) 1964/65	1963/64	1962/63
Albania	12,000	11,000	13,000
Austria	320,000	329,661	266,458
Belgium	450,000	354,607	334,751
Bulgaria	160,000	158,600	156,667
Czechoslovakia	830,000	1,104,400	1,031,110
Denmark	443,000	367,000	209,000
Finland	63,000	57,731	44,271
France	2,100,000	2,085,331	1,689,554
Germany, East	875,000	789,317	664,756
Germany, West	2,175,000	2,108,000	1,521,199
Greece	60,000	39,278	26,667
Holland	570,000	427,440	466,226
Hungary	500,000	457,200	434,260
Ireland	150,000	145,408	136,823
Italy	925,000	941,760	1,019,576
Poland	1,675,000	1,454,000	1,357,778
Rumania	460,000	318,127	312,085
Spain	486,000	384,442	462,213
Sweden	310,000	245,396	206,667
Switzerland	52,000	46,402	30,109
Turkey	733,000	512,610	433,052
U.K.	950,000	834,187	774,996
U.S.S.R.	8,600,000	6,150,000	6,667,000
Yugoslavia	350,000	341,566	251,702
TOTAL	23,249,000	19,663,463	18,509,920

Brevities

Sudan sugar factory managing agent appointment.—The Sudan Council of Ministers has agreed[2] to the acceptance of the offer of International Business Consultants (G.B.) Ltd. to act as Consultants for the management of Khashm-el-Girba and Guneid sugar factories, subject to the approval of the contract by the Attorney-General (which has subsequently been obtained.)

* * *

Iran sugar expansion[3].—The aggregate capacity of the five state-owned sugar factories in Iran is to be increased from 2500 to 5900 tons of sugar beet per day. Some 350 million rials are to be spent on increasing the capacity of private factories in the Fars, Khorassan, Luristan and Azerbaijan areas, and the Iran Manufacturing Corporation plans to finance the building of seven new factories in the private sector of the industry. Combined output from the state and private factories is at present in the region of 150,000–170,000 tons per year while current consumption is more than 450,000 tons a year and is expected to reach 550,000 tons in 1968. The Iran Government has granted credits for building two new factories either in the Mamassani district or in Sodj (Fars Province).

* * *

Brazil 1964/65 sugar plan[4].—The Instituto do Açucar e do Alcool has revised earlier studies and finally approved the 1964/65 sugar plan. Production for the coming season is estimated at 55·6 million bags (3,336,000 metric tons). One revision is of the export allocation which is now set at 7,000,000 bags (420,000 tons). Commenting on the plan in the *Boletim Cambial*, Senhor OMER MONT ALEGRE said that at current prices every bag of sugar exported represents a deficit of 2500 cruzeiros which, on exports of seven million bags, would mean a loss of 17,500 million cruzeiros which the Government would have to bear. It is reported from Sao Paulo that the sugar crop in the southern States is coming in normally. The weather has improved and there has been a consequent improvement in sugar content of the cane. However, few mills are obtaining more than 90 kilos of sugar per ton of cane crushed.

New refinery for Japan[5].—According to Mitsubishi Shoji Kaisha Ltd., The Ensuiko Sugar Refining Company has decided to set up a new refinery in the neighbourhood of Yokohama. The Taiyo Fisheries Co. Ltd. will participate in the new venture by providing the land for the factory and also finance, as well as distribution channels for sugar that the Taiyo company maintains at present for its own products. The capacity of the refinery will be 800/1000 tons daily; construction will be started in October 1964 and completed at the end of 1965. It will cost some 4000 million yen (approximately £4,000,000). The Taiyo Company will provide the refinery with two 15,000-ton bulk carriers for transportation of raw sugar to the refinery which will be on land facing to the sea where 50,000-ton vessels can anchor.

* * *

New sugar factory for Paraguay[6].—A new sugar factory is under construction in Volendam. Situated on the Río Paraguay, in the centre of a German settlement, this factory will have an initial capacity of 18,000 tons with the possibility of increasing this to 27,000 tons. It will produce sugar only for export, and foreign currency earnings are expected to amount to 4·1–4·6 million dollars annually.

* * *

Cairns bulk terminal opening[7].—The Premier of Queensland recently opened the £3,250,000 bulk sugar terminal built at Cairns in North Queensland. The terminal has a storage capacity of 100,000 tons and will serve the Mossman, Hambledon, Mulgrave and Babinda districts. When extensions to the existing terminals are completed they will have a total storage capacity of 1,285,000 tons of raw sugar, well over half the present total annual production.

* * *

Rumanian sugar imports and exports[8].—According to official Rumanian statistics, imports of sugar during the calendar year 1963 amounted to 44,900 metric tons, as compared with 37,000 tons in 1962. Sugar exports in 1963 amounted to 75,600 tons, compared with 310,080 tons in 1962.

* * *

Cane damage in Louisiana.—It is difficult to calculate the exact extent of the loss which the Louisiana cane crop has suffered as a result of hurricane Hilda and the American Sugar Cane League expects a harvest of only 7,150,000 short tons compared with a pre-hurricane estimate of 9,425,000 tons[9]. According to one early report[10] an output of only 500,000 short tons of sugar, raw value, can now be expected, compared with the pre-hurricane estimate of 825,000 tons. A later estimate[11], however, puts the loss in terms of sugar at some 150,000 tons. With cane either flattened or broken it is feared that the harvest will have to be extended and will run the risk of frost damage.

* * *

New sugar factory for Kenya[12]—A West German firm (Gutehoffnungshütte Sterkrade A.G.[13])is to build a sugar factory in the Chenelil area of Central Nyanza in Kenya which, according to press reports, will be capable of producing 45,000 tons of sugar per year. Some 12,000 acres of land are to be prepared for cane to supply the factory which is scheduled to commence production early in 1967. This is part of a scheme to develop Kenya's sugar industry for which the West German Government is to lend £2½ million. It is hoped that Kenya will be self-supporting in sugar by 1970 by which time annual production is expected to be in the region of 170,000 tons.

[1] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (27), 1–2.
[2] *Sudan Daily*, 1st October 1964.
[3] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (23), 15–16.
[4] *Public Ledger*, 5th September 1964.
[5] *Willett & Gray*, 1964, **88**, 367.
[6] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (23), 13.
[7] *Queensland Newsletter*, 15th October 1964.
[8] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (24), 12.
[9] *ibid.*, (28), 16.
[10] C. Czarnikow Ltd., *Sugar Review*, 1964, (682), 179.
[11] *ibid.*, (683), 181.
[12] *ibid.*, (678), 160.
[13] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (25), 18.

BREVITIES

New Polish beet seed[1].—A large area has been sown with a new type of sugar beet seed in Poland this year, according to reports from Warsaw. The Polish Plant Institute, which developed the seed, claims that all operations, including singling, can be carried out mechanically on the beet produced. The new root has a high sugar content and uniform shape and is stated to be more resistant to lack of moisture than present strains. In experiments conducted last year it was shown that cultivation costs could be cut between 40 and 70% using full mechanization and special pesticides.

* * *

Brazil sugar expansion[2].—By means of construction of new sugar factories and increased cane cultivation in areas where only coffee had been grown previously, it is planned to reach an annual production of 60 million bags (3,600,000 metric tons). A sugar factory is to be built in Remanso between Manzus and Itacoatiara, and five more in the state of Rio Grande do Sul, where one is under construction with an annual capacity of 250,000 bags of sugar (15,000 tons).

* * *

New sugar factory for Argentina[3].—A proposal by Ingenio Azucarero General San Martín to install a sugar mill and refinery in the Province of El Chaco, to produce 13,500 tons of sugar a year and 18,000–20,000 litres of alcohol a day, has been approved.

* * *

National Sugar Institute. The appointment has been announced of S.C. GUPTA, B.SC., A.H.B.T.I., F.I.I.S.T., F.R.I.C. as Director of the National Sugar Institute, Kanpur, India, in succession to Dr. S. N. GUNDU RAO.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 19th October* 1964)	s d
Anglo-Ceylon (5s)	6/11¼
Antigua Sugar Factory (£1)	13/6
Booker Bros. (10s)	18/9
British Sugar Corp. Ltd. (£1)	30/1½
Caroni Ord. (2s)	2/4½
Caroni 6% Cum. Pref. (£1)	15/3
Demerara Co. (Holdings) Ltd.	4/11¼
Distillers Co. Ltd. (10s units)	24/9
Gledhow Chaka's Kraal (R1)	20/–
Hulett & Sons (R1)	37/–
Jamaica Sugar Estates Ltd. (5s units)	4/6
Leach's Argentine (10s units)	17/–
Manbré & Garton Ltd. (10s)	37/10½
Reynolds Bros. (R1)	23/–
St. Kitts (London) Ltd. (£1)	19/9
Sena Sugar Estates Ltd. (5s)	7/6¾
Tate & Lyle Ltd. (£1)	35/6
Trinidad Sugar (5s stock units)	2/8¼
United Molasses (10s stock units)	32/–
West Indies Sugar Co. Ltd. (£1)	13/3

CLOSING MIDDLE

New York Stocks (*at 17th October* 1964)	$
American Crystal ($5)	17⅛
Amer. Sugar Ref. Co. ($12.50)	19
Central Aguirre ($5)	25⅞
Great Western Sugar Co.	36⅝
North American Ind. ($10)	13⅞
South P.R. Sugar Co.	32¼
United Fruit Co.	19¼

New mill for Mexico[4].—A $10 million contract for the building of a cane sugar factory in Mexico has been awarded to three French firms. The mill, situated at Tuxtepec in the state of Oaxaca, is to have a daily crushing capacity of 4000 tons of cane and will be operational within two years.

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Puerto Rico sugar production, 1964[5].—Sugar production during the 1964 season in Puerto Rico amounted to 978,128 tons, raw value, as compared with 978,307 tons in the previous year. Cane crushed reached 9,802,223 tons compared with 10,122,518 tons in 1963 when the average yield was 9·67% compared with 9·98% in 1964.

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New Indian sugar factory[6].—A scheme for setting up a sugar mill costing 14 million rupees (£1,050,000) in the Purnea district has been approved by the Indian Government. It will have an initial capacity of 1000 tons of cane per day and is expected to be commissioned in 1965.

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New sugar factory for Mozambique[7].—Marracuene Agricola Açucareira S.A.R.L. is to construct a $15 million sugar mill with an annual capacity of 40,000 tons. Operation of the plant is expected by June 1965.

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Japanese sugar factory for the Philippines[8].—Mitsubishi Heavy Industries Ltd. announced recently that it is to export a sugar factory to the Philippines; the plant will cost about $4 million and will have a daily cane capacity of 2000 tons. It will be built on the island of Cebu and will come into operation in 1966.

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Southern Rhodesia dam[9].—A £1,000,000 contract for construction of the Manjirenji Dam, 30 miles north of Chiredzi Township in the Lowveld, has been awarded to Sir Alfred McAlpine & Son (Rhodesia) (Pvt.) Ltd. The dam will provide water to irrigate 15,000 acres of land for sugar crops and should be completed in 1966.

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Sugar refinery for El Salvador[10]—A new sugar refinery is to be installed by the Cía. Azucarera Salvadorena in the Department of Sonsonate, with a capital of 14·3 million colones, and is expected to come into operation in mid-1965.

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World sugar production 1963/64.—World sugar production for 1963/64 is expected by F. O. Licht K.G.[11],in their revised estimate, to reach 54,796,270 metric tons, raw value, as compared with their previous estimate of 54,408,600 tons, and the 1962/63 crop of 51,459,284 tons.

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Venezuela sugar production, 1963[12]—The Maracaibo Chamber of Commerce has reported that production of sugar by the country's 15 mills fell from 275,780 tons in 1962 to 256,368 tons in 1963. Cane production was lower by 166,793 tons.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1964, (671), 132.
[2] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (20), 16–17.
[3] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 594.
[4] C. Czarnikow Ltd., *Sugar Review*, 1964, (672), 137.
[5] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (21), 12.
[6] C. Czarnikow Ltd., *Sugar Review*, 1964, (672), 137.
[7] *U.S. Dept. of Commerce report*, through *Willett & Gray*, 1964, **88**, 330.
[8] F. O. Licht, *International Sugar Rpt.*, 1964, **96**, (22), 19.
[9] *Overseas Review* (Barclays D.C.O.), July 1964., p. 29.
[10] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **29**, 582.
[11] *International Sugar Rpt.*, 1964, **96**, (25), 1–4.
[12] *Fortnightly Review* (Bank of London & S. America Ltd.) 1964, **29**, 580.